ENCYCLOPÆDIA BRITANNICA



The Encyclopædia Britannica
is published with the editorial advice
and consultation of the faculties of
the University of Chicago

*

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

ENCYCLOPÆDIA BRITANNICA

A New Survey of Universal Knowledge

Volume 5

CAST-IRON to COLE



THE UNIVERSITY OF CHICAGO

ENCYCLOPÆDIA BRITANNICA, INC.

CHICAGO · LONDON · TORONTO

COPYRIGHT

IN THE UNITED STATES OF AMERICA

1929, 1930, 1932, 1936, 1937, 1938, 1939
1940, 1941, 1942, 1943, 1944, 1945, 1946

1947

BY ENCYCLOPÆDIA BRITANNICA, INC.

COPYRIGHT 1947. COPYRIGHT UNDER
INTERNATIONAL COPYRIGHT UNION
BY ENCYCLOPÆDIA BRITANNICA, INC.

ALL RIGHTS RESERVED UNDER INTER-
AMERICAN COPYRIGHT UNION (1910)
BY ENCYCLOPÆDIA BRITANNICA, INC.

PRINTED IN THE U.S.A.

FOUNDED A.D. 1768

ENCYCLOPÆDIA BRITANNICA

Volume 5

CAST-IRON to COLE

CAST-IRON. It is said that cast-iron was first made in Sussex as early as the year 1350, but it was not until the end of the Tudor period that the practice of iron-founding was introduced into England from the continent of Europe where it had already been considerably developed. Although cast-iron and pig-iron have the same chemical composition, the expression cast-iron is generally applied to pig-iron which has been remelted in a crucible, or furnace, and cast into moulds.

Classification.—Cold- and hot-blast irons (*see* PIG-IRON) are divided, according to their content in phosphorus, into two main groups: (a) Hematite, and (b) Basic irons. The former contain only small percentages of this element, about .07%, while in the latter the phosphorus may reach as much as 3%. Each of these main groups is again subdivided into at least six grades, Nos. 1, 2, 3, foundry, forge and white irons. In passing along the series from "No. 1" to "white" the percentages of silicon and manganese gradually decrease, while those of combined carbon and sulphur increase. Hence it is possible, by mixing irons from different groups, to obtain cast-iron of almost any desired composition, due allowance being made for the changes which occur during remelting. Iron may be classified also according to (a) the method of manufacture; (b) the purpose for which it is intended; and (c) its composition. It was formerly graded by breaking the pig and examining the fracture, but this method has been largely superseded by chemical analysis.

(a) Method of Manufacture: (1) Coke Pig is smelted with coke; always with hot blast. (2) Charcoal Pig is smelted with charcoal, by hot or cold blast.

(b) Purpose for Which Intended: (3) Bessemer Pig. (4) Basic Open Hearth Pig. (5) Malleable Pig, for malleable cast-iron castings. (6) Foundry Pig. (7) Forge Pig is an inferior grade used for puddling and for some classes of foundry work.

(c) Chemical Composition: (8) Silicon Pig or High Silicon Pig. (9) Low Phosphorus Pig. (10) Special Low Phosphorus Pig. (11) Ferro-Alloys and Special Cast Irons (*e.g.*, ferro-manganese).

When pig-iron is melted under conditions which permit of the oxidation of the silicon, as in the cupola and reverberatory furnace, an iron which presents a greyish fracture when broken, and is quite soft and easy to machine, will, on continued remelting, ultimately become white and intensely hard. Conversely, by melting white iron with increasing quantities of siliceous pig-iron it is possible to convert the white into grey iron. These differences in appearance arise from changes in the condition of the carbon. Cast-iron contains upwards of 3.5% carbon, which in very grey iron is almost wholly in the graphitic state; this condition arises from the presence of large amounts of silicon, an element which has the property of decomposing carbide of iron (Fe_3C) into its constituents, iron and carbon. As the silicon is oxidized by remelting, more and more of the carbon combines with the iron, until ultimately, in white iron, carbon in the form of graphite is entirely absent. Manganese also is oxidized during remelting, while sulphur on the other hand is absorbed from the fuel.

Grades Commonly Used.—The following are examples of the grades in common use: for thin ornamental work, such as grates, stoves, hollow ware and other light castings, where in order to fill the mould great fluidity is required, a mixture of irons containing from 2.5% to 2.8% silicon and from 1.3% to 1.5% phosphorus is in common use; but in medium-sized castings and general work, where somewhat greater strength is required, iron containing a greater percentage of combined carbon and a reduced silicon content is necessary; and as strength rather than extreme fluidity is the main consideration, the phosphorus also may be reduced. For use in this connection, irons containing silicon from 2% to 2.25% and phosphorus from 1% to 1.3% are suitable. Where still greater strength is required, as in machinery castings, phosphorus and silicon are still further reduced, and a mixture of irons yielding an average content in silicon and phosphorus respectively of 1.15% to 1.2% and 0.4% to 0.6% is employed. In cases where castings have to resist wear, and have at the same time to machine with a highly polished surface, a very close grained iron is necessary, this condition being provided by an admixture of refined and cold-blast irons with an average silicon content of from 1% to 1.3%, and about 0.45% to 0.70% phosphorus. So far, only castings of the same physical properties throughout have been considered; for some classes of work, however, such as rolls used in the sheet metal industries and some types of car wheels, it is necessary to have an intensely hard surface and a soft interior in one and the same casting. This is obtained by taking advantage of the fact that given a suitable grade

of iron, it is possible by rapid cooling to retain the carbon in the outside portion of the casting in the combined condition. This process is known as "chill casting" and the parts of the mould where the metal is to be hardened are made of iron instead of sand, so that, when the molten metal comes in contact with them heat is so rapidly extracted from it that the separation of graphite is prevented, and the carbon retained in the combined condition; while towards the centre of the casting, where the rate of cooling is not so rapid, decomposition of the cementite can take place, and in consequence the iron in this region is quite soft. In this class of work the selection of the pig-iron is of the greatest importance, slight differences in composition having very marked influences on the depth to which the hardening effect penetrates. Iron for chill casting should be low in phosphorus, and silicon also should not be too high, or the carbon will not remain in combination. About 1·5% of silicon is probably best, but opinion is not unanimous on this point.

Malleable Cast-Iron.—Ordinary cast-iron is melted readily and easily cast into any desired shape, but it has the disadvantage that castings so made are relatively weak and brittle. It is possible, however, by making use of the facility with which carbide of iron can be split up into its constituents, to make castings which are stronger than ordinary cast-iron ones, and yet possess a considerable degree of ductility, almost approaching wrought-iron in this respect, though unlike forgings of the latter metal they cannot be welded, except by the "bronze rod" process, and at a temperature below the melting point of iron. Castings made in this way are called "malleable cast-iron castings," or shortly "malleable castings." The process has been in use for many years, having been described by Reaumur in 1722. For the production of castings by this method a refined hematite pig-iron is used containing from 2·5% to 3·0% carbon and from 0·5% to 1·0% silicon (the lower figure for large, and the higher one for small castings), and having as little as possible of sulphur, phosphorus, and manganese. Sulphur is supposed to promote the formation of blow-holes, but it has been found that 0·25% may be present without ill effect. Silicon and manganese prevent the castings being converted; while an excess of phosphorus causes brittleness in the finished casting. The castings, when removed from the moulds, are extremely brittle, on account of the nature of the pig-iron used, and when broken present a white fracture; they are packed in boxes containing red hematite ore and then annealed for a period of four or five days at a temperature of 800° to 900° C. After this treatment they present a grey fracture and can be readily dressed with a file or chisel; they will also admit of a considerable amount of deformation without fracture. The process described is the one followed in Europe. In America, where the decomposition of the carbide of iron, not the direct oxidation of the carbon, is regarded as the chief essential in the process of conversion, the annealing of the castings is carried out in a slightly different manner. They are packed in boxes containing sand or clay with or without admixture of oxide, and annealed at a temperature rather lower than that used in European practice, viz., 700° to 800° C. By either method a malleable casting is obtained, but the products of each when broken present a very different appearance and are designated "white heart" and "black heart" castings respectively, terms which explain themselves.

Since about 1850 the use of cast-iron for structural purposes has been gradually superseded by steel, but so many other applications have been found for it, that it is still in considerable demand, as it is the cheapest form of commercial iron. Its tensile strength, though considerably less than that of steel, is ample for many purposes, while in compression its strength is greater than that of any other known metal.

See E. L. Rhead *The Principles and Practice of Ironfounding* (Manchester, 1910); T. Turner *The Metallurgy of Iron* (5th ed. 1918); W. H. Hatfield *Cast-iron in the Light of Recent Research* (2nd ed. 1918); H. A. Schwartz *American Malleable Cast Iron;* Richard Moldenke *The Principles of Iron Founding.* (T. Ba.)

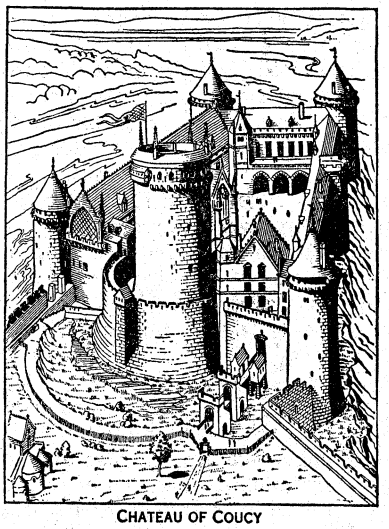
CASTLE, a small self-contained fortress, usually of the middle ages, though the term is sometimes used of prehistoric earthworks (*e.g.*, Hollingbury castle, Maiden castle), and sometimes of citadels (*e.g.*, the castles of Badajoz and Burgos) and small detached *forts d'arrêt* in modern times. It is also often applied to the principal mansion of a prince or nobleman, and in France (as *château*) to any country seat. Under its twofold aspect of a fortress and a residence, the mediaeval castle is inseparably connected with the subjects of fortification (*see* FORTIFICATION AND SIEGECRAFT) and architecture. For an account of Roman and pre-Roman *castella* in Britain *see* BRITAIN.

Mediaeval Castles.—The word "castle" (*castel*) was introduced into English shortly before the Norman Conquest to denote a type of fortress, then new to the country, brought in by the Norman knights summoned by Edward the Confessor to defend Herefordshire against the inroads of the Welsh. The essential feature of this type was a circular mound of earth surrounded by a dry ditch and flattened at the top. Around the crest of its summit was placed a timber palisade. This moated mound was styled in French *motte* (latinized *mota*). It is clearly depicted in the Bayeux tapestry, and was then familiar on the mainland of western Europe. A description of this earlier castle is given in the life of John, bishop of Terouanne (*Acta Sanctorum,* quoted by G. T. Clark, *Mediaeval Military Architecture*):—"The rich and the noble of that region being much given to feuds and bloodshed, fortify themselves . . . and by these strongholds subdue their equals and oppress their inferiors. They heap up a mound as high as they are able, and dig round it as broad a ditch as they can. . . . Round the summit of the mound they construct a palisade of timber to act as a wall. . . . Inside the palisade they erect a house, or rather a citadel, which looks down on the whole of the neighbourhood." St. John, bishop of Terouanne, died in 1130, but this castle of Merchem may be taken as typical of the practice of the 11th century. In addition to the mound, the citadel of the fortress, there was often appended to it a bailey or basecourt (*see* BAILEY), and sometimes two, of semilunar or horseshoe shape, so that the mound stood *à cheval* on the line of the enceinte. The rapidity and ease with which it was possible to construct castles of this type made them characteristic of the Conquest period in England. In later days a stone wall replaced the timber palisade and produced what is known as the shell-keep, as in the castles of Berkeley, Alnwick and Windsor.

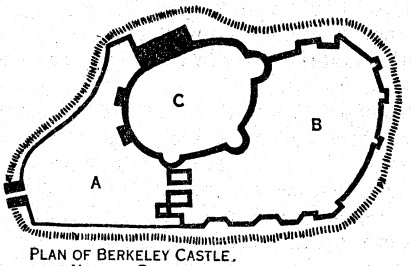
The Normans introduced also two other types of castle, the one where they found a natural rock stronghold which only needed adaptation, as at Clifford, Ludlow, the Peak and Exeter, to produce a citadel; the other a wholly distinct type, the high rectangular tower of masonry, of which the Tower of London is the best-known example. This type belongs rather to the more settled conditions of the 12th century when speed was not a necessity, and in the first half of which the fine extant keeps of Hedingham and Rochester were erected. These towers were originally surrounded by palisades, usually on earthen ramparts, which were replaced later by stone walls. The whole fortress thus formed was styled a castle, but sometimes more precisely "tower and castle," the former being the citadel, and the latter the walled enclosure, thus preserving the meaning of the Roman *castellum.* Reliance was placed by the engineers of that time simply on the inherent strength of the structure, the walls of which defied the battering-ram, and could only be undermined at the cost of much time and labour, while the narrow apertures were constructed to exclude arrows or flaming brands.

Influence of the Crusades.—At this stage the crusades, and the consequent opportunities afforded to western engineers of studying the solid fortresses of the Byzantine empire, revolutionized the art of castle-building, which henceforward follows recognized principles. Many castles were built in the Holy Land by the crusaders of the 12th century, and it has been shown (Oman, *Art of War: the Middle Ages,* p. 529), that the designers realized, first, that a second line of defences should be built within the main enceinte, and a third line or keep inside the second line; and secondly, that a wall must be flanked by projecting towers. From the Byzantine engineers, through the crusaders, we derive, therefore, the cardinal principle of the mutual defence of all the parts of a fortress. The *donjon* of western Europe was regarded as the fortress, the outer walls as accessory defences; in the East each envelope was a fortress in itself, and the keep became merely the

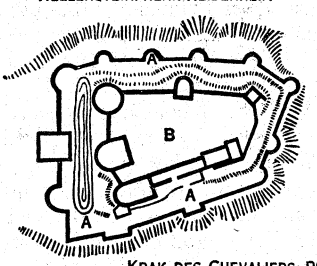

KREMLIN, MOSCOW


CHATEAU OF COUCY

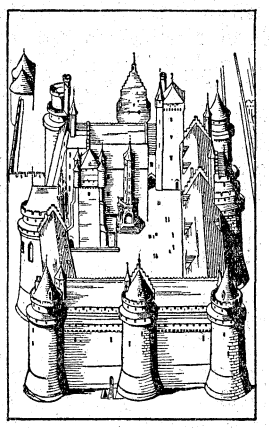

HELLENSTEIN, NEAR HEIDENHEIM

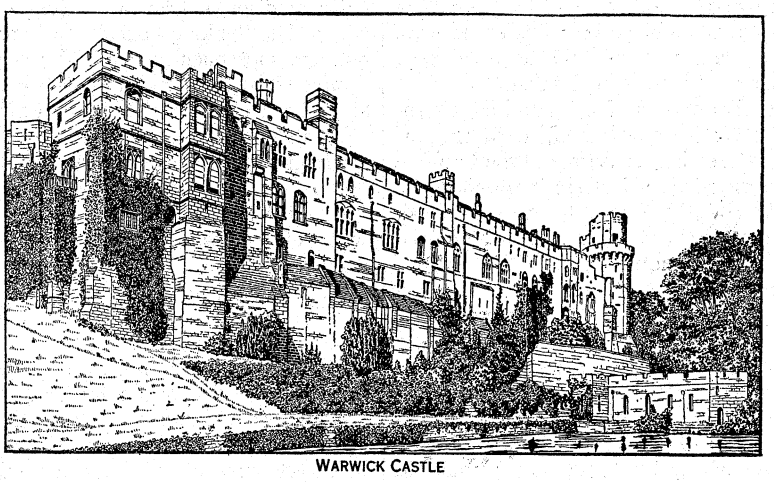


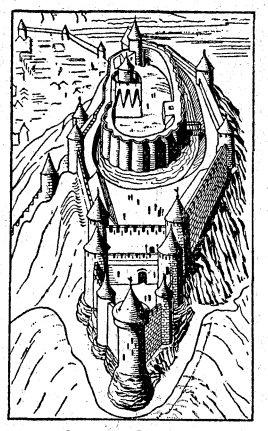
PLAN OF BERKELEY CASTLE, LATE NORMAN PERIOD

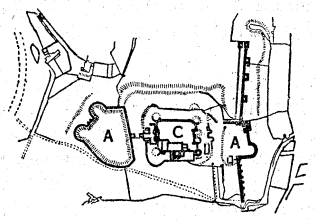


KRAK-DES-CHEVALIERS: PLAN

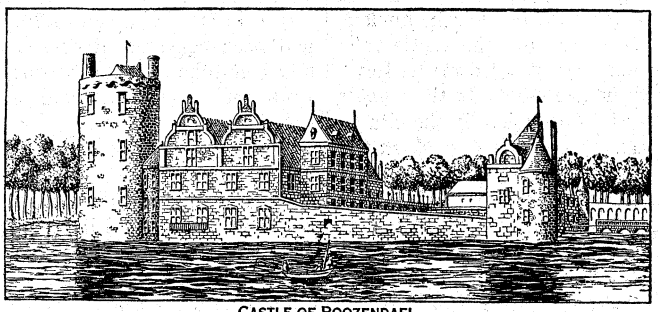

CHATEAU OF PIERREFONDS

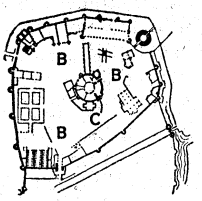

WARWICK CASTLE


CHATEAU GAILLARD



CAERPHILLY CASTLE: PLAN


CASTLE OF ROOZENDAEL



CHATEAU DE MONTARGIS: PLAN

CHATEAUX OF COUCY, PIERREFONDS, GAILLARD, AND DE MONTARGIS FROM VIOLLET-LE-DUC, "DICTIONNAIRE RAISONNE DE L'ARCHITECTURE FRANÇAISE"; WARWICK CASTLE, BY COURTESY OF THE G. W. RAILWAY

last refuge of the garrison. Indeed, the keep, in several crusader castles, is no more than a tower, larger than the rest, built into the enceinte and serving for its flanking defence, while the fortress was made strongest on the most exposed front. The idea of the flanking towers soon penetrated to Europe, and Alnwick castle (1140–50) shows the influence of the new system. The finest of all castles of the middle ages was Richard Coeur de Lion's Château Gaillard (1197) on the Seine near Les Andeleys. Here the innermost ward was protected by an elaborate system of strong defences, which included a *tête-de-pont* covering the Seine bridge. The castle stood upon high ground and consisted of three distinct enceintes or wards besides the keep, which was in this case merely a strong tower forming part of the innermost ward. Round instead of rectangular towers gradually became more usual, the finest examples of their employment as keeps being at Conisborough in England and at Coucy in France. Against the feeble siege artillery of the 13th century a well built fortress was almost proof, but the mines and the battering ram were more formidable, and it was realized that corners in the stonework of the fortress were more vulnerable than a uniform curved surface. Château Gaillard fell to Philip Augustus in 1204 after a strenuous defence, and the success of the assailants was largely due to the skilful employment of mines. An angle of the noble keep of Rochester was undermined and brought down by John in 1215.

The Concentric Plan.—The next development was the extension of the principle of successive lines of defence to form what is called the "concentric" castle, in which each ward was placed wholly within another which enveloped it; places thus built on a flat site (*e.g.*, Caerphilly castle) became for the first time more formidable than strongholds perched upon hills such as Château Gaillard, where, although the more exposed parts possessed many successive lines of defence, at other points, for want of room, it was impossible to build more than one or, at most, two walls. In these cases, the fall of the inner ward by surprise, escalade or

regular siege (as was sometimes feasible), entailed the fall of the whole castle. The adoption of the concentric system precluded any such mischance, and thus, even though siege-engines improved during the 13th and 14th centuries, the defence maintained itself superior to attack during the latter middle ages. Its final fall was due to the introduction of gunpowder. "In the 14th century the change begins, in the 15th it is fully developed, in the 16th the feudal fastness has become an anachronism."

Decline of Baronial Fortifications.—The general adoption of cannon placed in the hands of the central power, a force which ruined the baronial fortifications. The possessors of cannon were usually private individuals of the middle classes, from whom the prince hired the *matériel* and the workmen. A typical case will be found in the history of Brandenburg and Prussia (Carlyle, *Frederick the Great,* bk. iii.; ch. i.), the castle of Friesack, held by an intractable feudal noble, Dietrich von Quitzow, being reduced in two days by the elector Frederick I. with "Heavy Peg" (*Faule Grete*) and other guns (Feb. 1414). In England, the earl of Warwick in 1464 reduced the strong fortress of Bamborough in a week, and in Germany, Franz von Sickingen's stronghold of Landstuhl, formerly impregnable on its heights, was ruined in one day by the artillery of Philip of Hesse (1523). Heavy artillery was used for such work, of course, and against lighter natures, some castles and even fortified country-houses managed to make a stout stand as late as the Great Rebellion in England.

The castle thus ceases to be the fortress of small and ill-governing local magnates, and its later history is merged in that of modern fortification. But an interesting transitional type between the mediaeval stronghold and the modern fortress is found in the coast castles erected by Henry VIII., especially those at Deal, Sandown and Walmer (*c.* 1540). Walmer castle is still the official residence of the lord warden of the Cinque Ports. Viollet-le-Duc, in his *Annals of a Fortress* (English trans.), gives a full and interesting account of the repeated renovations of the fortress on his imaginary site in the valley of the Doubs, the construction by Charles the Bold of artillery towers at the angles of the castle, the protection of the masonry by earthen outworks and boulevards and, in the 17th century, the final service of the mediaeval walls and towers as a pure *enceinte de sûreté.* Here and there we find old castles serving as *forts d'arrêt* or block-houses in mountain passes and in some few cases, as at Dover, they formed the nucleus of purely military places of arms, but normally the castle falls into ruins, becomes a peaceful mansion, or is merged in the fortifications of the town which has grown up around it. In the *Annals of a Fortress* the site of the feudal castle is occupied by the citadel of the walled town. The baronial "castle" assumes *pari passu* the form of a mansion, retaining indeed some capacity for defence, but in the end losing all military characteristics save a few which survived as ornaments. Examples of such castellated mansions are seen in Wingfield Manor, Derbyshire, and Hurstmonceaux, Sussex, created in the 15th century. Many older castles which survived were altered to serve as residences. (C. F. A.)

Castles in English History.—Such strongholds as existed in England at the time of the Norman Conquest seem to have offered but little resistance to William the Conqueror, who, in order effectually to guard against invasions from without as well as to awe his newly-acquired subjects, immediately began to erect castles all over the kingdom, and likewise to repair and augment the old ones. Besides, as he had parcelled out the lands of the English amongst his followers, they, to protect themselves from the resentment of the despoiled natives, built strongholds and castles on their estates, and these were multiplied so rapidly during the troubled reign of King Stephen that the "adulterine" (*i.e.,* unauthorized) castles are said by one writer to have amounted to 1,115.

In the first instance, when the interest of the king and of his barons was identical, the former had only retained in his hands the castles in the chief towns of the shires, which were entrusted to his sheriffs or constables. But the great feudal revolts under the Conqueror and his sons showed how formidable an obstacle to the rule of the king was the existence of such fortresses in private hands, while the people hated them from the first for the oppressions connected with their erection and maintenance. It was, therefore, the settled policy of the Crown to strengthen the royal castles and increase their number, while jealously keeping in check those of the barons. But in the struggle between Stephen and the empress Maud for the crown, which became largely a war of sieges, the royal power was relaxed and there was an outburst of castle-building by the barons. These in many cases acted as petty sovereigns, and such was their tyranny that the native chronicler describes the castles as "filled with devils and evil men." These excesses paved the way for the pacification at the close of the reign, when it was provided that all unauthorized castles constructed during its course should be destroyed. Henry II., in spite of his power, was warned by the great revolt against him that he must still rely on castles, and the massive keeps of Newcastle and of Dover date from this period.

Under his sons the importance of the chief castles was recognized as so great that the struggle for their control was in the forefront of every contest. When Richard made vast grants at his accession to his brother John, he was careful to reserve the possession of certain castles, and when John rose against the king's minister, Longchamp, in 1191, the custody of castles was the chief point of dispute throughout their negotiations, and Lincoln was besieged on the king's behalf, as were Tickhill, Windsor and Marlborough subsequently, while the siege of Nottingham had to be completed by Richard himself on his arrival. To John, in turn, as king, the fall of Château Gaillard meant the loss of Rouen and of Normandy with it, and when he endeavoured to repudiate the newly-granted Great Charter, his first step was to prepare the royal castles against attack and make them his centres of resistance. The barons, who had begun their revolt by besieging the castle of Northampton, now assailed that of Oxford and seized Rochester castle. The king recovered Rochester after a severe struggle and captured Tonbridge, but thenceforth there was a war of sieges between John with his mercenaries and Louis of France with his Frenchmen and the barons, which was especially notable for the great defence of Dover castle by Hubert de Burgh against Louis. On the final triumph of the royal cause, after John's death, at the battle of Lincoln, the general pacification was accompanied by a fresh issue of the Great Charter in the autumn of 1217, in which the precedent of Stephen's reign was followed and a special clause inserted that all "adulterine" castles, namely those which had been constructed or rebuilt since the breaking out of war between John and the barons, should be immediately destroyed. And special stress was laid on this in the writs addressed to the sheriffs.

In 1223 Hubert de Burgh, as regent, demanded the surrender to the Crown of all royal castles not in official custody, and though he succeeded in this, Falkes de Breauté, John's mercenary, burst into revolt next year, and it cost a great national effort and a siege of nearly two months to reduce Bedford castle, which he had held. In the Barons' War (*q.v.*) castles again asserted their importance. The Provisions of Oxford included a list of the chief royal castles and of their appointed castellans with the oath that they were to take; but the alien favourites refused to make way for them till they were forcibly ejected. When war broke out it was Rochester castle that successfully held Simon de Montfort at bay in 1264, and in Pevensey castle that the fugitives from the rout of Lewes were able to defy his power. Finally, after his fall at Evesham, it was in Kenilworth castle that the remnant of his followers made their last stand, holding out nearly five months against all the forces of the Crown, till their provisions failed them at the close of 1266.

Thus for two centuries after the Norman Conquest castles had proved of primary consequence in English political struggles, revolts and warfare. And, although, when the country was again torn by civil strife, their military importance was of small account, the crown's historic jealousy of private fortification was still seen in the need to obtain the king's licence to "crenellate" (*i.e.,* embattle) the country mansion.

BIBLIOGRAPHY.—J. A. Deville, *Histoire du Château-Gaillard* (1829), *Château d'Argues* (1839); E. E. Viollet-le-Duc, *Dictionnaire raisonnée, s.v.* "Architecture" and "Château" (1854); *Essay on the Military*

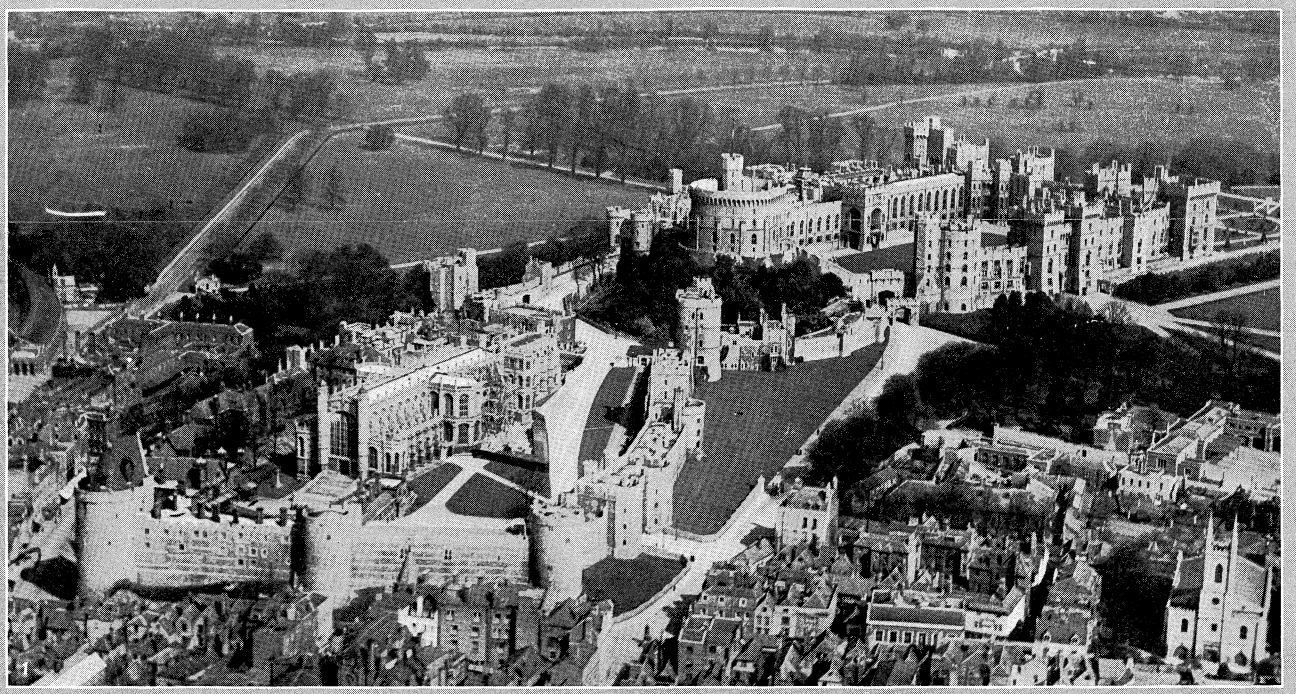


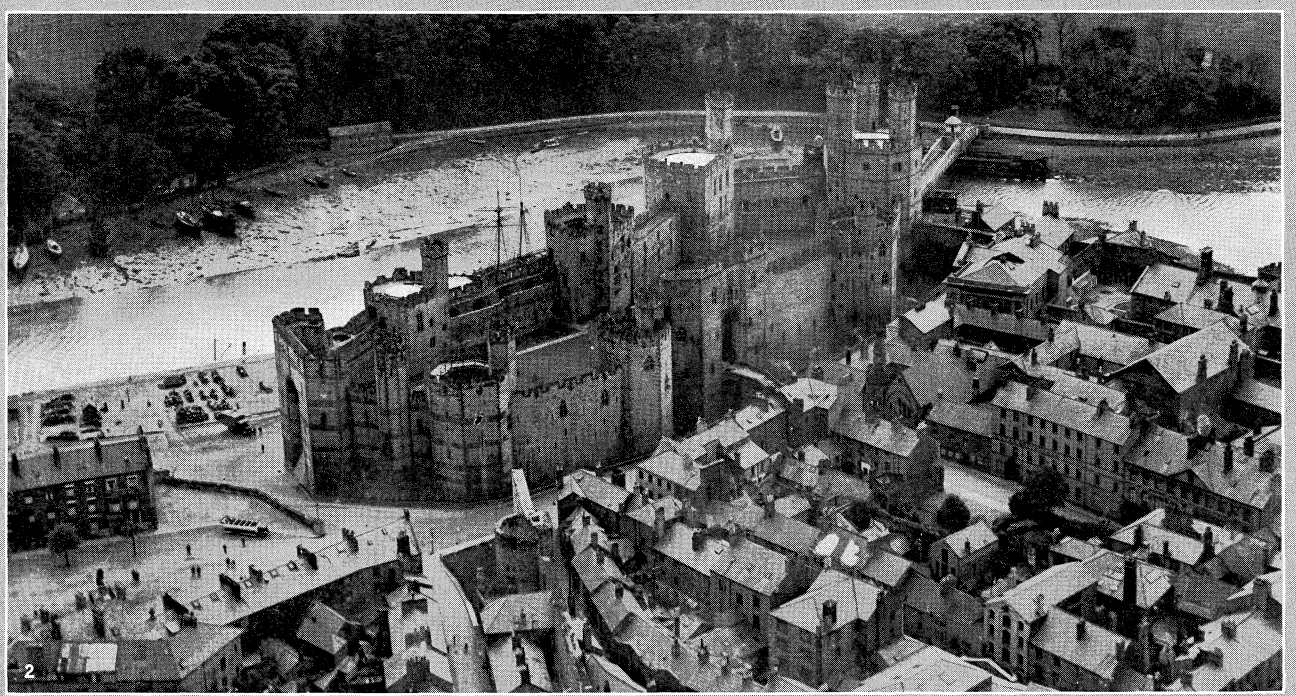
PHOTOGRAPH BY EWING GALLOWAY

CASTLE OF NEUSCHWANSTEIN, BAVARIA

This castle, situated on a sharp promontory in the foothills of the Alps, was designed for Ludwig II of Bavaria in 1869 by Dollmann, Riedel and Hofmann, who followed the design of the castle of Wartburg as closely as the site permitted. Neuschwanstein is built on the foundations of a mediaeval castle, Von der Hohenschwangen. It is a copy of the type evolved in the middle ages in mountain regions where the small space on the hilltops made necessary high buildings with diminished inner courts or wards. The main entrance is at the extreme right; further left are an outer and an inner court, and at the extreme left rises the main body of the castle with round lookout tower commanding a view of the surrounding country

CASTLE





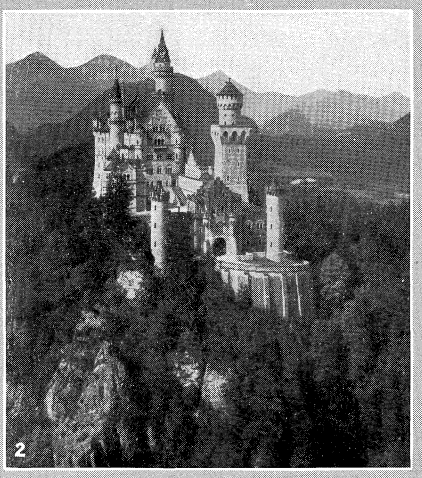
PHOTOGRAPHS, (1) AEROFILMS LTD., (2) AEROFILMS LTD., FROM EWING GALLOWAY

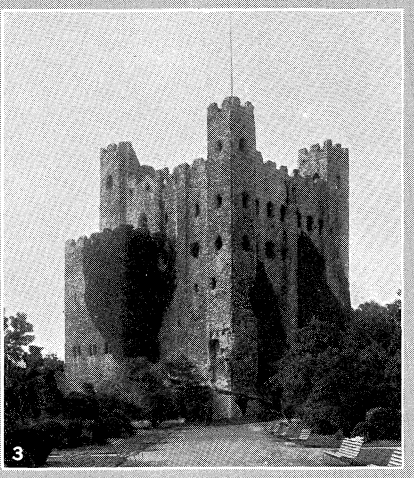
TWO CASTLES OF GREAT BRITAIN

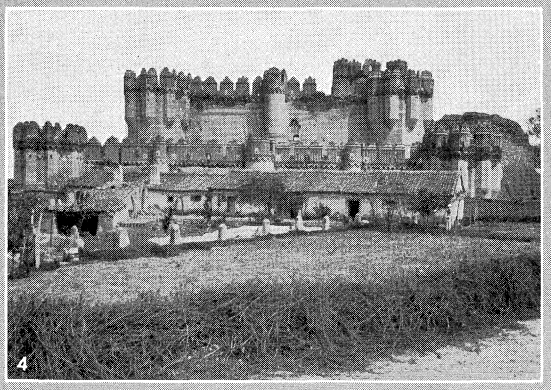
1. Windsor castle, a fortified spot since the early 11th century and a royal residence from the time of William the Conqueror. The round mound and ditch encircling the present round tower go back to the earliest building. In its present form, however, the castle dates largely from the time of Henry III., who built the first masonry structure (*c.* 1270), and Edward III., who almost entirely reconstructed it in 1344, as a meeting place for the Knights of the Garter. From that time on it has been continuously added to and improved—St. George's chapel, dating from 1473 to 1507; the Albert Memorial chapel, largely from 1501–03, (although the interior was much altered by Sir Gilbert Scott under Queen Victoria as a memorial to the prince consort) and the state apartments and residence quarters in the upper ward (to the right) from a reconstruction under George IV. and Queen Victoria, from designs by Sir Jeffrey Wyatville, who also increased the height of the old keep—the round tower near the centre. The oldest part of the existing castle is the round bell tower at the extreme left, with its high roof of French type, which dates from the time of Henry III. The greater part of the more recent construction having been built on foundations of older work, the whole presents an unusually vivid picture of what mediaeval castles of the largest type must have been in their prime
2. Carnarvon castle, Wales. Much smaller than Windsor, this also retains its ancient appearance. It was begun in 1283–84 by Edward I., from designs by his famous castle architect, Henry de Elreton, and was one of a chain of castles, including Conway and Beaumaris, intended for the pacification of the Welsh. Carnarvon was not completed until the reign of Edward II. Originally, a wall in the centre of the enclosed area divided it into two wards. The towers are of the British polygonal type. In France, at the time, round towers had become common. Despite the destruction of the interior residential buildings, Carnarvon castle is among the best preserved of those in the British Isles

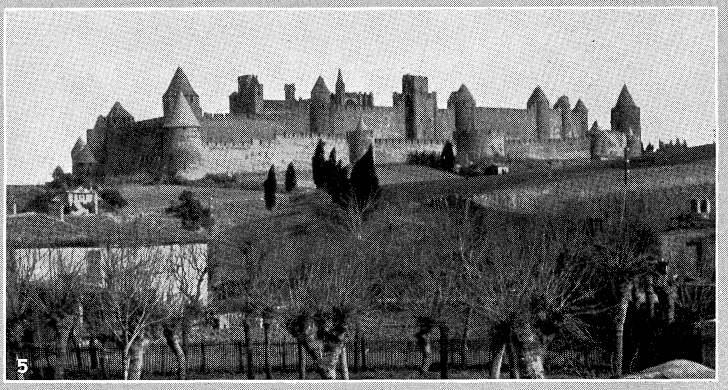
CASTLE



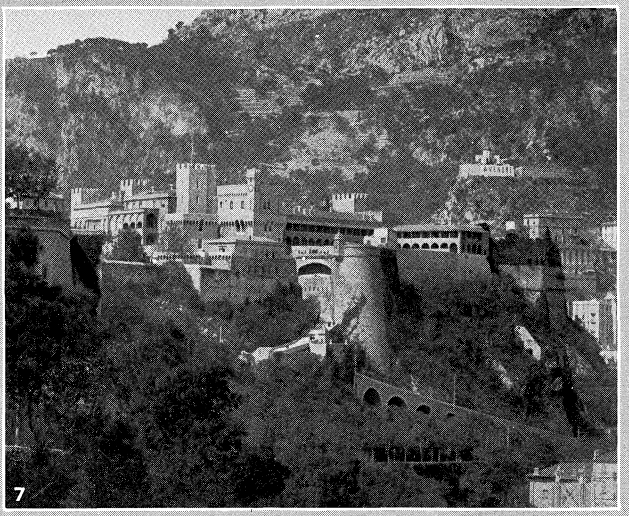












PHOTOGRAPHS, (1, 4, 7) EWING GALLOWAY, (2) THE GERMAN TOURIST INFORMATION BUREAU, (3) F. FRITH AND COMPANY, LTD., (5, 6) BURTON HOLMES, (7) ELMENDORFF

TYPES OF FEUDAL CASTLES

1. Alcazar at Segovia, built by Henry IV. of Castile (1454–74). This castle, placed for defence on a high, narrow plateau, served not only as the king's residence but also as the stronghold of the city walls. It is characteristic of the castle form which grew out of the combined military and residential requirements of the feudal period
2. The Bavarian royal castle of Neuschwanstein (shown also in Plate I), although modern, accurately represents the type of castle building developed in the hills of Germany in the middle ages. It is a product of the German Romantic Movement, built for Ludwig II. to rival the castle of Wartburg, whose design it closely follows
3. Rochester castle, Kent, the great square keep, 120 feet high, all that remains of the original castle, which was probably built before 1126, by William de Corbeil, archbishop of Canterbury. (It belongs to the type of square Norman castle keep, illustrated also by the Tower of London)
4. Castella Coca, Spain, built soon after 1473. Like Alcazar at Segovia, it is one of a chain of fortifications built by the kingdom of Castile during the reconquest of Spain from the Moors. Its warm red brick walls and projecting turrets belong to the style called *Mudejar*, which was developed by Moorish workmen under Christian supervision. The battlements are of the Moorish type
5. Walls of the citadel of Carcassonne, dating from the 13th and early 14th centuries, as restored under the direction of Viollet-le-Duc in the middle of the 19th century. The restoration gives an idea of the original appearance of a great mediaeval castle, of which the high, unbroken, battlemented walls and projection towers, either square with battlements or round with conical roofs, are characteristic features
6. Castle of Vajda Hunyadi in Hungary, showing characteristics similar to castles in western Europe. The projection of the upper part of the towers—machicolation—enabled defenders to discharge missiles directly upon the attackers below. The buildings shown in this picture date chiefly from about 1400 with parts of the residence portion of a later date
7. Palace of the Prince of Monaco. 17th century castle as restored

Architecture of the Middle Ages, trans. M. Macdermott (1860); *Annals of a Fortress,* trans. B. Bucknall (1875); G. T. Clark, *Mediaeval Military Architecture in England,* 2 vols. (1884); C. W. C. Oman, *Art of War in the Middle Ages* (1885); J. H. Round, *Geoffrey de Mandeville* (1891); J. D. Mackenzie, *The Castles of England,* illustrated (1897); "English Castles," *Quarterly Review* (July 1894); G. Neilson, "The Motes in Norman Scotland," *Scottish Review* (lxiv., 1898); W. St. John Hope, "English Castles of the 10th and 11th Centuries," *Archaeol. Journal* (lx., 1902); "Castles of the Conquest," *Archeologia* (lviii., 1902); E. S. Armitage, "Early Norman Castles of England," *Eng. Hist. Review* (xix., 1904); "Anglo-Saxon Burhs and Early Norman Castles," *Scot. Soc. Ant. Proc.* (xxxiv., 1900); "The Norman Origin of Irish Mottes," *The Antiquary* (Aug. and Sept., 1906); G. H. Orpen, "Motes and Norman Castles in Ireland," *Eng. Hist. Review* (xxi., xxii., 1906–07). (J. H. R.)

CASTLEBAR, urban district and county town of Co. Mayo, Eire, on the river and near the lough of same name. Pop. (1936) 4,826. The castle belonged to the De Burgh family but the town was founded in the reign of James I and received a charter in 1613. In 1641 the castle fell to the royalists. The town was held for a short period in 1798 by the French. Four miles northeast is a round tower 70 ft. high and 57 ft. in circumference. Trade is in linen goods and agricultural produce.

CASTLECONNELL, a village of Co. Limerick, Eire, on the left bank of the Shannon, 18 mi. S.E. of Limerick on the Great Southern railway. There are remains of a castle from which the town took its name, which was the seat of the kings of Thomond. It was destroyed in 1690. Castleconnell is a centre for the salmon fishing of the lower Shannon. Pop. (1936) 219.

CASTLE DONINGTON, a town of north Leicestershire, England, 13 mi. W.S.W. of Nottingham on the L.M.S.R. Pop. rural dist. (1938) 8,126. It lies on the flank of the hills overlooking the Trent and Soar valleys. There are slight remains of the castle. The church of St. Edward is a fine building of Early English and later date. Hosiery, silk and baskets are manufactured.

CASTLE-DOUGLAS, a small burgh, Kirkcudbrightshire, Scotland. Pop. (est. 1938) 3,192. It is situated on Carlingwark loch, 19½ mi. S.W. of Dumfries by the L.M.S.R. Its auction marts for sheep and cattle sales, from which it derives its chief importance, are the largest in the southwest of Scotland. The town is the chief centre of business in East Galloway, and it is also visited in summer for its scenery and fishing. Till 1765 it was only a village under the name of Causewayhead, but the discovery of marl in the lake brought it some prosperity, and it was purchased in 1792 by Sir William Douglas and called after him. Carlingwark loch contains several islets, on one of which is a crannog, or ancient lake dwelling. Threave castle, the Douglas stronghold 1369–1455, is on an island in the Dee, 2½ mi. west.

CASTLEFORD, an urban district in the West Riding of Yorkshire, England, on the river Aire near its junction with the Calder, 9 mi. S.E. of Leeds, on the L.N.E. and L.M.S. railways. Pop. (1938) 37,218. Area 6.8 sq.mi. Large glass-bottle and earthenware-jar works, chemical works, and neighbouring collieries employ the inhabitants. The district was considerably extended in 1938.

CASTLE GATE, a town in Carbon Co., Utah; 6,120 ft. above sea level; pop. (1940) 851. The name was taken from that of the peculiar gate-like passage in the canyon of Price river 1 mi. above the town. Here projecting pinnacles of grey sandstone, 650–700 ft. high, close in on the valley, leaving only a narrow passage resembling a gateway in the walls of a ruined castle. The town is the home of one of the largest producing coal mines in the Book Cliffs field, originally opened by the Pleasant Valley Fuel Co. in 1888 and now operated by the Utah Fuel Co.

CASTLE-GUARD, an arrangement under the feudal system, by which the duty of finding knights to guard royal castles was imposed on certain baronies, and divided among their knights' fees. The greater barons provided for the guard of their castles by exacting a similar duty from their knights. In both cases the obligation was commuted very early for a fixed money payment, which, as "castle-guard rent," lasted down to modern times.

See J. H. Round, "Castle-Guard," in *Archaeological Journal,* vol. lix., and "Castleward and Coinage," in *The Commune of London.*

CASTLEMAINE, ROGER PALMER, EARL OF (1634–1705), first husband of the duchess of Cleveland (*see* CLEVELAND, BARBARA VILLIERS, DUCHESS OF), English diplomatist and author. He was an ardent Roman Catholic, who defended his co-religionists in several publications. He wrote an account in French of the war against Holland (1665–67) in which he had served; an English version of his book was published in 1671. Denounced by Titus Oates as a Jesuit he was tried and acquitted, afterwards serving James II. as ambassador to Pope Innocent XI. After James II.'s flight, his Jacobite sympathies caused him to be suspected by the Government, and his time was mainly spent either in prison or in exile. He died at Oswestry on July 21, 1705.

CASTLEMAINE, a town 70 mi. N.W. of Melbourne, Victoria, Australia. Pop. (1933) 5,221. Castlemaine's gold mines were among the first discovered in the colony. Slate and flagstone are quarried in the district, which is also an important wine and fruit-producing area. It is near the centre of the chief sheep belt of Australia.

CASTLE PINCKNEY NATIONAL MONUMENT, a tract of 3½ ac. in South Carolina, U.S.A., set apart in 1924 as a government reservation. It is the site of a fort which was erected in 1810 and had previously been occupied by a revolutionary fort. Castle Pinckney is administered by the war department.

CASTLEREAGH, VISCOUNT: *see* LONDONDERRY, ROBERT STEWART, 2ND MARQUESS OF.

CASTLE RISING, a village of Norfolk, England, 4 m. N.E. of King's Lynn. Pop. of parish (1931) 450. The Norman castle for which it is famous stands on slightly elevated ground overlooking, to the west, the low marshy coast of the Wash. Its site is enclosed by artificial ramparts of earth and a dyke which is crossed by an ancient bridge. The keep is square and massive, and fairly perfect. In some parts, especially the entrance, the Norman carving is very rich. The foundations of a small chapel with apsidal eastern termination have been discovered outside the castle. The village of Castle Rising is the decayed remnant of a town of no little importance. Its church of St. Laurence is late Norman, with rich ornamentation; it shows traces of considerable alterations in the Early English period, but is an admirable example of the earlier style.

In Domesday Book the manor is given as having belonged to Archbishop Stigand, from whom it had passed to Odo of Bayeux, whose estates were confiscated in 1088. Granted to William de Albini, whose son built Rising castle, it passed eventually by sale to Isabel, queen of England, in 1332, remaining in the possession of the crown until Henry VIII. exchanged it for other lands with the duke of Norfolk. A mayor is first mentioned in 1343, and a borough existed in the 15th century. A survey of 1589–1590 declared that Castle Rising was an ancient borough by prescription. Castle Rising became a parliamentary borough in 1558, but was disfranchised in 1832 and the corporation abolished in 1835, although a mayor was elected for special purposes until 1883. Its fairs and markets were formerly important.

CASTLETON, a village of north Derbyshire, England, 10 mi. N.E. of Buxton. Pop. of parish (1931) 620. Lying at an elevation of about 600ft., it is surrounded on the north, west and south by steep hills rising to a height of from 1,400 to 1,700ft. above sea-level. The district is celebrated for its caves and mines and for the ruined Castle of the Peak, placed on a cliff immediately above the village. The Peak Cavern or Devil's Hole, penetrating this cliff, is the most magnificent in Derbyshire. For many generations the entrance to this cave has served as a workshop, held free of rent, to families employed in rope and twine making. Speedwell Cavern is not far distant, at the entrance to the fine pass of Winnats, by which Castleton and the Vale of Hope are approached from the west. Among several other caves is that known as the Blue John Mine, from the decorative fluorspar called "Blue John" which is obtained here. The church of St. Edmund, Castleton, retains a fine Norman chancel arch, and the vestry contains a valuable library. The Castle of the Peak, or Peveril Castle, is famous through Sir Walter Scott's novel *Peveril of the Peak.* Early earthworks, extending from below the castle in a semi-circle, can still in great part be traced. Before the Conquest the site was held by Gernebern and Hundinc, and was granted by the Conqueror to William Peverel, by whom the castle was built. In 1216 William Ferrers, earl of Derby, took

it from the rebellious barons, and was made governor by Henry III., who in 1223 granted a charter for a weekly market at the town. In 1328 the castle was given to John of Gaunt on his marriage with Blanche of Lancaster, and thus became part of the duchy of Lancaster. The castle has often been used as a prison, and from its position was almost impregnable.

CASTLETOWN, a town of the Isle of Man (Manx. *Bully Cashtel*), 10 mi. S.W. of Douglas, by the Isle of Man railway. Pop. (1939) 1,742. Area 2 sq.mi. It lies on both sides of a small harbour formed by the outflow of the Silver Burn into Castletown Bay. It was the legal capital of the island until 1862. In the centre of the town stands Castle Rushen, said to have been founded by the Dane Guthred, in 947–960, though the existing building is probably 14th century. Until the 18th century it was the residence of the lords of Man. The massive keep is square, and is surrounded by an outer wall, with towers and a moat. The council chamber and court-house were built in 1644. Near the castle is the Old House of Keys, where the members of the Manx parliament held their sessions until the removal of the seat of government to Douglas. King William's College, situated a mile to the north-east of Castletown, is the chief school in the island. A small shipping trade is maintained.

CASTOR AND POLLUX, in Greek and Roman mythology the twin sons of Leda, and brothers of Helen and Clytaemnestra. They were also known as *Dioscuri* (Gr. "lads of Zeus"), for, according to later tradition, they were the children of Zeus and Leda, whose love the god had won under the form of a swan. In some versions Leda is represented as having brought forth two eggs, from one of which Castor and Pollux were born, from the other Helen. According to another account, Zeus was the father of Pollux and Helen, Tyndareus (king of Sparta) of Castor and Clytaemnestra. In Homer they are said to have been the children of Tyndareus and Leda, and Helen is said to have been the daughter of Leda by Zeus. The Dioscuri were specially reverenced among people of Dorian race, and were said to have reigned at Sparta, where also they were buried. They were the friends of sailors, appearing in the shape of St. Elmo's fire during storms. Later, they were confounded with the Cabeiri (*q.v.*).

CASTOREUM, an oily viscid gland secretion contained in two pairs of membranous sacs between the anus and external genitals of both the male and the female Russian and American beaver; known also as beaver musk. After drying, it comes into commerce as more or less solid masses, of brown colour and a strong, rather disagreeable odour, due to the presence of about 2% of an essential oil, in addition to which a number of odourless organic and inorganic substances have been isolated. It was formerly used medicinally as a stimulant in hysterical affections, but at present serves almost exclusively for blending perfumes, in the same way as musk and civet, usually in the form of an alcoholic extract.

CASTOR OIL, the fixed oil obtained from the seeds of the castor oil plant or Palma Christi, *Ricinus communis,* family Euphorbiaceae. The plant is a native of tropical Africa, but is cultivated in most tropical and warmer temperate countries. Besides oil the seeds contain a powerful toxic substance (ricin) important as being, with abrin, the only vegetable substances to which antisera have been produced by immunological methods.

Much oil of excellent quality is obtained from India, Italy and California. The oil is obtained from the seeds by expression and decoction. One hundred pounds of good seeds may yield about five gallons of pure oil.

Castor oil is a viscid liquid, almost colourless when pure, with a slight odour, and a mild yet nauseous taste. Its specific gravity is 0·96 and it dissolves freely in alcohol, ether, and glacial acetic acid. It contains palmitic and several other fatty acids, but the chief is ricinoleic acid which occurs in combination with glycerin.

The active principle to which the oil owes its purgative properties has not been isolated. The dose is from a drachm to an ounce. By far the best way to administer the oil is in capsules, but it may be given in warm milk. It acts in about five hours, affecting the entire length of the bowel, but not increasing the flow of bile except in very large doses. The mode of its action is unknown. The oil will purge when rubbed into the skin or injected *per rectum.* It is an invaluable drug in temporary constipation and whenever a mild action is essential, as in pregnancy. It is useful for children and the aged, but must not be employed in cases of chronic constipation, which it only aggravates, whilst relieving the symptoms.

CASTRATO, an adult male soprano who has been operated on in his youth to prevent his voice from changing in the ordinary way to the normal masculine pitch. In former days such singers were very numerous and included some of the most famous in the whole history of the art, such as Caffarelli, Velluti, Senesino and Farinelli, but thanks to improved public opinion the abominable practice to which they owed their existence has now been entirely abandoned. Evirati was another name for singers of this class.

CASTREN, MATTHIAS ALEXANDER (1813–1853), Finnish ethnologist and philologist, was born at Tervola, Kemi, Finland, on Dec. 2, 1813. In 1838 he joined a medical fellow-student, Dr. Ehrström, in a journey through Lapland. In the following year he travelled in Russian Karelia; and in 1841 he undertook, in company with Dr. Elias Lönnrot, a third journey, which extended as far as Obdorsk, and occupied three years. On his return he published his *Elementa grammatices Syrjaenae* and *Elementa grammatices Tscheremissae* (1844). He then undertook an exploration of the whole government of Siberia, which resulted in a vast addition to previous knowledge, but seriously affected his health. The first-fruits of his collections were published as *Versuch einer ostjakischen Sprachlehre* (St. Petersburg, 1849). In 1850 he published a treatise *De affixis personalibus linguarum Altaicarum,* and was appointed to the new chair of Finnish language and literature at Helsingfors, next year becoming chancellor of the university. He was engaged on a Samoyedic grammar when he died on May 7, 1853.

Five volumes of his collected works appeared from 1852 to 1858, containing respectively—(1) *Reseminnen från åren 1845–44;* (2) *Reseberättelser och bref åren 1845–49;* (3) *Föreläsningar i Finsk mythologi* (Germ. trans. by A. Schiefner, 1853); (4) *Ethnologiska föreläsningar öfver Altaiska folken;* and (5) *Smärre afhandlingar och akademiska dissertationer.*

CASTRENSIS, PAULUS, an Italian jurist of the 14th century. He studied under Baldus at Perugia, and was a fellow-pupil with Cardinal Zabarella. He was admitted to the degree of doctor of civil law in the University of Avignon, but it is uncertain when he first undertook the duties of a professor. A tradition, which has been handed down by Panzirolus, represents him as having taught law for a period of 57 years. He was professor at Vienna in 1390, at Avignon in 1394, and at Padua in 1429; and, at different periods, at Florence, at Bologna and at Perugia. He was for some time the vicar general of Cardinal Zabarella at Florence, and his eminence as a teacher of canon law may be inferred from the language of one of his pupils, who styles him "famosissimus juris utriusque monarca." His most complete treatise is his readings on the *Digest,* and it appears from a passage in his readings on the *Digestum Vetus* that he delivered them at a time when he had been actively engaged for 45 years as a teacher of civil law. His death is generally assigned to 1436, but it appears from an entry in a ms. of the *Digestum Vetus,* which is extant at Munich, made by the hand of one of his pupils who styles him "praeceptor meus," that he died on July 20, 1441.

CASTRES, a town of south-western France, capital of an arrondissement in the department of Tarn, 29 m. S.S.E. of Albi. Pop. (1936) 24,361. The busiest town of its department, it has been a cloth-working centre since the 14th century. It lies on both banks of the Agout, which is fringed by old houses with projecting upper storeys.

Castres grew up round a Benedictine abbey, probably founded in the 7th century. It was a place of considerable importance as early as the 12th century, and ranked as the second town of the Albigenses. During the Albigensian crusade it surrendered to Simon de Montfort: in 1356 it was raised to a countship by King John of France, and was united to the crown by Francis I. in 1519. In the wars of the late 16th century the inhabitants sided with the Protestant party, fortified the town, and established an independent republic. They were brought to terms, however, by

Louis XIII., and forced to dismantle their fortifications; and the town was made the seat of the *chambre de l'édit,* for the investigation of the affairs of the Protestants, transferred (in 1679) to Castelnaudary. The bishopric of Castres, established by Pope John XXII. in 1317, was abolished at the Revolution. The church and former cathedral of St. Benoît dates only from the 17th and 18th centuries. The *hôtel de ville,* which contains a museum with some fine paintings by Goya, occupies the former bishop's palace, designed by Jules Mansart in the 17th century; the Romanesque tower beside it is the only survival of the abbey. Of several old mansions the Renaissance hôtel de Nayrac is the most interesting. Castres has a sub-prefecture, tribunals of first instance and of commerce, a board of trade-arbitrators and a chamber of commerce. Industries include, in addition to cloth-making, metal-working, tanning, turnery and the making of wooden shoes and furniture.

CASTRO, INEZ DE (d. 1355), mistress, and perhaps wife, of Peter I. (Pedro), king of Portugal, called *Collo de Garza, i.e.,* "Heron's Neck," was born in Spanish Galicia, in the earlier years of the 14th century, daughter of Don Pedro Fernandez de Castro, and Dona Aldonça Soares de Villadares, a noble Portuguese lady. Educated at the semi-Oriental provincial court of Juan Manuel, duke of Peñafiel, Inez grew up with Costança, the duke's daughter and her own cousin, who married in 1341 the infante Dom Pedro, son of Alphonso the Proud, king of Portugal. The young infanta and her cousin went to reside at Lisbon or at Coimbra, where Dom Pedro conceived that luckless passion for Inez which has immortalized them. Pedro's connection *par amours* with Inez would of itself have aroused no opposition. He might even have married her after the death of his wife in childbirth in 1345. According to his own assurance he did marry her in 1354. But by that time the rising power of the Castro family had created hatred among their rivals, both in Spain and Portugal. Alvaro Gonzales, Pedro Coelho and Diogo Lopes Pacheco persuaded the king, Alphonso, that his throne was in danger from an alliance between his son and the Castros, and urged the king to remove the danger by the murder of Inez. The old king went in secret to the palace at Coimbra, where Inez and the infante resided, accompanied by his three familiars, and by others who agreed with them. The beauty and tears of Inez disarmed his resolution, and he turned to leave her; but the men about him had gone too far to recede. Inez was stabbed to death and was buried immediately in the church of Santa Clara.

The infante had to be appeased by the concession of a large share in the Government. The three murderers of Inez took refuge in Castile. In 1357, however, Alphonso died, and the infante was crowned king of Portugal. Peter the Cruel, his nephew, surrendered the murderers. Diogo Lopes escaped, but Coelho and Gonzales were executed, with horrible tortures, in the king's presence.

The story, not authenticated, of the exhumation and coronation of the corpse of Inez has often been told. It is said that to the dead body, crowned and robed in royal raiment and enthroned beside the king, the assembled nobles of Portugal paid homage as to their queen, swearing fealty on the withered hand of the corpse. Inez was buried at Alcobaça, with extraordinary magnificence, in a tomb of white marble, surmounted by her crowned statue, destroyed by the French soldiery in 1810. From the brother of Inez, Alvaro Perez de Castro, the house of Portugal directly descended.

BIBLIOGRAPHY.—*See* Fernão Lopes, *Chronica del Rey Dom Pedro* (1735); Camoens, *Os Lusiadas;* Antonio Ferreira, *Ines de Castro*—the first regular tragedy of the Renaissance after the *Sofonisba* of Trissino; Luis Velez de Guevara, *Reinar despues de morir,* an admirable play; and Ferdinand Denis, *Chroniques chevaleresques de l'Espagne et du Portugal.*

CASTRO, JOÃO DE (1500–1548), called by Camoens *Castro Forte,* viceroy of the Portuguese Indies, the son of Alvaro de Castro, governor of Lisbon, served in north Africa between 1518 and 1538, soon after which date he went with his uncle Garcia de Noronha to the Indies. On arrival at Goa he volunteered for the relief of Diu. Returning to Europe, he was given command in 1543 of a fleet to clear the European seas of pirates. In 1545 he was sent to the Indies with six sail. He defeated Mahmud king of Gujarat and the Adil Khan and relieved Diu, losing one of his sons in the battle. He then captured Broach, subdued Malacca, and in 1547 was appointed viceroy by João III. He died at Ormuz, in the arms of his friend St. Francis Xavier, on June 6, 1548. He was buried at Goa, and afterwards taken home and buried in the convent of Bemfica.

See Jacinto Freire de Andrade, *Vida de D. João de Castro* (1651), Eng. trans. by Sir Peter Wyche (1664); Diogo de Couto, *Decadas da Asia,* vi. The *Roteiros* or logbooks of Castro's voyages in the East (Lisbon, 1833, 1843 and 1872) are of great interest.

CASTROGIOVANNI (ENNA), a town and episcopal see (Arab., *Kasr-Yani,* corruption of *Castrum Ennae*), in the province of Enna, Sicily, 95 mi. by rail S.E. of Palermo and 56 mi. W. of Catania. It is situated 2,605 ft. above sea-level in a strong strategic position, almost in the centre of the island, commanding a magnificent view of the interior. Pop. (1936) 21,261 (town); 23,817 (commune). Enna was one of the Sicel cities and the statement that it was colonized by Syracuse in 664 B.C. is improbable. It appears in history under Dionysius I of Syracuse, who after unsuccessful attempts finally acquired possession by treachery about 397 B.C. In 134–132 it was the headquarters of the slave revolt and was reduced only by treachery. Cicero speaks of it as a place of some importance, but in imperial times it seems to have been of little account. It was only by betrayal that the Saracens were able to take it in 859. In 1087 it fell into the hands of the Normans; and surviving fortifications are entirely mediaeval. The cathedral (1307) is of some interest. There are no remains of the famous temple of Demeter, from which Verres, as Cicero tells us, removed the bronze statue of the goddess. The lake of Pergusa, where Persephone was carried off by Hades (Pluto, Dis), lies 4 mi. to the south.

CASTRO URDIALES, a port of northern Spain, province of Santander, on the Bay of Biscay and terminus of a branch railway connected with the Bilbao-Santander line. Pop. (1940) 6,181 (mun., 11,963). Castro Urdiales is a modern town, although its castle and parish church, on the rocky peninsula which protects the tiny bay, date from the middle ages, when it was an important fishing port. Destroyed by the French in 1813, it was quickly rebuilt and increased rapidly in population and prosperity with the development of neighbouring iron-mines and of railway communication, which took place after 1879. The port is naturally sheltered but an artificial harbour has been constructed. Iron ore is by far the greatest export, but fish, especially sardines in oil, and *chacolí* wine are also important.

CASTRO Y BELLVIS, GUILLÉN DE (1569–1631), Spanish dramatist, was a Valencian by birth, and early enjoyed a reputation as a man of letters. At one time a captain of the coastguard, at another the governor of Scigliano, near Naples, Castro was nominated a knight of the order of Santiago in 1623. He settled at Madrid in 1626, and died there in such poverty that his funeral expenses were defrayed by charity. Lope de Vega dedicated to him a celebrated play entitled *Las Almenas de Toro* (1619), and when Castro's *Comedias* were published in 1618–21 he dedicated the first volume to Lope de Vega's daughter. The drama that has made Castro's reputation is *Las Mocedades del Cid* (1599?), to the first part of which Corneille was largely indebted for the materials of his tragedy. The two parts of this play, like all those by Castro, have the genuine ring of the old *romances;* and were among the most popular pieces of their day. Castro's *Fuerza de la costumbre* is the source of *Love's Care,* a play ascribed to Fletcher. He is also the reputed author of *El Prodigio de los Montes,* from which Calderón derived *El Mágico prodigioso.*

His *Obras* have been edited by E. J. Martínez (Madrid, 1925, etc.).

CASTRUCCIO CASTRACANI DEGLI ANTELMINELLI (1281–1328), duke of Lucca, born March 29, 1281, at Castruccio, near Lucca, was a noted *condottiere* and Ghibelline. He served under Philip IV. of France in Flanders, then with the Visconti in Lombardy, and in 1313 with Uguccione della Faggiuola, lord of Pisa, in central Italy. In 1316 he was elected lord of Lucca, and spent many years in incessant warfare against the

Florentines, whom he defeated at Altopascio in 1325, the year in which he was created duke of Lucca, Pistoja, Volterra and Luni by the emperor Louis the Bavarian. In 1327 he captured Pisa, of which he was made imperial vicar. He died Sept. 3, 1328.

BIBLIOGRAPHY.—Niccolo Machiavelli's *Life of Castruccio* is a mere romance; it was trans. into French, with notes, by Dreux de Radier in 1753. *See* F. Winkler, *Castruccio, Herzog von Lucca* (1897).

CASTRUM MINERVAE, an ancient town of the Sallentini in Calabria, 10m. S. of Hydruntum (mod. Otranto), with an ancient temple of Minerva, said to have been founded by Idomeneus, who formed the tribe of the Sallentini from a mixture of Cretans, Illyrians and Italian Locrians. It is also said to have been the place where Aeneas first landed in Italy, the port of which he named *Portus Veneris*.

CAST STEEL: *see* CRUCIBLE CAST STEEL.

CASUAL LABOUR, a term frequently used to describe the discontinuous and irregular employment which at certain times of the year is experienced in trades such as building, and in this somewhat loose sense of the term, casual labour is to be found in nearly every trade in proportions which vary with the unemployment situation in general, and the state of the industry itself in particular. The casual worker, however, with whom this article is primarily concerned is the man whose employment normally, and not only periodically, consists of a succession of jobs of short duration, whose contract of engagement is by the day or even by the hour, and who, from the method by which he is engaged, may be uncertain in the morning whether work will be available in the afternoon. He is typified in the casual labourer at the docks. It is in this industry and the ancillary transport trades, and in ship-repairing, that casualization is most extensive. The nature of the problem may conveniently be illustrated by the conditions under which the dock labourer is employed.

These conditions have their origin in the day-to-day variations in the amount of loading and unloading which has to be done at the docks. Trade movements in general, and seasonal causes such as the periodical arrival of staple imports like wool and timber, may influence the extent of these variations, but their intensity is mainly due to the natural uncertainties, accentuated by the vagaries of wind, weather and tide, associated with the arrivals and departures of ships. One vessel may just manage to catch a tide and afford employment for two or three hundred men; another may be held up by a sudden fog, leaving workless the anxious crowd of men who had carefully followed its progress up the river. From causes such as these the daily volume of work at the docks fluctuates to such an extent as to become almost unpredictable.

It is obvious that to meet a varying load of this sort a large reserve of labour is required, but the extent to which this reserve must necessarily be larger than that of most industries is not so apparent without a prior idea of the general layout of most dock areas. The expression "the Port of London," or "the Port of Liverpool" tends to obscure the fact that these areas consist of a number of separate docks and separate wharves, stretching for some miles on both banks of the river, between many of which there are no means of transferring labour with any degree of rapidity. It would be impossible, for example, to switch a gang of dockers from Tilbury in time to meet a shortage of labour brought about by an unexpected demand at Wapping. This may appear rather an extreme illustration, but the "turning round" of a ship, it must be remembered, is work which has to be done at high pressure and with the utmost expedition. It follows, therefore, that as the volume of work at Tilbury may vary quite independently of the amount at Wapping, a supply of labour sufficient to meet the maximum requirements of each area must always be available. In short, the load of a port like London is the aggregate of the loads of each separate labour area.

The Existence of Excessive Casualization.—The difficulty of providing a supply of labour to meet the practical requirements of the industry has tended to become somewhat obscured in the denunciation of the casual system of engagement. In solving the problem it must be admitted that the system gives rise to a great deal of chronic under-employment; that it was in the past and still is in many respects a vicious and demoralizing system; and further that casualization tends to breed a class of inefficients and unemployables. But in spite of the social problem which it creates, the system has remained, not so much because of the passive attitude of employers or public opinion in general, as by reason of the impossibility of obtaining, without a substantial margin of casual workers, a supply of available labour which will rise or fall as occasion demands. The practical problem of decasualization lies in reducing this margin to the lowest possible proportions. In the past it is clear that owing to the methods and conditions of recruitment of the casual labourer, the margin was unnecessarily large; with every reduction in the margin there will be a corresponding diminution in the evils incidental to excessive casualization.

The extent to which indiscriminate selection and separate pools of labour spread work among an unnecessarily large number of men have been made familiar by the writings of Mayhew, Booth and others. But while the main features of the system of "calling on" still remain, something has been done to check the excessive competition for employment, which in pre-War days, caused much chronic distress among dock labourers. This over-competition arose through the influx into the docks of workers unable to find other employment, this being most seriously felt in years of trade depression, as for example, 1905–06. In theory, the remedy is obvious, but the practical application of the principle of restricting the right to look for work has proved no easy matter. It was not until 1912 that the first important experiment in this direction was made in Great Britain in the Liverpool Docks scheme.

The Liverpool Docks Scheme.—At the time the scheme was initiated, practically all the work at the Port of Liverpool was done by casual labour, of which there was an abnormally large surplus. It was estimated that the total number of men required on the busiest day was not more than 20,000, while the number normally seeking employment was over 29,000, and yet, it appears, "at a time when the surplus of labour exceeded 7,000, lodging houses in Liverpool were attracting labour from Ireland by advertisement that work was plentiful at the docks."

Dock Labour and Decasualization.—The attempt to remedy this state of affairs was made by "registering" dockers, from which the name "Registration Scheme" is derived, and limiting the right to look for employment to men in possession of "tallies," which are brass tokens bearing the registered number of each docker. Special provision was made for facilitating the distribution of labour, while other reforms included the weekly centralized payment of wages, the object of the last mentioned being to save dockers from the hardship of tramping from employer to employer to collect their week's pay. The control of the issue of tallies as well as the general supervision of the scheme was under a joint committee of employers and workpeople.

A valuable commentary on the practical difficulties of decasualization is afforded by the 15 years working of the scheme. Although backed by their union, the scheme was launched only in the face of the fiercest opposition of sections of the dockers; when this was overcome, the casual workers objected to being shifted outside their own labour area. The special arrangements intended to improve the mobility of labour have thus been ineffective, and as a result the reduction of the casual margin has proved even more difficult than was anticipated. It is true that the position of the casual labourer at Liverpool is still unsatisfactory, though it is better than in 1912, but it is equally true that in warding off the threatened influx of unemployed from other trades the scheme has made the problem much less acute than it would have been.

Registration Schemes and the Post-War Problem.—During the World War period casualization as a problem practically ceased to exist in Great Britain. In most of the largest ports, registration schemes operated by "Port Labour Committees" were set up to deal with War-time labour questions, including the issue of exemption certificates and the release of dockers for military service; and at the Armistice, schemes on somewhat similar lines were resuscitated to assist in meeting the dual problem caused by congestion at the docks and the threatened rush of entrants from

other trades. Except in one or two instances (*e.g.*, Bristol), these schemes, for various reasons, either became ineffective or fell into abeyance. This was unfortunate, as the establishment of a registration scheme is the first essential step towards decasualization. As a result, however, of the movement which originated in the appointment of the Roche Committee of Enquiry in 1919, and subsequently led to the formation of a standing committee under Sir Donald Maclean in 1924, registration schemes have been established in practically every large port.

A general idea of the problem can be obtained from a survey of the conditions of the Port of London, not only because casualization there is more extensive, and probably more intensive as well, than in any other large area, but also because conditions in London serve best to illustrate the extent to which the varying volume of work at the docks creates casualization in other trades, and in this way brings into existence a vast pool of casual labour.

Port of London Registration Scheme.—It was not until 1920 that a registration scheme was established to deal with the port of London as a whole. As far back as 1905 a successful attempt at decasualization was made by one of the largest employers in the port, the London and India Dock company, and this reform was carried a little farther when this company and others were absorbed in the Port of London Authority in 1908. But the decasualization of one body of dock workers into various grades of "permanent" and "preference" men, while affording incontrovertible evidence of the beneficial effects of the reform to the men involved, and also of the economies which could be effected by a systematic distribution of labour, only tended to make the burden more acute for the remaining casual margin. The intensity of the problem in London is, in fact, due in considerable measure to the existence of so many specialized workers, such as deal porters and coal porters, and the non-interchangeability of the work of these men with that of the ordinary casual labourer. That the problem was accentuated by the influx of workers from other trades, particularly since the commencement of the post-War depression, there was little doubt, and the delay in evolving a suitable registration scheme arose not from apathy on the part of the authorities concerned, or from opposition on the part of the dockers (such as, for example, has proved so great a stumbling-block in Glasgow) but mainly from the difficulty of dealing as a whole with the many diverse elements in the port. Following the recommendations of the Roche Committee of Enquiry these difficulties were overcome.

The scheme was framed on the lines of the Liverpool model, the control of the issue of tallies, as is essential for the smooth working of a registration scheme, being under a joint committee of employers and workpeople. Such was the extent of the casual problem in London that, although applications were carefully scrutinized, the committee found it necessary to issue about 61,000 tallies. This number obviously exceeded the port requirements, but owing to difficulties which arose in the working of the scheme, the register was reduced by only about 7–8,000 in the first five years. On the reconstitution of the committee in 1925, it was found possible, with closer co-operation from employers and trade unions, to effect further reductions. At the end of 1927 the number of tallies in circulation was about 40,000, and although the retention of a registry of this size still involves the existence of a substantial fringe of under-employed workers, it is considered, in view of adverse London factors, that it hardly exceeds normal requirements.

The Transport Trades.—Casual labour has so far been treated as it emerges from the varying amount of loading and unloading at the docks. It would be misleading, however, to suggest that this is more than one aspect. Since the varying volume of dock work necessarily causes a varying load in transportation and distribution, the different transport trades must each have their separate casual margins. The extent of casualization thus engendered is difficult to estimate. Its existence is most apparent in a large distributive area like London; and there is little doubt that the post-War depression in Great Britain with the general shortening of contracts incidental thereto has increased the dimension of the problem. While a more systematic distribution of the load might possibly lessen the intensity of its fluctuations, it is difficult to see that there is any way to a general diminution of casualization in these trades other than that which would follow from a trade revival.

Ship-repairing Industry.—The special problem of casualization in the ship-repairing industry arises from the short, intermittent spells of work which the industry affords. The decision to send a ship to the yard for repair or overhaul depends on an almost infinite variety of factors, ranging from the age of the ship and the general state of trade, to the manifold uncertainties associated with the operation of steamship traffic. Ship-repairing jobs, moreover, unlike shipbuilding contracts, are essentially short in their nature. The quick "turn round" of a vessel is a factor even more essential in ship-repairing yards than at the docks. The conditions of the industry are, therefore, such as to involve for its personnel long periods of unemployment between short spells of intensive employment. The "scaler" or "rigger" may be working overtime for two or three days on end and obtain no further work for days or weeks, or even months thereafter.

Decasualization in ship-repairing is even more difficult than in dock labour. It is accentuated by the fact that in most of the big ship-repairing centres the yards are often spread over a wide area or separated by distances too long to make labour effectively mobile. But an unnecessarily large margin of casual labour is retained owing to the wasteful methods by which this labour is recruited and distributed. In this industry, to an even greater extent than at the docks, the old system of small, detached "calling on" stands remains general.

Future of Decasualization.—The existence of an under-employed fringe of casual workers at the docks, and in other industries, gives rise to one of the most pressing industrial problems of the day. It is a problem whose solution cannot be found in the force of economic tendencies; moving in the direction of driving from these industries those who are unable to obtain a livelihood there. The possibility of short spells of employment at the relatively high rate of wages, which is a general feature of industries utilizing a high proportion of casual labour—the ship-repairing industry in particular—is sufficiently attractive to compensate for long periods of under-employment. It is, therefore, abundantly clear, in view of the manifest evils incidental to chronic under-employment, that decasualization, from every point of view, is a step which is eminently desirable.

Ethical and moral considerations, however, should not be permitted to obscure the fact that, not only from the economic needs of the industries concerned, but also because of the problem involved in making provision for the unemployed margin displaced in decasualization, the step must necessarily be a gradual one. As Sir William Beveridge pointed out in 1908 (*Unemployment—A Problem of Industry*), it is a step which should be made in times of good trade rather than of bad trade, and it is one in which an important part can be played by an efficient system of Employment Exchanges.

BIBLIOGRAPHY.—A very wide literature exists on the casual labour question. The most modern and at the same time the most informative book on the subject is by Lascelles and Bullock, *Dock Labour and Decasualization* (1924), where a comprehensive bibliography is given in appendix C. (G. C. P.)

United States.—The term "casual labour" is used in the United States for irregular, short-time employment of a wide variety of types. It ranges from extra help for house-cleaning, snow-shovelling and the like to short engagements on docks and in agriculture, lumbering, contracting and other industries. Many thousands pick up a precarious livelihood at such work.

The construction industry makes frequent calls for men to work from a day to two or three weeks. They expect a supply of casual labour to be continually available. Increasing mechanization and decreased use of labour in proportion to the volume of work done are tending to reduce the construction demand for casual labour. Little attention has been given to the problem as such by the industry. Mercantile establishments hire casual help at the holiday season, for sales and other rush or extra emergency work. Part of this demand is satisfied in the case of the larger stores by a reserve list largely consisting of married women. Many of them

do not want steady employment. The remainder is genuine casual hiring. Caterers, hotels and restaurants hire casual labour for waiting table at banquets and other social functions; advertisers, theatres and business houses to distribute advertising matter. These are typical of a wide range of casual jobs in ordinary business. The maritime, agricultural and lumbering industries have had mass problems of casual labour. Dock work is in all countries the familiar example of large scale casual employment. American and Canadian agriculture and lumbering have offered only casual engagements to a larger number of workers than have been employed on the docks.

Longshore (dock) work is subject to unpredictable daily variations due to the irregularity of arrival of ships and variations in cargoes. The unceasing hiring, discharge and new hiring of longshoremen has in every port produced intense competition for jobs, the accumulation of surpluses of labour around the docks and easy access into longshore work of unemployed men from other industries. But it has also produced more constructive effort for decasualization than in any other "casual" occupation.

Seattle was the pioneer among American ports in regularizing longshore work. The decasualization plan in effect there in 1939 evolved from a plan started in 1921. The successful strikes of the International Longshoremen's Association in 1934 and 1936 resulted in the reorganization of the plan and its extension from Seattle, Portland and Los Angeles to all American ports on the Pacific coast. It had not been established on the Atlantic coast down to 1939. The question whether the employers or the union should control the dispatching halls (hiring halls) was a basic issue in the 1934 strike. The issue was compromised by putting the dispatching halls under the supervision of a Labor Relations Committee composed of an equal number of employer and union representatives. All personnel necessary for operating the scheme are selected by the committee except—and the exception is of vital importance—the dispatchers, who are elected by the union. No one can serve for more than two consecutive years on the dispatching staff. The union, therefore, has actual control of the employment process. Theoretically, a longshoreman who is not a member of the union can register at the dispatching hall as a "permit man" and be listed for work. Actually, there is both a closed shop and a closed union, and "permit men" have little chance. Even members of the union who come from other ports are permitted to work on the local docks for a period of but 30 days and only on a "visitor's card." The union will not increase its membership except when its members see that the labour supply is inadequate, and they will not admit it is inadequate until they are earning over $1,800 a year.

The present dispatching system went into operation March 4, 1935. Its procedure equalizes man-earnings through equalization of gang hours. Most of the longshoremen are assigned to eight-man gangs. The balance are on "the extra board" and used to fill the places of absentees and to increase the size of gangs when necessary for handling cargoes. The cumulative annual earnings of each gang are recorded daily on a blackboard in the dispatching hall. Assignments of gangs to the employers are made each day on the basis of balancing the gangs' earnings. The dispatching office at Seattle stated that they would balance the man-year earnings of all the men on the Seattle docks for the year 1939 with a variation of not more than two or three dollars per man in annual earnings.

Until recently there were "preferred gangs" and "casual gangs." Employers asked for particular gangs for certain classes of work, such as unloading lumber. In the interest of equalizing earnings, the union did away with the preferred gangs. Employers complain that some gangs are not competent to handle some cargoes but from the point of view of equalization of earnings the present plan produces an almost perfect result.

The men on "the extra board" are sent out under the same principle of earnings equalization but union men are given a preference, men whose initiation is pending second chance, and permit men (non-union) last chance.

American agriculture has been another source of extensive casual employment. A large, but never enumerated, number of people have been used in the wheat harvest of the great plains, the California and Atlantic coast fruit and vegetable harvests, in onion growing in Texas and other States, sugar beets, peas, tomatoes, corn and similar products in various parts of the country. In 1935, California estimated its harvest labour needs at 198,000 persons, 50,000 of whom would be non-residents of the county where the crops were harvested. Most of these crops, in addition to their seasonality, have a high sensitivity to weather, which may in a short period of time advance or retard maturity of the crops.

The increased use of the combine, which cuts and threshes wheat in a single operation, and many other forms of agricultural machinery have greatly diminished in recent years the casual labour demand for wheat harvesting, cotton, peas and corn. But in solving to a degree the casual labour problem, they have in some cases intensified other types of unemployment problems.

The lumbering industry, like the agricultural, has greatly diminished its demand for casual labour, partly through the decrease in merchantable forests, partly through increased mechanization and longer lumbering seasons.

Much of the American casual labour problem has centred around the *migratory* casuals, as contrasted with the resident casuals. It is the combination of habitual migration with short time employment that distinguishes the migratory casual from all other types of workers in the American labour supply.

The agricultural, lumbering and construction industries have been the most important employers of migratory workers, and typically on a very irregular and casual basis. Ordinarily, the migratory casuals have lived (and do now) on the very margin of subsistence. When in need, because non-residents form a poor law point of view, they seldom have had a clean-cut right to public relief. It was the established practice either to give them emergency aid and make them leave town immediately or to arrange to ship them to the locality where they last had legal residence. There they might or might not be accepted as eligible for relief. When the Federal Emergency Relief Administration was set up in 1933, its relief program for transients gave the migratory casuals recognized rights to relief for the first time in American history. The right was destroyed in 1935 when the WPA was set up and the Federal direct relief system liquidated.

BIBLIOGRAPHY.—D. D. Lescohier, *Sources of Supply and Conditions of Employment of Harvest Labor in the Wheat Belt,* Bulletin 1211, U.S. Department of Agriculture (May 23, 1924); A. H. Hansen et al., *The Duluth Casual Labor Group* (University of Minnesota Press, 1932); Eldon E. Shaw and John A. Hopkins, *Trends in Employment in Agriculture, 1909–36,* WPA Report No. A-8 (Nov. 1938); John H. Webb, *The Transient Unemployed,* WPA Research Monograph III (1935); John H. Webb, *The Migratory Casual Worker,* WPA Research Monograph No. 7 (1937); Marvel Keller, *Decasualization of Longshore Work in San Francisco,* WPA Report No. L-2 (April 1939) (Bibliography); Boris Stern, *Cargo Handling and Longshore Conditions,* United States Bureau of Labor Statistics, Bulletin 550 (Feb. 1932); Edward E. Swanstrom, *The Waterfront Problem, a Study in Decasualization and Unemployment Insurance* (Fordham University Press, 1938) (Bibliography). (D. D. L.)

CASUALTIES, in military use, the losses of a force in war by death, wounds, sickness, desertion or any other cause (from Lat. *casus,* that which falls out). The duty of dealing with all casualties from wounds or sickness falls to the medical services, the personnel of which treats each case from the moment of its occurrence to the eventual recovery or death of the patient.

CASUAL WARD. The casual ward is a part of the British method of dealing with vagrancy. Under the Poor Law as reformed in 1834 the primary duty of boards of guardians was to relieve destitute persons within their districts. Gradually, however, it was extended to the administering of relief to vagrants also, or casual paupers, as they were officially termed, and the treatment depended very much upon the board of guardians and master of the workhouse, who might act with either great harshness or unexpected kindness.

Any vagrant or unemployed man walking from place to place and seeking work usually obtained an order for the casual ward from the relieving officer or his assistant, though he could be admitted to the workhouse without an order; vagrants were searched —usually perfunctorily—and deprived of money and tobacco, which were restored to them on discharge. They were given a bath

on admission, and a meal, usually sugarless cocoa and a piece of bread. For the night the clothes of the inmates were taken away (and sometimes disinfected) and a rough nightshirt provided. Sleeping accommodation on the floor or a truckle bed was provided either in cells or associated wards. In return for the food and lodging tasks of wood sawing or chopping, digging, oakum-picking, or scrubbing floors were imposed, though in many wards this obligation was not too rigidly enforced.

Vagrancy Committee, 1906.—In 1906 a local government departmental committee enquired into the subject of vagrancy and considered the improvement of the casual ward. Among recommendations made were the transference of the wards to the control of the police authorities and the issue of way-tickets such as are used on the continent of Europe and, formerly, in some English counties; and the detention of habitual vagrants in labour colonies (which was also proposed by the royal commission on the Poor Laws 1910). Way-tickets were to contain a description of the vagrant, name of his trade, his reason for wayfaring and his proposed destination; also his signature and possibly his finger-prints. The name of each casual ward was to be stamped on the ticket and its duration limited to, possibly, a month; a man holding such would be entitled at the casual ward to a night's lodging, supper, and breakfast and then after two hours' work as payment, could leave. The name of the ward on his route that he should reach by next nightfall would be entered on the ticket, and on his arrival there the procedure would be repeated. The plan was never carried out.

After 1918, as a result of post-war conditions and industrial disputes the great increase in the numbers of wayfarers applying for assistance to the Poor Law guardians threw the system out of gear and, following the abolition of the boards of guardians by the Local Government Act 1929, and the transference of their functions to the county and borough councils, a re-organization was effected by the Poor Law Act 1930, supplemented by various orders, especially the Public Assistance (Casual Poor) Order 1931. The provision of and admission to casual wards thus became the business of the Public Assistance Committees of the councils, and joint Vagrancy Committees have been established throughout the country to bring about a uniform system and effect economies in expenditure.

Today the casual is admitted and supervised by officials properly trained for the purpose, and, except in special circumstances, is not allowed to discharge himself before the second morning (excluding Sunday) following admission unless he has a current vacancy ticket given him by an Employment Exchange; his clothing is taken, and cleaned if necessary; money, if any, and other articles are also taken from him, and the cost of relief deducted from such money before its return; a day-room and proper sleeping accommodation must be provided, also a clean towel; and any case of infectious disease or mental illness must be reported to the Ministry by the medical officer, who must visit the ward and examine every casual therein once a month. Stone-breaking and corn-grinding are not now among the tasks that may be imposed, and no work may be called for on Sunday, Christmas day, or Good Friday. (*See* VAGRANCY.)

CASUARIIDAE: *see* CASSOWARY.

CASUARINA, a genus of odd trees of the Casuarinaceae family containing about 35 species, chiefly Australian, but a few Indo-Malayan. The long whip-like green branches are longitudinally grooved and bear at the nodes whorls of small scale-leaves, the shoots resembling those of *Equisetum* (horse-tail). The flowers are unisexual. The staminate are borne in spikes, each flower consisting of a central stamen which is surrounded by two scale-like perianth-leaves. The pistillate are borne in dense spherical heads; each flower stands in the axil of a bract and consists of two united carpels flanked by a pair of bracteoles; the long styles hang out beyond the bracts, and the one-chambered ovary contains two ovules. In the fruit the bracteoles form two woody valves between which is a nutlet; the aggregate of fruits resembles small cones. Pollen is transferred by the wind to the long styles. The pollen-tube does not penetrate the ovule through the micropyle but enters at the opposite end—the chalaza (*see* ANGIOSPERMS). The wood is very hard, and several species are valuable timber trees. From a fancied resemblance of the wood to that of the oak these trees are known as "oaks," and the same species has different names in different parts such as "she-oak," "swamp-oak," "iron-wood" and "beef-wood." Several species are cultivated in the subtropical parts of the United States, especially the beef-wood (*C. equisetifolia*), which has become widely naturalized in Florida. *See* J. H. Maiden, *Useful Native Plants of Australia* (London and Sydney, 1889).

CASUISTRY, the art of bringing general moral principles to bear on particular actions. It is, in short, applied morality; anybody is a casuist who reflects about his duties and tries to bring them into line with some intelligible moral standard. But morality at different times has worn very different dresses. It has sometimes been thought of as an outward law, sometimes as an inward disposition; and each of these rival conceptions has developed a casuistical method of its own. Believers in law have put their trust in authority or logic; while believers in disposition chiefly look to our instinctive faculties—conscience, common-sense or sentiment. The legal is the older group, and to it the name of casuist is often exclusively reserved, generally with the implication that its methods are too purely technical to commend themselves to mankind at large. But common-sense and conscience are quite as definite guides as logic or authority; and there seems no good reason for refusing to give the name of casuistry to their operations.

The casuistry of primitive man is uncompromisingly legal. His morality is not yet separated from his religion; and religion for him means the cult of some superior being—the king or priest of his tribe—whose person is charged with a kind of sacred electricity. "His divinity is a fire, which, under proper restraints, confers endless blessings; but if rashly touched, or allowed to break bounds, it burns or destroys what it touches. Hence the disastrous effects supposed to follow a breach of taboo; the offender has thrust his hand into the divine fire, which shrivels up and consumes him on the spot" (Frazer, *The Golden Bough,* i. 169). Elaborate rules are accordingly drawn up to secure the maximum of benefit, and the minimum of inconvenience, from this sacred fire; and in the application of these rules does savage casuisty consist. At a higher stage of civilization the god is no longer present in person but issues to his worshippers categorical commands. These logic must seize upon and develop as far as they will go; for the breach of some trifling consequence of a rule might mean the loss of the deity's favour. Hence the rise of sacred books among most Eastern peoples. On the Jewish Decalogue, for instance, follows the law, and on the law the rabbinical schools. Some of these will be stricter, and some laxer; but on the whole all tend to "aggravate" the law—down to the point of forbidding the faithful to wear a girdle, or to kill a noxious insect on the Sabbath. Though indeed we might look nearer home than the Talmud for similar absurdities; most Puritan communities could furnish strange freaks of Sabbatarian casuistry. Nor have the Catholics been one whit behind them. Their scholastic doctors gravely discuss whether—since water is the "matter" of baptism—a soul can be made regenerate by milk, or rose-water or wine.

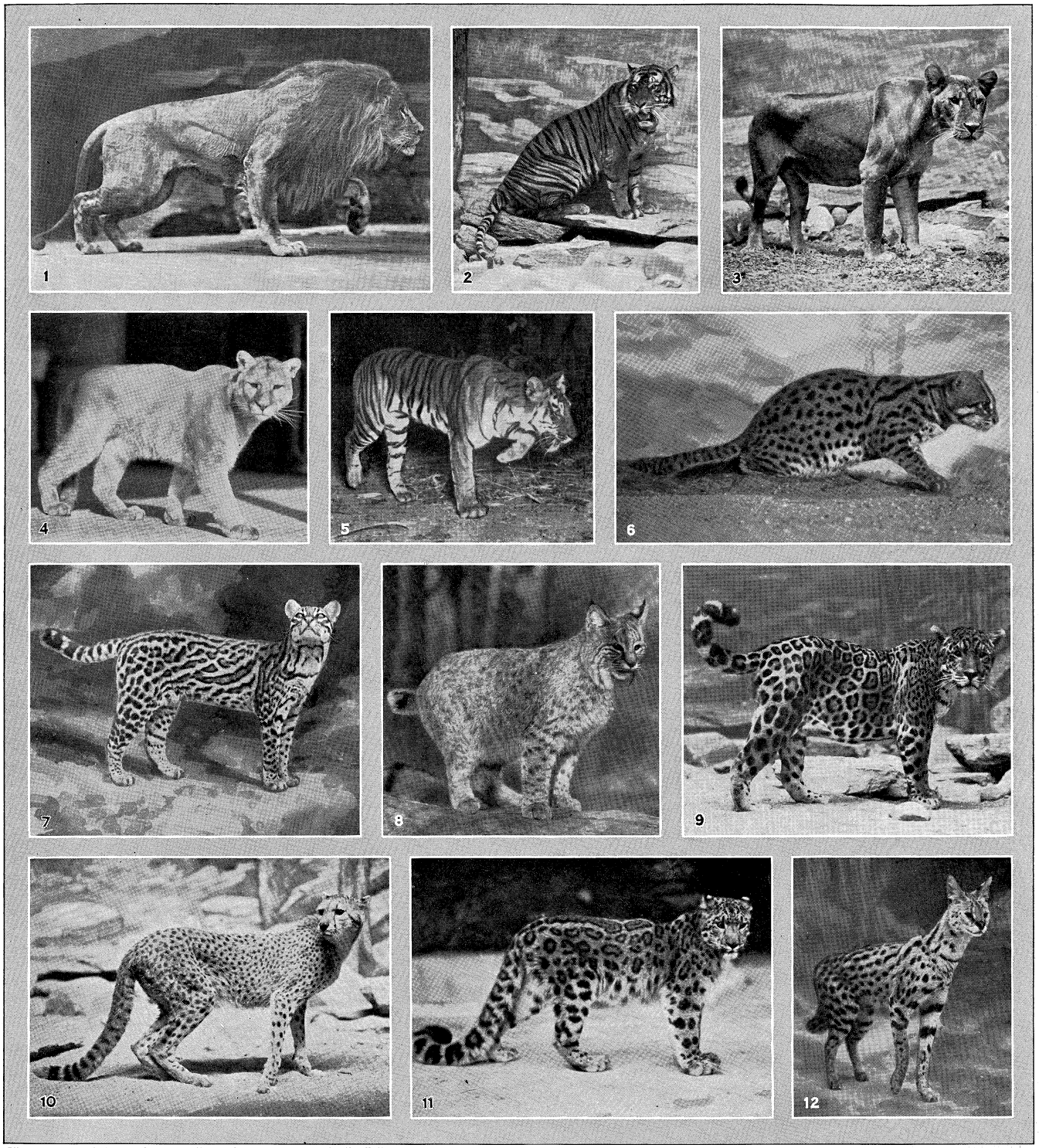
At the opposite pole stood ancient Greece. Here ceremonial casuistry found no place, because there were no sacred books. "Among the Greeks writing never attained the consecration of religion. No system of doctrine and observance, no manuals containing authoritative rules of morality, were ever transmitted in documentary form. In conduct they shrank from formulae. Unvarying rules petrified action; the need of flexibility, of perpetual adjustment, was strongly felt" (Butcher, *The Greek Genius,* p. 182). For this reason their interest in ethical speculations was all the keener; their great thinkers were endlessly engaged in settling what the relation ought to be between duty and self-interest. Ought one to swallow up the other—and, if so, which should prevail? Or was it possible to patch up a compromise between them? The great Stoic philosophers took the austerest line, and held that duty should always and everywhere be our only law. But it was one thing to enunciate such magnificent theories in a lecture, and quite another to apply them in

the market-place. Casuistry came to the aid of average human nature—that is to say, pupils began to confront the master with hard cases taken from daily life. And more than one master was disposed to make large—even startlingly large—concessions to the exigencies of practice. This concrete side of moral philosophy came specially into evidence when Stoicism was transplanted to Rome. Cicero's *De Officiis* abounds in the kind of question afterwards so warmly discussed by Dr. Johnson and his friends. Is it ever right to tell a lie? May a lawyer defend a client whom he knows to be guilty? In selling my goods, is it enough not to disguise their shortcomings, or ought I candidly to admit them? Seneca even made the discussion of such problems into a regular discipline, claiming that their concrete character gave an interest in morality to those who had no love for abstractions; while they prevented those who had from losing themselves in the clouds. And M. Thamin maintains, that, if his heroes did not form great characters, at any rate they taught the Roman child to train its conscience. But, then, Cicero and Seneca took common-sense as their guide. They decided each problem on its merits, looking more to the spirit than to the letter, and often showing a practical sagacity worthy of Johnson himself. Quite in the great doctor's spirit is Cicero's counsel to his son, to hear what the philosophers had to say, but to decide for himself as a man of the world. Such advice could not be grateful to the philosophers themselves—then a definite professional class, not unlike the "spiritual directors" of a later Rome, who earned their bread by smoothing away the doubts of the scrupulous on all matters intellectual and moral. Their great weapon was their logic; and a logician, as Pascal says, must be very unfortunate or very stupid if he cannot manage to find exceptions to every conceivable rule. In their hands casuistry became the art of finding such exceptions. From the Greek sophists they borrowed ingenious ways of playing off one duty against another, or duty in general against self-interest—leaving the doubter the alternative of neglecting the one and being a knave, or neglecting the other and being a fool. Or else they raised a subtle distinction between the act and the intention. To get drunk for the sake of a drink was the mark of a beast; but wine was a powerful stimulant to the brain, and to fuddle oneself in order to think great thoughts was worthy of a sage. No doubt these airy paradoxes were not always seriously taken; but it is significant that a common Roman proverb identified "philosophizing" (*philosophatur*) with thinking out some dirty trick.

Christianity swept the whole discussion on to a higher plane. All the stress now fell on the disposition, not on the outward act. The good deeds of a just man were a natural consequence of his justice; whereas a bad man was no whit the better, because he now and then deviated into doing right. Actions, in short, were of no account whatever, apart from the character that produced them. "All things are lawful unto me," said St. Paul, "but all are not expedient." And St. Augustine sums the whole matter up in the famous phrase: "Have charity, and do as thou wilt." Narrow-minded Christian consciences, however, could not stay long on this level; law was so very much more satisfying a guide than vague, elusive charity. And law in plenty was forthcoming, so soon as the Church developed the discipline of public confessions followed by appropriate penances for each fault. At first the whole proceeding was informal and impulsive enough; but by the 7th century it had grown thoroughly stereotyped and formal. *Libri Poenitentiales* began to appear—detailed lists of all possible sins, with the forfeit to be exacted from each. As public penance finally decayed, and auricular confession took its place, these were superseded by the *Summae de Poenitentia*—law-books in the strictest sense. These were huge digests of all that popes, councils, Early Fathers had decided on every kind of question pertaining to the confessional—what exactly is a sin, what kind of questions the priest must ask, under what conditions he could give absolution. As such, they were eagerly welcomed by the clergy; for a single magistrate, sitting in secret without appeal, necessarily grasps at whatever will lighten his burden of responsibility. Nor was their complexity a stumbling-block. The mediaeval mind was only too prone to look on morality as a highly technical art, quite as difficult as medicine or chancery law—a path where wayfaring men were certain to err, with no guide but their unsophisticated conscience. What could they possibly do but cling to their priest with a "blind and unexpressed faith"?

Against this state of things the Reformation was a violent protest. Catholicism increasingly took for granted that a man imperilled his soul by thinking for himself; Protestantism replied that he could certainly lose it, if he left his thinking to another. For it is to the individual conscience God speaks; through the struggles of the individual conscience He builds up a strong and stable Christian character. "A man may be a heretic in the truth," says Milton in his *Areopagitica* (1644), "if he believes things only because his pastor says so, or the Assembly so determines, without knowing other reason, though his belief be true, yet the very truth he holds becomes his heresy. There is not any burden that some would not gladlier post off to another than the charge and care of their religion. A wealthy man, addicted to his pleasures and his profits, finds religion to be a traffic so entangled, and of so many piddling accounts, that of all mysteries he cannot skill to keep a stock going upon that trade. What does he therefore but resolve to give over toiling, and find himself some factor, to whose care and conduct he may commit the whole managing of his religious affairs—some divine of note and estimation that must be. To him he adheres, resigns the whole warehouse of his religion with all the locks and keys into his custody, and indeed makes the very person of that man his religion. So that a man must say his religion is now no more within himself, but is become a dividual moveable, which goes or comes near him, according as that good man frequents the house."

Twelve years after the *Areopagitica* appeared Pascal's *Provincial Letters* (1656–1657). These deal with the casuists of the Counter-Reformation in the spirit of Milton, laying especial stress on the artificiality of their methods and the laxity of their results. Not, of course, that they meant deliberate evil; Pascal expressly credits them with good intentions. But they were drawn, almost to a man, from Italy or Spain, the two countries least alive to the spirit of the Reformation; and most of them were Jesuits, the order that set out to be nothing Protestantism was, and everything that Protestantism was not. Hence they were resolutely opposed to any idea of reform; for to begin making changes in the Church's system would be a tacit admission that Luther had some show of reason on his side. On the other hand, they would certainly lose their hold on the laity, unless some kind of change were made; for many of the Church's rules were obsolete, and others far too severe to impose on the France of Montaigne or even the Spain of Cervantes. Thus caught between two fires the casuists developed a highly ingenious method, not unlike that of the Roman Stoics, for eviscerating the substance of a rule while leaving its shadow carefully intact. The next step was to force the confessors to accept their lax interpretation of the law; and this was accomplished by their famous theory of *probabilism*—first taught in Spain about 1580. This made it a grave sin in the priest to refuse absolution, whenever there was some good reason for giving it even when there were other and better reasons for refusing it. This principle does not deserve all the abuse that has been lavished upon it. It secured uniformity in the confessional, and thereby protected the penitent from the caprices of individual priests; and by depriving these of responsibility, it forced the penitent back on himself. But the gain was more than counterbalanced by the evil. The less the Church could expect from its penitents, the more it was driven to trust to the miraculous efficiency of sacramental grace. Once get a sinner to confession, and the whole work was done. However bad his natural disposition, the magical words of absolution would make him a new man. As for most penitents, all they cared for was to scrape through by the skin of their teeth. Casuistry might insist that it only proposed to fix the minimum of a minimum, and beg them for their soul's sake to aim a little higher. Human nature seldom resists the charms of a fixed standard—least of all when it is applied by a live judge in a visible court. If the priest must be satisfied with little, why be at the trouble of offering more? For this reason, probabilism found vigorous opponents in

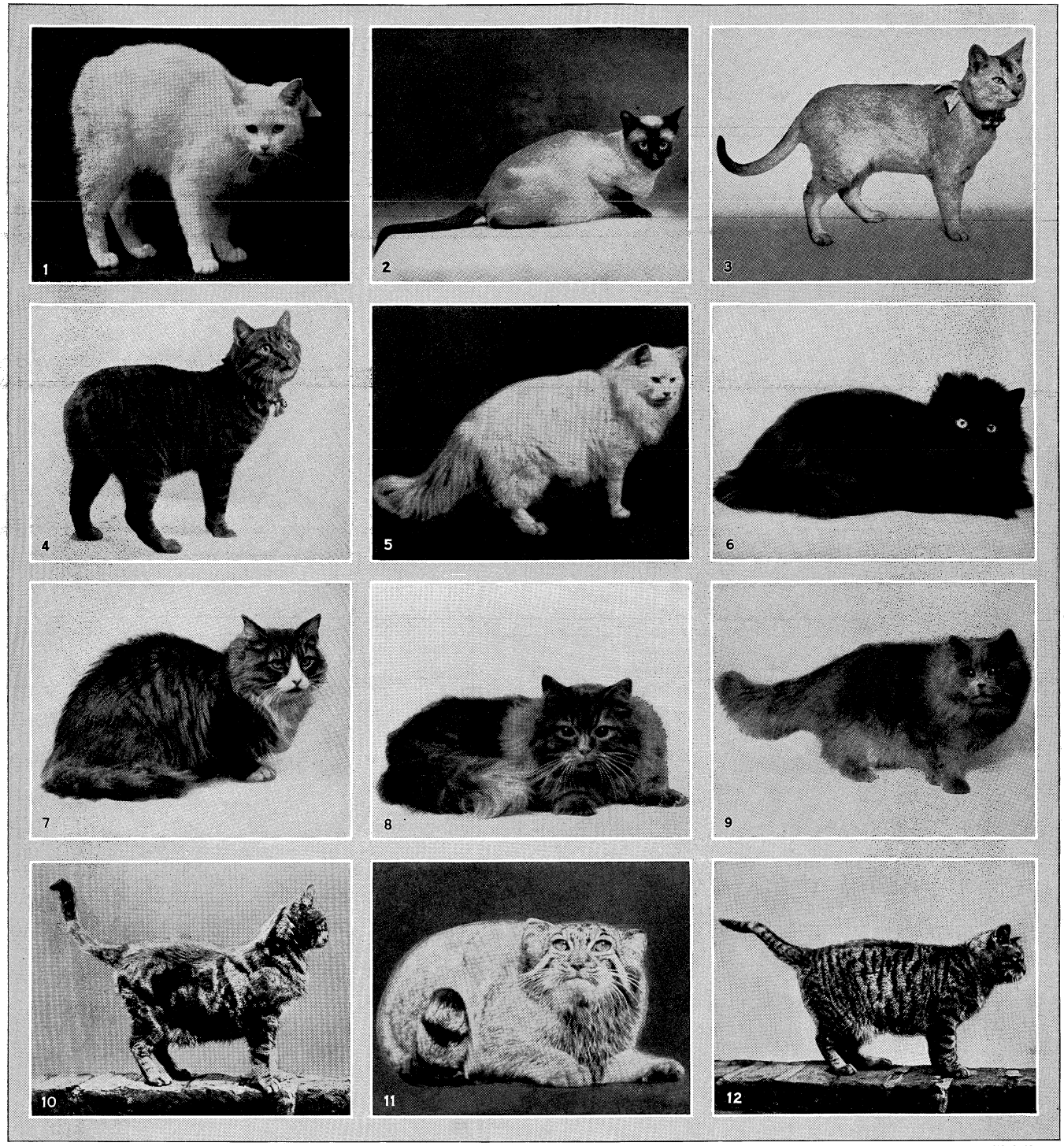


BY COURTESY OF (1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12) NEW YORK ZOOLOGICAL SOCIETY, (5) FROM CHAMPION, "WITH A CAMERA IN TIGERLAND" (CHATTO AND WINDUS, LONDON; DOUBLEDAY, DORAN & CO., INC., NEW YORK)

MEMBERS OF THE CAT FAMILY FOUND IN AFRICA, ASIA AND AMERICA

1. Lion (*Panthera leo*), one of the two largest of the cat family, the other a tiger. It is found in Africa, Mesopotamia, Persia and India
2. The Bengal tiger (*Panthera tigris*), a fierce beast of prey which sometimes, especially in old age, becomes a man-eater
3. Lioness (*Panthera leo*), about a foot shorter than the adult male and generally considered more dangerous when attacked
4. Puma or mountain lion (Felis concolor), a large American cat extensively distributed from Canada to Patagonia. It is of a uniform colour
5. Tigress (*Panthera tigris*), somewhat smaller than the male but equally aggresive, especially when protecting her young
6. Leopard cat (Felis bengalensis), a small, savage wildcat of tropical Asia that feeds largely on game birds
7. Ocelot (Felis pardalis), an American forest cat ranging from Texas to Paraguay. Its fur is yellow or grey marked with spots
8. The red or bob-tail lynx (Lynx rufus), a North American species that ranges south to Mexico. Its reddish summer coat is less spotted
9. Jaguar (*Panthera onca*), the largest of American cats. It ranges from Texas to Patagonia and sometimes develops into a man-eater
10. Cheetah or Hunting Leopard (*Acinonyx jubata*), so called because it is used in the hunting of game. It is a native of Africa and Asia
11. The snow-leopard (*Panthera uncia*), an inhabitant of highland Central Asia. Its name is suggested by its grey spotted fur
12. Serval (*Felis serval*), an African wildcat that preys on small quadrupeds and is prized by the natives for its skin, which is a spotted yellow

CAT



BY COURTESY OF (3, 4) HELEN HILL SHAW, (8) GERTRUDE E. TAYLOR; PHOTOGRAPHS, (1, 2, 6, 7) THOMAS FALL COPR., (5, 9) THE KEYSTONE VIEW COMPANY, (10, 12) TOPICAL PRESS AGENCY, (11) W. G. BERRIDGE

DOMESTIC CATS

1. White Manx (tailless) cat, Champion Chelsea, "Villish Mona Veen"
2. Siamese cat, Champion "Simple"
3. Abyssinian (silver) male cat, owned by Mrs. Carew-Cox
4. Striped Manx cat
5. White Persian cat, "Morvich," owned by Mrs. J. H. Clark
6. Black Persian, Champion "Sally Girl"
7. Tabby cat
8. Red Tabby Persian cat
9. Blue Persian cat
10. Blotched domestic cat
11. The manul or Pallas's cat
12. Striped domestic cat

Bossuet and other eminent divines; and various of its excesses were condemned by the popes during the latter half of the 17th century. After a long eclipse it was finally re-established, though in a very modified form, by Alfonso Liguori about the middle of the 18th century.

In Protestant countries casuistry shrank and dwindled, though works on the subject continued to be written both in Germany and England during the 17th century. The best known of the Anglican books is Jeremy Taylor's *Ductor Dubitantium* (1660). But the Protestant casuist never pretended to speak authoritatively; all he did was to give his reasons, and leave the decision to the conscience of his readers. "In all this discourse," says Bishop Sanderson, one of the best of the English writers, "I take it upon me not to write edicts, but to give my advice." Very soon, however, these relics of casuistry were swept away by the rising tide of common-sense. The 18th century loved to discuss hard cases of conscience, as a very cursory glance at Fielding's novels (1742–1751) or Boswell's *Life of Johnson* (1791) will show. But the age was incurably suspicious of attempts to deal with such difficulties on any kind of technical system. Pope was never tired of girding at

> Morality by her false guardians drawn,
> Chicane in furs, and casuistry in lawn.

while Fielding has embodied the popular conception of a casuist in Parson Thwackum and Philosopher Square, both of whom only take to argument when they want to reason themselves out of some obvious duty. Still more outspoken is the Savoyard vicar in the *Émile* (1762) of Jean Jacques Rousseau: "Whence do I get my rules of action? I find them in my heart. All I feel to be good is good; all I feel to be evil is evil. Conscience is the best of casuists; it is only when men wish to cheat it that they fly to logical quibbles." Extravagant as this sentiment sounds, it paved the way to better things. The great object of 17th-century moralists had been to find some general principle from which the whole of ethics could be deduced; common-sense, by turning its back on abstract principles of every kind, forced the philosophers to come down to the solid earth, and start by enquiring how the world does make up its mind in fact. During the last two centuries deduction has gone steadily out, and psychology come in. Ethics has become more distinctively a science, instead of an awkward hybrid between a science and an art; its business has been to investigate what moral conduct is, not to lay down the law as to what it ought to be. Hence they deliberately refuse to engage in casuistry of the old-fashioned sort. Further, it is increasingly felt that ethical judgments do not depend on reason alone, but involve every element in our character; and that the real problem of practical morality is to establish a harmonious balance between the intelligence and the feelings—to make a man's "I think this is right" correspond with his "I feel that it is so." Whether systematic training can do anything to make the attainment of this balance easier is a question that has lately engaged the attention of many educational reformers; and whatever future casuistry may still have before it would seem to lie along the lines indicated by them.

There is an excellent study of the ancient casuists by M. Raymond Thamin, *Un Problème moral dans l'antiquité* (1884). For the Roman Catholic casuists *see* Döllinger and Reusch, *Moralstreitigkeiten im siebzehnten Jahrhundert* (Nordlingen, 1889), and various articles ("Casuistik," "Ethik," "Moralsysteme," etc.) in Wetzer and Welte's *Kirchenlexicon* (Freiburg, 1880–96). *See* also the editions of Pascal's *Provincial Letters*, by John de Soyres (with English notes, Cambridge, 1880), and A. Molinier (Paris, 1891). The Anglican casuists are discussed in Whewell, *Lectures on Moral Philosophy* (1862). For general reflections on the subject *see* the appendix to Jowett's edition of the Epistle to the Romans (1855). Most modern text-books on ethics devote some attention to the matter—notably F. H. Bradley in his *Ethical Studies* (1927). *See* also Hastings Rashdall, *Theory of Good and Evil* (Oxford, 1907). (ST. C.)

CASUS BELLI, an act or omission which, if not rectified, may justly be remedied by war. Interference with the full exercise of a nation's rights or independence, an affront to its dignity, an unredressed injury, are instances of *casus belli.* (*See* ARBITRATION.)

CAT, the name of the well-known domesticated animal *Felis catus,* but in a wider sense employed to denote all the more typical members of the family Felidae. The word "cat" is also applied to other objects, in all cases an application of the name of the animal. In mediaeval siegecraft the "cat" was a movable penthouse used to protect besiegers when approaching a wall or gateway.

"Cat" or "cat-head," in nautical usage, is the projecting beam on the bow of a ship used to clear the anchor from the sides of the vessel when weighed. The name is also used for a type of vessel, formerly used in the coal and timber trade in northeast England; it is still applied to a small rig of sailing boats. The instrument of punishment, generally called the "cat o' nine tails," consists of a handle of wood or rope, about 18 in. long, with nine knotted cords or thongs.

Origin of the Domestic Cat.—Although bones of cats were found in the dwellings of ancient cavemen, it is very probable that these cats were not domestic. About 3000 B.C. in Egypt, when agriculture had become well established, the Egyptians tamed the cat to protect their stores of grain. These animals proved so valuable that they were later considered to represent one of the gods, perhaps to give cats better protection. The wild species from which they were derived was the African wild cat (*Felis lybica*), one race of which occurred in Egypt. This is a gray cat with a slightly buffy cast, marked with blackish stripes and spots on the body and legs, the tail with a black tip and several rings, and the feet dusky. Its hair is short and the build and general proportions are like those of the common house cat. Modern domestic cats interbreed freely with the African wild cat.

From Egypt domestic cats spread slowly throughout the civilized world. In Europe they undoubtedly interbred with the European wild cat (*Felis silvestris*), a very closely related species with longer fur and tail. In the Egyptian wild cat the pads of the toes are wholly black, and the black extends up to the heel. In the European wild cat, on the other hand, the black is limited to a small round spot on the pads. In domestic cats with wild colouring the soles of the hind feet correspond in this particular with the Egyptian wild cat.

Two distinct types of so-called tabby cats are recognized. In one the pattern consists of narrow, vertical stripes and in the other of longitudinal or obliquely longitudinal stripes, which, on the sides of the body, tend to assume a spiral or whirl arrangement. One or other of these types is to be found in cats of almost all breeds, and there appear to be no intermediate stages. The striped type is the wild pattern of both European and African wild cats; but the origin of the blotched pattern was probably a mutation.

Tame cats from Egypt were imported into Italy at an early date by Phoenician traders and became established long before the Christian era. Their progeny spread over Europe, more or less crossed with the indigenous species. Remains of cats found in Roman villas at Silchester and Dursley are probably referable to the domesticated breed. The earliest record in Great Britain dates from about A.D. 936 when Howel Dda, prince of south central Wales, enacted a law for their protection.

There are fewer breeds of domestic cats than there are of dogs, and the differences are not so great as those shown in the various breeds of rabbits. Except in a very few cases there is no need to suppose crossing with other species to explain the peculiar characters of certain cats.

All animals are liable to show individual variation which can be selected and established in pure strains. Larger mutations occur rarely but are likely to make their appearance from time to time.

Breeds of Domestic Cats.—Apart from the division on the basis of their pattern, mentioned above, domestic cats are divided into short-haired and long-haired groups. The former resemble the wild cats of Europe and Africa, the long-haired types having developed in Persia and Afghanistan. Cats of both groups vary, on the one hand, toward melanism, black colouration like that seen in many wild species of cats, while on the other hand white cats are fairly common. A nearly white tiger and a similarly coloured cheeta have been reported, and an albino leopard is known,

but albinism is very rare among all species of Felidae. Tortoise-shell cats are generally females with a mixed colour of black and yellow (and white); yellow or sandy cats are usually males. The genetic factors for red and black are thought to be situated in the sex chromosomes, which accounts for the peculiar inheritance of these colours.

There are two varieties of the long-haired cats, the Angora and the Persian. The former has a pointed head, long nose, and long, silky fur. The Persian (which may come from Afghanistan) has a rounded face and coarse fur; its tail is thickest near the tip. In the United States and parts of Europe the latter cat has replaced the Angora. These long-haired cats are often thought to have been derived from the manul (*Felis manul*) of the steppes of central Asia, but long-haired breeds of goats, rabbits and dogs indicate that it is not necessary to suppose such an unlikely ancestry.

The tailless or Manx cat, in which the tail may be represented merely by a tuft of hair without any bone, is common in the far east. In the Malay regions and Philippines normal long-tailed cats are rarely seen, and kink-tailed or short-tailed cats predominate. Whether the tailless cat reached the Isle of Man from elsewhere or whether it developed there as a sudden independent mutation is not known. The fur is usually longer and more lax than in ordinary cats. In New England and the middle Atlantic states they are often called "rabbit cats," and people suppose they are part rabbit, incredible as such a crossing would be. The cry is said to differ somewhat from that of tabby cats.

Among the domestic cats of India, spotted colouring, much like that of the Indian desert cat (*Felis constantina ornata*) is common. This cat is a close relative of the African wild cat, and crossing between it and domestic cats is quite possible.

The Abyssinian breed is characterized by lack of spots and stripes on the body, each hair being "ticked" like that of a wild rabbit (known to geneticists as agouti). The head and neck retain the typical markings of the African wild cat and the tail ends in a black tip. The colour is typically reddish brown. The fur is short, the ears relatively large and occasionally tipped with long hairs. Ordinary striped tabbies sometimes produce kittens with this type of colouration, and there is little question but that this breed originated entirely from the African wild cat, probably through the Egyptian cat.

By far the most remarkable of the domestic breeds is the Siamese cat. It was first imported into England in 1884 and reached the U.S. in 1895; it became popular and numerous in both countries. Siamese cats often have kinky tails and cross-eyes, defects which breeders have not been able to eliminate from the strain. The head is rather long and pointed, the body also elongate, the hair sleek and short, and the eyes blue. The general colour is cream or buffy, with the face, ears, paws and tail dark chocolate-coloured in a variety in which the eyes are yellow. The young are white. Temperature modifies the development of the colour, less blackish developing under warm conditions, while in cold the entire animal darkens more than normally. The Siamese type of colouration is known in rabbits and other animals, in which it is often called "Himalayan." In the several thousand years cats have been in Siam, the mutation undoubtedly appeared and was fixed by selection and careful breeding. After 1924, several strains of long-haired Siamese cats were produced scientifically by crossing with Persians and inbreeding.

Numerous clubs have been founded in Europe and North America to encourage the breeding of cats and to promote cat shows. Short-haired breeds are rather easy to manage, but the long-haired varieties need more care and when shedding are nuisances.

European Wild Cat.—The wild European species, *F. silvestris*, conforms closely in pattern to the striped phase of domestic tabby but is brownish gray or buffy. The hair of the tail is long, especially toward the tip, which gives a club shape to this member. The geographical range of the wild cat formerly included Great Britain, central and southern Europe, and portions of central Asia. It is now, however, much reduced in numbers and it is doubtful if it is found anywhere without at least a trace of the domestic form in its constitution. In Great Britain wild cats survive only in some Scottish forests. Remains of the wild cat occur in English caverns; in Ireland the wild species has apparently been unknown during the historic period.

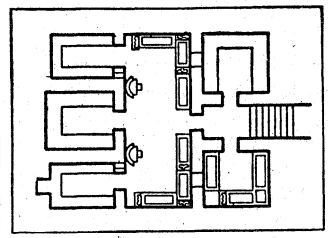
The favourite haunts of the wild cat are mountain forests where rocks or cliffs are interspersed with trees. Crevices in the rocks or the hollow trunks of trees afford sites for the lairs, where the young (2 to 5) are produced and reared. The kittens, usually born in May, are at first blind, although furred. Wild cats are described as some of the most ferocious and untamable of all animals. How far this lends support to the view of the origin of our domestic breeds is uncertain. Hares, rabbits, field mice, water rats, rats, squirrels, moles, game birds, pigeons, and small birds form the chief food of the wild cat, while fawns of roe deer are sometimes killed.

BIBLIOGRAPHY.—St. George Mivart, *The Cat* (London, 1881); R. Lydekker, "Cats," in *Allen's Naturalists' Library* (1888); F. Hamilton, *The Wild Cat of Europe* (London, 1896); Frances Simpson, *The Book of the Cat* (London, 1903); E. H. Forbush, *The Domestic Cat* (Boston, 1916); E. B. Simmons, *Cats* (1935); E. B. H. Soame, *Cats, Long-Haired and Short* (1934); Carl Van Vechten, *Tiger in the House* (1920); Ida M. Mellen, *The Science and Mystery of the Cat* (New York, 1940). (J. E. HL.)

CATACLYSM, a great flood (Gr. κατακλυσμός, a deluge). In geology an overwhelming catastrophe producing sudden changes in the earth's surface; figuratively, any violent change that sweeps away the existing social or political order.

CATACOMBS. Tombs hewn in solid rock were used by the Etruscans as independent family burial places, grouped together. They often rise in the hillside by tiers or are on the same level branching off into streets and alleys. Their plan is for the most part that of a house and the walls are often covered with paintings in an archaic style in red and black. At Poggio Gaiella, near Chiusi, the ancient Clusium, is a cemetery with a sepulchral chamber containing a large hall about 25 ft. in diameter supported by a cylindrical rock pillar. Opening out of this and other chambers are low winding passages, just large enough for a man to creep through, and this tomb has been surmised to be that of Lars Porsena, king in his day of Etruria (*see* fig. 2).

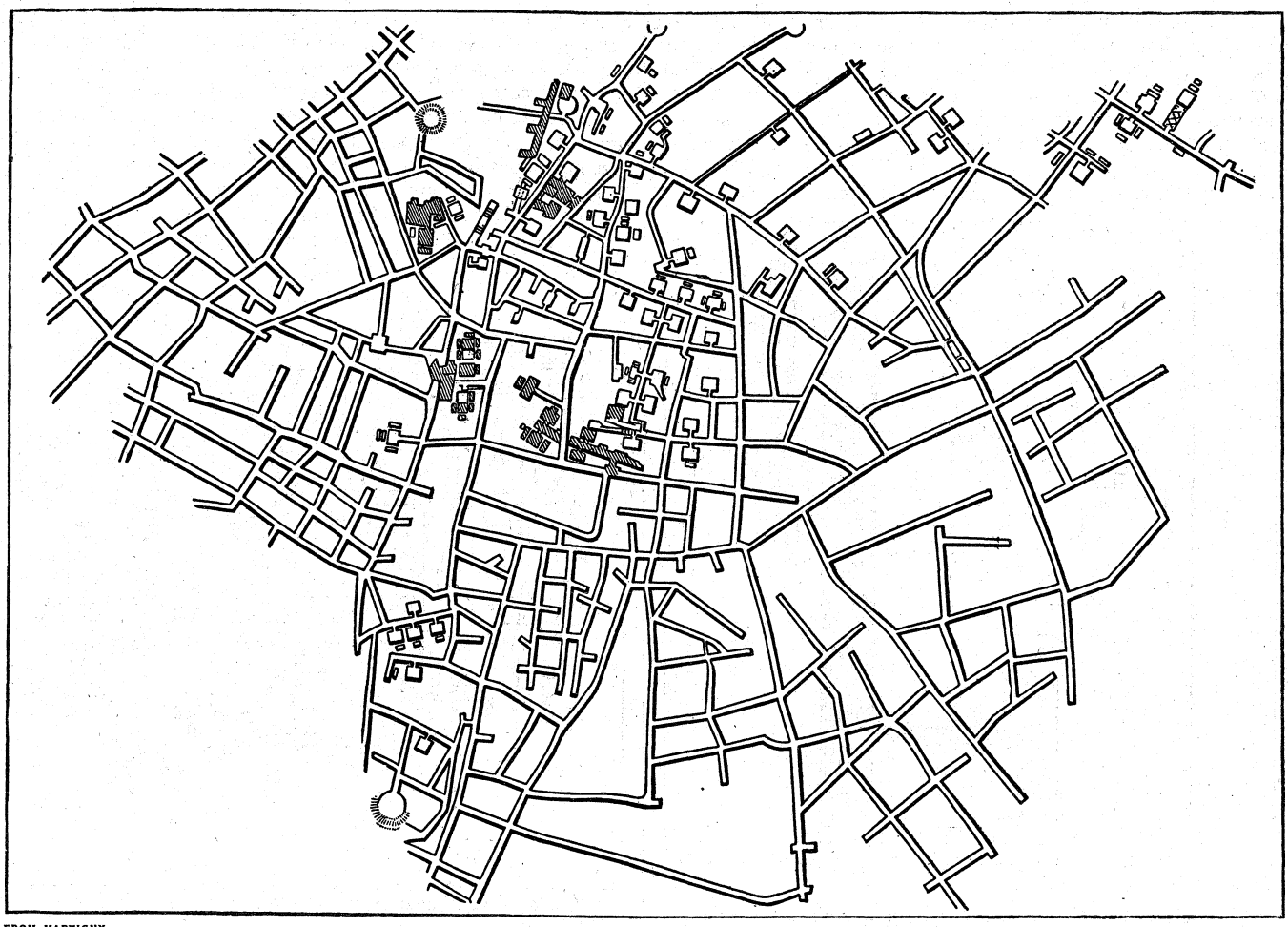
In the days of the republic inhumation was general and the bodies of the Scipios and the Nasos were buried in still existing catacombs, the term applied by transference to subterranean excavations for the interment of the dead. Originally it designated the natural configuration—in hollows—of a district close to the Appian way (*see* ROME). In the vaults below the church of St. Sebastiano lay, according to tradition, the bodies of the apostles St. Peter and St. Paul for seven months until removed to the basilicas which bear their names. The place became an object of pilgrimage and its name κατακυμβας, "by the hollow," developed as a generic name for all burial places of the same kind.



FROM DENNIS

FIG. 1.—PLAN OF ETRUSCAN TOMB AT CERVETRI

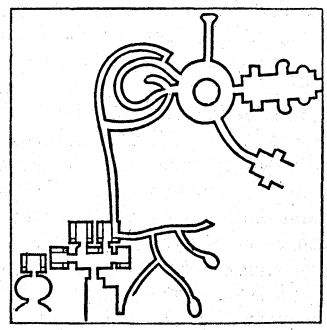
Rome is built upon a rock and the three strata named by geologists *tufa litoide, tufa granolare* and *pozzolana* have all been exploited. The *tufa litoide* is quarried as building stone. The catacombs of Rome—the most extensive known—are constructed in this stratum alone as it enabled the engineers to form vertical walls for the galleries in which the dead were placed and to work with comparative ease. The pozzolana used as an ingredient for mortar was worked from the lowest stratum so that in spite of old erroneous persistent beliefs the burial places are distinct from the pozzolana, excavated in different strata, though here and there starting from the same level. The catacombs form a vast labyrinth of narrow galleries usually from 3 to 4 ft. wide with small chambers at intervals, excavated at successive levels (fig. 1). The dead are buried in the galleries in long horizontal recesses in the walls, tier upon tier, even to 12 ranges. The galleries generally run in straight tiers, at the same level, in storeys (seven in one part of the cemetery of S. Calixtus), and intersect at various angles (*see* fig. 3). The graves (*loculi*) were usually parallel to



FROM MARTIGNY

FIG. 3.—PLAN OF PART OF THE CEMETERY OF S. AGNESE AT ROME

the gallery in Christian cemeteries, but in pagan areas the recess was usually at right angles. Some loculi held four or more bodies, most held one (fig. 5). They were carefully closed by slabs of marble or huge tiles cemented together. When an epitaph was set up, it was painted or engraved on these tiles. Table tombs and arched tombs are also found. Sarcophagi are rare. The family vaults—cubicula—were small apartments, usually rectangular, sometimes circular or polygonal, opening from the main corridors and frequently ranged regularly along the sides of the galleries. Loculi were cut for later burials in the same family area and the inscriptions and mural decorations were frequently damaged or destroyed. The funeral feast was celebrated by the family in its vault, both on the day of burial and on the anniversary. The Eucharist, the invariable accompaniment of funerals in the early Christian Church, was celebrated here, and in some of the catacombs are larger halls and connected suites of chapels which may have been constructed for congregational worship in the days of persecution (fig. 4). Baptisteries have been discovered. The catacombs were also used as places of refuge, for which they were admirably adapted, both by the intricacy of their design and by access through secret passages to sand quarries and the open country.



FROM DENNIS

FIG. 2.—PLAN OF A PORTION OF THE PRINCIPAL STOREY IN THE POGGIO GAIELLA CEMETERY

Almost without exception they had their origin in small burial areas, the property of private persons, and their great development was due to the spread of Christianity and the burial of the dead in this manner conformed to Roman usage. There was no reason for secrecy and since interment in rock-hewn tombs had been practised in Rome by Jewish settlers before the rise of the Christian Church, the practice may well have been popularly, perhaps correctly, associated with the Jewish population which contributed elements to the new religious order. At a later period the grave diggers seem to have acquired or to have established a kind of property in the catacombs and to make new graves recklessly destroyed the religious paintings on the walls. The major part of the catacombs belong to the 3rd and early part of the 4th centuries. By A.D. 354 when St. Jerome visited them, interment in them had become rare. By the time of Pope Damasus (A.D. 366–384) they had become the resort of pilgrims. They were adapted to this by the orders of the pope. The works of art were restored. The epitaphs were renewed. In this latter work he employed an engraver named Furius Philocalus whose work can be recognized at once.

As a result the improvements described have lessened the value of the catacombs as memorials of the religious art of the 2nd and 3rd centuries. Subterranean interment ceased with the sack of Rome by Alaric in A.D. 410. The catacombs shared in the destruction of Rome by the Goths in the 6th century and by the Lombards at a later date. Pope Paul I. and Pope Pascha I. found them in such decay and pollution that the holy relics they contained were translated elsewhere and the catacombs soon ceased to attract pilgrims. By degrees their existence was forgotten and they were discovered by chance in 1578 and have been studied, explored, investigated and described by scholars such as Baronius, Antonio Bosio (d. 1629), Marc Antonio Boldetti (*c.* 1720), Seroux d'Agincourt (1825) Raoul Rochette and most notably in recent times by Father Marchi of the Society of Jesus. Additions to our knowledge have been made by de Rossi and include the rediscovery near the catacomb of Priscilla, on the Via Salaria Nuova,

of the Cosmeterium Jordanorum, first found in 1578 but soon afterwards choked up and lost. It is possible now to identify the tombs of martyrs like Nereus and Achilleus, said to have been baptized by St. Peter, who with their mistress Petronilla, of the Aurelian family and the spiritual daughter of St. Peter, suffered death for their faith under Domitian. Many of the names of persons mentioned in the Epistles of St. Paul are found here and every fresh excavation yields similar evidence.

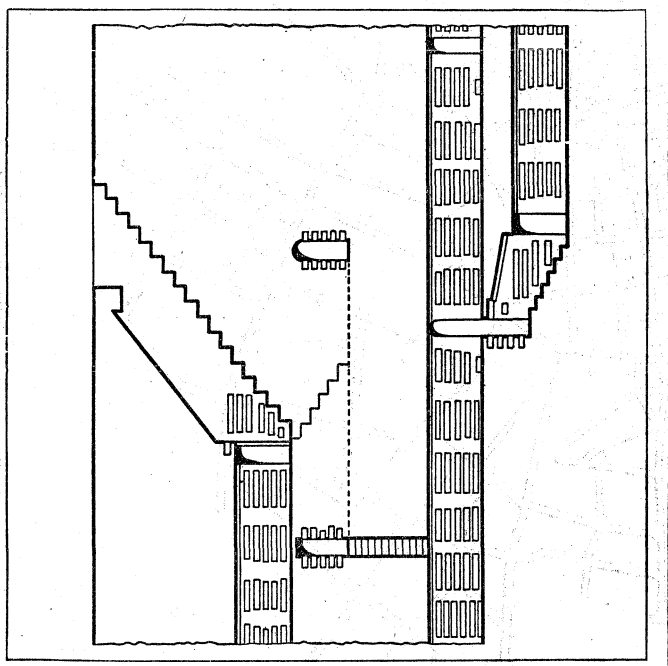
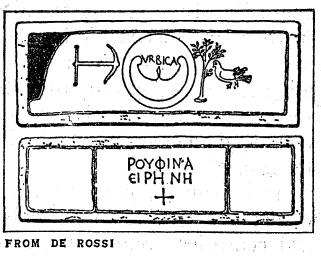


FIG. 4.—SECTION OF GALLERIES AT DIFFERENT LEVELS IN THE CATACOMBS OF ROME

At Syracuse there are very extensive catacombs known as "the Grottos of St. John." There is an entire underground city with several storeys of larger and smaller streets, squares and cross ways cut out of the rock; at the intersection of the cross ways are great circular halls of a bottle shape, like a glass-house furnace, lighted by air shafts. The galleries are generally very narrow, furnished on each side with arched tombs, and communicating with family sepulchral-chambers closed originally by doors, the marks of the hinges and staples being still visible. The walls are in many places coated with stucco adorned with frescoes including palms, doves, *labara* and other Christian symbols. This cemetery differs widely in arrangement from the Roman catacombs.

The catacombs at Malta are near the ancient capital of the island. The passages were all cut in a close-grained stone, and are very narrow, with arched ceilings, running very irregularly, and ramifying in all directions. The greater part of the tombs stand on either side of the galleries in square recesses (like the table-tombs of the Roman catacombs) and are rudely fashioned to imitate sarcophagi. The interments are not nearly so numerous as in other catacombs, nor are there any vestiges of painting, sculpture or inscriptions. At Taormina in Sicily is a Saracenic catacomb, also figured by Agincourt. The main corridor is 12 ft. wide, having three or more ranges of *loculi* on either side, running longitudinally into the rock, each originally closed by a stone bearing an inscription.



FROM DE ROSSI

FIG. 5.—LOCULI IN CATACOMBS OF ROME. GRAVES OF URBICA AND RUFINA

In Egypt we find a small Christian catacomb at Alexandria. The *loculi* here also are set endways to the passage. The walls are abundantly decorated with paintings, one of a liturgical character. But the most extensive catacombs at Alexandria are those of Egypto-Greek origin, from the largest of which, according to Strabo (lib. xvii. p. 795), the quarter where it is placed had the name of the Necropolis. The plan is remarkable for its regularity (fig. 8). Here, too, the graves run endways into the rock. There are other catacombs in the vicinity of the same city.

Subterranean cemeteries of the general character of those described are very frequent in all southern and eastern countries. A vast necropolis in the environs of Saida, the ancient Sidon, consists of a series of apartments approached by staircases.

Recent Discoveries.—At Rome, after the death of de Rossi (1894) a small subterranean basilica in the catacomb of SS. Peter

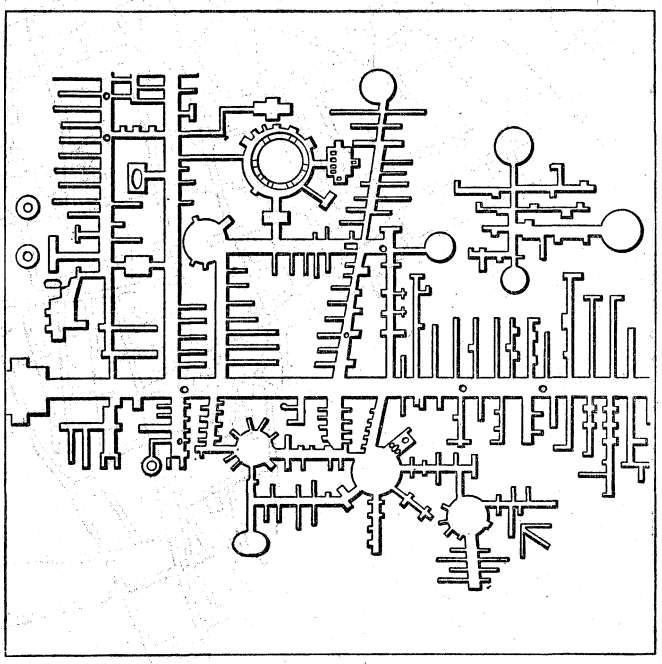


FIG. 6.—THE PLAN OF THE CATACOMB OF S. JOHN, SYRACUSE

and Marcellinus on the Via Labicana, with pious acclamations on the plaster similar to those in the Papal crypt in St. Calixtus was discovered in 1896. In the cemetery of Domitilla in 1897–1898 a fine double crypt with frescoes representing Christ seated between six male and female saints and an inscription relating to a new saint (Eulalius) in a cubiculum of the 3rd century was brought to light. In 1899–1900 were discovered two opposite cubicula in the catacomb of SS. Peter and Marcellinus, both covered with frescoes, the vault being in one case decorated with the scene which represents Christ seated among the apostles and pronouncing sentence upon the defunct. An inscription discovered in 1900 on the site of the ancient cemetery of St. Ciriaca, and dating from A.D. 405, states that one Euryalus bought a site *ad mensam beati martyris Laurentii* from a certain *fossor* whose name has been erased, an example of what was known as *memoriae damnatio*, or the blotting out of a name on account of some dishonourable action. In 1901–1902 excavations in the cemetery of Santa Priscilla, near the Cappella Greca, revealed a polygonal chamber which may have originally been the *nymphaeum* of the great villa of the Acilii Glabriones. It may have been used as a burial-place for martyrs, and as the sepulchral chapel of Pope Marcellinus, who died in A.D. 304 during the persecutions of Diocletian. In 1902, in that part of the Via Ardeatina which passes between the cemeteries of Calixtus and Domitilla, was discovered a crypt with frescoes and the sanctuary of a martyr; this, rather than a neighbouring crypt brought to light in 1897, may prove to be the sepulchral crypt of SS. Marcus and Marcellianus. In a cubiculum leading out of a gallery

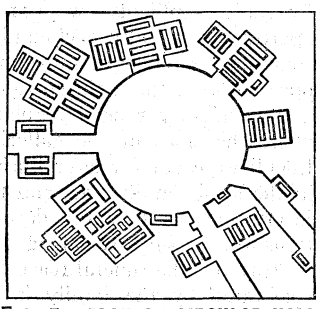


FIG. 7.—PLAN OF CIRCULAR HALL IN CATACOMBS OF S. JOHN, SYRACUSE

in the vicinity there was also discovered an interesting impression in plaster of an inscription of the mother of Pope Damasus, beginning:

Hic Damasi Mater Posvit Lavren (tia Membra).

In the same year building operations in the Via di Sant' Onofrio revealed the presence of catacombs beneath the foundations: examination of the *loculi* showed that no martyrs or illustrious

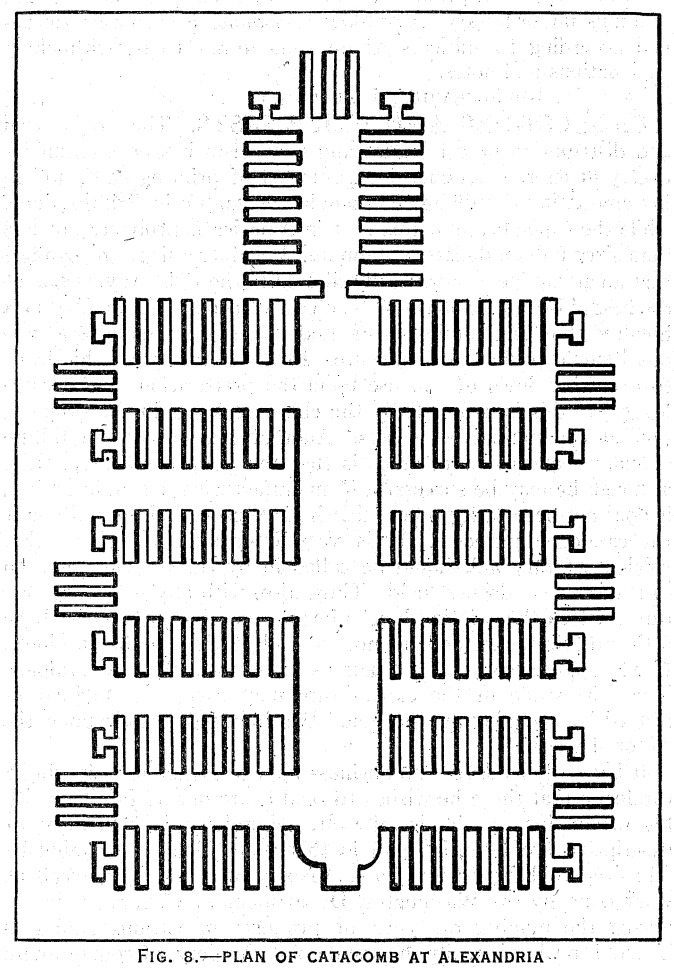


FIG. 8.—PLAN OF CATACOMB AT ALEXANDRIA

persons were buried there. Work was also carried out at the catacomb of Albano (Marucchi *Nuovo Bull.*, 1902, pp. 89 ff.).

In 1903 a new cemetery with frescoes came to light on the Via Latina, considered by Marucchi to have belonged to a heretical sect. In the same year the Jewish cemetery on the Via Portuense, was rediscovered. The subterranean basilica of SS. Felix and Adauctus, discovered by Boldetti and afterwards choked up with ruins, was cleared again: the crypt, begun by Damasus and enlarged by Siricius, contains frescoes of the 6th–7th centuries. In the same year extensive catacombs were revealed on the site of Hadrumetum near Sousse in Tunisia.

In 1907–08 interesting discoveries were made in the South East of Sicily (P. Orsi, *Notizie degli Scavi*, 1908). The year 1911 witnessed the discovery of the remarkable *hypogeum* of Trebius Justus on the Via Latina, with frescoes showing gnostic influence (*Nuovo Bull.* 1911 and 1912). In 1912 a catacomb was found at Grottaferrata which has since been excavated by the Basilian monks. In 1915–1916 a *memoria* of SS. Peter and Paul was explored beneath the basilica of S. Sebastiano, *Ad catacumbas*, on the Appian way. *Graffiti* with invocations to these apostles, dating from the fourth century were discovered (Marucchi, *Nuovo Bullettino*, for 1916, 1917, 1919, 1920). In 1917 was found subterranean basilica of the first century, perhaps the work of a pagan *sodalitas* (g. Bagnani, *Journ. of Roman Studies*, 1919, p. 78). In 1919, not far from the Porta Maggiore and the ancient Via Labicana, a *hypogeum* with two frescoed chambers was discovered. The subjects were unusual; one, Christ instructing his sheep from a book recalled a passage in the inscriptions of Abercius in the Lateran; others were scenes from the story of Job diverging from those usual in the Catacombs; a group of 12 figures, perhaps apostles, including two recalling the traditional types of SS. Peter and Paul (Marucchi, *Nuovo Bull.* 1921). The year 1921 witnessed the rediscovery near the catacomb of Priscilla on the Via Salaria Nuova, of the *Coemeterium Jordanorum*, first found in 1578 but soon afterwards choked up and lost (Marucchi and Josi, *Nuovo Bull.* 1922).

BIBLIOGRAPHY.—The classical work on the catacombs of Rome is G. B. De Rossi's *Roma sotterranea*. The volume by Mgr. Wilpert, *Le Pitture delle catacombe romane* (Rome, 1903), in which all the important frescoes are reproduced in colours, is complementary to the *Roma sotterranea*. All new discoveries made by the *Commissione di archeologia sacra* are chronicled in the *Nuovo Bullettino de archeologia* the *Notizie degli scavi*.

For accounts of the catacombs *see*:—Armellini, *Gli Antichi Cimiteri cristiani di Roma e d'Italia* (Rome, 1893); O. Marucchi, *Le Catacombe romane* (Rome, 1903; also translated into French), *Manuale di epigrafia cristiana* (Milan, 1904); M. Besnier, *Les Catacombes de Rome* (Paris, 1909); F. X. Kraus (*Realencyklopädie* and *Geschichte der christlichen Kunst*) and Dom F. Cabrol's *Dictionnaire d'archéologie chrétienne et liturgie*, articles with bibliography, by H. Leclercq.

Among the older works are: Bosio, *Roma sotterranea*, Severano's edition (1632), and Aringhi's edition (1651); Boldetti, *Osservazioni sopra i cimiteri dei santi martiri* (Rome, 1720); Bottari, *Sculture e pitture sagre*, etc. (Rome, 1737–1754); Seroux d'Agincourt, *Histoire de l'art par les monuments* (Paris, 1823; German ed., 1840); G. Marchi, *Monumenti delle arti cristiane primitive* (Rome, 1844); Raoul Rochette, *Tableau des catacombes de Rome* (2nd ed., Paris, 1853); Perret, *Les Catacombes de Rome* (Paris, 1855)—a sumptuous folio work, but not always accurate; Roller, *Les Catacombes de Rome* (Paris, 1881); V. Schultze, *Die Katakomben* (Leipzig, 1882).

Works written in English are: Northcote and Brownlow, *Roma sotterranea* (London, 1869; based upon De Rossi); Wharton Marriott, *The Testimony of the Catacombs* (1870); J. H. Parker, *The Archaeology of Rome: the Catacombs;* Smith and Cheetham, *Dictionary of Christian Antiquities, s.v.* "Catacombs"; R. Lanciani, *Pagan and Christian Rome* (1892); W. Lowry, *Christian Art and Archaeology*, ch. ii. (1901; a useful introduction to the subject); H. Gee, "The Church in the Catacombs," in W. Lefroy's *Lectures in Ecclesiastical History* (1896); Th. Mommsen, in the *Contemporary Review* (May 1871).

The catacombs at Naples are described in C. F. Bellermann, *Über die ältesten christlichen Begräbnisstätten und besonders die Katakomben zu Neapel* (Hamburg, 1839); Armellini, as above and V. Schultze, *Die Katakomben von San Gennaro dei Poveri in Neapel* (Jena, 1877).

For the catacombs in Malta, A. A. Caruana, *Ancient Pagan Tombs and Christian Cemeteries in the Islands of Malta* (Malta, 1898), and A. Mayr, "Die altchristlichen Begräbnisstätten auf Malta," in *Römische Quartalschrift*, vol. xv. pp. 216 and 352 (Rome, 1901), and E. Becker, *Malta Sotterranea* (Strasbourg, 1913), may be consulted.

The fullest accounts of the Sicilian catacombs are given by J. Fuhrer, *Forschungen zur Sicilia sotterranea* (Munich, 1897); C. Barreca, *Le Catacombe di San Giovanni in Siracusa* (Syracuse, 1906); J. Fuhrer and V. Schultze, *Die altchristlichen Grabstätten Siziliens* (Berlin, 1907); and P. Orsi, *Per la Siracusa Sotterranea* (Catania, 1906).

A catacomb of the 5th century, discovered at Kertch in South Russia, is described by J. Kulakovsky in *Materials for Russian Archaeology* (St. Petersburg, 1896; a publication of the Russian Imperial Archaeological Commission), but it is written in Russian, as also is the account by V. Latyshev, in *Vizantieski Vremennik*, vol. vi. pp. 337 ff. (St. Petersburg, 1899).

The catacombs at Hadrumetum (Sousse) are described by A. F. Leynaud, *Les Catacombes d'Hadrumète, deuxième campagne de fouilles* (1904–1905). *See* also *Revue Tunisienne* (1905), p. 250.

For the catacombs of Alexandria, de Rossi in *Bull. di archeologia Cristiana* (Nov. 1864, Dec. 1865); Neroutsos Bey, *L'Ancienne Alexandrie.* (W. R. B.; O. M. D.)

CATAFALQUE, a word of unknown origin, occurring in various forms in many European languages, meaning a funeral scaffold or temporary stage; a movable structure of wood, sometimes richly decorated, erected temporarily at funeral ceremonies in a church to receive the coffin or effigy of the deceased; also an open hearse or funeral car.

CATALAN. It is generally assumed that Catalan was imported from Roussillon into Spain during Carolingian times; the contrary view has, however, been put forward, namely that Catalan originally developed in Spain and was introduced into Cerdagne and Roussillon by Catalan immigration. Whatever the truth may be, philologically Catalan is to be regarded as pertain-

ing to the Provençal rather than to the Hispanic branch. Like Hispanic it changes L. *ū* into *u* and L. *au* into *o, cf.*, L. *mūrum*, Cat. *mur*, Hisp. *muro* (Prov. Fr. *mur*); L. *aurum*, Cat. and Hisp. *oro* (Prov. *aur*, Fr. *or*). Unknown to Catalan, however, are the characteristically Hispanic diphthongizations of open *e* and open *o* in position, *cf.*, L. *terra*, Hisp. *tierra*, but Cat. *terra*; L. *fortem*, Hisp. *fuerte*, but Cat. *fort* (as in Prov. and Fr.). Moreover Catalan and Provençal both change proparoxytones into paroxytones, whereas in Hispanic the proparoxytones are preserved, *e.g.*, L. *anima*, Cat. and Prov. *alma, arma*.

Catalan is nowadays spoken in the major part of the department of the Pyrénées Orientales, in Andorra, at Alghero (Sardinia) whither it was brought by the Aragonese in the second quarter of the 14th century but where it is steadily succumbing to the disruptive influence of Italian and Sardinian; in the provinces of Huesca, Saragossa, Ternel; in the greater part of the provinces of Castellon de la Plana and Alicante; in much of the province of Valencia; and in the Balearic islands and Pithyusae, conquered by Jaime I. of Aragon (1229–34). The territory occupied by Catalan contains in Spain 4,486,000 inhabitants, in France some 200,000.

Catalan embraces two groups, viz., (A) continental, subdivided into (a) oriental, (b) occidental, (c) Valencian, (d) Roussillonnais; (B) insular, subdivided into (a) dialects of the Balearic islands and Pithyusae, (b) dialect of Alghero. All these idioms present only minor phonetic differences. In the Balearic islands *es, sa* constitute the definite article (as also in the sub-dialect of oriental Catalan termed for this reason, *salat*) instead of *el, la*.

The outstanding difference between the Catalan of Spain and that of Roussillon, is that whereas the former is a real language with a flourishing literature, the latter is a mere patois.

BIBLIOGRAPHY.—P. Fouché, *Chronique philologique des parlers provençaux anciens et modernes* (Bibl.) in *Revue de linguistique romane* T. II. (Janvier-Juin, 1926) p. 113–136; A. Griera, *Le domaine catalan (compte rendu rétrospectif jusqu'à 1924)* in *Revue de linguistique romane* T. I. (Janvier-Juin, 1925) p. 35–113. These bibliographical articles will be continued in the following volumes. (L. B.)

CATALANI, ANGELICA (1780–1849), Italian opera-singer, was born at Sinigaglia, and was the lucky possessor of one of the most remarkable soprano voices, of extraordinary compass and purity, ever known. For nearly thirty years she sang at all the great opera houses, receiving very large fees; her first appearance in London having been at the King's theatre in 1806. She remained in England, a prima donna without a serious rival, for seven years. Then she was given the management of the opera in Paris, but this resulted in financial failure, owing to the incapacity and extravagance of her husband, Captain Valabrègue —author of the historic remark "ma femme et quatre ou cinq poupées voila tout ce qu'il faut"—whom she had married in 1806. But her continental tours continued to be enormously successful until she retired in 1828. She died of cholera in Paris.

CATALEPSY, a term applied to a nervous affection characterized by sudden suspension of sensation and volition, and rigidity of the whole or of certain muscles of the body. The subjects are mostly females of highly nervous temperament. The exciting cause of an attack is usually mental emotion, either sudden, *e.g.* a fright, or gradual, *e.g.* prolonged depression. The symptoms vary even in the same individual in different attacks. Sometimes there is complete insensibility, together with a statue-like appearance of the body which retains any attitude it may be made to assume during the continuance of the attack. In this condition the whole organic and vital functions appear to be reduced to the lowest possible limit consistent with life, and may simulate actual death. At other times excitement accompanies the cataleptic symptoms, and the patient sings or utters passionate exclamations, while quite unconscious. The attack may be short or may last for many hours, or even for several days; and it is conceivable that in such cases the appearances might be mistaken for real death, as is alleged to have occasionally happened. Although catalepsy is said to occur in persons in perfect health, careful inquiry will usually reveal some abnormality; in women, menstrual derangement is generally found to have preceded the affection. It is sometimes associated with epilepsy and with grave forms of mental disease. In ordinary cases, however, the mental phenomena closely resemble those of hysteria. In many subjects of catalepsy there is weakness of the will, whereby the tendency to lapse into the cataleptic state is not resisted but encouraged, and attacks may thus be induced by trivial circumstances (*see* HYPNOTISM).

CATALOGUE, a list or enumeration, generally in alphabetical order, of persons, things, etc., and particularly of the contents of a museum or library. A *catalogue raisonnée* is such a list classified according to subjects or on some other basis, with short explanations and notes.

(*See* also BIBLIOGRAPHY; LIBRARIES.)

CATALOGUES AND PRICE LISTS. The preparation and distribution of catalogues and price lists has become an industry of enormous dimensions, the cost of printing and publishing amounting to millions of pounds per annum in Britain alone, while the expenditure of this sort in America is probably not less than sixty million dollars per annum. It is increasingly recognized that an attractive catalogue, distributed in the right way, is one of the best aids to salesmanship. The cost of production of fifty or a hundred thousand catalogues of moderate size amounts to a serious item in business expenditure. In not a few cases this leads to a cutting down of expense upon the preparation of the catalogue and this is undoubtedly the chief weakness in the preparation of commercial price lists. Another reason for the failure of many expensive catalogues is that the publisher forgets that, although he may be successful in manufacturing a certain article, it does not necessarily follow that he is successful in describing it for catalogue purposes. It is very important, therefore, that efficient literary aid should be called in by the business man to to make his catalogues lucid. Thus, also, with any necessary pictures. Often the printing blocks in an expensive production have little artistic merit, and do not do full justice to the products. If we suppose ten thousand pounds to be spent upon a catalogue issue, the value of the expenditure may easily be doubled or trebled by spending an additional two hundred pounds upon the editorial work.

It is not difficult for the business man to forget in preparing a catalogue that those he wishes to read it are not as familiar with his productions as he is himself. Simplicity and lucidity of description are essential, and in this connection care should be taken to avoid the listing of a complexity of types. The excellent work done by the Washington Department of Commerce in reducing the number of types of products in various trades is directed to what is really the same point. Variety, of course, there should be, but the types chosen for listing should be distinctly different, and the reasons for the differences very clearly stated.

If, for example, the catalogue offers a series of gas heaters and cookers, the types chosen should not only be essentially different, but the essential differences should be made quite clear to the reader. If the stove is a heating appliance, the kind of room for which it is suited, the kind of flue needed, the method of installation, and the cost of maintenance should all be demonstrated. When prices vary in a series, the reason for the differences should appear. Nothing is more confusing or stultifying in a catalogue than to be told on one page that Type A of a certain manufacture is the "best," or the "finest," when the very next page refers to another thing of the same sort priced at a much higher figure. What should be done is to show clearly that the article priced is good value at its price; good value for its particular purpose; good value to meet a particular need.

The Listing of "Extras."—Every endeavour should be made in drawing up a catalogue to offer each article ready for use, at a price covering the entire equipment necessary to put it into use. Thus, at one time it was the unfortunate practice of motor-car manufacturers to offer their machines at a certain price, and then to add a long list of extras necessary to fit out the machine ready for the road. This practice has, happily, been abandoned in the automobile industry, but it still obtains in many other trades. First, the buyer is offered the article at a certain price, but this price does not represent the thing ready for use or consumption; a number of extras are listed in a confusing way so that the real

price of the article fit for use has to be worked out with more or less difficulty. The manufacturer of a machine-tool gains when he offers his product completely fitted with necessary safety-appliances; equally the manufacturer of a roofing felt is likely to increase his sales if his price list shows the material put into convenient rolls well packed, accompanied with the necessary amount of cement for the lapping of edges, and with purpose-made nails to fix it. The aim of every catalogue should be to offer the articles it lists ready for use.

The format of a catalogue is of great importance. The catalogue of a store should be divided into sections and well indexed. In the case of the small catalogue, or "folder," it is far better to concentrate upon one really good production at a time than to issue a sheaf of documents of different sizes which are only too likely to bewilder and irritate the would-be buyer. It is quite usual at trade exhibitions to be handed half a dozen differently shaped folders referring to a single object, instead of being given one handy, pocket-sized, beautifully printed, well-considered piece of printing.

An excellent aid to business in a catalogue, and one that is much appreciated by buyers, is the insertion of intelligent matter directly or indirectly relating to the articles offered. This may be illustrated by the case of a sports catalogue. The manufacturer of cricket-bats or tennis-rackets does well to include in his catalogue expert directions for the preservation of the articles sold, or hints on the laws of the game, or other interesting cognate matter. Again, the catalogue of a piano-player may well be accompanied by a lucid account of the invention, instructions for the care of the instrument, hints as to getting the best results from it, and so forth.

As to catalogues for the export market, it is an old complaint, and a just one, that their publishers too often fail to adapt them to the needs of the country to which they are supposed to appeal. If a catalogue is prepared for South America, for example, it is quite useless to prepare it in English; it should be translated into Spanish (or into Portuguese, if for Brazil) and weights and measures and prices expressed in their proper equivalents. Consular reports from foreign countries again and again dwell upon the neglect of these elementary measures for making an export catalogue useful.

CATALONIA (*Cataluña*), an autonomous region, and formerly a province of Spain, formerly also a principality of Aragon; bounded on the north by the Pyrenees, west by Aragon, south by Valencia, and east by the Mediterranean Sea. Population (1940) 2,890,974; area, 12,414 sq. miles. The triangular territory of Catalonia forms the north-east corner of the Iberian Peninsula. It was divided in 1833 into four provinces, Barcelona, Gerona, Lérida and Tarragona (*see* separate articles). The surface is much broken by southern spurs of the Pyrenees. Running south-west to north-east, and united on the north with one of the offsets of the Pyrenees, is the range of the Sierra Llena, which bisects Catalonia, and forms its central watershed. The principal rivers are the Ter, the Llobrégat and the Ebro (*q.v.*), which all run into the Mediterranean. The coast is in places difficult but has important harbours, *e.g.*, Barcelona and Tarragona. Cut off orographically on the south and west Catalonia has had more associations with south France than with the Douro or Guadalquivir basins, and the Catalan language differs considerably from Castilian Spanish and has affinities with Provençal. Catalonia was one of the first of the Roman possessions in Spain, forming the north-eastern portion of Hispania Tarraconensis. About 470 it was occupied by Alans and Goths. It was conquered by the Moors in 712, but these invaders were in turn dispossessed by the Spaniards and the troops of Charlemagne in 788. Catalonia was subsequently ruled by French counts, who soon made themselves independent of France. By the marriage of Count Raymond Berenger IV. of Barcelona with Petronilla of Aragon, Catalonia became annexed to Aragon but this union was frequently severed. In 1640, when Philip IV. attempted to deprive Catalonia of its rights and privileges, it gave itself up to Louis XIII. of France. It was restored to Spain in 1659, and was once more occupied by the French from 1694 to 1697. Under Philip V. Catalonia, in 1714, was deprived of its cortes and liberties. From 1808 to 1813 it was held by France. It was the scene of civil war in 1823, and of revolutionary operations in the Carlist wars. It supported the Loyalist cause in 1936–39. *See* also SPAIN and BARCELONA.

The average yearly temperature varies from 48° to 75°; the rainfall is about 21 in. with a maximum in the early fall months and a lower maximum in the spring. The dwarf-palm, orange, lime and olive grow in the warmer tracts; and on the higher grounds the thorn-apple, pomegranate, myrtle, esparto and heaths flourish. There is much woodland, but meadows and pastures are rare. Wheat, maize, millet, rye, flax, liquorice, vines and fruits of all sorts—especially nuts, almonds, oranges, figs and walnuts and chestnuts—are produced. Few cattle, but numbers of sheep, goats and swine are reared. Coastal fisheries are excellent. The wines are for the most part rough and strong, though good when matured. Catalonia was prominent in the wool industry early in the Middle Ages, and in modern times the extended use of water-power for textile manufacture made Barcelona an important industrial and commercial city. With the increase of irrigation the country around the city was developed as a wheat growing area.

CATALPA, a genus of trees belonging to the family Bignoniaceae and containing about 10 species in North America, the West Indies and China. The best known is the common catalpa (*C. bignonioides*), native to the southeastern United States, but often cultivated in parks and gardens, both in Europe and America. It is a stately tree with large, heart-shaped, pointed leaves and panicles of white, bell-shaped flowers streaked with yellow and brown-purple. The hardy catalpa (*C. speciosa*), with larger flowers, found in woods from Indiana to Missouri southward to Tennessee and Arkansas, has become naturalized elsewhere through cultivation, especially south of its native range.

CATALYSIS. The term catalytic agent was introduced by J. J. Berzelius (1836) into chemistry to include those substances which by their presence accelerate the rate of reactions proceeding with a decrease in free energy towards equilibrium. In general, the catalyst provides an alternative path for the reaction; thus the chemical union of two components to form a product, $A+B \rightarrow AB$, may proceed directly or *via* a series of reactions, such as $A+X \rightarrow AX$, $AX+B \rightarrow AXB$, $AXB \rightarrow AB+X$, in which the substance X is a catalyst. In reversible systems catalysts must necessarily accelerate both forward and reverse reactions equally, since the equilibrium point cannot be affected by a material which acts solely as a catalytic agent. Catalytically accelerated reactions may be either homogeneous or heterogeneous in character, the former taking place in gases and liquids, the latter at interfaces, more especially at gas–solid and liquid–solid interfaces.

Catalysts both in homogeneous and heterogeneous systems theoretically possess an indefinite life, but in practice loss generally occurs, (*a*) through side reactions unconnected with the main reaction, as in the gradual reduction of sulphuric acid in the etherification processes; (*b*) through the formation of inactive compounds with impurities present in the reactants, as in the formation of nickel sulphide from sulphur compounds present as impurity in hydrogen employed in hydrogenation (*q.v.*) processes; (*c*) through removal from the reacting system either by vaporization, as in the case of catalysis of platinum in the formation of sulphur trioxide, or by coagulation, such as occurs in colloidal metal catalysts employed for hydrogenation; (*d*) through sintering and fusion due to overheating of the active surfaces.

Catalysis in Gas Reactions.—Simple collision between the molecules of two reacting gases is not sufficient to ensure reaction. In general but a small number of such collisions are effective in promoting chemical reaction, the number of these effective collisions rising, in the case of bimolecular reactions, exponentially with the temperature. It was first suggested by Arrhenius that effective collisions were those which took place between excited or active molecules, whilst normal molecules did not so react. In the majority of cases it is sufficient to assume that excited or active molecules are produced not prior to but in the act of collision itself. It is yet unknown whether the excited molecule resulting in collision possesses a transitory existence before reac-

tion, or whether excitation and reaction are simultaneous processes. An activating collision results when the energy available for activation exceeds a critical value, the "critical energy increment." The source of this energy is, in simple molecules, the kinetic energy available on collision; in complex molecules it appears that part or all of the potential energy in the molecule can supplement the kinetic. The fraction of the total number of collisions effective will be dependent both on the complexity of the molecule and the magnitude of the critical energy increment. Introduction of a catalyst may augment the velocity of a reaction by effecting a two-stage reaction with two small critical energy increments, as alternative to a one-stage reaction, with a large value for the critical increment. Although the catalytic influence of small quantities of water on the rate of many chemical reactions (*e.g.*, certain combinations of sulphur dioxide; or the thermal combination of hydrogen and chlorine) has long been established, the mechanism of any one of these reactions is not sufficiently well known to establish beyond doubt their homogeneous nature.

We have noted that only certain high-speed collisions between normal molecules effect chemical reaction, but similar results may be obtained by slow-speed collision provided that one of the colliding molecules already possesses sufficient potential energy available on collision to effect the required chemical change. These potentially active or excited molecules may be generated from the normal species by photochemical means, and thus they serve as catalysts or photosensitizing agents in what are primarily photochemical reactions. The case of the catalysis of the union of hydrogen and oxygen by light of wave length $\lambda = 2537$ may be cited. These gases do not combine with appreciable speed at ordinary temperature when exposed to radiation of this frequency. On the addition of a small quantity of mercury vapour, however, rapid combination is effected. The energy of activation for the hydrogen–oxygen combination is supplied, as shown by Franck and Cario, by collision with mercury atoms which by the absorption of radiation have been converted into excited mercury atoms. Numerous similar gas reactions may be carried out with similar photosensitizing catalysts which include, not only mercury in effecting hydrogenation of oxygen, carbon monoxide and ethylene or the decomposition of ammonia, but also bromine and chlorine in the decomposition of ozone. In considering the equilibrium point attained when such photocatalysts are employed, not only the active masses of the reactants, but likewise the radiation density must be taken into consideration.

In the recombination of atomic hydrogen to the molecular state it is evident that the resultant molecule is not stable unless the energy of dissociation can be liberated on association. If the resultant molecule possesses an electric moment, this energy which must be liberated can escape in the form of radiation, but for molecules possessing small or no electric moments such radiation cannot take place, and thus atomic recombination does not occur. If, however, molecules are present, intermolecular collisions between two atoms and a molecule may result in the transfer of part or all of the superfluous energy to the molecule, and the atoms can combine the molecules thus acting in a catalytic manner. The recombination of bromine atoms is apparently facilitated by the presence of bromine molecules.

Finally mention may be made of the catalytic influence of ions in chemical reactions. In the case of polymerization of acetylene, the energy of activation may be supplied by the recombination of ions of other and indifferent gases. Around each ion both positive and negative clusters of acetylene molecules are formed, and on reaction of these ions with each other the acetylene clusters absorb the energy set free on recombination and are converted into the polymeride.

Catalysis in Solution.—In solution, cases of catalytic acceleration of reactions are common, the classical examples being the catalytic activity of oxonium (H_3O^+) and hydroxyl (OH^-) ions on hydrolytic changes such as ester hydrolysis or sugar inversion. Other ions exert in many cases marked specific effects, such as the iodide ion in the decomposition of hydrogen peroxide, the chloride ion in the decomposition of chloramine, organic amines in the hydrolysis of nitramide, and the ions of polyvalent elements such as barium, vanadium and chromium in oxidation processes. In the majority of these catalysed reactions an adequate explanation for the mechanism is found in the hypothesis that the reactants and catalyst form a critical complex or quasi-compound. This complex is always in equilibrium with the reactants and can either revert back to the original reactants or undergo a change resulting in the formation of the products. If A and B react to produce C in a reaction catalysed by X, the hypothesis can be expressed in the form

$$A+B+X \rightleftarrows (ABX) \qquad (1)$$

$$(ABX) \rightarrow C+X \qquad (2)$$

The rate of reaction is determined by two factors—the concentration of the quasi-compound (ABX), and its specific reaction rate R. For extremely dilute solutions the reaction rate is given by the expressions $dx/dt = k(\mathrm{ABX}) = kKC_AC_BC_X$. If the reactants or catalysts are electrolytes, even dilute solutions are no longer ideal and the equilibrium of the reaction (1) is no longer dependent on the concentrations but, as Guldberg and Waage first observed, on the active masses of the reactants. If the relationship between the active mass and the concentration is expressed by the relationship $a_A = f_AC_A$, where f_A is the activity coefficient, the equilibrium constant K of the quasi-compound (ABX) is given by

$$K = \frac{C_{ABX} f_{ABX}}{(C_A f_A)\,(C_B f_B)\,(C_X f_X)}$$

or the reaction velocity in solutions is given by

$$dx/dt = k\,(\mathrm{ABX}) = kK(C_Af_A)\,(C_Bf_B)\,(C_Xf_X)/f_{ABX}$$

This generalization is further simplified by the observations of Milner, Brönsted, Debye and Hückel that in dilute solutions the activity coefficients of the various reacting species f_A, f_B, f_C, etc., are almost completely determined by the concentrations and valencies of the reacting species, and are given to a fact approximated by an equation of the form $\log_e f = -A^{Z+Z-}\sqrt{C} + BC$, where Z_+ Z_- are the products of the valencies of the ions in a reacting salt of concentration C. We thus can classify reactions in solutions into various types: *see* ELECTROLYSIS.

Type 1. The catalytic agent is a simple ion causing reaction in a neutral molecule in the presence of a large excess of the other reactant. This type includes most of the catalytic reactions involving oxonium and hydroxyl ions, such as the mutarotation of glucose, ester hydrolysis, the decomposition of diazoacetic ester and nitrosotri-acetoneamine, as well as the decomposition of nitramide by salts and acids. If in ester hydrolysis the concentration of the ester be represented by $[E]$ and that of the catalytic oxonium ion by $[H_3O]$ we obtain for the reaction velocity the expression

$$dx/dt = k[E\cdot H_3O\cdot A_9] = kK[E]f_0[H_3O]f_1/f_1 = kK[E][H]f_0$$

where f_0, f_1, f_2, etc., are the activity coefficients for neutral molecules, univalent and divalent ions, respectively.

Type 2. The catalytic agent consists of two ions of opposite sign causing reaction in a neutral molecule present in dilute solutions. This type includes the decomposition of hydrogen peroxide by the ions of hydrogen iodide and hydrogen bromide. The relationship expressing the reaction velocity in terms of the concentrations and activity coefficients of the reacting species is

$$dx/dt = k[H\cdot I'H_2O_2\cdot I'] = kK[H_2O_2]f_0f_1[H]f_1[I']/f_0 = kK[H_2O_2]f_1^2[H][CI'].$$

We have noted that many sugars undergo mutarotation, the velocity of which is accelerated by the addition of acids, and have seen that the formal representation of the reaction velocity in terms of the activities and concentrations is readily deduced on the assumption of the transitory existence of a quasi-compound or intermediary complex involving the oxonium ion H_3O and the sugar. It follows that not only do free oxonium ions in solution exert a catalytic influence, but also any substance which is capable of reacting with the sugar to yield such a complex will likewise be catalytically active. These have been termed *proton*

donators and include such substances as the weak acids, the NH'_4 ion, the HSO'_4 ion, the complex cobaltamine ion $[Co(NH_3)_5, H_2O]^{+++}$. In addition to acids, bases likewise catalyse the hydrolysis of esters and the mutarotation of sugars. Included in the bases are all substances which are capable of reacting with a hydrogen or oxonium ion, such as the anions of acids, *e.g.*, the SO_4'' or acetate ions, neutral pyridine, and basic complex ions of the type $[Co(NH_3)_5OH]^{++}$. This acid and basic catalysis can be expressed in the form of simple equations representing a species of hydrogen displacement or electrolytic action. Denoting the sugar by HG we obtain

(*a*) Catalysis by an acid or proton donator HM,

$$M \vdots H+G \vdots H+OH_2 \rightarrow M'+HG+OH'_3.$$

(*b*) Catalysis by a base or proton acceptor M,

$$M'+H \vdots G+H \vdots OH \rightarrow MH+GH+OH'.$$

In non-aqueous solutions it is likewise assumed that a quasi-compound or association complex between reactants and catalyst is first formed, and here the solvent may act both as solvent and as catalyst. Whilst the energy of activation determined from the temperature coefficient in the case of gaseous bimolecular reactions defines the reaction rate fairly accurately, reactions with large energies of activation proceed but slowly at low temperatures. This is not the case for reactions in non-aqueous solutions, an indication that the formation or change of the reacting complex must involve an interaction of some kind with the solvent molecules. The following data on the rate of addition of aniline to bromoacetophenone in various solvents exemplify this fact:

Solvent	*Energy of activation* (Cals. per gm.-mol.)	*Velocity coefficient of reaction*
Benzene	8,088	0·000985
Chloroform	10,700	0·00186
Methyl alcohol	12,440	0·0748
Ethyl alcohol	13,900	0·0624

Catalysis at Solid Surfaces.—Many reactions, such as the combination of hydrogen with ethylene, proceed readily at ordinary temperatures when the reactants are exposed to the clean surfaces of certain metals such as platinum or nickel. Thanks chiefly to the work of Faraday, Bodenstein and Langmuir, it is now established that these reactions actually proceed on the surface of the metal, which is thus a true catalyst. Many industrial operations are now conducted through the agency of such contact agents or surface catalysts; amongst the more important of these may be mentioned the synthesis and oxidation of ammonia, the preparation of sulphuric anhydride (*see* SULPHURIC ACID), the synthesis of methanol and hydrocarbons from water gas, and the hydrogenation (*q.v.*) of numerous unsaturated organic compounds, including the fats. In the fine-chemical industry the introduction of the methods of Sabatier has resulted in simple methods for the preparation of numerous compounds, such as cyclohexane, "decalin," phthalic anhydride, acetic acid and acetone.

In some cases the rate of reaction is dependent on the rate of diffusion of the reactants to, or of the products from, the surface; this is more frequently the case in reactions which involve either the interaction of a gas and a liquid at a solid surface or combustive reactions taking place at relatively high temperatures; but in the majority of cases of low temperature catalysis the reaction proceeds sufficiently slowly to ensure attainment of equilibrium between the adsorbed gas and the gas in close proximity to the catalyst. For such reactions several different types of surface action can readily be identified. In a number of cases, such as the decomposition of alcohols at a copper surface or the hydrolysis of sugars by certain enzymes, the reaction rate is independent of the concentration of the reactant; we may regard the catalyst surface as being saturated with reactant over the whole range of concentrations, and the rate of reaction measured is consequently merely the rate of liberation of the products of reaction from the surface. In some cases, *e.g.*, the decomposition of ozone at a silver surface, every molecule striking the surface appears to undergo decomposition, and the rate of reaction is consequently strictly proportional to the partial pressure of the reactant. It is evident that for low concentrations of reactant or an inactive catalyst, the first case, viz., a zero-order reaction may be transformed into one of this second or unimolecular type.

For bimolecular reactions, *e.g.*, the hydrogenation of ethylene at metal surfaces or the oxidation of oxalic acid in solution at carbon surfaces, the reaction velocity is a function of the concentrations of both of the reactants and attains a maximum at some suitable ratio of the reactant concentrations. At this point the reactants are adsorbed in the optimum ratio for interaction. Occasionally the reaction products inhibit the reaction; thus the sulphur trioxide formed in the catalytic union of sulphur dioxide and oxygen, and the oxygen set free in the catalytic decomposition of nitrous oxide hinder the reactions by which they are formed. In these cases the reaction products do not volatilize immediately on formation from the surface but are relatively strongly adsorbed, so that, in effect, the area of surface available for reaction is reduced.

Poisons and Promoters.—Active surfaces, as first noted by Faraday, are extremely susceptible to impurities, and the rate of reaction may be very seriously affected by even small quantities of suitable poisons. It is not difficult to detect extraordinarily minute concentrations of materials, such as cyanides, by their effect in reducing the catalytic power of platinum in the decomposition of hydrogen peroxide. Such poisons are strongly adsorbed, and differ only in the length of life on the surface from the many products of reactions which may exert an inhibiting action on the reaction by adsorption. In technical processes, the methods of elimination of poisons such as carbon monoxide and sulphur compounds from hydrogen have to be elaborate and efficient, and a large fraction of the total cost of a process may be incurred by the purification processes.

The quantitative study of poisoning action has revealed the fact that, for low temperature catalysis at least, only a small quantity of poison is necessary to effect complete destruction of the catalytic activity. This result has led to the view that only a small fraction of the surface is catalytically active, or that the seats of catalytic activity are active parts small in area and distributed irregularly over the surface of the catalyst. These active patches likewise appear to be differentiated from the remainder of the catalyst surface in other ways; thus, they are much more susceptible to the influence of temperature which effects sintering of the material, and on adsorption of many gases the heat evolution is markedly different from that occurring on adsorption on the remainder of the material. At high temperatures the differentiation between the active patches and the rest of the surface is not so marked, and the whole surface appears to be nearly uniform in catalytic activity.

The efficiency of a given weight of catalyst is dependent on the specific surface of the active patches at low temperatures and on the total surface at high temperatures. Such a desired increase in surface may be effected by utilization of catalyst supports such as magnesium sulphate or asbestos (*see* SULPHURIC ACID) for the distribution on their surfaces of catalysts such as platinum or vanadium pentoxide. Nickel oxide can be employed as a support for nickel employed in processes of hydrogenation.

It has been noted that an increase in catalytic activity for a certain weight of material may be obtained, not only by effecting an increase in the specific surface, but also by incorporating into the material other substances termed *promoters*. The catalytic efficiency is found to be greater for such promoted catalysts than for either constituent singly. In industrial practice the use of promoted catalysts is now general, *e.g.*, iron-potash-alumina mixtures for the ammonia synthesis, iron and chromium oxides for obtaining hydrogen from water gas, and zinc and chromium for the synthesis of methanol. (*See* METHYL ALCOHOL.) Two views have been advanced as to the function of promoters. By some, it is considered that the reaction accelerated by the promoted reaction is in reality a two-stage reaction in which the velocity of one stage are greatest on one constituent and that of the second stage greatest on the other constituent. In the hydrogenation of carbon monoxide one stage may be regarded as an association of carbon monoxide and hydrogen to form a methanolic complex,

and the second stage might be considered as a dehydration of this complex. Nickel promoted with dehydrating catalysts is particularly effective for this reaction. The alternative view is based upon early observations of Faraday that perfect crystals of a hydrated salt do not effloresce in a dry atmosphere, but on scratching, efflorescence spreads from the patch throughout the crystal. The molecules at phase interfaces appear to exist in a particularly labile condition. This observation can be readily confirmed in the auto-accelerated decomposition of many solids, and in the reduction of copper oxide by hydrogen, which only takes place at the boundary between the oxide and the metal. Promoted catalysts are characterized by the presence of numerous discontinuities in the composition of the surface phase, and it is to be anticipated that, if surface actions take place more readily at these points, it is possible that catalytic actions on these discontinuities may likewise proceed more easily. The mechanism by which such reactions take place on surfaces is unknown; there is ample evidence that in complex organic molecules adherence to the surface is effected by certain portions of the molecule, thus primary fatty alcohols adhere to a copper surface by means of their $-CH_2OH$ group and it is in this group that reaction takes place.

Heterogeneous catalysts include the colloidal catalysts, both organic (the enzymes) and inorganic (colloidal platinum and palladium). The former are remarkable in that some of them are almost specific in their action, whilst both are characterized by possessing a specific reacting surface which is liable to great modifications with small changes in environment. We find also, as is the case in the decomposition of hydrogen peroxide or in the oxidation of benzaldehyde, that the walls of the containing vessel, as well as particles of dust in the liquids, may readily provide surfaces which possess catalytically active portions.

Inhibitors.—Whilst catalysts accelerate the course of a reaction certain substances can hinder or even entirely stop a reaction. These are termed inhibitors. Several of these are of technical importance and are sometimes known as stabilizing agents; thus acetanilide will stabilize hydrogen peroxide against decomposition, hydroquinone (quinol) will inhibit acrolein from polymerization, and iodine will inhibit benzaldehyde and cellulose acetate from autoxidation. In many cases a simple explanation for the inhibition of a reaction by the addition of such substances is to be found in the hypothesis that the inhibitor removes a catalyst. Often the catalyst consists of dust particles on the walls of the containing vessel on which the inhibitor is selectively adsorbed and thus effects a poisoning action. Some investigators incline to the view that the removal, diminution in concentration, or poisoning of a positive catalyst by the inhibitor is not sufficient as an explanation of the results. They believe that many such reactions which can be inhibited are chain reactions in the sense that the reaction is propagated as a chain through the gas or liquid by a reacting molecule setting off another with which it comes in contact. An inhibitor, it is imagined, breaks the chain and thus slows down the reaction. (E. K. R.)

See G. Woker, *Die Katalyse,* 2 vols. (1910–1915); P. Sabatier, *Catalysis in Organic Chemistry,* trans. E. E. Reich (1923); W. Ostwald, *Über Catalysis* (Leipzig, 1923); H. Freundlich, *Colloid and Capillary Chemistry,* trans. H. S. Hatfield (1926), and numerous articles in the *Journal* of the Chemical Society.

CATAMARAN: *see* SHIP: *Primitive Craft.*

CATAMARCA, an Andean province of the Argentine republic, lying between 26° and 30° S. latitude and 65° and 69° 30′ W. longitude. It is bounded on the north by the province of Salta, east by the provinces of Tucumán and Santiago del Estero, south by the provinces of Córdoba and La Rioja and west by Chile, from which it is separated by the cordillera of the Andes. Prior to the official decree of Sept. 23, 1943, which divided the territory of Los Andes between the provinces of Jujuy, Salta and Catamarca, the area of Catamarca was approximately 27,775 sq.mi. According to the latest official census (1914) the population was 100,391; the official estimate of Dec. 31, 1943, being 162,115. The chief city of the province is Catamarca (pop., est. 22,000), the capital, situated on a fertile tableland in the southeastern part of the province. Other important cities are Andalgalá, Ancasti, Tinogasta and Belén.

The region is in general mountainous, with many high peaks perpetually covered by snow. Between the numerous longitudinal ranges of mountains are tablelands and valleys, some of the latter being exceedingly fertile while others are completely barren and covered by sand. The climate varies with altitude but is for the most part warm and dry, the rainfall ranging from 8 to 15 in. in the west to 24 in. in the east. Water is one of the major problems in the province and its scarcity has greatly retarded the development of agriculture and grazing. In 1940 the principal crops sown and their approximate acreages were alfalfa 34,600; maize 21,000; wheat 15,300 and grapes 2,600. In the same year there were 250,000 head of cattle, 170,000 sheep, 10,000 swine, 46,000 horses, 334,000 goats and 55,600 mules and asses. The principal minerals of the province that are exploited are wolfram, copper, mica, antimony, clay, asbestos and tin. Of these, and in direct response to markets created by World War II, wolfram and mica rank first in economic importance. Another industry that characterizes the region, carried on largely by women, is the hand weaving of fine ponchos and cloth from wool and vicuña. Olives are grown extensively and plans have been projected for the development of a large oil extracting plant at Copacabana (Tinogasta). When completed this factory will produce high-grade olive oil and tártago oil, the latter being used as a lubricant in aeroplane engines.

Two railways, the Central Córdoba and the Central Norte Argentino, serve the southeastern part of the province with a total of 375 mi. of track. The latter line provides direct communication between the capital of the province and the federal capital, a distance of 895 mi. which is covered in 36 hours. In 1940 there were approximately 2,300 mi. of improved roads and highways, mostly in the eastern half of the province. No regular air service has yet (1945) been established. (R. W. RD.)

CATAMARCA (*San Fernando de Catamarca*), capital of province of same name on Río del Valle de Catamarca, Argentina, 230 mi. (318 mi. by rail) N.N.W. of Córdoba. Pop. (1914 census) 13,262; (1940 est.) 22,000. Catamarca is connected by railways with La Rioja and Patquia and with Córdoba. The city stands in a narrow, picturesque valley at the foot of the Sierra de Ambato, 1,772 ft. above sea-level. The valley is highly fertile, partially wooded, and produces fruit in abundance, wine and some cereals. In the city are flour mills and tanneries, and among its exports are leather, fruit, wine, flour and a curious embroidery for which the women of Catamarca have long been famous. There is a fine church and a national college occupies the old Merced convent. The alameda is one of the prettiest in the Argentine Republic, having a reservoir of 2 ac. surrounded by shrubbery and walks. Catamarca was founded in 1683 by Fernando de Mendoza because the town of Chacra, the former provincial capital, a few miles north of Catamarca, had been found unhealthful and subject to inundations. Previous to the selection of Chacra as the provincial capital, the seat of government was at San Juan de Londres, founded in 1558 and named after the capital of England by order of Philip II. in honour of his marriage with Queen Mary. The arid surroundings of Londres led to its partial abandonment and it is now a mere village. Cholla, a suburb of Catamarca, is inhabited wholly by Calchaquí Indians, a remnant of the original inhabitants of this region.

CATANIA, a city and episcopal see of Sicily, the chief town of the province of Catania, on the east coast, 59 m. by rail S. of Messina, and 151 m. by rail S.E. of Palermo (102 m. direct). Pop. (1936) 241,462 (town); 244,972 (commune). The cathedral of S. Agatha, with relics of the saint, retains its three original Norman apses (1091), but is otherwise baroque and there are other good baroque churches and palaces. In the west the huge Benedictine abbey of S. Nicola (now suppressed) occupies about 21 ac. and contains the museum, a library, observatory, etc. This was the highest point of the ancient city, which lay almost entirely to the west of the modern Via Stesicorea Etuca, which runs for 3,000 yd. in a straight line towards the summit of Mt. Etna. The university, founded in 1444, has regained some of its former importance. To the south near the harbour is the massive Castel

'Ursino, erected in 1232 by Frederick II. The Roman theatre (no Greek theatre has been found) has been superimposed upon the Greek building, some foundations of which, in calcareous stone, of which the seats are also made, still exist. It is 106 yd. in diameter, and is estimated to have accommodated 7,000 spectators. Close to it are the remains of the so-called Odeum, of similar plan to the theatre but without a stage, and to the north is the church of S. Maria Rotonda, originally a Roman domed structure, perhaps part of a bath. To the north, in the Piazza Stesicoro, is the amphitheatre, a considerable portion of which has been uncovered, including a part of the arcades of the exterior already excavated. The external diameters of the amphitheatre are 410 and 348 ft., while the corresponding diameters of the arena are 233 and 167 ft. It is thus the third largest Roman amphitheatre known, being surpassed only by that at Verona and the Colosseum. Remains of many other Roman buildings also exist beneath the modern town, among the best preserved of which may be noted the public baths (*Thermae Achilleae*) under the cathedral, and those under the church of S. Maria dell' Indirizzo. The number of baths is remarkable, and gives some idea of the luxury of the place in Roman times. The majority were excavated by Prince Ignazio Biscari (1719–86). Some monumental Roman tombs have also been found, and it is only from their position that we can infer the boundaries of the Roman city, for no remains of its walls exist.

Catania exports sulphur, pumice stone, asphalt, oranges and lemons, almonds, filberts, cereals, wine and oil. The harbour is a good one. There is an old harbour with an area of .03 sq.mi. and a new harbour of .16 sq. mi.; the combined length of quays is 2 mi. Sulphide of carbon is produced here; and there are large dyeworks.

The ancient Catina (Gr. *Katane,* Rom. *Catina*[1]) was founded in 729 B.C. by colonists from Naxos, perhaps on the site of an earlier Sicel settlement—the name is entirely un-Greek, and may be derived from *κάτινον,* which in the Sicel language, as *catinum* in Latin, meant a basin, and would thus describe the situation. Charondas, a citizen of Catina, is famous as its lawgiver, but his date and birthplace are alike uncertain; the fragments preserved of his laws show that they belong to a somewhat primitive period. The poet Stesichorus of Himera died here. Very little is heard of Catina in history until 476 B.C., when Hiero I. removed its inhabitants to Leontini, repeopled it with 5,000 Syracusans and 5,000 Peloponnesians, and changed its name to Aetna. In 461 B.C., however, with the help of Ducetius and the Syracusans, the former inhabitants recovered possession of their city and revived the old name. Catina was, however, an ally of Athens during the Syracusan expedition (415–413 B.C.), and served as the Athenian base of operations in the early part of the war. In 403 B.C. it was taken by Dionysius of Syracuse, who plundered the city, sold the inhabitants into slavery and replaced them with Campanian mercenaries. In the First Punic War it was one of the first cities of Sicily to be taken by the Romans (263 B.C.). In 123 B.C. there was an eruption of Etna so violent that the tithe on the territory of Catina payable to Rome was remitted for ten years. It appears to have flourished in the first century B.C., but to have suffered from the ravages of Sextus Pompeius. It became a Roman colony under Augustus, and it is from this period that the fertile plain, hitherto called the plain of Leontini, begins to be called the plain of Catina. It seems to have been at this time the most important city in the island, to judge from the language of Strabo and the number of inscriptions found there. In A.D. 251 a lava stream threatened the town and entered the amphitheatre, which in the time of Theodoric had fallen into ruins, as is clear from the fact that he permitted the use of its fallen stones for new buildings. It was occupied by Belisarius in 546, sacked by the Saracens in 902 and taken by the Normans. The latter founded the cathedral; but the town was almost entirely destroyed by earthquake in 1170, and devastated by Henry VI. in 1197. It became the usual residence of the Aragonese viceroys of the 13th and 14th centuries, and one of them, De Vego, reconstructed the fortifications in 1552. In 1669 an eruption of Etna partly filled up the harbour, but spared the town, which was, however, almost entirely destroyed by the earthquake of 1693. During World War II Catania was heavily bombed by Allied planes. Near Catania the Germans put up a stiff resistance against the British in the summer of 1943.

See A. Holm, *Catania Antica* (trans. G. Libertini) (Catania, 1925); F. de Roberto, *Catania* (Bergamo, Arti Grafiche, 1907).

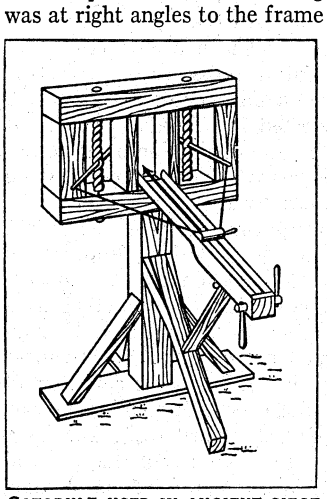
[1]This is the form vouched for by the inscriptions.

CATANZARO, a town and episcopal see of Calabria, Italy, capital of the province of Catanzaro, 1,125 ft. above sea-level. Pop. (1936) 27,907 (town); 45,400 (commune). The station for the town (Catanzaro Sala) is on a branch connecting the two main lines along the east and west coasts of Calabria, 6 mi. N. by W. of Catanzaro Marina on the east coast, and 20 mi. E. of S. Eufemia Biforcazione, on the west coast line. The town enjoys a comparatively cool climate in summer, and commands fine views. Numerous wealthy families reside here. The town was bombed by the Allies in World War II.

CATAPHYLL, a botanical term denoting any rudimentary scalelike leaf which precedes the foliage leaves, as a bud scale, etc.

CATAPULT, a generic name for warlike engines of the crossbow type used by the ancients (Lat. *catapulta,* Gr. *καταπέλτης*). (*See* ENGINES OF WAR.) They are usually classed as (*a*) catapults and (*b*) ballistae (*λιθοβόλοι*). The former were smaller and were used with arrows for what is now called direct fire (*i.e.,* at low angles of elevation); the latter were large siege engines discharging heavy bolts or stones at a high angle of elevation, like the modern howitzer.

The essential parts of the catapult (see illustration) were the frame, the propelling gear, the trough (corresponding to the modern barrel) and the pedestal. The frame consisted of two horizontal beams forming top and bottom sills, and four strong upright bars mortised into them. The three open spaces or compartments resembling narrow windows, between these four uprights, carried the propelling and laying gear. The propelling gear occupied the two outer "windows." In each a thick skein of cord or sinews was fastened to the top and bottom sills and tightly twisted. The stiff wooden arms were inserted in the two skeins, and a specially strong bowstring joined the tips of these arms. In the middle compartment was the hinged fore-end of the trough, which was at right angles to the frame and at the back of it. The trough could be laid for elevation by a movable prop, the upper end of which was hinged to the trough, while the lower ran up and down a sort of trail fastened to the pedestal. The whole equipment was laid for "line" by turning the frame, and with it the trough, prop and trail by a pivot in the head of the pedestal. Sliding up and down in the trough was a block, fitted with a trigger mechanism, through which passed the middle of the bowstring. The pedestal was a strong and solid upright resting upon, and strutted to, a framework on the ground; its upper end, as mentioned above, took the pivot of the frame and the head of the trail.



CATAPULT USED IN ANCIENT SIEGE WARFARE
This engine, capable of discharging a 26 in. arrow weighing ½ lb., had an effective range of 400 yards

On coming into action the machine was laid for direction and elevation. The block and with it the bowstring was next forced back against the resistance of the twisted skeins to the rear end of the trough, this being effected by a windlass attachment. The trigger being then pressed or struck with a hammer, the bowstring was released from the block, the stiff arms were violently brought back to the frame by the untwisting of the skeins, and the arrow was propelled through the centre "window" with great velocity. A small machine of the type described weighed about 85 lb., and sent a "three-span" (26in.) arrow weighing ½ lb. at an effective man-killing velocity somewhat over 400yds.

The ballista was considerably larger and more expensive than this. In Scipio's siege train, at the attack of New Carthage (Livy xxvi. 47, 5), the number of the ballistae was only one-sixth that of the catapults. In the ballista the rear end of the trough (which projected in front of the frame) always rested upon the ground, or rather was fixed to the framework of the pedestal—which was a heavy trestle construction—and the trough was thus restricted to the angle of elevation, giving the maximum range (45°). Even so, the range was not appreciably greater than that of a catapult, and in the case of the largest ballistae (90-pounder) it was much less. These enormous engines, which, once in position, could not be laid on any fresh target, were used for propelling beams and stones rather than for shooting arrows, that is, more for the destruction of material than for man-killing effect. The skeins that supplied the motive force of all these engines were made of the sinews of animals, twisted raw hide, horsehair rope, and, in at least one celebrated case, of women's hair. In 146 B.C., the authorities of Carthage, having surrendered their engines to the Romans in the vain hope of staying their advance, new ones were hurriedly constructed, and the women and virgins of the city cut off their hair to supply the needed skeins.

The modern implement known as a "catapult" is formed by a forked stick, to the forks of which are attached the ends of a piece of elastic. To the middle of this elastic a pocket is fitted to contain a bullet or small stone. In use the forked stick is held in the left hand and the pocket drawn back with the right. Aim is taken and, the pocket being released, the missile flies through the fork of the stick. Though classed as a toy, this weapon can do considerable execution among birds, etc., when skilfully used. The name of "catapult" has also been given to a bowling machine which is used for cricket practice.

CATARACT, a waterfall (Gr. καταρράκτης, a floodgate, or waterfall, something which rushes down). The earliest use in English is of a floodgate or portcullis, and this survives in the name of a disease of the eye (*see* EYE, DISEASES OF; OPHTHALMOLOGY). The term is also used of a device to regulate the strokes in certain types of steam-engine.

CATARGIU (or CATARGI), **LASCAR** (1823–1899), Rumanian statesman, belonged to an ancient Walachian family, one of whose members had been banished in the 17th century by Prince Matthew Bassaraba and had settled in Moldavia. Under Prince Gregory Ghica (1849–56) Catargiu rose to be prefect of police at Jassy. In 1857 he became a member of the *Divan ad hoc* of Moldavia, a commission elected in accordance with the treaty of Paris (1856) to vote on the proposed union of Moldavia and Walachia. His strongly conservative views, especially on agrarian reform, induced the Conservatives to support him as a candidate for the throne in 1859. During the reign of Prince Cuza (1859–66) Catargiu was one of the Opposition leaders. On the accession of Prince Charles in May 1866 Lascar Catargiu became president of the council (prime minister); but finding himself unable to co-operate with his Liberal colleagues, I. C. Bratianu and C. A. Rosetti, he resigned in July. After eight more ministerial changes, culminating in the anti-dynastic agitation of 1870–71, Catargiu formed, for the first time in Rumanian history, a stable Conservative cabinet, which lasted until 1876. Impeachment of himself and his cabinet was threatened, but the proposal was withdrawn in 1878, and he remained in opposition until 1889, when he formed a short-lived cabinet, taking the portfolio of the Interior. In the Florescu ministry of March 1891 he occupied the same position, and in Dec. he again became president of the council, retaining office until 1895. He died at Bucharest on April 11, 1899.

CATARRH, a term chiefly signifying mild inflammation of the mucous membrance of the respiratory passages, in popular language a "cold." It is the result of infection by a micro-organism esp. *M. catarrhalis,* and begins with sneezing and profuse watery discharge from the nostrils and eyes while smell and taste are impaired. There is usually sore throat and bronchial irritation, causing hoarseness and cough. Sometimes temporary loss of voice results. There is always more or less feverishness and discomfort, and frequently an extreme sensitiveness to cold. After a few days the symptoms begin to abate, the discharge from the nostrils and chest becoming thick and yellow. Where natural resistance is low bronchitis or broncho-pneumonia may ensue.

Treatment. A hot bath with a dose of sp. etheris nitr., Dover's powder or aspirin at night is sometimes useful. Preventive treatment is by vaccine therapy (*q.v.*). Locally a snuff made of menthol 1 part, ammonium chloride 3 parts and boracic acid 2 parts will relieve the discomfort of the nose. The term catarrh is used in a wider sense to describe a similar pathological condition of any mucous surface in the body, *e.g.* gastric catarrh, intestinal catarrh, etc. (*See* also RESPIRATORY SYSTEM, DISEASES OF, and ALIMENTARY SYSTEM, DISEASES OF THE.)

CATARRHINE MONKEY, the term used (in contradistinction to Platyrrhine, *q.v.*) to describe those apes which have the nostrils approximated; the aperture pointing downward; and the intervening septum narrow. These are the distinguishing features of all the old world primates. (*See* PRIMATES.)

CATASTROPHE. In ancient Greek drama the change in the plot which leads up to the conclusion (Gr. καταστρέφειν, to overturn). Hence any sudden change, particularly of a disastrous nature, and in geology a great convulsion of the earth's surface.

CATAUXI, a numerous cannibal tribe of South American Indians of the Purús river district, Brazil. They cultivate manioc and make pottery and bark canoes.

CATAWBA, the principal tribe of the eastern division of the Siouan stock of American Indians; habitat, South Carolina. They were friendly to British and Americans, long at war with the Iroquois. The population in the 17th century was about 5,000; in 1780 about 500; 1907, 60.

CATAWBA, an amber coloured, richly flavoured wine made from the light-red grape of the same name. The grape is a variety of the *Vitis labrusca,* a North American and Asiatic species, and takes its name from the Catawba river in North and South Carolina. In 1807 the grape was grown in Washington, D.C., but it was not until about 1823 that the name Catawba was given to it. It spread rapidly in New York, Ohio and Ontario, and in 1928 was extensively grown in the Finger lake section of New York. The vine is extremely prolific, the fruit being large and very sweet. The grapes are readily preserved, and their great use is partly accounted for by that fact. The wine is largely used as a base for champagne.

CATBALOGAN, a municipality (with administrative centre and 16 *barrios* or districts) and capital of the province and island of Samar, Philippine Islands. Pop. (1939) 26,654, only one was white. It lies midway between the ports of Manila and Zamboanga and is a port of call for coastwise and other craft. Abacá (Manila hemp) is produced in the country tributary to the town and there are manufactures of woven fibres and mats which are also made from *tiking* (sedge). Most of these are exported. The fisheries are important. The vernacular is Samarino, a dialect of Bisayan. Of those inhabitants 6 to 19 inclusive, 21.6% attend school, and of those ten years old and over 37% are literate.

CATBIRD (*Dumetella carolinensis*), a North American bird of the thrasher family Mimidae, about 9 in. long, a summer visitor from the Gulf of Mexico, north to New Brunswick and Hudson Bay. Its plumage is slate-gray, with a black cap and tail and chestnut under tail coverts. It is noted for its beautiful song, with much of the charm of its close relative, the mocking-bird. The name expresses the mewing protest of the bird when angry. The catbird winters in the southern states, in Cuba and from Mexico to Panama. It is resident in Bermuda. In Australia, a name given to any one of several bowerbirds (*q.v.*), especially to *Ailuroedus crassirostris,* which builds no bower. The name comes from a catlike mewing.

CATBOAT, a small sailing-boat of the pleasure variety, having the mast stepped forward and carrying a single fore-and-aft mainsail set on a boom and gaff, known as a *cat rig.* They are also known as Una boats, and frequently carry a centre-board (*q.v.*).

CATCH, a form of concerted vocal music virtually indistinguishable from the round, save for the fact that it is always

humorous in character. The catch had its greatest vogue in earlier centuries, when also the words to which it was sung were too often more jocose than refined. Particulars of various collections available occupy a column of small print in Grove. Of the innumerable catch and glee clubs which existed in England in former days one, known simply as the Catch Club, founded as long ago as 1761, still exists. (*See* also under CANON; CONTRAPUNTAL FORMS; GLEE; RONDEL.)

CATCH-CROPS are rapidly growing crops that occupy the soil for short periods of time to absorb or "catch" nitrates that might otherwise be carried away in drainage waters. They are usually grown between the times of two principal crops or between the rows of another crop. Rye, oats and vetch are frequently used, but other crops and plants, including weeds, may serve as well. When the immature plants are plowed under, the nitrogen absorbed is returned to the soil where it can again be used to nourish other plants. Many gardeners and farmers have found that they can improve their production efficiency by giving attention to the use of catch-crops in their cropping systems.

In practice, however, the term catch-crops is often used with other meanings. Some regard them as quickly maturing crops grown between two principal crops for the purpose of keeping the land completely utilized. Defined in this way, catch-crops may occupy idle land for longer periods of time and include more species of plants than under the more restricted definition given above. The crops serving as catch-crops will be useful, not only for conserving nitrates, but also for soil protection, soil enrichment and as additional sources of feed for livestock.

Special crops planted between two principal crops for the purpose of protecting the soil against water and wind erosion are frequently called cover-crops. They may also function as catch-crops and as sources of organic matter for soil enrichment.

Crops planted between two principal crops, chiefly for the purpose of soil enrichment, are more accurately described as green manure crops. Legumes, because of their ability to obtain nitrogen from the atmosphere, are used more frequently for this purpose than non-legume crops. In the North American corn-belt, for instance, biennial sweet clover, a deep rooted legume, is widely used as a green manure crop. It is seeded in early spring in either fall- or spring-seeded grains and plowed under the following spring for corn. If conditions are favourable, as much as 100 lb. or more of atmospheric nitrogen and several tons of organic matter rich in nutrient minerals may be added to an acre of land. In addition to these benefits, the sweet clover or other green manure crops may also serve as catch and cover crops.

In view of the overlapping functions of catch, cover and green manure crops, it is difficult to use these classifications accurately. Some call all special crops planted between two principal crops catch-crops, while others use the designations that best express the major purposes for which the crops are grown. (F. C. BR.)

CATCHMENT AREAS. The term "catchment area" is used to describe the collecting area from which water would flow to a stream or river, the boundary of the area being determined by the ridge separating water flowing in opposite directions. The amount of water collected within the catchment area would depend on the extent of that area, the amount of rain which has fallen on the surface, and the proportion of that rainfall which has been lost by evaporation or absorption. The term "run-off" has been adopted to describe that portion of the rainfall which ultimately finds its way to the stream, and the ratio between the rainfall and the "run-off" varies widely, according to the climatic conditions. In England and Scotland the average annual rainfall varies from a little over 20 in. to 175 in., and the annual loss by evaporation from a land surface varies from about 10 to 18 in., being less in the north, increasing towards the south.

Evaporation.—The loss by evaporation depends on the hours of sunshine, the temperature, and the humidity of the atmosphere, and varies greatly during the different periods of the year as might naturally be expected. The following average figures for the period 1883–1900 illustrate the effect of these various factors on the proportion of the rainfall which flowed over Teddington weir from the Thames catchment area above that point.

	Average hours of sunshine.	Average temperature.	Average humidity.	Proportion of rainfall flowing over Teddington weir.
		Degrees.	Degrees.	Per cent.
Jan.–March .	57·5	39·6	84·5	60·9
April–June .	163·2	53	74·3	30
July–Sept. .	159·8	60·2	75·7	12
Oct.–Dec. .	46·1	41	86·5	28

The total annual loss by evaporation in Britain is less in regions of high rainfall than in areas of low rainfall, and the seasonal loss varies in a similar manner. The influence of climatic conditions on the evaporation is so marked, that in tropical countries the proportion of the rain which flows off the ground is small.

It has been held that forests tend to increase the discharge of a river by reducing evaporation, but such evidence as has been obtainable fails to support this view. Shade cast by the trees would reduce evaporation, but rain which would otherwise flow from the ground, is absorbed by the trees. Although forests have but little effect on the annual loss by evaporation, their presence has an influence in delaying the flow of water from the hillsides, and when a catchment area has been cleared of timber, floods tend to become more intense.

Evaporation from a water surface is greater than from a land surface, especially in tropical countries, and is a matter of importance when lakes occupy a considerable proportion of the catchment area.

Absorption.—The amount of rain falling on the surface which percolates downwards depends on the porosity of the surface soil and the nature of the underlying rock, whether impermeable, porous, or fissured.

When the surface is impermeable, there would be no loss by percolation.

When the surface is permeable but is underlain by impermeable rock, water percolates downwards till that rock is reached and then travels underground in the direction of the steepest inclination of the rock surface, which is generally towards the stream, water lost by percolation reappearing as springs. Such percolation has little influence on the annual run-off, but may have a marked effect on its variations throughout the year. Thick beds of permeable material, such as sand or gravel, absorb large volumes of water, acting as natural storage reservoirs. During periods of abundant rainfall the beds would become saturated, and during periods of dry weather water so absorbed would be gradually discharged, thus maintaining a considerable flow in the stream.

This point is of great importance when it is desired to utilize the water of a stream without constructing a storage reservoir to balance its fluctuations, as the quantity of water which could be taken during certain periods would be limited to the dry weather flow.

When the surface is permeable and is underlain with permeable or fissured rock, such as chalk, the entire rainfall on the catchment area might percolate downwards, reappearing in the form of springs issuing either within or without the limits of the catchment area.

In the former case there would be no surface flow above the point where the springs break out, and in the latter, the whole catchment area would be void of streams. (W. J. E. B.)

CATECHISM, a compendium of instruction (particularly of religious instruction) arranged in the form of questions and answers. The custom of catechizing was followed in the schools of Judaism and in the Early Church, where it helped to preserve the Gospel narrative. (*See* CATECHUMEN.)

The catechism as we know it is intended primarily for children and uneducated persons. Its aim is to instruct, and it differs from a creed or confession in not being in the first instance an act of worship or a public profession of belief. The first regular catechisms seem to have grown out of the usual oral teaching of catechumens, and to have been compiled in the 8th and 9th cen-

turies. They continued on through the Middle Ages to the 16th century. The original of all modern catechisms, because of its question and answer form, is the *Disputatio Puerorum Per Interrogationes Et Responsiones* (*Patr. Lat.*, CI, 1097–1144), of the 9th century. In the 12th century the *Elucidarium* of Honorius of Autun (*Patr. Lat.*, CLXXII, 1110–1176) and the *De Quinque Septenariis* of Hugh of St. Victor (*Patr. Lat.*, CLXXV, 405–414) were well known and had much influence on subsequent catechisms. Jean Gerson (1363–1429), chancellor of the University of Paris, took great interest in catechizing, taught children both at Paris and Lyons, and wrote among other catechetical works his *ABC des simples gens*. The first catechism printed in Germany was the *Christenspiegel* of Coelde, which first appeared in 1470, proved very popular and was in its 5th edition by 1514. But though catechisms had already been in use, the 16th century saw a tremendous increase in their number and importance, as ever-increasing facilities for printing were available and the age of the Reformation began. Both the new Protestant Churches and the Catholic Church strove zealously to instruct their members and to win new adherents.

In 1520 Luther had brought out a primer of religion dealing briefly with the Decalogue, the Creed and the Lord's Prayer; and other leaders had done something of the same kind. In 1529 all these efforts were superseded by Luther's Smaller Catechism meant for the people themselves and especially for children, and by his Larger Catechism intended for clergy and schoolmasters. These works did much to mould the character of the German people and powerfully influenced other compilations.

In 1537 John Calvin at Geneva published his catechism for children. It was called *Instruction and Confession of Faith for the use of the Church of Geneva* and explained the Decalogue, the Apostles' Creed, the Lord's Prayer and the Sacraments. It was the work of a man who knew little of the child mind, and, though it served as an admirable and transparent epitome of his famous *Institutes*, it was too long and too minute for the instruction of children. Calvin came to see this, and in 1542 drafted a new one which was much more suitable for teaching purposes. This was used in Geneva and in Scotland. The Reformed churches of the Palatinate, on the other hand, used the Heidelberg Catechism (1562–63), mainly the work of two of Calvin's disciples, Kaspar Olevianus and Zacharias Ursinus. This work is perhaps the most widely accepted symbol of the Calvinistic faith, and is noteworthy for its emphasis on the less controversial aspects of the Genevan theology. As revised by the synod of Dort in 1619, it became the standard of most of the Reformed churches of central Europe, and in time of the Dutch and German Reformed Churches of America.

Since 1648 the standard Presbyterian catechisms have been those compiled by the Westminster assembly, presented to parliament in 1647, and then authorized by the General Assembly of the Church of Scotland (July 1648) and by the Scottish parliament (Jan. 1649). The Larger Catechism is "for such as have made some proficiency in the knowledge of the Christian religion," but is too detailed and minute for memorizing, and has never received anything like the reception accorded to the Shorter Catechism, which is "for such as are of weaker capacity." The work was done by a committee presided over first by Herbert Palmer, master of Queens', Cambridge, and then by Anthony Tuckney, master of Emmanuel. The Shorter Catechism, after a brief introduction on the end, rule and essence of religion, is divided into two parts: I. The doctrines we are to believe (1) concerning the nature of God, (2) concerning the decrees of God and their execution. II. The duties we are to perform (1) in regard to the moral law, (2) in regard to the gospel—(*a*) inward duties, *i.e.*, faith and repentance, (*b*) outward duties as to the Word, the sacraments and prayer. It has 107 questions and answers, while that of the Anglican Church has but 24, grouping as it does the ten commandments and also the petitions of the Lord's Prayer, instead of dealing with them singly.

Though the Catholic Church had long been using catechisms, they were multiplied with new emphasis as the Church swung into the Counter Reformation. The most famous was that of the Jesuit Peter Canisius, first published in 1555. It went through 400 editions within 150 years. Another catechism which had a large circulation and greatly influenced later works was that of Bellarmine (1597); in France those of Auger (1563) and Bossuet (1687) were outstanding. The *Catechism of the Council of Trent*, completed in 1566, was never intended as an ordinary catechism. It was written for and addressed to parish priests, to serve as model and guide in their instructions and sermons to the people. The Catholic Church, because its unity of doctrine is otherwise so safeguarded, has never adopted any one official catechism for all its members. Each bishop is free to adapt his method of instruction to local conditions. Many bishops themselves, however, have desired a universal catechism; at the Vatican council (1870) the project was seriously discussed, with Bellarmine's catechism proposed as model. In more recent times well known catechisms have been the *Baltimore Catechism* (1885) in the United States, the *Penny Catechism* in England, and that of Deharbe (1847) in Germany. In the present century, pedagogical-catechetical congresses and periodicals (e.g., *Journal of Religious Instruction*, Joseph F. Wagner, N.Y.) have stimulated new methods, which methods in turn have produced new catechisms and aids. The classic survey of this period is *Où En Est L'Enseignement Religieux?* (Louvain, 1937), which lists and appraises the books and methods of the different countries.

Peter Mogilas, in 1643, composed the *Orthodox Confession of the Catholic and Apostolic Eastern Church*. This counteraction to the activities of the Jesuits and the Reformed Church was standardized by the synod of Jerusalem in 1672. A smaller catechism was drawn up by order of Peter the Great in 1723. The catechisms of Levshin Platon (1762) and V. D. Philaret (1839), each in his day metropolitan of Moscow, are bulky compilations which cannot be memorized, though there is a short introductory catechism, prefaced to Philaret's volume (Eng. trans. in Blackmore's *Doctrine of the Russian Church, 1845*).

The catechism of the Church of England is included in the Book of Common Prayer. It has two parts: (i) the baptismal covenant, the Creed, the Decalogue and the Lord's Prayer drawn up probably by Cranmer and Ridley in the time of Edward VI, and variously modified between then (1549) and 1661; (ii) the meaning of the two sacraments, written on the suggestion of James I at the Hampton Court conference in 1604 by John Overall, then dean of St. Paul's. This supplement to what had become known as the Shorter Catechism established its use as against the longer one, *King Edward VIth's Catechisme* which had been drawn up in 1553 by John Ponet, bishop of Winchester, and enlarged in 1570 by Alexander Nowell, Overall's predecessor as dean of St. Paul's. By the rubric of the Prayer Book and by the 59th canon of 1603, the clergy are enjoined to teach the catechism in church on Sundays and holidays after the second lesson at Evening Prayer. This custom, long fallen into disuse, has largely been revived during recent years, the children going to church for a special afternoon service of which catechizing is the chief feature. Compared with the thoroughness of most other catechisms this one seems scanty, but it has a better chance of being memorized, and its very simplicity has given it a firm hold on the inner life and conscience of devout members of the Anglican communion throughout the world.

Almost every Christian denomination has its catechism or catechisms. Besides those already enumerated there are two interesting joint productions. In 1898 the National Council of the Evangelical Free Churches in England and Wales published an *Evangelical Free Church Catechism*, representing directly or indirectly the beliefs of 60 or 70 millions of avowed Christians in all parts of the world, a striking example of inter-denominational unity. *The School Catechism* was issued in 1907 by a conference of members of the Reformed churches in Scotland, which met on the invitation of the Church of Scotland. In its compilation representatives of the Episcopal Church in Scotland co-operated, and the book, though "not designed to supersede the distinctive catechisms officially recognized by the several churches for the instruction of their own children," certainly "commends itself as

suitable for use in schools where children of various churches are taught together."

During the 19th century in the United States the Sunday School was recognized by various Protestant denominations as the primary instrument for religious instruction. By the middle of the century the Bible was regarded as primary curriculum material, the catechism secondary, though still important.

See the *Encyclopaedia of Religion and Ethics, s.v.* (A. J. G.; X.)

CATECHOL, PYROCATECHIN or **PYROCATECHOL,** ortho-dihydroxybenzene, crystallizes in white rhombic prisms, which melt at 104° and boil at 245°; it is readily soluble in water, alcohol and ether. Catechol, $C_6H_4(OH)_2$, was first prepared in 1839 by H. Reinsch in distilling catechin (the juice of *Mimosa catechu*); it occurs free in kino and in beechwood tar; its sulphonic acid is present in the urine of man and the horse. It is formed in the alkaline fusion of many resins, and may be prepared by fusing ortho-phenolsulphonic acid, *o*-chlorophenol, *o*-bromophenol and phenoldisulphonic acid with potash, by acid hydrolysis of *o*-phenylenediamine (*see* AMINES), or, better, by heating its methyl ether, guaiacol, $C_6H_4(OH)(OCH)_3$, a constituent of beechwood tar, with hydriodic acid.

Ferric chloride gives a green coloration with aqueous catechol, while its alkaline solution rapidly changes to a green and finally to a black colour on exposure to the air. It reduces ammoniacal silver solutions in the cold with formation of a silver mirror and alkaline cupric salts to cuprous oxide on heating.

Guaiacol may be obtained directly from beechwood tar, from catechol by methylation with potash and potassium methyl sulphate at 180°, or from anisole by nitration and subsequent reduction to amino-anisole, which is then diazotized and boiled with water. It melts at 28° and boils at 250°. It is employed in medicine as an expectorant. The dimethyl ether or veratrol is also used in medicine. Many other catechol derivatives have been suggested for therapeutic application. Guaiacol carbonate is known as duotal, the phosphate as phosphatol, the phosphite as guaiaco-phosphal; phosphotal is a mixture of the phosphites of creosote phenols. The valerianic ester of guaiacol is known as geosote, the benzoic as benzosol, the salicylic as guaiacolsalol, while the glycerin ether appears as guaiamar.

Catechol is the starting-point in the synthesis of the active principle of the suprarenal capsules which is variously known as adrenaline, epinephrine and suprarenine. The successive stages in this synthesis are catechol, chloroacetocatechol, methylaminoacetocatechol (adrenalone) and inactive adrenaline, which is resolved into physiologically active *l*-adrenaline through the bitartrate.

CATECHU or **CUTCH,** an extract obtained from several plants (the derivation is from the Malay *Kachu*), its chief sources being the wood of two species of acacia (*A. catechu* and *A. suma*), both natives of India. This extract is known as black catechu. A similar extract, known in pharmacy as pale catechu (*Catechu pallidum*), and in general commerce as gambir, or *terra japonica,* is produced from the leaves of *Uncaria gambir* and *U. acida,* cinchonaceous plants growing in the East Indian Archipelago. A third product to which the name catechu is also applied, is obtained from the fruits of the areca or betel palm, *Areca catechu.*

Ordinary black catechu is usually imported in three different forms. The first and best quality, known as Pegu catechu, is obtained in blocks externally covered with large leaves; the second and less pure variety is in masses, which have been moulded in sand; and the third consists of large cubes packed in coarse bags. The wood of the two species of *Acacia* yielding catechu is taken for the manufacture when the trees have attained a diameter of about 1ft. The bark is stripped off and used for tanning, and the trunk is split up into small fragments, which are covered with water and boiled. When the extract has become sufficiently thick it is cast into the forms in which the catechu is found in commerce.

Catechu so prepared is a dark brown, or, in mass, almost black, substance, brittle, and having generally a shining lustre. It is astringent, with a sweetish taste. In cold water it disintegrates, and in boiling water, alcohol, acetic acid and strong caustic alkali it is completely dissolved. Chemically it consists of a mixture of a peculiar variety of tannin termed catechu-tannic acid with catechin or catechuic acid, and a brown substance due to the alteration of both these principles. Catechu-tannic acid is an amorphous body soluble in cold water, while catechin occurs in minute, white, silky, needle-shaped crystals, which do not dissolve in cold water. A very minute proportion of quercetin, a principle yielded by quercitron bark, has been obtained from catechu.

Gambir.—Gambir, which is similar in chemical composition to ordinary catechu, occurs in commerce in the form of cubes of about an inch in size, with a pale brown or yellow colour, and an even earthy fracture. For the preparation of this extract the plants above mentioned are stripped of their leaves and young twigs, and these are boiled down in shallow pans. The juice is strained off, evaporated, and when sufficiently concentrated is cast into shallow boxes, where, as it hardens and dries, it is cut into small cubes.

Gambir and catechu are extensively employed in dyeing and tanning. For dyeing they have been in use in India from the most remote period, but it was only during the 19th century that they were placed on the list of European dyeing substances. Catechu is fixed by oxidation of the colouring principle, catechin, on the cloth after dyeing or printing; and treated thus it yields a variety of durable tints of drabs, browns and olives with different mordants (*see* DYEING). The principal consumption of catechu occurs in the preparation of fibrous substances exposed to water, such as fishing-lines and nets, and for colouring stout canvas used for covering boxes and portmanteaus under the name of tanned canvas. Black catechu is official in most pharmacopoeias except that of Great Britain, in which pale catechu is the official drug. The actions and uses of the two are similar, but black catechu is the more powerful. The dose is from five to twenty grains. The *pulvis catechu compositus* contains catechu and kino, and may be given in doses twice as large as those named. The drug has the actions and uses of tannic acid, but owing to the relative insolubility of catechu-tannic acid, it is more valuable than ordinary tannic acid in diarrhoea, dysentery and intestinal haemorrhage.

CATECHUMEN, a technical term applied to a person receiving instruction in the Christian religion with a view to baptism (Gr. κατηχούμενος, one receiving instruction, from κατηχεῖν, to teach orally). The catechumenate grew naturally out of Judaism, which as a missionary religion had to instruct recruits. These were admitted by circumcision and baptism, women by baptism only. Second-century practice in Palestine is described in *Yebamot* 47 a.b. "They acquaint him with some of the lighter and some of the weightier commandments. . . . As they show him the penalty of breaking commandments, so they show him the reward of keeping them. . . . If he accepts, they circumcise him forthwith . . . when he is healed they at once baptize him." The ordeal was clearly much lighter for women. For this and other reasons there was a considerable body of potential proselytes on the fringe of Judaism. They were known as "God-fearers"; if they shrank from circumcision themselves they generally had the rite performed on their sons (G. F. Moore, *Judaism,* i. 323 ff.).

The Apostles are said to have instructed converts after baptism (Acts ii. 41, 42); the earliest teaching was presumably an explanation of the Messianic prophecies in the Old Testament. On the Gentile mission Paul's strongest appeal was made to "The God-fearers," who had been already won for monotheism and Jewish standards of morality, and for whom circumcision was no longer necessary. The word κατηχεῖν applied to Christian instruction, presumably both before and after baptism, occurs in the New Testament in Luke i. 4 (of Theophilus), Acts xviii. 25 (of Apollos—the exact meaning is disputed; *see* APOLLOS) and Gal. vi. 6 ("let him that is *taught* communicate with him that *teacheth* in all good things").

As the Gentile element in the Church preponderated, instruction became more definite. It was probably undertaken by the "teachers" (1 Cor. xii. 28). *The Teaching of the Twelve Apostles,* i.–vi. is a manual of ethical teaching. The *Shepherd* of Hermas was widely used (Eus. *H. E.* III. iii. 6.). Justin Martyr (*Apol.* i. 61) says converts are taught to pray for forgiveness before baptism.

In the 4th century, with the rise of heresy, detailed doctrinal teaching was given. Of those treatises which have survived, the most important are Cyril of Jerusalem's *Catechetical Lectures,* Gregory of Nyssa's *Catechetical Oration,* and Augustine's *de Rudibus Catechizandis.* By this time the postponement of baptism had become general; thus Constantine was not baptized till he was at the point of death. Accordingly a large proportion of Christians belonged to the catechumenate. Most of them were merely "adherents" of the Church; others were under definite instruction for baptism. The preparation, preceded probably by a period of probation, generally coincided with the 40 days of Lent, the baptism taking place on Easter Eve. The preparation consisted of (*a*) instruction in what must be renounced, (*b*) instruction in the faith, (*c*) exorcisms of evil spirits (*see* BAPTISM). All catechumens attended the first part of the Eucharistic Service, known in the West as *Missa Catechumenorum,* after which they were "dismissed." As infant baptism became general, the catechumenate decayed. The baptismal rites now used are clearly adaptations of rites intended for the reception of adult catechumens. In the mission field the catechumenate has been revived and primitive conditions are repeated. Thus a polygamist will often be a life-long "adherent" debarred from baptism by marriage difficulties of his own making. (W. K. L. C.)

CATEGORICAL means generally unconditional, not subject to any conditions or reservations. 1. *In Logic*—The term categorical is used to describe those judgments or propositions which are neither hypothetical nor disjunctive. These latter are the two types of conditional propositions (*see* CONDITION); categorical propositions are those which make absolute or unconditional assertions, like *S is P* or *S is not P.* But the distinction between categorical and conditional propositions is relative to the extent that it is frequently possible to express a proposition of the one type as a proposition of the other type without much violence to their meaning, *e.g.,* the categorical assertion: *Equilateral triangles are equiangular,* can also be expressed in the conditional form: *If a triangle is equilateral it is equiangular* (hypothetical), or *either a triangle is equiangular or it is not equilateral* (disjunctive). 2. *In Ethics* Kant introduced the term "categorical imperative" for a moral law that is unconditional or absolute, or whose validity or claim does not depend on any ulterior motive or end. According to Kant there is only one such categorical imperative, which he formulates variously. One formula is: "Act only on such a maxim as you can will that it should become a universal law." This is purely formal, and expresses the condition of the rationality of conduct, rather than the condition of its morality. Another formula given by Kant is: "So act as to treat humanity, whether in your own person or in another, always as an end, and never as only a means." (*See* KANT, and ETHICS, HISTORY OF.)

CATEGORICAL IMPERATIVE: *see* CATEGORICAL.

CATEGORY means a predicate. Now the predicate of an assertion is usually some class-name or concept under which the subject is brought, in the case of affirmative assertions, or from which the subject is excluded, in the case of negative assertions. In popular usage, accordingly, the term category is applied to *any* class or concept. Philosophically, however, the term category is confined to *ultimate* modes of being, or to the ultimate concepts or modes of apprehension by which reality is known. The first systematic account of categories was given by Aristotle. His account held the field for many centuries. Its most serious competitor in the history of philosophy is the account given by Kant. But although the general orientation of the two philosophers was very different, yet their lists of categories are remarkably similar when due allowance is made for their difference in philosophical standpoint.

Aristotle's Account of the Categories.—This is contained partly in the treatise of that name which forms the first of the collection of logical treatises known as the *Organon,* and partly in the *Metaphysics.* Aristotle assumed that our ultimate modes of apprehending reality correspond to ultimate modes of being. Like most pre-Kantian philosophers who were not sceptics Aristotle did not seriously consider the possibility that reality may not be in itself what it is perceived or conceived to be. The Aristotelian categories were accordingly regarded by him as expressing at once ultimate modes of being and ultimate modes of apprehension (or predication). His list of categories was as follows (the Latin and English equivalents are added for convenience).

οὐσία	*substantia*	substance	ποτέ	*quando*	time
ποσόν	*quantitas*	quantity	κεῖσθαι	*situs*	position (or situation)
ποιόν	*qualitas*	quality	ἔχειν	*habitus*	state (or condition)
πρός τι	*relatio*	relation	ποιεῖν	*actio*	activity
ποῦ	*ubi*	place	πάσχειν	*passio*	passivity (or being acted on)

How exactly Aristotle arrived at his scheme of ten categories is not known. It has been suggested that he was guided by familiar grammatical distinctions—nouns, adjectives of quantity and of quality, adverbs of place and of time, the active and the passive voice of verbs, and so on. But there is no real evidence of this contention. A certain degree of correspondence between categories and grammatical distinctions would be inevitable in any case, seeing that distinctions in thought naturally find expression in linguistic differences.

In order to understand the Aristotelian list of categories one must be clear about the meaning of "ultimate modes of being" which they were intended to express. J. S. Mill was under the impression that the list was intended to be a table of classification of all nameable things, and consequently criticized it as at once defective in some respects and redundant in others. But that was a misconception. To be a "thing" is only one "mode of being," namely, that of "substance," in the Aristotelian list. But the same concrete reality can embody many or all modes of being. Of Aristotle, for instance, one can predicate that he was a man (substance) who lived in Athens (place) in the 4th century B.C. (time), taught philosophy (activity), was accused of atheism (passivity), felt depressed (state), fled to friends (relation), and so on. A classification of "things" would be bad if it included the same object (say, Aristotle) in several classes at once. But it is quite different with "modes of being." Several or all ultimate modes of being may, and do, exist in the same concrete individual, and yet such mode of being may be quite distinct from, and irreducible to, any other. To be a "thing" is different from being a "quantity" or "quality," etc., and none of them can be made intelligible by reference to the other. The predicate "green" may be explained by reference to "colour," and "colour" may be explained by reference to "quality"; but "quality" itself cannot be usefully explained by reference to any other term, but is ultimate in this sense. Similarly with the other categories—they were all intended to express ultimate modes (or *summa genera*) of being, and therefore of predication.

Aristotle himself did not regard his ten categories as of equal importance. It is clear that he regarded substance as, in a sense, the most fundamental category, inasmuch as quantity, quality, etc., can only exist in substances. Hence the Scholastic, Cartesian and Spinozistic distinction between *Substance* and *Accidens* (or *Mode*), between that which exists by itself and that which only exists in another. Curiously enough recent thought has tended more and more to discard the category of substance altogether (*see* SUBSTANCE) in favour of a world of "events" in space-time. There is also a tendency to discard the categories of activity and passivity or at least to reduce them to that of quantity (*see* CAUSALITY).

Kant's Account of the Categories.—This is most intimately connected with his "critical" standpoint, and constitutes the very core of his philosophy. Kant dismisses the idea that we can have knowledge of things as they are in themselves (*noümena*), and he confines human knowledge to phenomena, that is, to *appearances* of the real rather than to the inner *being* of it. This standpoint involves jettisoning of one side of the doctrine of the categories as taught by Aristotle, namely, the claim that they represent ultimate modes of *being.* From Kant's point of view the enquiry must confine itself to ultimate modes of human apprehension or forms of synthesis. Now Kant held that in all so-called human knowledge certain raw materials are supplied from outside, but that they are worked up, as it were, by certain forms of

apprehension which are inherent in the human mind (*see* A PRIORI), and he distinguished two groups of such forms of synthesis. In one group he placed space and time, which he regarded as forms of synthesis involved already in the very possibility of apprehending things at all in sense-perception. They are forms of *sense*-apprehension or perception (as distinguished from forms of *thought*). In the other group he placed the categories or forms of thought. This restriction of the term category to a mode of *thought* as distinguished from any other mode of apprehension is peculiar to Kant. Aristotle made no such distinction, and using the term category in the Aristotelian sense, it may be said that Kant recognized the Aristotelian categories of space and time, at least as modes of predication. In Kant's special sense, however, the categories are forms of conceptual or intellectual synthesis. Now judgment is the same as thought or understanding. The ultimately different forms of judgment should consequently express the ultimately different kinds of synthesis of the understanding. Kant accordingly derived his list of categories from the different forms of judgment. But instead of critically determining first what the ultimate forms of judgment are he took over from formal logic the usually recognized list with just a little further elaboration or over-elaboration. His result is represented in the following table which gives the Kantian categories together with the various forms of judgment to which they severally correspond. It will be observed that they are grouped into four principal classes with three divisions in each.

Form of Judgment	*Corresponding Category*
I. Quantity.	I. Quantity.
(*a*) Singular (*This S is P*)	(*a*) Unity
(*b*) Particular (*Some S's are P*)	(*b*) Plurality
(*c*) Universal (*All S's are P*)	(*c*) Totality
II. Quality	II. Quality
(*a*) Affirmative (*S is P*)	(*a*) Reality
(*b*) Negative (*S is not P*)	(*b*) Negation
(*c*) Infinite (*S is not P*)	(*c*) Limitation
III. Relation	III. Relation
(*a*) Categorical (*S is P*)	(*a*) Substantiality
(*b*) Hypothetical (*If A, then C*)	(*b*) Causality
(*c*) Disjunctive (*Either A or B*)	(*c*) Reciprocity
IV. Modality	IV. Modality
(*a*) Problematic (*S may be P*)	(*a*) Possibility and Impossibility
(*b*) Assertive (*S is P*)	(*b*) Existence and Non-existence
(*c*) Apodictic (*S must be P*)	(*c*) Necessity and Contingency.

It will be noticed that Kant's table of categories includes a number of the Aristotelian categories, and to these must be added space and time, which Kant did not call categories, but which he practically recognized as categories in Aristotle's sense of the term, at least on the epistemological side if not on the ontological side. But there are also obvious differences between the two schemes. The most remarkable of these is the entire absence from the Aristotelian scheme of anything corresponding to Kant's categories of modality. This difference is significant because it shows most clearly the difference in their ways of approaching the problem. Kant, as already indicated, was mainly or exclusively interested in thought, and possibility, actuality, and necessity certainly express real differences in our way of thinking about things. Aristotle, however, regarded the categories primarily as modes of being; and differences of modality do not express any differences in the being of things.

Later Tendencies.—The problem of the categories continued to attract deep interest after the time of Kant, and occupied a very prominent place in the thought of Hegel whose whole philosophy turned on it. English philosophers also devoted a good deal of attention to the problem, especially J. S. Mill. Gradually, however, interest was lost in the categories as a special problem, although it continued to receive some attention from historians of philosophy, and is of course dealt with incidentally in such new systems of philosophy as that of S. Alexander (*Space, Time and Deity*). The fact is that the new movements in geometry and in physics are tending to upset such familiar categories as those of space, time, substance and causality, and the whole subject may be said to be in the melting-pot.

BIBLIOGRAPHY.—H. W. B. Joseph, *Introduction to Logic* (1916); J. S. Mill, *System of Logic* (1875); B. Bosanquet, *Knowledge and Reality* (1892); E. v. Hartmann, *Kategorienlehre* (1896); F. A. Trendelenburg, *Geschichte der Kategorienlehre* (1846); W. Windelband, *System der Kategorien* (1900). *See* also ARISTOTLE; KANT; HEGEL. (A. WO.)

CATENA, VINCENZO DI BIAGIO (*c.* 1470–1531) Venetian painter, a descendant of an old Venetian family, and not the same person as the artist Vincenzo da Treviso, with whom he was at one time erroneously identified. Catena probably studied in Giovanni Bellini's studio in Venice during the last decades of the 15th century. Ridolfi, the earliest of Catena's biographers, says of him: "The character of Catena's genius as a painter was noble, as his works show. In addition, he was the possessor of great wealth, which enabled him to paint at ease and to gain distinction. He lived at the same time as Giorgione, whose glory he strove to emulate by every means in his power." The Bellinesque phase of his art is represented by the three following pictures, which are all signed: "Virgin and Child," in the Walker gallery at Liverpool; "Virgin and Child with Saints and Donors," in the Mond Collection; "The Holy family with a saint," at Budapest. The "Trinity" in the church of S. Simeone Grande at Venice, and the "Virgin and Child with two Saints" in the Venice Academy (348) may also be ascribed to this early period. The following works may be classified as representing his second or middle period, when Giorgione's influence made itself increasingly felt; "The Doge Leonardo Loredan kneeling before the Virgin" (1510), in the Doge's Palace; the "St. Jerome in his Study," and the "Madonna and Child, with a kneeling warrior," both in the National Gallery. The latter picture was purchased as by Giorgione. "The Adoration of the Infant Christ with Donor and Shepherd boy," of Lord Brownlow's collection; "Christ giving the Keys to St. Peter" in the Gardiner collection at Boston; half figure of Judith in the Querini-Stampalia collection in Venice, and his masterpiece dated 1520, the "Glorification of St. Cristina," in S. Maria Mater Domini at Venice; these all belong to the middle and best period. The "Judith" ascribed to Giorgione in the Hermitage at Leningrad has been ascribed to Catena by two authorities (Hadeln, Richter). A representative work of Catena's last period is the "Holy Family" at Dresden (Woermann 65) which is cool in tone and pale in colour. Catena was a good portraitist; the Berlin museum contains his portrait of Raimund Fugger mentioned by Vasari; at the National Gallery, London, and the Vienna museum are two portraits in the Bellini style. Catena died soon after Sept. 30, 1531, the date of his last will. He left his property to the Painter's gild at Venice, with provision for dowries to daughters of poor painters.

BIBLIOGRAPHY.—Vasari, Milanesi, *Vite;* Ridolfi, *Maraviglie dell' Arte* (1648); Boschini, *Le riche Minere* (1674); B. Berenson, *Venetian Painters* (1899); J. P. Richter, *Mond Collection* (1910); Crowe and Cavalcaselle, *History of Painting in North Italy* (edit. T. Borenius, 1912); baron v. Hadeln in Rieme, *Lexikon der Bildenden Künste* (1912).

CATENARY: *see* CURVES, SPECIAL.

CATERAN, the band of fighting men of a Highland clan (Gaelic *ceathairine,* a collective word meaning peasantry); hence the term is applied to the Highland, and later to any, marauders or cattle-lifters.

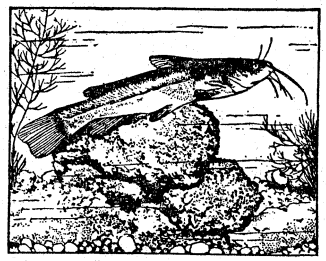
CATERHAM, forms with Warlingham an urban district of Surrey, England, 20 mi. S. of London by the S.R. Pop. (1938) 27,100. Area 12.9 sq.mi. It lies in healthy Downs country, and has grown in modern times into a large residential town. Three planning schemes were adopted. Large barracks and the metropolitan district insane asylum are in the neighbourhood.

CATERPILLAR, the popular name given to the larva of butterflies, moths and saw-flies (*see* LEPIDOPTERA; HYMENOPTERA; INSECTS; METAMORPHOSIS).

CATESBY, ROBERT (1573–1605), English conspirator, son of Sir William Catesby of Lapworth, Warwick, prominent recusant, was born in 1573, and entered Gloucester hall (now Worcester college), Oxford, in 1586. In 1596 he was one of those arrested on suspicion during an illness of Queen Elizabeth. In 1601 he took part in the rebellion of Essex, was wounded in the fight and imprisoned, but finally pardoned on the payment of an

enormous fine. In 1602 he dispatched Thomas Winter and the Jesuit Tesimond *alias* Greenway to Spain to induce Philip III to organize an invasion of England, and in 1603, after James's accession, he was named as an accomplice in the "Bye plot." Exasperated by his personal misfortunes and by the repressive measures under which his co-religionists were suffering, he was now to be the chief instigator of the Gunpowder plot. The idea seems first to have entered his mind in May, 1603. About the middle of Jan. 1604 he imparted his scheme of blowing up the Parliament house to his cousin Thomas Winter, subsequently taking in Guy Fawkes and several other conspirators. But his determination not to allow warning to be given to the Roman Catholic peers was the actual cause of the failure of the plot. A fatal mistake had been made in imparting the secret to Francis Tresham, in order to secure his financial assistance; and there is little doubt that he was the author of the celebrated letter to his brother-in-law, Lord Monteagle, which betrayed the conspiracy to the government on Oct. 26. On receiving the news, Catesby exhibited extraordinary coolness; he refused to abandon the attempt, and his confidence was strengthened by Fawkes's report that nothing in the cellar had been touched or tampered with. After the discovery of the conspiracy Catesby fled with his fellow-plotters, taking refuge ultimately at Holbeche, Staffs., where on the night of Nov. 8 he was overtaken and killed. He had married Catherine, daughter of Thomas Leigh of Stoneleigh, Warwick, and left a son, Robert, who inherited that part of the family estate which had been settled on Catesby's mother and was untouched by the attainder. Robert is said to have married a daughter of Thomas Percy. (*See* also GUNPOWDER PLOT.)

CAT-FISH, the name generally given to the fishes of the suborder Siluroidea of the order Ostariophysi, in which the air-bladder is connected with the internal ear by a chain of ossicles, probably enabling the fishes to hear well. From the Cyprinoids (characins, carps and electric eels) the Siluroids are distinguished by having the body naked or armoured with bony plates, never normally scaled, and by a number of osteological characters: the air-bladder generally extends laterally so that on each side it is in contact with the skin above the pectoral fin. The name "cat-fish" has reference to the long barbels or feelers about the mouth, of which one pair supported by the maxillaries is always present; generally there are two pairs below the chin, and frequently another developed from the valves between the nostrils. Nearly all the Siluroids are fresh water fishes, but two families are secondarily marine, the Ariidae, found on the coasts and in estuaries of all tropical countries, and the Plotosidae of the Indo-Pacific. The group is a large and varied one, containing probably about 2,000 species belonging to 23 different families; most are omnivorous, feeding on almost any kind of animal or vegetable food, and acting as scavengers. The spines of the dorsal and pectoral fins, which are so generally present, are powerful weapons, capable of inflicting severe and sometimes poisonous wounds.

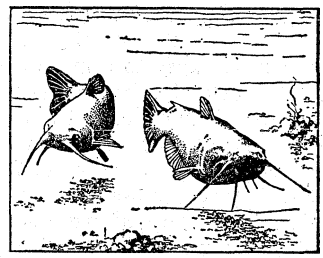


BY COURTESY OF THE NEW YORK ZOOLOGICAL SOCIETY

FIG. 1.—CAT-FISH OF NORTH AMERICA, OF THE FAMILY AMIURIDAE

The cat-fishes of North America belong to the family Amiuridae, which is peculiar to that continent, and is known from fresh-water deposits in Wyoming dating from the middle Eocene age. The Amiuridae are closely related to the Bagridae of Africa and Asia, and like them and most Siluroids have a short dorsal fin, with a spine, followed by an adipose fin on the tail. The anterior rays of the pectoral fins are spinous. The head is rather flat, with the mouth terminal and moderately wide, and the jaws with bands of small teeth; there are eight barbels. There are about 25 species, some of which are small; *Amiurus lacustris* of the Great Lakes attains a weight of more than 150 lb. These fishes scoop out a nest in the mud, and the male parent guards the eggs, and later swims with the brood near the shore.

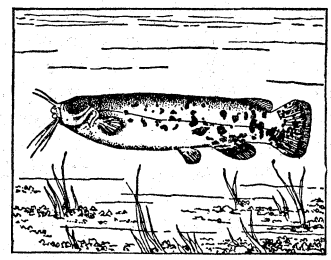
The European cat-fish (*Silurus glanis*), the "Wels" of the Germans, is said to reach a length of 10 ft. and a weight of 400 lb. It has a very long tail, beneath which is the long anal fin. Another species (*Parasilurus aristotelis*) occurs in Greece; the remaining Siluridae are Asiatic. In South and Central America are no less than nine families of Siluroids, all endemic. *Diplomyste* of Chile and Argentina, with toothed maxillary, is the most primitive living Siluroid, but other South American forms are highly specialized. Of the Aspredinidae, *Aspredo batrachus* is remarkable for the way in which the female carries the eggs on the abdomen; these sink into the soft spongy skin and a cup develops round each and then becomes stalked. The Trichomycteridae include *Stegophilus* and *Vandellia*, little slender naked fishes that live parasitically in the gill chambers of other fishes, and are said to enter the urethra of persons bathing, and by distending the short spines with which the gill-covers are armed, to cause inflammation or even death.



BY COURTESY OF THE NEW YORK ZOOLOGICAL SOCIETY

FIG. 2.—CAT-FISH OF THE GREAT LAKES, (AMIURUS LACUSTRIS)

The Loricariidae, with about 300 species, are mostly fishes that are covered by a long armour of five series of bony plates on each side, and have the lips expanded into a sucker by means of which they hold on to stones. They feed mainly on mud and algae and have a very long intestine that is coiled like a watch-spring. In some species there are pronounced sexual differences, the males having broader and blunter heads, margined with spines or bristles, or bearing branched tentacles on the snout. In the mountain streams of the Andes the Loricariidae are represented by small forms (*Cyclopium* or *Arges*) known as "prenadillas"; in these regions there are no carnivorous fishes to attack them and they are completely naked, having lost the bony armour that protects the lowland forms. A mining engineer who had diverted a stream in order to empty a pot-hole, observed a number of these fishes climb a precipice from the hole to the stream above it, obtaining alternate holds with the sucker and the rough surface of the pelvic fins; these were moved forward by the contraction of special muscles attached to the pelvic bones, while the sucker was holding. The Callichtyidae are another armoured family, but with only two rows of plates on each side of the body. Callichthys builds nests of grass, sometimes placed in a hole scooped out of the bank; both parents guard the nest. In the South American Doradidae, as in the similar but unrelated Mochochidae of Africa, the air-bladder is a sound-producing organ. *Doras* travels from one pond to another in the dry season, sometimes journeying all night. The Clariidae of Africa and Asia are also air-breathing fishes, provided with air-chambers above the gills; in *Clarias* special vascular tree-like organs nearly fill the chamber, but in *Saccobranchus* these are absent and the air-sac extends backwards for half the length of the fish. These are elongate, more or less eel-shaped fishes; in the dry season they burrow in the mud, but some species are said to leave their burrows at night and crawl about on land in search of food.



FROM JORDAN, "FISHES" (D. APPLETON)

FIG. 3.—CAT-FISH OF AFRICA, (MALOPTERURUS ELECTRICUS)

The African Amphiliidae and the Sisoridae of India have the lower surface of the head and abdomen flat and the paired fins horizontal, an adaptation to life in mountain torrents; in some genera the lips form a sucker similar to that of the Loricariidae. The electric cat-fish (*Malopterurus electricus*) is widely distributed in Africa. The skin is soft, and immediately beneath it lies the electric organ, formed of rhomboidal cells of a fine gelatinous substance, and differing from that of other fishes in being part of the tegumentary system, not derived from the muscles. Certain species of *Synodontis*, a genus common in the Nile, are white on the back and blackish beneath, a coloration connected with their habit of swimming belly upwards. The Ariidae,

most of which live in salt water, are typical Siluroids in form and structure of the fins, whereas the other marine family, the Plotosidae, have a very long tail, with the long anal fin confluent with the caudal. In some species of *Arius* the eggs, few in number and as large as marbles, are carried about by the male in his mouth. *Bucklandium* from the lower Eocene (London clay) is an Ariid. (C. T. R.)

CATGUT, the name applied to cord of great toughness and tenacity prepared from the intestines of sheep, or occasionally from those of the horse, mule and ass. Those of the cat are not employed, and therefore it is supposed that the word is properly *kitgut, kit* meaning "fiddle," and that the present form has arisen through confusion with *kit*-cat. The substance is used for the strings of harps and violins, as well as other stringed musical instruments, for hanging the weights of clocks, for bow-strings, and for suturing wounds in surgery. To prepare it the intestines are cleaned, freed from fat, and steeped for some time in water, after which their external membrane is scraped off with a blunt knife. They are then steeped for some time in an alkaline lye, smoothed and equalized by drawing out, subjected to the antiseptic action of the fumes of burning sulphur, if necessary dyed, sorted into sizes, and twisted together into cords of various numbers of strands according to their uses. The best strings for musical instruments are imported from Italy ("Roman strings"), and it is found that lean and ill-fed animals yield the toughest gut.

CATHA, a shrub (*Catha edulis,* family Celastraceae) native to Arabia and to Africa from Abyssinia to the Cape. It is also cultivated, especially in Arabia, where it is called *khat, kat,* or *kasta.*

The Arabians make a kind of tea from the dried leaves and young shoots. These are also chewed extensively for their stimulant properties, which somewhat resemble those of coca.

CATHARS (Cathari or Catharists), a widespread heretical sect of the middle ages. This article relates to the Western Cathars, as they appear (1) in the Cathar Ritual written in Provençal and preserved in a 13th-century ms. in Lyons, published by Clédat, Paris, 1888; (2) in Bernard Gui's *Practica inquisitionis haereticae pravitatis,* edited by Canon C. Douais, Paris, 1886; and (3) in the *procès verbal* of the inquisitors' reports. Some are dualists, and believed that there are two gods or principles, one of good and the other of evil, both eternal; but as a rule they subordinated the evil to the good, and all were universalists in so far as they believed in the ultimate salvation of all men.

Their tenets were as follows:—The evil god, Satan, who inspired the malevolent parts of the Old Testament, is god and lord of this world, of the things that are seen and are temporal, and especially of the outward man which is decaying, of the earthen vessel, of the body of death, of the flesh which takes us captive under the law of sin and desire. This world is the only true purgatory and hell, being the antithesis of the world eternal, of the inward man renewed day by day, of Christ's kingdom which is not of this world. Men are the result of a primal war in heaven, when hosts of angels incited by Satan or Lucifer to revolt were driven out, and were imprisoned in terrestrial bodies created for them by the adversary.

How shall man escape from his prison-house of flesh, and undo the effects of his fall? For mere death brings no liberation, unless a man is become a new creation, a new Adam, as Christ was; unless he has received the gift of the spirit and become a vehicle of the Paraclete. If a man dies unreconciled to God through Christ, he must pass through another cycle of imprisonment in flesh; perhaps in a human, but with equal likelihood in an animal's body. For when after death the powers of the air throng around and persecute, the soul flees into the first lodging of clay that it finds. Christ was a life-giving spirit, and the *boni homines,* the "good men," as the Cathars called themselves, are his ambassadors. They alone have kept the spiritual baptism with fire which Christ instituted, and which has no connection with the water baptism of John; for the latter was an unregenerate soul, who failed to recognize the Christ, a Jew whose mode of baptism with water belongs to the fleeting outward world and is opposed to the kingdom of God.

The Cathars fell into two classes, corresponding to the Baptized and the Catechumens of the early church, namely, the Perfect, who had been "consoled," *i.e.,* had received the gift of the Paraclete; and the *credentes* or Believers. The Perfect formed the ordained priesthood and controlled the church; they received from the Believers unquestioning obedience, and as vessels of election in whom the Holy Spirit already dwelt, they were adored by the faithful, who were taught to prostrate themselves before them whenever they asked for their prayers. They alone were become adopted sons, and so able to use the Lord's Prayer, which begins, "Our Father, which art in heaven." The Perfect alone knew God and could address him in this prayer, the only one they used in their ceremonies. The mere *credens* could at best invoke the living saint, and ask him to pray for him.

All adherents of the sect seem to have kept three Lents in the year, as also to have fasted Mondays, Wednesdays and Fridays of each week; in these fasts a diet of bread and water was usual. But a *credens* under probation for initiation, which lasted at least one and often several years, fasted always. The life of a Perfect was so hard, and, thanks to the inquisitors, so fraught with danger, that most Believers deferred the rite until the death-bed, as in the early centuries many believers deferred baptism. The rule imposed complete chastity. The passages of the New Testament which seem to connive at the married relation were interpreted by the Cathars as spoken in regard of Christ and the church. The Perfect must also leave his father and mother. The family must be sacrificed to the divine kinship. He that loveth father or mother more than Christ is not worthy of him, nor he that loveth more his son or daughter. The Perfect takes up his cross and follows after Christ. He must abstain from all flesh diet except fish. He may not even eat cheese or eggs or milk, for they, like meat, are produced *per viam generationis seu coitus.* Everything that is sexually begotten is impure. Fish were supposed to be born in the water without sexual connection, and on the basis of this old physiological fallacy the Cathars framed their rule of fasting. And there was yet another reason why the Perfect should not eat animals, for a human soul might be imprisoned in its body. Nor might a Perfect or one in course of probation kill anything, for the Mosaic commandment applies to all life.

The central Cathar rite was *consolamentum,* or baptism with the spirit. The spirit received was the Paraclete, the Comforter, derived from God and sent by Christ, who said, "The Father is greater than I." Of a consubstantial Trinity the Cathars naturally had never heard. Infant baptism they rejected because it was unscriptural and because all baptism with water was an appanage of the Jewish demiurge Jehovah, and as such expressly rejected by Christ. The *consolamentum* removes original sin, undoes the effects of the primal fall, clothes upon us our habitation which is from heaven, restores to us the lost garment of immortality. A Consoled is an angel walking in the flesh, whom the thin screen of death alone separates from Christ and the beatific vision. The rite was appointed by Christ, and has been handed down from generation to generation by the *boni homines.*

In the case of a candidate for initiation the Perfect addresses the postulant by the name of Peter; and explains to him from Scripture the indwelling of the spirit in the Perfect, and his adoption as a son by God. The Lord's Prayer is then repeated by the postulant after the elder, who explains it clause by clause. Then came the Renunciation, primitive enough in form, but the postulant solemnly renounced, not Satan and his works and pomp, but the harlot church of the persecutors; he renounced the cross which its priests had signed on him by baptism and other magical rites. Next followed the spiritual baptism itself, consisting of imposition of hands, and holding the Gospel on the postulant's head. The elder begins a fresh allocution by citing Matt. xxviii. 19, Mark xvi. 15, 16, John iii. 3 (where the Cathars' text must originally have omitted in v. 5 the words "of water and," since their presence contradicts their argument). Acts ix. 17, 18, viii. 14–17, are then cited; also John xx. 21–23, Matt. xvi. 18, 19, Matt. xviii. 18–20, for the Perfect one receives in this rite power

to bind and loose. The Perfect's vocation is then defined in terms of a strictly literal observance of the Commandments and the Sermon on the Mount. Asked if he will fulfil these demands, the postulant answers: "I have this will and determination. Pray God for me that he give me his strength." The next episode of the rite exactly reproduces the Roman *confiteor* as it stood in the 2nd century; "the postulant says: '*Parcite nobis.* For all the sins I have committed, in word or thought or deed, I come for pardon to God and to the church and to you all.' And the Christians shall say: 'By God and by us and by the church may they be pardoned thee, and we pray God that he pardon you them.' "

There follows the act of "consoling." The elder takes the Gospel off the white cloth, where it has lain all through the ceremony, and places it on the postulant's head, and the other *boni homines* present place their right hands on his head; they shall say the *parcias* (spare), and thrice the "Let us adore the Father and Son and Holy Spirit," and then pray thus: "Holy Father, welcome thy servant in thy justice and send upon him thy grace and thy holy spirit." Then they repeat the "Let us adore," the Lord's Prayer, and read the Gospel (John i. 1–17). This was the vital part of the whole rite. The *credens* is now a Perfect one; the Perfect ones present give him the kiss of peace, and the rite is over.

The Cathar Eucharist was equally primitive, and is thus described by a contemporary writer in a 13th-century ms. in the Milan Library:—"The Benediction of bread is thus performed by the Cathars. They all, men and women, go up to a table and standing up say the 'Our Father,' [as according to St. Gregory (*Ep.* ix. 12–26), was the custom of the apostles]. And he who is prior among them, at the close of the Lord's Prayer, shall take hold of the bread and say: 'Thanks be to the God of our Jesus Christ. May the Spirit be with us all.' And after that he breaks and distributes to all. And such bread is called bread blessed, although no one believes that out of it is made the body of Christ."

AUTHORITIES.—J. B. Mullinger, art. "Albigenses" in Hastings, *Encyclopaedia of Religion and Ethics,* vol. i.; C. H. Haskins, "Robert le Bougre" in *American Historical Review,* 1902; F. C. Conybeare, *The Key of Truth* (Oxford, 1898); J. J. I. Döllinger, *Beiträge zur Sektengeschichte* (München, 1890); Jean Guiraud, *Questions d'histoire* (Paris, 1906); C. Douais, *Les Hérétiques du midi au XIIIe siècle* (Paris, 1891); L. Clédat, *Le Nouveau Testament, traduit au XIIIe siècle en langue provençale, suivi d'un rituel cathare* (Paris, 1887); Ch. Schmidt, *Histoire et doctrine de la secte des Cathares* (Paris, 1849).

CATHARSIS means purification. Since the time of Aristotle the term has been definitely associated with the question of the effects of tragedy on the spectators or on the actors. Aristotle maintained that tragedy and also certain kinds of music tend to purify the spectators and listeners by artistically exciting certain emotions which act as a kind of homeopathic relief from their own selfish passions. Goethe was of opinion that the catharsis affects the actors in the tragedy rather than the spectators or readers. Lessing, on the other hand, held that it affects the spectators and readers rather than the performers. Lessing also maintained that catharsis takes the form of a sublimation of the emotions or their conversion into virtuous dispositions.

BIBLIOGRAPHY.—Butcher, *Aristotle's Theory of Poetry* (1895); J. Bernays, *Zwei Abhandlunger über die Aristotelische Theorie des Dramas* (1880); G. E. Lessing, *Hamburgische Dramaturgie* (1769, etc.).

CATHARTIDAE: *see* VULTURE.

CATHAY, the name by which China became known to mediaeval Europe. It is derived from Khitai, the name of the kingdom of Khitan Tartars (10th and 11th centuries A.D.) which, based on Manchuria (the north-east gateway into China), included at times part of north China as well, and which towards its close had its capital at Yenking (Kublai Khan's *Cambaluc, q.v.,* and the modern Peking). The Central Asian Tartars, in touch only with its northern territories, knew China by this name and the Russians through contact with them introduced it into Europe. The Russians and the peoples of central Asia still know China as Khitai or Kitai. Although in Marco Polo's time all China was under the control of the Great Khan, he limits Cathay to the country north of the Yang-tze Valley and calls south China by the separate name of Mangi. The distinction was at that time a real one, since Mangi retained the old Sung culture practically undiluted while Cathay bore the impress of the Tartar Conquest (*see* CHINA). In the 16th century, however, when European navigators following the sea-route via the Spice Islands reached Far Eastern waters it was Mangi which they knew as China and Cathay was understood as lying away to the north of it and to be reached by a still undiscovered sea-route. Hence ensued the search for the north-west and north-east passages from Europe to the renowned Cathay. This dualism corresponds to the much earlier distinction apparent in Roman literature between the Seres—the Chinese as approached by the overland route—and the Sinae—the Chinese as approached by the sea-route from the south. It was not until the early 17th century that the identity of the country and of the people reached by the two routes was realized.

CATHCART, SIR GEORGE (1794–1854), English soldier, third son of the 1st Earl Cathcart, was born in London on May 12, 1794. He was educated at Eton and Edinburgh university. In 1810 he entered the army, and in 1812 accompanied his father to Russia as aide-de-camp. He served with the Russian army in Germany in 1813 and in France in 1814, and in 1850 he published *Commentaries* on these campaigns. After the peace of 1814 he accompanied his father to the congress of Vienna. He was present at Quatre Bras and at Waterloo, as an aide-de-camp to the duke of Wellington, whom he accompanied to the congresses of Aix-la-Chapelle and Verona, and in 1826 to Prussia. Promoted lieutenant-colonel in 1826, he was placed on half-pay in 1834. In 1838 he was sent as commander of the King's Dragoon Guards to Canada. In March, 1852, he succeeded Sir Harry Smith as governor and commander-in-chief at the Cape, and brought the Kafir war to a successful conclusion. He promulgated the first constitution of Cape Colony, and conducted operations against the Basuto. Cathcart received a K.C.B. in 1853. In Dec., 1853, he was made adjutant-general of the army and was sent out to the Crimean War in command of the 4th division. He fell at the battle of Inkerman (Nov. 5, 1854) and his remains, with those of other officers, were buried on Cathcart's Hill.

See *Colburn's United Service Magazine,* Jan., 1855; *Correspondence of the Hon. Sir George Cathcart relative to Kaffraria* (1856); A. W. Kinglake's *Invasion of the Crimea,* vol. v.

CATHCART, WILLIAM SCHAW CATHCART, 1ST EARL (1755–1843), English soldier and diplomatist, was born at Petersham Sept. 17, 1755, and died at his estate near Glasgow June 16, 1843. In 1868 he went to St. Petersburg, where his father, the 9th Baron Cathcart (1721–76), was ambassador. Succeeding to the barony in 1776 he joined the army, and served in America, where he commanded an irregular corps, the "British Legion," and was quartermaster-general to the forces. From 1793 to 1795 he served with the 29th foot in the Low Countries, and was appointed commander-in-chief in Ireland, 1803–05, after which he commanded the British expedition to Hanover (1805). After his successful conduct of the expedition to Copenhagen, which surrendered to him in 1807, he was created Viscount Cathcart of Cathcart and Baron Greenock of Greenock. Promoted to the rank of general in 1812, he served in Russia, as ambassador and military commissioner, with the headquarters of the allies, throughout the War of Liberation (1812–14), and was raised to an earldom, for his services, in 1814.

His son, CHARLES MURRAY CATHCART, 2ND EARL (1783–1859), succeeded to the title in 1843. In 1800 he entered the 2nd Life Guards, and served in the Mediterranean (1805–06), in the Walcheren expedition of 1809, and at Barossa, Salamanca, and Vittoria. He was also present at Waterloo, after which he received the C.B. From 1846 to 1849 he was commander-in-chief in Canada; in 1859 he was raised to the rank of full general. Cathcart's interest in scientific pursuits led to his discovery, in 1841, of a new mineral which was named Greenockite.

CATHCART, a civil parish, partly in Renfrewshire and partly in Lanarkshire, Scotland. Part of the parish was added to Glasgow in 1911. The Renfrewshire portion has the larger area

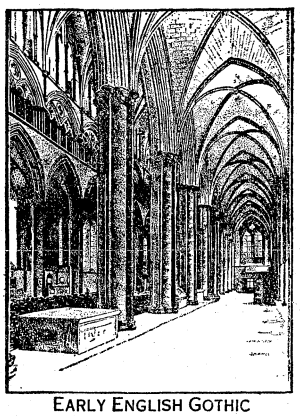
(3.7 sq.mi.), but the smaller population (4,649), the area of the Lanarkshire portion being 1.1 sq.mi. and the population (1931) 58,669, a large increase. The industries include paper-making and chemical manufactures. The parish includes the town of Cathcart (pop. 2,915), and the villages of Old and New Cathcart, but much of it, though outside the city boundaries, is practically continuous with some of the southern suburbs of Glasgow. The White Cart flows through the parish. In the 12th century Cathcart became a barony of the Cathcarts, who derived the title of their lordship (1460) and earldom (1814) from it. On the Queen's Knowe, a hillock near the ruins of Cathcart castle, a memorial marks the spot where Queen Mary watched the progress of the battle of Langside (1568), the site of which lies within the parish.

CATHEDRAL, more correctly "cathedral church" (*ecclesia cathedralis*), the church which contains the official "seat" or throne of a bishop—*cathedra,* one of the Latin names for this, giving us the adjective "cathedral." The adjective has gradually, for briefness of speech, assumed the character of a substantive.

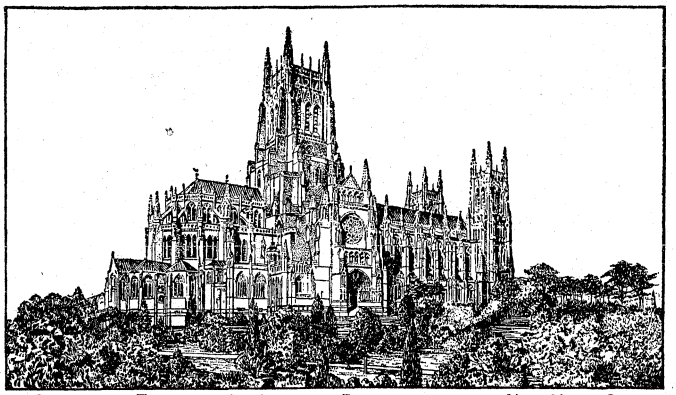
History and Organization.—It was early decreed that the *cathedra* of a bishop was not to be placed in the church of a village, but only in that of a city. There was no difficulty as to this on the continent of Europe, where towns were numerous, and where the cities were the natural centres from which Christianity was diffused among the people who inhabited the surrounding districts. In the British isles, however, the case was different; towns were few and, owing to other causes, instead of exercising jurisdiction over definite areas or districts, many of the bishops were bishops of tribes or peoples, as the bishops of the South Saxons, the West Saxons, the Somersaetas and others. The *cathedra* of such a bishop was often migratory, and was at times placed in one church, and then another, and sometimes in the church of a village. In 1075 a council was held in London, under the presidency of Archbishop Lanfranc, which, reciting the decrees of the council of Sardica held in 347 and that of Laodicea held in 360 on this matter, ordered the bishop of the South Saxons to remove his see from Selsey to Chichester; the Wilts and Dorset bishop to remove his *cathedra* from Sherborne to Old Sarum, and the Mercian bishop, whose *cathedra* was then at Lichfield, to transfer it to Chester. Traces of the tribal and migratory system may still be noted in the designations of the Irish see of Meath (where the result has been that there is now no cathedral church) and Ossory, the cathedral church of which is at Kilkenny. Some of the Scottish sees were also migratory. Occasionally two churches jointly share the distinction of containing the bishop's *cathedra.* In such case they are said to be con-cathedral in relation to each other. Instances of this occurred in England before the Reformation in the dioceses of Bath and Wells, and of Coventry and Lichfield. Hence the double titles of those dioceses. In Ireland an example occurs at Dublin, where Christ Church and St. Patrick's are jointly the cathedral churches of that diocese. Cathedral churches are reckoned as of different degrees of dignity: (1) the simple cathedral church of a diocesan bishop, (2) the metropolitical church to which the other diocesan cathedral churches of a province are suffragan, (3) the primatial church under which are ranged metropolitical churches and their provinces, (4) patriarchal churches to which primatial, metropolitical and simple cathedral churches alike owe allegiance. The title of "primate" was occasionally conferred on metropolitans of sees of great dignity or importance, such as Canterbury, York, Rouen, etc., whose cathedral churches remained simply metropolitical. The removal of a bishop's *cathedra* from a church deprives that church of its cathedral dignity, although often the name clings in common speech, as for example at Antwerp, which was deprived of its bishop at the French Revolution.

The history of the body of clergy attached to the cathedral church is obscure, and as in each case local considerations affected its development, all that can be attempted is to give a general outline of the main features which were more or less common to all. Originally the bishop and cathedral clergy formed a kind of religious community, which, in no true sense a monastery, was nevertheless often called a *monasterium.* The word had not the restricted meaning which it afterwards acquired. Hence the apparent anomaly that churches like York and Lincoln, which never had any monks attached to them, have inherited the name of minster or monastery. In these early communities the clergy often lived apart in their own dwellings, and were not infrequently married. During the two centuries, roughly bounded by the years 900 and 1100, the cathedral clergy became more definitely organized, and were also divided into two classes. One was that of a monastic establishment of some recognized order of monks, very often that of the Benedictines, while the other class was that of a college of clergy, living in the world, and bound by no vows, except those of their ordination, but governed by a code of statutes or canons. Hence the name of "canon" given to them. In this way arose the distinction between the monastic and secular cathedral churches. In England the monastic cathedral churches were Bath, Canterbury, Carlisle, Coventry, Durham, Ely, Norwich, Rochester, Winchester and Worcester, all of them Benedictine except Carlisle, which was a church of Augustinians. The secular churches were Chichester, Exeter, Hereford, Lichfield, Lincoln, St. Paul's (London), Salisbury, Wells, York and the four Welsh cathedral churches. In Ireland all were secular except Christ Church, Dublin (Augustinian) and Down (Benedictine), and none, even in their earliest days, were ever, it is believed, churches of recognized orders of monks, except the two named. In Scotland St. Andrew's was Augustinian, Elgin (or Moray), Glasgow and Aberdeen were always secular, and ordered on the models of Lincoln and Salisbury. Brechin had a community of Culdees till 1372, when a secular chapter was constituted. The cathedral church of Galloway, at Whithorn, of English foundation, was a church of Praemonstratensians. In the case of monastic cathedral churches there were no dignitaries, the internal government was that of the order to which the chapter belonged, and all the members kept perpetual residence. The reverse of this was the case with the secular chapters; the dignities of provost, dean, precentor, chancellor, treasurer, etc., soon came into being, for the regulation and good order of the church and its services, while the non-residence of the canons, rather than their perpetual residence, became the rule, and led to their duties being performed by a body of "vicars," who officiated for them at the services of the church.

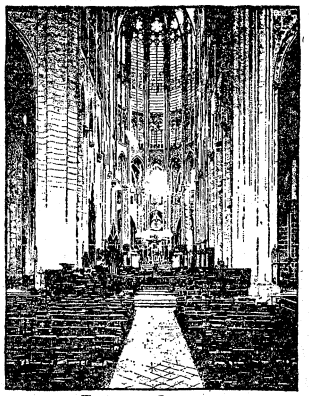
The normal constitution of the chapter of a secular cathedral church comprised four dignitaries (there might be more), in addition to the canons. The dean (*decanus*) seems to have derived his designation from the Benedictine dean who had ten monks under his charge. The dean, as already noted, came into existence to supply the place of the provost in the internal management of the church and chapter. In England the dean was the head of all the secular cathedral churches, and was originally elected by the chapter and confirmed in office by the bishop. He is president of the chapter, and in church has charge of the due performance of the services, taking specified portions of them by statute on the principal festivals. He sits in the chief stall in the choir, which is usually the first on the right hand on entering the choir at the west. Next to the dean (as a rule) is the precentor (*primicerius, cantor,* etc.), whose special duty is that of regulating the musical portion of the services. He presides in the dean's absence, and occupies the corresponding stall on the left side, although there are exceptions to this rule, where, as at St. Paul's, the archdeacon of the cathedral city ranks second and occupies what is usually the precentor's stall. The third dignitary is the chancellor (*scholasticus, écolâtre, capiscol, magistral,* etc.), who must not be confounded with the chancellor of the diocese. The chancellor of the cathedral church is charged with the oversight of its schools, ought to read divinity lectures, and superintend the lections in the choir and correct slovenly readers. He is often the secretary and librarian of the chapter. In the absence of the dean and precentor he is president of the chapter. The easternmost stall, on the dean's side of the choir, is usually assigned to him. The fourth dignitary is the treasurer (*custos, sacrista, cheficier*). He is guardian of the fabric, and of all the furniture and ornaments of the church, and his duty was to provide bread and wine for the eucharist, and candles and incense, and he regulated such matters as the ringing of the bells. The treasurer's stall



EARLY ENGLISH GOTHIC
13TH CENTURY
SALISBURY. THE NAVE



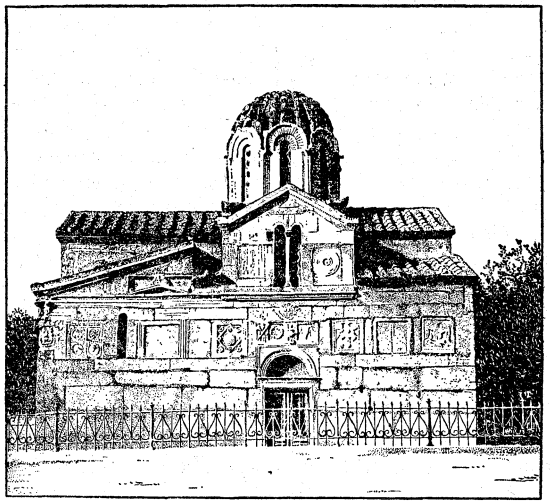
COMPLETED EXTERIOR. ST. JOHN THE DIVINE. NEW YORK CITY
(Cram & Ferguson, Architects, for the Completion)
(Heins & Lafarge, Architects, for Older Portions)



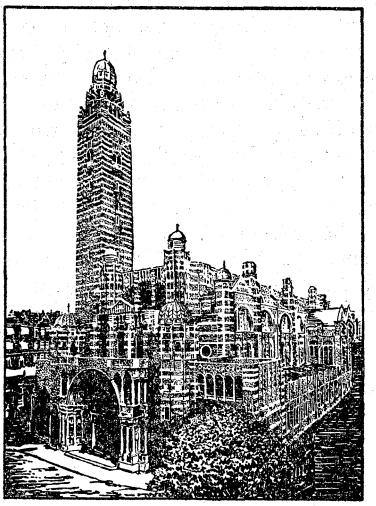
FRENCH GOTHIC.
13TH-14TH CENTURIES
BEAUVAIS. THE CHOIR



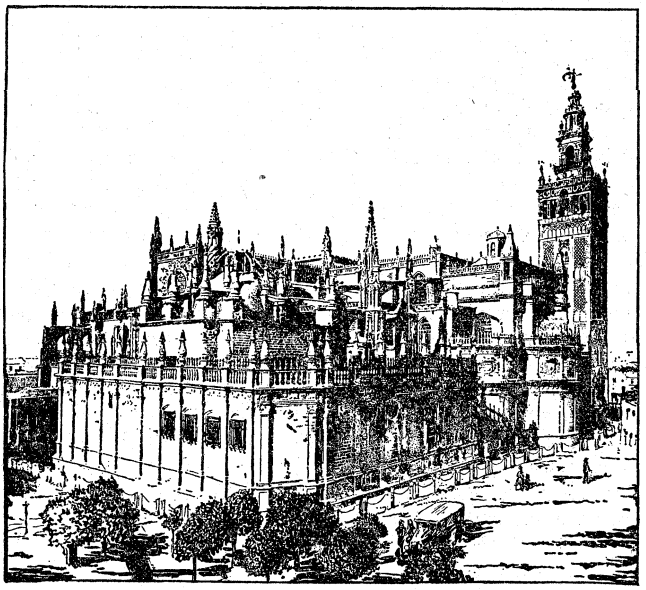
BYZANTINE. RUSSIAN TYPE
CATHEDRAL OF ST. BASIL.
MOSCOW



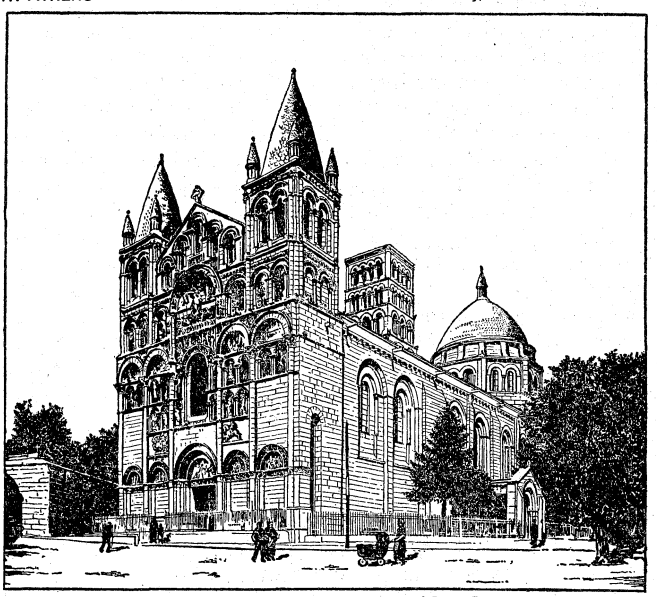
BYZANTINE. GREEK TYPE.
11TH CENTURY
CATHEDRAL AT ATHENS



MODERN ENGLISH 1896-1903
WESTMINSTER CATHEDRAL, LONDON
(J. F. Bentley, Architect)



SPANISH LATE GOTHIC AND RENAISSANCE
14TH-16TH CENTURIES
SEVILLE CATHEDRAL, SPAIN



FRENCH ROMANESQUE 12TH CENTURY
LA CATHEDRALE ST. PIERRE AT ANGOULEME
(Restored and Altered, 19th Century)

A. T. Richard

EXAMPLES OF CATHEDRAL ARCHITECTURE FROM THE 11TH TO THE 20TH CENTURY

Although a cathedral is usually large, a small building can serve, as in the case of the tiny cathedral at Athens. Salisbury and Beauvais represent the English and French phases of Gothic; that of Seville shows the Spanish style; the Moscow example is characteristic of Russian 16th and 17th century churches, and Westminster cathedral (Roman Catholic) and the cathedral of St. John the Divine are typical adaptations of Byzantine and Gothic precedents to the needs of a modern cathedral

is opposite to that of the chancellor. These four dignitaries, occupying the four corner stalls in the choir, are called in many of the statutes the *"quatuor majores personae"* of the church. In many cathedral churches there were additional dignitaries, as the praelector, subdean, vice-chancellor, succentor-canonicorum and others, who came into existence to supply the places of the other absent dignitaries, for non-residence was the fatal blot of the secular churches, and in this they contrasted very badly with the monastic churches, where all the members were in continuous residence. Besides the dignitaries there were the ordinary canons, each of whom, as a rule, held a separate prebend or endowment, besides receiving his share of the common funds of the church. For the most part the canons also speedily became non-resident, and this led to the distinction of residentiary and non-residentiary canons, till in most churches the number of resident canons became definitely limited in number, and the non-residentiary canons, who no longer shared in the common funds, became generally known as prebendaries only, although by their non-residence they did not forfeit their position as canons, and retained their votes in chapter like the others. This system of non-residence led also to the institution of vicars choral, each canon having his own vicar, who sat in his stall in his absence, and when the canon was present, in the stall immediately below, on the second form. The vicars had no place or vote in chapter, and, though irremovable except for offences, were the servants of their absent canons whose stalls they occupied, and whose duties they performed. Abroad they were often called demi-prebendaries, and they formed the *bas choeur* of the French churches. As time went on the vicars were themselves often incorporated as a kind of lesser chapter, or college, under the supervision of the dean and chapter. There was no distinction between the monastic cathedral chapters and those of the secular canons, in their relation to the bishop or diocese. In both cases the chapter was the bishop's *consilium* which he was bound to consult on all important matters and without doing so he could not act. Thus, a judicial decision of a bishop needed the confirmation of the chapter before it could be enforced. He could not change the service books, or "use" of the church or diocese, without capitular consent, and there are many episcopal acts, such as the appointment of a diocesan chancellor, or vicar general, which still need confirmation by the chapter.

All the English monastic cathedral chapters were dissolved by Henry VIII., and, except Bath and Coventry, were refounded by him as churches of secular chapters, with a dean as the head, and a certain number of canons ranging from twelve at Canterbury and Durham to four at Carlisle, and with certain subordinate officers as minor canons, gospellers, epistolers, etc. The precentorship in these churches of the "New Foundation," as they are called, is not, as in the secular churches of the "Old Foundation," a dignity, but is merely an office held by one of the minor canons.

English cathedral churches, at the present day, may be classed under four heads: (1) the old secular cathedral churches of the "Old Foundation," enumerated in the earlier part of this article; (2) the churches of the "New Foundation" of Henry VIII., which are the monastic churches already specified, with the exception of Bath and Coventry; (3) the cathedral churches of bishoprics founded by Henry VIII., viz., Bristol, Chester, Gloucester, Oxford and Peterborough (the constitution of the chapters of which corresponds to those of the New Foundation); (4) modern cathedral churches of sees founded since 1836, viz., (*a*) Manchester, Ripon and Southwell, formerly collegiate churches of secular canons; (*b*) St. Albans and Southwark, originally monastic churches; (*c*) Truro, Newcastle and Wakefield, formerly parish churches, (*d*) Birmingham and Liverpool, originally district churches. The ruined cathedral church of the diocese of Sodor (*i.e.*, the Southern Isles) and Man, at Peel, in the Isle of Man, appears never to have had a chapter of clergy attached.

BIBLIOGRAPHY.—Frances, *De ecclesiis cathedralibus* (Venice, 1698); Bordenave, *L'Estat des églises cathédrales* (Paris, 1643); Van Espen, *Supplement III.*, cap. 5; Hericourt, *Les Loix ecclésiastiques de France* (Paris, 1756); *La France ecclésiastique* (Paris, 1790); Daugaard, *Om de Danske Klostre i Middelalderen* (Copenhagen, 1830); Hinschius, *Das Kirchenrecht der Katholiken u. Protestanten in Deutschland*, ii. (Berlin, 1878); Walcott, *Cathedralia* (London, 1865); Freeman, *Cathedral Church of Wells* (London, 1870); Benson, *The Cathedral* (London, 1878); Bradshaw and Wordsworth, *Lincoln Cathedral Statutes* (Camb., 1894). (X.; S. H. M.)

Architecture.—The architectural importance of the cathedral arises not from any specific differences between cathedrals and other churches but from the fact that cathedral building is intimately associated with the development of Gothic architecture (*see* GOTHIC ARCHITECTURE). The archaeologists of the late 19th century considered the rise of the secular clergy in the 12th and 13th centuries the most important factor in the birth of Gothic architecture. Contemporary (1928) critical opinion discounts this, and points out that Gothic ideas first had tentative expression in the abbey church of St. Denis, near Paris (1140). It is nevertheless a fact that the construction of many large cathedral churches in France, in the second half of the 12th century, furnished architects with many new structural and aesthetic problems. Public opinion of the time, generally in revolt against the feudal domination of the great monasteries, broke the controlling sway of monastic architectural tradition, and lay architects became the rule rather than the exception. The development that followed in the half century between 1150 and 1200, in which many discreet Romanesque experiments in vaulting, window and door design, stained glass, buttressing and planning, particularly of the east end, reached a compelling synthesis, is unique in architectural history. In the domain of the Eastern Church, where no such break between lay and monastic clergy occurred, it is significant that there was no such architectural development; Russian cathedrals remained simple Russo-Byzantine churches up to the 18th century.

Recent times have witnessed the renascence of the idea of the cathedral as a great popular monument. This movement is evidenced in the magnificent Liverpool cathedral, designed by Sir Giles Gilbert Scott in a free and modernized Gothic style, and in the Gothic cathedral of S. John the Divine in New York, begun by Heinz and LaFarge and now (1928) entirely remodelled and in course of completion by Ralph Adams Cram; and that at Washington, D.C., by Frohman, Robb and Little. These great modern cathedrals differ from earlier examples in their recognition of the fact that in them the congregation is of relatively greater importance than the clergy and choir and the consequent attempt to obtain enormous open spaces as close as possible to the chancel. In general, the eastern arm and the transepts are thereby shorter than the usual Gothic proportion, whereas the crossing is given immensely greater importance. (*See* APSE; RELIGIOUS AND MEMORIAL ARCHITECTURE; BYZANTINE AND ROMANESQUE ARCHITECTURE; GOTHIC ARCHITECTURE.)

BIBLIOGRAPHY.—Viollet-le-Duc, *Dictionnaire raisonné de l'architecture française du XI. au XVI. siècle* (1854–68); A. K. Porter, *Mediaeval Architecture* (1912); Sir T. G. Jackson, *Gothic Architecture* (1915). (T. F. H.)

CATHELINEAU, JACQUES (1759–1793), French Vendean chieftain during the Revolution, was born on Jan. 5, 1759, at Tin-en-Manges, Maine-et-Loire. In the first years of the Revolution, Cathelineau listened to the exhortations of Catholic priests and royalist *émigrés*, and joined the insurrection provoked by them against the revolutionary government. Collecting a band of peasants and smugglers, he took the chateau of Gallais, where he captured a cannon, christened by the Vendeans the "Missionary"; he then took the towns of Chemillé, Cholet, Vihiers and Chalonnes (March, 1793). His companions committed atrocities which brought upon them terrible reprisals on the part of the Republicans. Meanwhile Cathelineau's troops increased, and he combined with the other Vendean chiefs, such as N. Stofflet and Gigot d'Elbée, taking the towns of Beaupreau, Fontenay and Saumur. The first successes of the Vendeans were due to the fact that the Republicans had not expected an insurrection. When the resistance to the insurgents became more serious differences arose among their leaders. To avoid these rivalries, it is thought that Cathelineau was named generalissimo of the rebels, though his authority over the undisciplined troops was not increased by the new office. In 1793, all the Royalist forces tried to capture Nantes. Cathelineau entered the town

in spite of the resistance of Gen. J. B. Clanclaux, but he was killed, and the Vendean army broke up. Numerous relatives of Cathelineau also perished in the war of La Vendée. (*See* also VENDÉE, WARS OF THE; CHOUANS.)

See C. Port, "La Légende de Cathelineau" in the review *La Révolution Française,* vol. xxiv. (1893).

CATHER, WILLA SIBERT (1876–), American author, was born at Winchester, Va., on Dec. 7, 1876 and as a child of eight or nine was taken to a Nebraska ranch. After her graduation from the University of Nebraska in 1895, she taught English in the Allegheny high-school, worked on the Pittsburgh *Leader* and travelled widely. Her first volume of stories, *The Troll Garden* (1905), led to an appointment as associate editor of *McClure's Magazine* (1906–12), which was then a vigorous periodical, a pioneer in the field of magazine journalism, less dignified than the old monthlies, but alive with the spirit of reform and direct appeal to an ever increasing audience more interested in substance than in form. Miss Cather's first distinguished work in pure literature was *O Pioneers!* (1913), in which, on Sarah Orne Jewett's advice, she endeavoured to recapture "in memory, people and places" which she believed to be forgotten. With it she put herself in the forefront of those who had begun to realize the importance of pioneer life in America. *My Antonia* (1918) was another book with the same general background, which established her reputation as a novelist of unusual depth and power of beauty, who could see deep currents of emotion running in those Main Streets and prairies which Sinclair Lewis was to satirize for their decline into dullness. In *One of Ours* (1922), she stepped aside, not altogether successfully, to tell a story of a Western boy in the World War. This novel was awarded a Pulitzer prize. *The Song of the Lark* (1915) was another pioneer story; *A Lost Lady* (1923) was also told against a prairie background, but its simplicity of telling, its depth of tragedy and fineness of insight into the secret and the weakness of woman's charm far outweigh the interest of its local colour. In *The Professor's House* (1925), she began experiments with a new technique of story-telling, constructing her story of an intellectual's soul development according to the familiar methods of music. In *Death Comes for the Archbishop* (1927), she told in the form of a chronicle a simple and vivid story of two saints of the South-west. This, *A Lost Lady, Shadows on the Rock* (1931), and *Lucy Gayheart* (1935) are her best books. Her short stories in the collection *Youth and the Bright Medusa* (1920), escape the stereotyping that has devitalized so many American short-story writers. Her first book was in verse, *April Twilights* (1903); her first novel *Alexander's Bridge* (1912).

Among the writers who in the early 20th century have deepened and refined the study of American character, Willa Cather is perhaps pre-eminent. Her style is restrained, sometimes almost cold, but rising into passages of great beauty, and always in harmony with her subject. Her themes are broader and more human than Mrs. Wharton's; her analysis of human motives deeper than Tarkington's; and she is perhaps closer to essential Americanism in its spiritual and emotional aspects than any other contemporary writer. She is not rich in humour, nor pointed in satire, and in this differs from her nearest contemporaries, but she comes closest in American literature of this period to the classic ideal of balance, insight, restraint.

See articles on her work by T. K. Whipple in *Spokesmen: Modern Writers and American Life;* A. Porterfield, *Contemporary American Authors,* edited by J. C. Squire; Elizabeth S. Sergeant, *Fire Under the Andes* (1927). (H. S. C.)

CATHERINE, SAINT. The Roman hagiology contains seven saints of this name. 1. ST. CATHERINE OF ALEXANDRIA, virgin and martyr, whose day of commemoration recurs on Nov. 25. 2. ST. CATHERINE OF SIENA, 1347–80, Dominican tertiary whose feast is observed on April 30. 3. ST. CATHERINE OF SWEDEN, daughter of St. Bridget, who died abbess of Vadstena in 1381, and is commemorated on March 22. 4. ST. CATHERINE OF BOLOGNA, 1413–63, abbess of the Poor Clares in Bologna, canonized by Pope Clement XI, and mentioned in the Roman Martyrology on March 9. 5. ST. CATHERINE OF GENOA (1447–1510), who belonged to the noble family of Fieschi, devoted her life to the sick, especially during the plague at Genoa in 1497 and 1501. She was beatified by Clement X in 1675 and canonized by Clement XII in 1737, her feast being on July 22. *See* F. von Hügel, *The Mystical Element in Religion as studied in St. Catherine of Genoa,* 2nd ed. (1923). 6. ST. CATHERINE DE' RICCI, of Florence (1522–1590), became a Dominican nun at Prato. She was famous during her lifetime for the weekly ecstasy of the Passion, during which she experienced the sufferings of the Holy Virgin contemplating the Passion of her Son. She was canonized in 1746 by Benedict XIV, who fixed her festal day on Feb. 13. In Celtic and English martyrologies (Nov. 25) there is also commemorated St. Catherine Audley (*c.* 1400), a recluse of Ledbury, Hereford. Pius XI in 1930 canonized ST. CATHERINE TOMÀS (d. 1574), of Majorca.

Of the first two saints something more must be said. Of St. Catherine of Alexandria, history has little to tell. According to the legend recorded in the Roman martyrology, and in Simeon Metaphrastes, Catherine upbraided the Emperor Maximinus for his cruelties, and adjured him to give up the worship of false gods. The angry tyrant, unable to refute her arguments, sent for pagan scholars to argue with her, but they were discomfited. Catherine was then scourged and imprisoned. When the empress went to reason with her, Catherine converted her as well as the Roman general and his soldiers, who had accompanied her. Maximinus now ordered her to be broken on the wheel; but the wheel was shattered by her touch. The axe proved fatal, and the martyr's body was borne by angels to Mt. Sinai, where Justinian I. built the famous monastery in her honour. Another variation of the legend is that in which, having rejected many offers of marriage, she was taken to Heaven in vision and betrothed to Christ by the Virgin Mary.

Of these marvellous incidents very little, by the universal admission of Catholic scholars, has survived the test of modern criticism, though her actual existence is generally admitted. In the middle ages she was a most popular saint, her festival being, in certain dioceses of France, a holy day of obligation even as late as the 17th century. The wheel being her symbol, she was the patron saint of wheelwrights and mechanics, as well as the tutelary saint of nuns and maidens, and of philosophers.

St. Catherine of Siena, the youngest daughter of a dyer, was born on March 25, 1347. At an early age she began to practise asceticism and see visions, and when seven dedicated her virginity to Christ. In 1363 she became a Dominican tertiary, and renewed in her home the life of the anchorites in the desert. She resumed family life in 1366 when she began to tend the sick and the poor. Her peculiarities excited suspicion, and charges seem to have been brought against her by some of the Dominicans, to answer which she went to Florence in 1374, soon returning to Siena to tend the plague-stricken. At the invitation of the ruler of Pisa she visited that city in 1375 to arouse enthusiasm for the proposed crusade, and to prevent Pisa and Lucca joining the Tuscan league against the pope. Fra Raimondo relates that, after an ecstasy at Pisa, she told him she had received the *stigmata,* or imprint of the wounds of the crucified Christ, but by her prayer the marks were made invisible. In 1376, Catherine resolved to bring back Pope Gregory XI. from Avignon, attempting first by correspondence to reconcile Gregory and the Florentines, who had been placed under an interdict, and then going in person as the representative of the latter to Avignon. Gregory empowered her to treat for peace, but the Florentine ambassadors proved faithless. Catherine, however, was able to persuade the pope to return to Genoa and then to push on to Rome. There he found life very difficult, and in 1378 sent Catherine on an embassy to Florence, especially to the Guelph party. While she was urging the citizens to make peace with the pope there came the news of his death. During the troubles that ensued in Florence, Catherine nearly lost her life, and sorely regretted not winning her heart's desire, "the red rose of martyrdom." Peace was signed with the new pope, Urban VI., and Catherine, having accomplished her second great political task, went home to Siena. Thence on the outbreak of the schism Urban summoned her to Rome, where she quelled the revolt of the people and tried to win for Urban the support of Europe.

Under the great strain, she died on April 29, 1380, and was canonized by Pius II. in 1461.

Catherine lived on in her writings and disciples. Among the latter were her confessor and biographer, Fra Raimondo, later master-general of the Dominicans, William Flete, an ascetically-minded Cambridge man, Stephano Maconi, who became prior-general of the Carthusians, and the two secretaries, Neri di Landoccio and Francesco Malavolti. The last of her band of reformers, Tommaso Caffarini, died in 1434, but the work was taken up by Savonarola. Catherine's writings consist of: (1) a dialogue entitled, *The Book of Divine Doctrine, given in person by God the Father, speaking to the mind of the most glorious and holy virgin Catherine of Siena, and written down as she dictated it in the vulgar tongue, she being the while entranced, and actually hearing what God spoke in her.* The book has a significant place in the history of Italian literature. "In a language which is singularly poor in mystical works it stands with the *Divina Commedia* as one of the two supreme attempts to express the eternal in the symbolism of a day, to paint the union of the soul with the suprasensible while still imprisoned in the flesh." (2) The prayers (26 in all) which are mostly mystical outpourings. (3) Letters, nearly 400, addressed to kings, popes, cardinals, bishops, conventual bodies, political corporations and individuals. By their historical importance, their spiritual fragrance, their literary value, and their beautiful Tuscan vernacular, the letters put their author almost on a level with Petrarch.



AFTER A WOODCUT FROM "CATHARINA DA SIENA," 1500
ST. CATHERINE OF SIENA

BIBLIOGRAPHY.—*Acta Sanctorum* XII, pp. 861–986, contains the *Vita* of Fra Raimondo; *The Little Flowers of St. Catherine of Siena,* collected by Innocenzo Taurisano, tr. by Charlotte Dease, presents selections from the important sources, the *Vita,* the *Processus* (early testimonies of her followers), the *Miracoli,* the *Supplementum* and three of the saint's letters; *L'Opere,* ed. Girolamo Gigli (Rome 1866); J. Joergensen, *Life of St. Catherine of Siena* (1938); V. D. Scudder, *St. Catherine as seen in her Letters* (1905).

CATHERINE I. (1683–1727), empress of Russia, was the daughter of a Lithuanian peasant named Skavronsky, who died when she was a child. Martha Skavronskaya became a servant in the home of Pastor Glück, the Protestant superintendent of the Marienburg district, and married a Swedish dragoon called Johan. When the Swedes evacuated Marienburg, Martha became one of the prisoners of war of Marshal Sheremetev, who sold her to Prince Menshikov, at whose house, Peter the Great became her lover. After the birth of their first daughter Catherine, Martha was received into the Orthodox Church, when she was rechristened under the name of Catherine Alexeyevna, the tsarevich Alexius being her godfather. She received the title *Gosudaruinya* or sovereign (1710), and Peter, who had divorced the tsaritsa Eudoxia, married her in 1711. Henceforth the new tsaritsa was her husband's inseparable companion. She was with him during the campaign of the Pruth, and Peter always attributed the successful issue of that disastrous war to her courage and sang-froid. She was with him, too, during his earlier Caspian campaigns. He was devoted to her, and she was able to act as a buffer between the tsar and his advisers in his frequent accesses of rage.

By the *ukaz* of 1722 Catherine was proclaimed Peter's successor, to the exclusion of the grand-duke Peter, the only son of the tsarevich Alexius, and on May 7, 1724, was solemnly crowned empress-consort in the Uspensky cathedral at Moscow, on which occasion she wore a crown studded with no fewer than 2,564 precious stones, surmounted by a ruby, as large as a pigeon's egg, supporting a cross of brilliants. Within a few months of her coronation a dangerously familiar flirtation with her gentleman of the chamber, William Mons, caused some scandal. Mons was decapitated and his severed head, preserved in spirits, was placed in the apartments of the empress, but she attended Peter during his last illness, and closed his eyes when he died (Jan. 28, 1725). She was at once raised to the throne by the party of Prince Menshikov and Count Tolstoy with the support of the Guards.

The great administrative innovation of Catherine's reign was the establishment of the *Verkhovny Tainy Sovyet,* or supreme privy council. The executive power was thus concentrated in the hands of a few persons, mainly of the party of Reform (*ukaz* of Feb. 26, 1726). The foreign policy of Catherine I. was principally directed by the astute Andrei Ostermann. Russia now found herself opposed to England, chiefly because Catherine protected Charles Frederick, duke of Holstein, and George I. found that the Schleswig-Holstein question might be reopened to the detriment of his Hanoverian possessions. In the spring of 1726, an English squadron was sent to the Baltic and cast anchor before Reval. The empress protested, and the fleet was withdrawn, but on Aug. 6 Catherine acceded to the anti-English Austro-Spanish league. Catherine died on May 16, 1727. Though quite illiterate, she was an uncommonly shrewd, sensible and good-tempered woman. Her personal extravagance was a byword.

See the authorities referred to *s.v.* PETER I.

CATHERINE II. (1729–1796), empress of Russia, known as CATHERINE THE GREAT, was the daughter of Christian Augustus, prince of Anhalt-Zerbst, and his wife, Johanna Elizabeth of Holstein-Gottorp. She was born at Stettin on May 2, 1729. Her baptismal name was Sophia Augusta Frederica. In 1744 she was taken to Russia, to be affianced to the grand-duke Peter (afterwards Peter III.), the nephew of the empress Elizabeth, and her recognized heir. Frederick the Great favoured the alliance, his object being to strengthen the friendship between Prussia and Russia, to weaken the influence of Austria and to ruin the chancellor Bestuzhev, who was a known partisan of the Austrian alliance. The diplomatic intrigue failed, but Elizabeth took a strong liking to Sophia, and the marriage was finally decided on. On June 28, 1744, she was received into the Orthodox Church at Moscow, and was renamed Catherine Alexeyevna. On the 29th she was formally betrothed, and was married on Aug. 21, 1745 at St. Petersburg. Her married life was wretched. Peter was subnormal in physique and in mind, and his wife despised him. She was a clever and ambitious girl, and was determined that nothing should stand in the way of her ambitions. She accepted the conditions of her marriage because it was the means to power. During the 17 years of her life as grand-duchess she matured her mind and avoided a breach with Elizabeth. For ten years the marriage was barren, and the only reason for supposing that the future tsar Paul, who was born on Oct. 2, 1754, was the son of Peter, is the strong similarity of their characters. Catherine had many lovers. The scandalous chronicle of her life was the commonplace of all Europe. Her most trusted agents while she was still grand-duchess, and her chief ministers when she became empress, were also her lovers.

The Empress Elizabeth died on Jan. 5, 1762. The grand-duke succeeded without opposition as Peter III. He committed every possible folly, grovelled before Frederick the Great, insulted the Church, and threatened to divorce Catherine. She refrained from open opposition and acted with the political prudence which she had shown as grand-duchess. In July Peter foolishly retired with his Holsteiners to Oranienbaum, leaving his wife at St. Petersburg. On the 13th and 14th of that month, a "pronunciamiento" of the regiments of the guard removed him from the throne and made Catherine empress. She issued a manifesto in which she claimed to stand for the defence of Orthodoxy, and the glory of Russia. The guards were manipulated by the four Orlov brothers. The eldest, Gregory, was her recognized chief lover, and he was associated with his brother Alexis in the office of favourite. But the hatred felt for Peter III. was spontaneous, and Catherine had no need to do more than let it be known that she was prepared to profit by her husband's downfall. Peter was sent to a country

house at Ropcha, where he died on July 17 in the course of a scuffle during dinner. His custodian, Alexis Orlov, said he could not remember what happened. Catherine in a second manifesto said she had accepted the throne for the good of the country and remarked that autocracy was a danger if the ruler lacked the requisite qualities.

Catherine the Great ruled Russia for 34 years. Although born a German princess she identified herself completely with the Russian people. She was in the truest sense the successor of Peter the Great. Her private life was the object of unceasing curiosity and interest among her contemporaries, and a mass of literature has grown up around the subject of her lovers and her relations with them. Catherine was never dominated by her lovers who were the instruments of her policy; it was she who governed Russia, not her favourites. Her main interests were intellectual and political, and her love affairs subsidiary. She was the disciple and friend of the Encyclopaedists, especially of Voltaire, the reading of whose works had first awakened her mind. She corresponded with him, with D'Alembert, and, more voluminously, with F. M. Grimm, who spent nearly a year at her court in 1777–78. Grimm reports that her conversation was even more brilliant than her letters. Catherine also corresponded at intervals with Frederick the Great and with Joseph II. Her letters are graceful and witty, and they show real political and diplomatic insight. She was determined to make Russian society as cultivated as the society of Paris and Berlin. At court she insisted on a high standard of decorum and of manners, she encouraged the nobles to travel, and fostered the love of French culture. She herself employed Grimm and others to collect works of art and antiquities for her, and practised sculpture and painting herself. She had a passion for reading, made a digest of Blackstone's *Commentaries* and found Buffon's *Histoire naturelle* light reading. Her enthusiasm for Russian history led her to begin to write a history of Russia from the earliest times, and she completed a play, having for its hero the legendary Oleg, which she said was an imitation of Shakespeare. Her comedies, proverbs, and tales are very numerous. To find time for all her activities she rose at five, made her own fire, and would sometimes work 15 hours a day. She seemed to have worked in bouts, taking long spells of work with intervals of relaxation. The new culture which she sought to impose on her court was not entirely superficial. She herself was kind and reasonable to her servants. She was not revengeful, and when she usurped the throne showed no hostility to her husband's advisers; nevertheless she had a fund of hardness, and showed little kindness to her son Paul.

Since Catherine was a disciple of the Encyclopaedists it was natural that she should start out with the definite intention of carrying out domestic reform in Russia, though by methods of the benevolent despotism fashionable in Europe in the period before the French Revolution shook the fabric of society. In fact she, a foreigner and usurper, had to depend for support on the nobility, whose privileges she vastly increased by relieving them of the duty of military service and giving them new powers over their serfs. She also increased their numbers by grants of Crown lands. Serfdom was not mitigated, but vastly increased under her rule. The terrible condition of the peasants led to one revolt after another in favour of one of the numerous pretenders, which culminated in the widespread rising on the Volga, the jacquerie led by Pugachev (1773–75). French culture among the landowners did not lead to any improvement in the handling of the peasants. This state of affairs was in startling contrast with the humanitarian tone of the *Instructions* which Catherine drew up for the grand commission which she summoned in Dec. 1766 to Moscow to advise on internal reform. The *Instructions*, based principally on the works of Montesquieu and Beccaria, were so radical that their circulation in France was forbidden. Very little came of the 18 months' work of the grand commission, except in the development of the organization of local government. With the outbreak of the French Revolution Catherine, like other European sovereigns, fell back on methods of repression. Radishchev, who wrote in his *Journey from St. Petersburg to Moscow* (1790) a truthful account of the condition of the peasants, was banished to Siberia, though the sentiments expressed were only those of Catherine's own *Instructions* of 1766. Catherine had some able assistants in her domestic administration, notably Sivers.

The foreign policy of her reign aimed at the expansion of Russia, and from that point of view was brilliantly successful. Catherine knew the limits to which she could safely go in the "russification" of frontier districts, and showed a certain liberality to the populations which she incorporated. She conducted her own foreign policy, and the galaxy of excellent soldiers and diplomats which she gathered round her carried out her instructions implicitly. She had the gift of discovering ability, and kept in the closest touch with all her servants. Among her generals were Alexander Galitsin, Rumyantsev, Peter Panin, Suvorov, and Potemkin. Suvorov was one of the greatest of Russian generals, but he never enjoyed quite the confidence she gave to Potemkin, whose military abilities were mediocre, but who was first her lover and then her close friend and correspondent. Her chief advisers and assistants in foreign business were Nikita Panin, Bezborodko, Repnin, Dmitri Galitsin and Vorontsoff. The story of the two shameless partitions of Poland and of the wars with Turkey which gave Russia the Crimea and free access to the Black sea for the products of the Ukraine is told under RUSSIA: *History*. It is sufficient to say here that the extension of Russian territory during her reign to the Niemen and the Dniester on the west, and to the Black sea on the south must be placed primarily to the account of Catherine's diplomacy and direction, well served as she was by her generals and her ministers.

She died on Nov. 10, 1796, of apoplexy.

The original sources for the history of her policy and her character are to be found in the publications of the Imperial Russian Historical Society, vols. i.–cix. (St. Petersburg), begun in 1867; her private and official correspondence will be found in vols. i., ii., iv., v., vi., vii., viii., ix., x., xiii., xiv., xv., xvii., xx., xxiii., xxxii., xxxiii., xxxvi., xlii., xliii., xlvii. xlviii., li., lvii., lxvii., lxviii., lxxxvii., xcvii., xcviii., cvii., cxv., cxviii. The *Memoires de l'imperatrice Catherine II., écrits par elle-même* (London 1859), with pref. by Alex. Herzen, bring her life up to the end of 1759, but were not begun until 1780. They must be used with caution, especially as regards her husband Peter III. *See* also A. Brückner, "Katharina die Zweite," in *Allgemeine Geschichte in Einzeldarstellungen* (Berlin 1883); O. Hoetzsch, "Catherine II.," in *Camb. Mod. Hist.* vol. vi., where a bibliography will be found. A complete bibliography was prepared by B. von Bilbassoff, *Katharina II., Kaiserin von Russland in Urteile der Weltliteratur* (Berlin, 1897). *See* also Princesse Lucien Murat, *La vie amoureuse de la grande Catherine* (1927); *Mémoires*, trs. by Katherine Anthony (1927); *Correspondence with Sir Charles Hanbury-Williams*, ed. and trans. by the Earl of Ilchester and Mrs. Langford-Brooke (1928).

CATHERINE DE MEDICI (1519–1589), queen of France, was born in Florence in 1519. She was a daughter of Lorenzo II. de Medici and a French princess, Madeleine de la Tour d'Auvergne. Having lost both her parents at an early age, Catherine was sent to a convent to be educated; and she was only 14 when she was married (1533) at Marseilles to the duke of Orleans, afterwards Henry II. It was her uncle, Pope Clement VII., who arranged the marriage with King Francis I., Henry's father, who was glad to strengthen his influence in the Italian peninsula. For ten years after her marriage she had no children. In consequence, a divorce began to be talked of at court. But Catherine had the happiness of bringing her husband grandchildren ere he died. During his reign (1547–59), Catherine lived a quiet and passive but observant life. Henry being completely under the influence of his mistress, Diane de Poitiers, she had little authority. In 1552, when the king left the kingdom for the campaign of Metz, she was nominated regent, but with very limited powers. This continued even after the accession of her son Francis II. Francis was under the spell of Mary Stuart, and she, little disposed to meddle with politics on her own account, was managed by her uncles, the cardinal of Lorraine and the duke of Guise. The queen-mother, however, soon grew weary of the domination of the Guises, and entered upon a course of secret opposition. On April 1, 1560, she placed in the chancellorship Michel de l'Hôpital (*q.v.*), who advocated the policy of conciliation.

On the death of Francis (Dec. 5, 1560), Catherine became regent during the minority of her second son, Charles IX. She was then 41 years old, but, although she was the mother of nine children, she was still very vigorous and active. She retained her in-

fluence for more than 20 years in the troubled period of the wars of religion. At first she listened to the moderate counsels of l'Hôpital in so far as to avoid siding definitely with either party. Like so many of the Italians of that time she looked upon statesmanship as a career in which finesse, lying and assassination were the most effective weapons. By habit a Catholic, but above all things fond of power, she was determined to prevent the Protestants from getting the upper hand, yet resolved not to allow them to be utterly crushed, in order to use them as a counterpoise to the Guises. This trimming policy met with little success; rage and suspicion so possessed men's minds that she could no longer control the opposing parties, and one civil war followed another to the end of her life.

In 1567, after the "Enterprise of Meaux," she dismissed l'Hôpital and joined the Catholic Party. But, having failed to crush the Protestant rebellion by arms, she resumed in 1570 the policy of peace and negotiation. She conceived the project of marrying her favourite son, the duke of Anjou, to Queen Elizabeth of England, and her daughter Margaret to Henry of Navarre. To this end she became reconciled with the Protestants, and allowed Coligny to return to court and to re-enter the council. Of this step she quickly repented. Charles IX. conceived a great affection for the admiral and showed signs of taking up an independent attitude. Catherine, thinking her influence menaced, sought to regain it, first by the murder of Coligny, and, when that had failed, by the massacre of St. Bartholomew (*q.v.*). The chief responsibility for this crime, therefore, rests with Catherine; unlike the populace, she had not even the excuse of fanaticism. After the death of Charles in 1574, and the succession of Anjou under the name of Henry III., Catherine pursued her old policy of compromise and concessions; but as her influence is lost in that of her son, it is unnecessary to dwell upon it. She died on Jan. 5, 1589, a short time before the assassination of Henry, and the consequent extinction of the House of Valois.

In her taste for art and her love of magnificence and luxury, Catherine was a true Medici; in architecture especially she was well versed, and Philibert de l'Orme relates that she discussed with him the plan and decoration of her palace of the Tuileries. Catherine's policy provoked a crowd of pamphlets, the most celebrated being the *Discours merveilleux de la vie, actions et déportemens de la reine Catherine de Médicis,* in which Henri Estienne undoubtedly collaborated.

See *Lettres de Catherine de Medicis,* edited by Hector de la Ferrière (1880–1905), in the *Collection de documents inédits sur l'histoire de France;* A. von Reumont, *Die Jugend Caterinas de Medici* (1854; French trans. A. Baschet, 1866); H. Bouchot, *Catherine de Medicis* (1899). For a more complete bibliography *see* Ernest Lavisse, *Histoire de France* (vol. v., by H. Lemonnier, and vol. vi. by J. H. Mariéjol, 1904–05). *See* also the books of E. Sichel, *Catherine de Medici and the French Reformation* (1905) and *The Later Years of Catherine de Medici* (1908); J. H. Mariéjol, *Catherine de Medicis* (1920); L. Romier, *Le Royaume de Catherine de Medicis, etc.* (1921); P. Van Dyke, *Catherine de Medicis* (1923).

CATHERINE OF ARAGON (1485–1536), queen of Henry VIII. of England, daughter of Ferdinand and Isabella of Spain, was born on Dec. 15, 1485. She left Spain in 1501 to marry Arthur, prince of Wales, eldest son of King Henry VII., and landed at Plymouth on Oct. 2. The wedding took place on Nov. 14 in London, and soon afterwards Catherine accompanied her husband to Wales, where, in his 16th year, the prince died on April 2, 1502. On June 25, 1503, she was formally betrothed to the king's second son, Henry, now prince of Wales, and a papal dispensation for the alliance was obtained. The marriage, however, did not take place during the lifetime of Henry VII. Ferdinand endeavoured to cheat the English king of the marriage portion agreed upon, and Henry made use of the presence of the unmarried princess in England to extort new conditions, and especially to urge the marriage of his daughter Mary to the archduke Charles, grandson of Ferdinand, and afterwards Charles V. Catherine was thus from the first the unhappy victim of state politics. Writing to Ferdinand on March 9, 1509, she describes the state of poverty to which she was reduced, and declares the king's unkindness impossible to be borne any longer.

Henry VIII. married her on June 11, 1509. At first he showed himself an affectionate husband, and the alliance with Ferdinand was maintained against France. During Henry's invasion of France in 1513 she was made regent; she made the preparations for the Scottish expedition, and was riding north to put herself at the head of the troops when the victory of Flodden Field ended the campaign. After Henry's return next year there was a breach with Ferdinand, and the king angrily reproached his wife; but she took occasion in 1520, during the visit of her nephew Charles V. to England, to urge the policy of gaining his alliance rather than that of France. Immediately on his departure, on May 31, 1520, she accompanied the king to France, on the visit to Francis I., when the sovereigns met at the Field of the Cloth of Gold; but in 1522 war was declared against France and the emperor again welcomed to England. She is represented by Shakespeare as pleading in 1521 for the unfortunate duke of Buckingham. Between Jan. 1510 and Nov. 1518 Catherine gave birth to six children (including two princes), who were all stillborn or died in infancy except Mary, born in 1516, and opinion ascribed this series of disasters to the curse on incestuous unions. To avoid a fresh dispute concerning the succession, and the revival of the civil war, a male heir to the throne was a pressing necessity. The question of the possible dissolution of the marriage occupied Henry's mind. It was doubtful whether the pope had the power to legalize his marriage with Catherine, his brother's betrothed, and the case for the desired divorce was therefore more hopeful.

Rumours, probably then unfounded, of an intended divorce had been heard abroad as early as 1524. But the creation in 1525 of the king's illegitimate son Henry, as duke of Richmond—the title borne by his grandfather Henry VII.—and the precedence granted to him over all the peers as well as the princess Mary, together with the special honour paid at this time by the king to his own half-sister Mary, were the first real indications of the king's thoughts. In 1526, and perhaps earlier, Wolsey had been making tentative inquiries at Rome on the subject. In May 1527 a collusive and secret suit was begun before the cardinal, who, as legate, summoned the king to defend himself from the charge of cohabitation with his brother's wife; but these proceedings were dropped. On June 22 Henry informed Catherine that they had been living in mortal sin and must separate. During Wolsey's absence in July at Paris, where he had been commissioned to discuss vaguely the divorce and Henry's marriage with Renée, daughter of Louis XII., Anne Boleyn (*q.v.*) is first heard of in connection with the king, his affection for her having, however, begun probably as early as 1523, and the cardinal on his return found her openly installed at the court. In October 1528 the pope issued a commission to Cardinal Campeggio and Wolsey to try the cause in England, and bound himself not to revoke the case to Rome, confirming his promise by a secret decretal commission which, however, was destroyed by Campeggio. But the trial was a sham. Campeggio was forbidden to pronounce sentence without further reference to Rome, and was instructed to create delays, the pope assuring Charles V. at the same time that the case should be ultimately revoked to Rome.

The object of all parties was now to persuade Catherine to enter a nunnery and thus relieve them of further embarrassment. While Henry's envoys were encouraged at Rome in believing that he might then make another marriage, Henry himself gave Catherine assurances that no other union would be contemplated in her lifetime. But Catherine with courage and dignity held fast to her rights, demanded a proper trial, and appealed not only to the bull of dispensation, the validity of which was said to be vitiated by certain irregularities, but to a brief granted for the alliance by Pope Julius II. Henry declared the latter to be a forgery, and endeavoured unsuccessfully to procure a declaration of its falsity from the pope. The court of the legates accordingly opened on May 31, 1529, the queen appearing before it on June 18 for the purpose of denying its jurisdiction. On the 21st both Henry and Catherine presented themselves before the tribunal, when the queen threw herself at Henry's feet and appealed for the last time to his sense of honour, recalling her own virtue and helplessness. Henry replied with kindness, showing that her wish for the revocation of the cause to Rome was unreasonable in view of the

paramount influence then exercised by Charles V. on the pope. Catherine nevertheless persisted in making appeal to Rome, and then withdrew. After her departure Henry, according to Cavendish, Wolsey's biographer, praised her virtues to the court. "She is, my lords, as true, as obedient, as conformable a wife as I could in my phantasy wish or desire. She hath all the virtues and qualities that ought to be in a woman of her dignity or in any other of baser estate." On her refusal to return, her plea was overruled and she was adjudged contumacious, while the sittings of the court continued in her absence. Subsequently the legates paid her a private visit of advice, but were unable to move her from her resolution. Finally, however, in July 1529, the case was, according to her wish, and as the result of the treaty of Barcelona and the pope's complete surrender to Charles V., revoked by the pope to Rome: a momentous act, which decided Henry's future attitude, and occasioned the downfall of the whole papal authority in England. On March 7, 1530 Pope Clement issued a brief forbidding Henry to make a second marriage, and ordering the restitution of Catherine to her rights till the cause was determined; while at the same time he professed to the French ambassador, the bishop of Tarbes, his pleasure should the marriage with Anne Boleyn have been already made, if only it were not by his authority (Cal. of State Papers, For. and Dom. iv., 6290). The same year Henry obtained opinions favourable to the divorce from the English, French and most of the Italian universities, but unfavourable answers from Germany, while a large number of English peers and ecclesiastics, including Wolsey and Archbishop Warham, joined in a memorial to the pope in support of Henry's cause.

Meanwhile, Catherine was still treated by Henry as his queen. On May 31, 1531 she was visited by 30 privy councillors, who urged the trial of the case in England, but they met only with a firm refusal. On July 14 Henry left his wife at Windsor, removing himself to Woodstock, and never saw her again. In August she was ordered to reside at the Moor in Hertfordshire, and at the same time separated from the princess Mary, who was taken to Richmond. In October she again received a deputation of privy councillors, and again refused to withdraw the case from Rome. In 1532 she sent the king a gold cup as a new year's gift, which the latter returned, and she was forbidden to hold any communication with him. Her cause found champions and sympathizers among the people, among the court preachers, and in the House of Commons, while Bishop Fisher had openly taken her part in the legatine trial. Subsequently Catherine was removed to Bishops Hatfield, while Henry and Anne Boleyn visited Francis I. Their marriage, anticipating any sentence of the nullity of the union with Catherine, took place after their return about Jan. 25, 1533. On May 10 Archbishop Cranmer, opened his court, and declared on the 23rd the nullity of Catherine's marriage and the validity of Anne's. On Aug. 10 the king caused proclamation to be made forbidding her the style of queen; but Catherine refused to yield the title for that of princess-dowager. Not long afterwards she was removed to Buckden in Huntingdonshire. Here her household was considerably reduced, and she found herself hemmed in by spies, and in fact a prisoner. A project for removing Catherine from Buckden to Somersham, in the isle of Ely, with a still narrower maintenance, was prevented by her resistance. The attempt in November to incriminate the queen in connection with Elizabeth Barton failed.

She passed her life now in religious devotions. On March 23, 1534 the pope pronounced her marriage valid, but by this time England had thrown off the papal jurisdiction, the parliament had transferred Catherine's jointure to Anne Boleyn, and the decree had no effect on Catherine's fortunes. She refused to swear to the new act of succession, which declared her marriage null and Anne's infant the heir to the throne, and soon afterwards she was removed to Kimbolton, where she was well treated. On May 21 she was visited by the archbishop of York and Tunstall, bishop of Durham, who vainly threatened her with death if she persisted in her refusal. She was kept in strict seclusion, separated from Mary and from all outside communications, and in Dec. 1535 her health gave way. She died on Jan. 8, 1536, not without suspicions of poison, which, however, may be dismissed. She was buried by the king's order in Peterborough cathedral. Before her death she dictated a last letter to Henry, according to Polydore Vergil, expressing her forgiveness, begging his good offices for Mary, and concluding with the astounding assurance—"I vow that mine eyes desire you above all things." The king himself affected no sorrow at her death, and thanked God there was now no fear of war.

Catherine is described as "rather ugly than otherwise; of low stature and rather stout; very good and very religious; speaks Spanish, French, Flemish, English; more beloved by the islanders than any queen that has ever reigned." She was a woman of considerable education and culture, her scholarship and knowledge of the Bible being noted by Erasmus, who dedicated to her his book on *Christian Matrimony* in 1526. She endured her bitter and undeserved misfortunes with extraordinary courage and resolution, and at the same time with great womanly forbearance, of which a striking instance was the compassion shown by her for the fallen Wolsey.

BIBLIOGRAPHY.—*See* the article in *Dict. of Nat. Biog.* by J. Gairdner, and those on Henry VIII. and Wolsey, where the case is summed up very adversely to Henry and J. A. Froude, *The Divorce of Catherine of Aragon* (1891) where it is regarded from the contrary aspect; *Cambridge Modern History,* vol. ii. (1903); A. F. Pollard, *Henry VIII.* (1905); M. Hume, *The Wives of Henry VIII.* (1905).

CATHERINE OF BRAGANZA (1638–1705), queen consort of Charles II. of England, daughter of John IV. of Portugal by Louisa de Gusman, daughter of the duke of Medina Sidonia, was born at Villa Viçosa on Nov. 25, 1638. She was a useful medium for contracting an alliance with England, and negotiations for a marriage, begun during the reign of Charles I., were renewed immediately after the Restoration. On June 23, 1661, in spite of Spanish opposition, the marriage contract was signed, by which England secured Tangier and Bombay, certain trading privileges, religious and commercial freedom in Portugal, and two million Portuguese crowns (about £300,000), in return for military and naval support to be given to Portugal against Spain, and liberty of worship for Catherine; in May 1662 she reached England, and the marriage took place in London. Catherine had little personal charm, and Charles's preoccupation with his mistresses soon led her to withdraw from his society; her intention of returning to Portugal was thwarted by the dismissal of her Portuguese retinue, and she was forced to pass a life of neglect and retirement in the midst of the debaucheries of the court. As the prospect of her bearing children diminished, schemes were set on foot to procure a divorce on various pretexts. As a Roman Catholic Catherine was attacked by the inventors of the Popish Plot; in 1678 the murder of Sir Edmund Berry Godfrey was ascribed to her servants, and Titus Oates accused her of a design to poison the king. On Nov. 28 Oates brought a charge of high treason against her, the Commons passed an address for her removal from Whitehall and it was only the king's protection that saved her from having to stand her trial in June 1679. On Nov. 17 in the House of Lords, Shaftesbury moved for a divorce, so that Charles might marry a Protestant, but the bill was opposed by the king. After the Oxford parliament Charles's influence revived, and the queen's position was no more assailed.

During Charles's last illness in 1685 Catherine did much to assist his reconciliation with the Catholic Church, and she exhibited great grief at his death. She afterwards resided at Somerset House and at Hammersmith, where she had privately founded a convent. She interceded with great generosity, but ineffectually, for Monmouth the same year. On June 10, 1688, she was present at the birth of the prince of Wales and gave evidence before the council in favour of the genuineness of the child. She maintained at first good terms with William and Mary; but the practice of her religion aroused jealousies, while her establishment at Somerset House was said to be the home of cabals against the Government; and in 1691 she settled for a short time at Euston. She left England finally in March 1692 and arrived at Lisbon in Jan. 1693. She took her residence at the palace of Bemposta, built by herself, near Lisbon. In 1703 she supported the Methuen Treaty, which cemented still further the alliance between Portugal and England, and in 1704 she was appointed regent of Portugal during the illness of her brother, King Pedro II., her administration

being distinguished by several successes gained over the Spaniards. She died on Dec. 31, 1705, bequeathing her great wealth, the result of long hoarding, after the payment of divers charitable legacies, to King Pedro; and was buried with great ceremony and splendour at Belem.

See L. C. Davidson, *Catherine of Braganza* (1908).

CATHERINE OF VALOIS (1401–1437), queen of Henry V. of England, daughter of Charles VI. of France by Isabel of Bavaria, was born in Paris on Oct. 27, 1401, and was educated in a convent at Poissy. After negotiations for a marriage between Henry, prince of Wales, afterwards Henry V., and each of her two elder sisters, had broken down, Henry IV. proposed that his son should marry Catherine in 1413, and Henry V. renewed this proposal when he became king in March of the same year, demanding at the same time a large dowry and the restoration of Normandy, and other territories in France. War broke out, on the rejection of these demands, but finally, after the treaty of Troyes, Henry and Catherine were betrothed on May 21, 1420, and married at Troyes, June 2, 1420. Catherine was crowned in Westminster Abbey on Feb. 23, 1421, and gave birth to a son, afterwards Henry VI., in the following December. In May 1422 she joined Henry in France, and after his death in the following August, she returned to England. Her name began to be coupled, now, with that of Owen Tudor, a Welsh squire, and when in 1428 Humphrey, duke of Gloucester, secured the passing of an act to prevent her from marrying without the consent of the king and council, she seems already to have been married to Tudor. In 1436 Tudor was imprisoned and Catherine retired to Bermondsey Abbey, where she died on Jan. 3, 1437. By Tudor Catherine had three sons and a daughter; the eldest son, Edmund, created earl of Richmond in 1452, was the father of Henry VII.

See Agnes Strickland, *Lives of the Queens of England,* vol. iii. (1877).

CATHETUS, in architecture, the central circular form round which the volute or spiral of the Ionic or Composite order twists.

CATHODE, the conductor by which an electric current leaves an electrolyte (*q.v.*) or a discharge tube. It is also called the "negative" electrode. (*See* also ANODE; ELECTRICITY, CONDUCTION OF: *Liquids* and *Gases;* and ELECTROLYSIS.)

CATHODE RAYS are the streams of negatively charged particles leaving the cathode in a discharge tube containing a gas at a low pressure (*see* ELECTRICITY, CONDUCTION OF: *Conduction in Gases*). The cathode rays consist of electrons (*see* ELECTRON). Cathode rays have many applications, one of the chief being the excitation of X-rays by the impinging of swift electrons against a hard anticathode (*see* also COOLIDGE TUBE; X-RAYS, NATURE OF; SPECTROSCOPY, X-RAY). This bombardment, besides exciting X-rays, generates a considerable amount of heat and the anticathode can be used as a *cathode ray furnace* for melting small quantities of metal, etc. Forms of apparatus making use of the deflection of a beam of cathode rays by magnetic and electric fields are the *cathode ray oscillograph,* or cathode ray tube, which indicates the variation and values of an alternating current or voltage (*see* INSTRUMENTS, ELECTRICAL), and the *cathode ray manometer,* in which a change of pressure is communicated to tourmaline crystals which become electrically charged (*see* ELECTRICITY) and produce an electric field which is measured by a cathode ray oscillograph (*see* BALLISTICS).

CATHOLIC, derived from a Greek word meaning "universal" and used by ecclesiastical writers since the 2nd century to distinguish the Church at large from local communities or heretical and schismatic sects. A notable exposition of the meaning of the term, as it had developed during the first three centuries, was given by Cyril of Jerusalem (348): the Church is called catholic on the fourfold ground of its world-wide extension, its doctrinal completeness, its adaptation to the needs of men of every kind, and its moral and spiritual perfection (*Catech.,* xviii., 23). The theory that what has been universally taught or practised is true was first fully developed by St. Augustine in his controversy with the Donatists (393–420), but it received classic expression in a paragraph of St. Vincent of Lerin's *Commonitorium,* ii., 6 (434), from which the well-known formula, *quod ubique, quod semper, quod ab omnibus creditum est,* is derived. St. Vincent maintained—curiously enough *á propos* of an extreme Augustinian theory of grace—that the true faith was that which the Church professed throughout the world in agreement with antiquity and the consensus of distinguished theological opinion in former generations (*cf. op. cit.,* ii. 3, 6, xx.). Thus the term tended to acquire the sense of orthodox.

Some confusion in the history of the term has been inevitable as various groups, which have been condemned by Rome as heretical or schismatic, have not renounced their claim to the note of catholicity, so that in the modern world not only the Roman Catholic Church but also the Eastern Orthodox Church, the Anglican Church, and a variety of national Churches and minor sects claim to be Catholic, if not the only true Catholic Church. From this point of view the meaning attached to the term "Catholic" and the claim to catholicity will be conditioned by the theory of the nature and constitution of the Church accepted, being rigid and exclusive or tolerant and comprehensive as that is rigid or tolerant. The earlier theologians of the Anglican Church were primarily interested in proving the agreement of the Anglican theology with the teaching of the ante-Nicene Fathers, but with the Oxford Movement a school of theologians arose who interpreted the catholicism of the Church of England in a much wider sense. A product of this school was the so-called "Branch Theory" of the Church, which maintained that the Anglican, Roman, and Eastern Orthodox Churches were all branches of the one true Catholic Church, and that reunion could be achieved by concessions of these three divisions on controversial questions which divided them without affecting their catholic character. But this theory has been repeatedly condemned by Roman theologians. It has also failed to recommend itself to the Eastern Orthodox Church.

BIBLIOGRAPHY.—J. H. Newman, *Essays Critical and Historical* (Essay x, "The Catholicity of the Anglican Church"); Ch. Gore, *Catholicism and Roman Catholicism* (1923); M. J. Congar, *Divided Christendom* (London, 1939). For further bibliographical data see *Christendom* (Chicago, 1935–), an ecumenical review published by the American Sections of the World Conference on Faith and Order.

CATHOLIC APOSTOLIC CHURCH, THE, a religious community often called "Irvingites," though neither actually founded nor anticipated by Edward Irving (*q.v.*). Irving's relation to this community was, according to its members, somewhat similar to that of John the Baptist to the early Christian Church, *i.e.* he was the forerunner and prophet of the coming dispensation, not the founder of a new sect; and indeed the only connection which Irving seems to have had with the existing organization of the Catholic Apostolic body was in "fostering spiritual persons who had been driven out of other congregations for the exercise of their spiritual gifts." Shortly after Irving's trial and deposition (1831), certain persons were, at some meetings held for prayer, designated as "called to be apostles of the Lord" by certain others claiming prophetic gifts. In the year 1835, six months after Irving's death, six others were similarly designated as "called" to complete the number of the "twelve," who were then formally "separated," by the pastors of the local congregations to which they belonged, to their higher office in the universal church on the 14th of July 1835. This separation is understood by the community not as "in any sense being a schism or separation from the one Catholic Church, but a separation to a special work of blessing and intercession on behalf of it." The "apostles" always held the supreme authority, though, as their number dwindled, "coadjutors" were appointed to assist the survivors, and to exercise the functions of the "apostolate." The last "apostle" died on the 3rd of February 1901.

For the service of the church a comprehensive book of liturgies and offices was provided by the "apostles." It dates from 1842 and is based on the Anglican, Roman and Greek liturgies. Lights, incense, vestments, holy water, chrism, and other adjuncts of worship are in constant use. The ceremonial in its completeness may be seen in the church in Gordon Square, London, and elsewhere. The community has always laid great stress on symbolism, and in the eucharist, while rejecting both transubstantiation and consubstantiation, holds strongly to a real (mystical) presence. It

stresses also the "phenomena" of Christian experience and deems miracle and mystery to be of the essence of a spirit-filled church.

Each congregation is presided over by its "angel" or bishop (who ranks as angel-pastor in the Universal Church); under him are four-and-twenty priests, and with these are the deacons, seven of whom regulate the temporal affairs of the church—besides whom there are also "sub-deacons, acolytes, singers and door-keepers." The priesthood is supported by tithes.

See J. G. Simpson, art. "Irving and the Catholic Apostolic Church" in Hastings' *Encyclopaedia of Religion and Ethics;* and for further details of doctrines, ritual, etc., R. N. Bosworth, *Restoration of Apostles and Prophets, Readings on the Liturgy, The Church and Tabernacle* and *The Purpose of God in Creation and Redemption* (6th ed., 1888); G. Miller, *History and Doctrines of Irvingism* (1878).

CATHOLIC EMANCIPATION, the movement for the abolition of the penal laws against Catholics. (*See* ENGLISH HISTORY; IRELAND; ROMAN CATHOLIC CHURCH.)

CATHOLIC UNIVERSITY OF AMERICA, THE, an institution of higher education at Washington, D.C., founded at the third plenary council of Baltimore in 1884. The constitutions of the university were approved by Pope Leo XIII, and the graduate school of sacred sciences was opened Nov. 13, 1889. A school of philosophy and social sciences was inaugurated in 1895, followed by the school of law (1895) and the school of canon law (1923). A reorganization of the schools took place in 1930, when all courses in philosophy, letters and sciences, except technological, were grouped under the graduate school of arts and sciences and the college of arts and sciences. The technological courses were grouped under a school of engineering and architecture. Schools of social work, nursing education and social science were later added. In 1942 the university's teaching staff numbered 231. The enrolment was 2,027, of whom 1,029 were religious students and 998 lay students.

CATILINE (LUCIUS SERGIUS CATILINA) (*c.* 108–62 B.C.), a member of an ancient but impoverished patrician family of Rome. He was a supporter of Sulla, and during the proscription he was conspicuous for his greed and cruelty. He was guilty of at least one murder. In 77 he was a quaestor, in 68 praetor and in 67-66 governor of Africa. His impeachment for extortion having disqualified him as a candidate for the consulship, he formed a conspiracy, behind which, in all probability, were Crassus and Caesar. The new consuls were to be murdered on Jan. 1, but the plot—the execution of which was deferred till Feb. 5—failed. Soon after, Catiline was acquitted through bribery in the trial for extortion. His scheme widened. The city was to be fired; those who opposed the revolution were to be slain; all debts were to be cancelled; there was to be a proscription of wealthy citizens. Catiline intended to secure the consulship for 63 with C. Antonius as colleague, but Cicero got first place, and Catiline was defeated. C. Antonius, in whom Catiline hoped to find a supporter, was won over by his colleague Cicero. Before the next *comitia consularia* assembled, the orator had given so impressive a warning of impending danger that Catiline was once more rejected (63), and the consuls were invested with absolute authority. Catiline now resolved upon open war; preparations were set on foot throughout Italy, especially in Etruria, where revolt was raised by C. Manlius (or Mallius), one of Sulla's veterans. A plan to murder Cicero in his own house on the morning of Nov. 7 was frustrated. On the next day Cicero attacked Catiline so vigorously in the senate (in his first Catilinarian oration) that he fled to his army in Etruria. Next day Cicero awoke the terror of the people by a second oration delivered in the forum, in consequence of which Catiline and Manlius were declared public enemies, and the consul Antonius was despatched with an army against them. Meanwhile the conspirators in the city tried to induce some Gallic envoys who happened to be in Rome to join them. The plot was betrayed to Cicero, at whose instigation documentary evidence was obtained, implicating Lentulus and others. They were arrested, proved guilty and on Dec. 5 put to death in the underground dungeon on the slope of the Capitol. This act was afterwards attacked as a violation of the constitution, on the ground that the senate had no power of life and death over a Roman citizen. In the beginning of 62 Catiline saw his legions shut in between those of Metellus Celer and C. Antonius. Near Pistoria he was completely defeated by Antonius, and himself fell in the battle. It must not be forgotten that our authorities for this conspiracy were all members of the aristocratic party. Some of the incidents given as facts by Dio Cassius are absurdities; and Cicero paid more regard to the effect than to the truthfulness of an accusation. We find him at one time seeking a political union with Catiline; at another, declaiming against him as a murderer and profligate. Lastly, though Sallust's vivid narrative is consistent throughout, it is obvious that he cherished very bitter feelings against the democratic party. Nevertheless, we cannot regard Catiline as an honest enemy of the oligarchy, or as a disinterested champion of the provincials.

See E. S. Beesley, *Catiline, Clodius and Tiberius* (1878); E. von Stern, *Catilina und die Parteikampfe in Rom* 66–63 (1883); C. Thiaucourt, *Étude sur la conjuration de Catiline* (1887); J. E. Blondel, *Histoire économique de la conjuration de Catiline* (1893); Gaston Boissier, *La Conjuration de Catiline* (1905), and *Cicero and his Friends* (Eng. trans.); E. G. Hardy, "The Catilinarian Conspiracy—a re-study of the Evidence," *Journal of Roman Studies* (1917); W. H. Heitland, *The Roman Republic* (1923); T. Rice Holmes, *The Roman Republic* ch. IV., and part II. pp. 446–473 (1923); Tyrrell and Purser's ed. of Cicero's *Letters* (index vol. *s.v.* "Sergius Catilina").

CATINAT, NICHOLAS (1637–1712), marshal of France, was born on Sept. 1, 1637, in Paris, entered the Gardes Françaises at an early age, and distinguished himself at the siege of Lille in 1667. He served with great credit in the campaigns of 1676–78 in Flanders, was employed against the Vaudois in 1686, and after taking part in the siege of Philipsburg at the opening of the War of the League of Augsburg, he was appointed to command the French troops in the south-eastern theatre of war. In 1690 he conquered Savoy, and in 1691 Nice; the battle of Staffarda, won by him over the duke of Savoy in 1690, and that of Marsaglia in 1693, were among the greatest victories of the time. In 1696 Catinat forced the duke to make an alliance with France. He had in 1693 been made a marshal of France. At the beginning of the War of the Spanish Succession, Catinat was placed in charge of operations in Italy, but he was hampered by the orders of the court and the insufficiency of the forces for their task. He suffered a reverse at Carpi (1701) and was soon superseded by Villeroi, to whom he acted as second-in-command during the campaign of Chiari. He died at St. Gratien on Feb. 25, 1712.

CATION, a positively charged particle or ion which moves toward the negative electrode (cathode) during an electrolysis or an electrical discharge. The cation consists of a single atom or a group of atoms (radical) and bears a specific number of unit positive charges equal to its electrovalence. The silver ion (Ag^+) and the ammonium ion (NH_4^+) are both univalent cations while mercurous ion (Hg_2^{++}) and cupric ion (Cu^{++}) are bivalent cations. In solution the ion is usually in combination with a number of the solvent molecules. (*See* also ELECTRICITY: *Historical Introduction;* ELECTRICITY, CONDUCTION OF: *Conduction in Liquids;* ELECTROCHEMISTRY.) (J. B. Ps.)

CATKIN or **AMENTUM,** a pendulous spike of simple flowers separated by bracts, found in many trees, as, for example, willow and poplar. (*See* FLOWER.)

CATLETTSBURG, a residential city of north-eastern Kentucky, U.S.A., on the Ohio river, at the mouth of the Big Sandy, where Ohio, West Virginia and Kentucky meet; the county seat of Boyd county. It is on Federal highway 60 and the Chesapeake and Ohio railway. The population in 1920 was 4,183 (95% native white), and was 4,524 in 1940 by the federal census. Catlettsburg has Ashland Oil & Refining company, Virginia Gasoline and Oil company and Carbide & Carbon Chemicals corporation, and is connected by bus with Ashland, Ky. and Huntington, W.Va.

CATLIN, GEORGE (1796–1872), American ethnologist, was born at Wilkes-Barre (Pa.), in 1796. He was educated as a lawyer and practised in Philadelphia for two years; but art was his favourite pursuit, and forsaking the law he established himself at New York as a portrait painter. In 1832, realizing that the American Indians were dying out, he resolved to rescue their types and customs from oblivion. With this object he spent many years among the Indians in North and South America. He lived with them, acquired their languages, and studied very thoroughly

their habits, customs and mode of life, making copious notes and many studies for paintings. In 1840 he came to Europe with his collection of paintings, most of which are now in the National museum, Washington, as the Catlin gallery; and in the following year he published the *Manners, Customs and Condition of the North American Indians* in two volumes, illustrated with 300 engravings. This was followed in 1844 by *The North American Portfolio,* containing 25 plates of hunting scenes and amusements in the Rocky mountains and the prairies of America, and in 1848 by *Eight Years' Travels and Residence in Europe.* In 1861 he published a curious little volume, in "manugraph," entitled *The Breath of Life,* on the advantage of keeping one's mouth habitually closed, especially during sleep; and in 1868 *Last Rambles amongst the Indians of the Rocky Mountains and the Andes.* He died in Jersey city (N.J.), on Dec. 22, 1872.

See W. H. Miner, *George Catlin* with an annotated bibl. (1901); also *My Life Among the Indians* (ed. by N. G. Humphreys, 1909).

CATO, DIONYSIUS, the supposed author of the *Dionysii Catonis Disticha de Moribus ad Filium.* In the middle ages the author of the *Disticha* was supposed to be Cato the elder, who wrote a *Carmen de Moribus,* but extracts from this in Aulus Gellius show that it was in prose. Nothing is really known of the author or date of the *Disticha;* it can only be assigned to the 3rd or 4th century A.D. It is a small collection of moral apophthegms, monotheistic in character, not specially Christian. The book had a great reputation in the middle ages, and was translated into many languages; it is frequently referred to by Chaucer, and in 1483 a translation was issued from Caxton's press at Westminster.

See editions by F. Hauthal (1869), with full account of mss. and early editions, and G. Némethy (1895), with critical notes; Eng. trans. by Chase (Madison, 1922); *see* also F. Zarncke, *Der deutsche Cato* (1852), a history of middle age German translations; J. Nehab, *Der altenglische Cato* (1879); E. Bischoff, *Prolegomena zum sogenannten Dionysius Cato* (1893), in which the name is discussed; F. Plessis, *Poésie latine* (1909), 663; for mediaeval translations and editions *see* Teuffel, *Hist. of Roman Lit.* § 398, 3.

CATO, MARCUS PORCIUS (95–46 B.C.), Roman philosopher, called *Uticensis.* On the death of his parents he was brought up in the house of his uncle, M. Livius Drusus. After serving in the ranks against Spartacus (72 B.C.) he acted as military tribune (67) in Macedonia. On his return he became quaestor, and showed so much zeal and integrity in the management of the public accounts that he obtained a provincial appointment in Asia, where he strengthened his reputation. He admired the discipline which Lucullus had enforced in his own eastern command, and supported his claims to a triumph, while he opposed the pretensions of Pompey. As tribune in 62 he prosecuted L. Licinius Murena, consul-elect, for bribery. Cato supported Cicero at the time of the conspiracy of Catiline and voted for the execution of the conspirators, thus incurring the resentment of Julius Caesar, who did his utmost to save them.

Cato was now regarded as one of the leaders of the senatorial nobility. He vainly opposed Caesar's candidature for the consulship in 59, and his attempt, in conjunction with Bibulus, to prevent the passing of Caesar's agrarian law proved unsuccessful. Yet he was still an obstacle of sufficient importance for the triumvirs to desire to get rid of him. At the instigation of Caesar he was sent with a mission to settle the affairs of Cyprus (58). On his return two years later he continued to struggle against the combined powers of the triumvirs in the city, and became involved in scenes of violence and riot. He obtained the praetorship in 54, and endeavoured to suppress bribery, in which all parties were equally interested. He failed to attain the consulship, and had made up his mind to retire from public life when the civil war broke out in 49. He realized that the sole chance for the free state lay in supporting Pompey, whom he had formerly opposed. At the outset of the war he was entrusted with the defence of Sicily, but finding it impossible to hold the island he joined Pompey at Dyrrhachium. He was not present at the battle of Pharsalus, and after the battle, when Pompey abandoned his party, Cato led a small remnant of their forces into Africa. After his famous march through the Libyan deserts, he shut himself up in Utica, and even after the decisive defeat at Thapsus (46), in spite of the wishes of his followers, he determined to keep the gates closed till he had sent off his adherents by sea. When the last of the transports had left the port he cheerfully dismissed his attendants, and soon afterwards stabbed himself.

He had been reading, we are told, in his last moments Plato's dialogue on the immortality of the soul, but his own philosophy had taught him to act upon a narrow sense of immediate duty without regard to the future. He conceived that he was placed in the world to play an active part, and when disabled from carrying out his principles, to retire gravely from it. He had lived for the free state, and it now seemed his duty to perish with it. In politics he was a typical doctrinaire, blind to the fact that his national ideal was an anachronism. The only composition by him which we possess is a letter to Cicero (*Ad. Fam.* xv. 5). The school of the Stoics, which took a leading part in the history of Rome under the earlier emperors, looked to him as its saint and patron. Immediately after his death Cato's character became the subject of discussion; Cicero's panegyric *Cato* was answered by Caesar in his *Anticato.* Brutus, dissatisfied with Cicero's work, produced another on the same subject; in Lucan Cato is represented as a model of virtue and disinterestedness.

See his *Life* by Plutarch; also C. W. Oman, *Seven Roman Statesmen of the Later Republic, Cato . . .* (1902); Mommsen, *Hist. of Rome* (Eng. trans.), bk. v. ch. v.; Gaston Boissier, *Cicero and his Friends* (Eng. trans., 1897); esp. pp. 277 foll.; Warde Fowler, *Social Life at Rome* (1909).

CATO, MARCUS PORCIUS (234–149 B.C.), Roman statesman, surnamed "The Censor" or "The Elder," was born at Tusculum of an ancient plebeian family. He was bred to agriculture, but, having attracted the notice of L. Valerius Flaccus, he was brought to Rome, and became successively quaestor (204), aedile (199), praetor (198), and consul (195). During his term of office he vainly opposed the repeal of the Lex Appia, to restrict extravagance on the part of women. Meanwhile he served in Africa, and took part in the campaign of Zama (202). He held a command in Sardinia and again in Spain, which he subdued with great cruelty, thereby gaining a triumph (194). In the year 191 he acted as military tribune in the war against Antiochus III. of Syria. If he was not personally engaged in the prosecution of the Scipios (Africanus and Asiaticus) for corruption, it was his spirit that animated the attack upon them. Cato's enmity dated from the African campaign when he quarrelled with Scipio for his lavish distribution of the spoil amongst the troops, and his general luxury and extravagance.

Cato opposed the spread of the new Hellenic culture which threatened to destroy ancient Roman simplicity. His purpose was shown most clearly in the discharge of the censorship; hence his title of "Censor." He revised with unsparing severity the lists of senators and knights, ejecting the men whom he judged unworthy, either on moral grounds or from want of means. The expulsion of L. Quinctius Flamininus for cruelty was an example of his rigid justice. His regulations against luxury were very stringent, and he supported the Lex Orchia (181) and Lex Voconia (169). He repaired the aqueducts, cleansed the sewers, prevented private persons drawing off public water for their own use, ordered the demolition of houses which encroached on the public way, and built the first basilica in the forum near the curia. He raised the amount paid by the publican for the right of farming the taxes, and at the same time diminished the contract prices for the construction of public works.

From the date of his censorship (184) to his death in 149, Cato held no public office, but continued to distinguish himself in the senate as the persistent opponent of the new ideas. Like many others he was shocked at the licence of the Bacchanalian mysteries; and he urged the dismissal of the philosophers (Carneades, Diogenes and Critolaus), who came as ambassadors from Athens, on account of the dangerous nature of their views. Almost his last public act was to urge his countrymen to the Third Punic War and the destruction of Carthage. In 157 he was one of the deputies sent to arbitrate between Carthage and Numidia and was so struck by Carthaginian prosperity that he was convinced that the security of Rome depended on the annihilation of Carthage.

From this time, in season and out of season, he kept repeating the cry: "Delenda est Carthago" ("Carthage must be destroyed").

Cato regarded the family as the germ of the State, and proved himself a hard husband, a strict father, a severe and cruel master. There was little difference apparently, in the esteem in which he held his wife and his slaves; his pride alone induced him to take a warmer interest in his sons. The Romans respected this behaviour as a traditional example of the old Roman manners (Livy xxxix. 40).

Cato was the first Latin prose writer of any importance, and the first author of a history of Rome in Latin. His treatise on agriculture (*De Agricultura* or *De Re Rustica*) is the only work by him that has been preserved. It contains a miscellaneous collection of rules of good husbandry, conveying much curious information on the domestic habits of the Romans of his age. His most important work *Origines,* in seven books, related the history of Rome from its earliest foundations to his own day. His speeches, of which 150 were collected, were chiefly directed against the young nobles of the day. He also wrote a set of maxims for the use of his son (*Praecepta ad Filium*) and some rules for everyday life in verse (*Carmen de Moribus*). The collection of proverbs in hexameter verse, extant under the name of Cato, probably belongs to the 4th century A.D. (*See* CATO, DIONYSIUS.)

BIBLIOGRAPHY.—There are lives of Cato by Cornelius Nepos, Plutarch and Aurelius Victor, and many particulars of his career and character are to be gathered from Livy and Cicero. *See* also G. Kurth *Caton l'ancien* (Bruges, 1872); F. Marcucci *Studio critico sulle Opere di Catone il Maggiore* (1902). The best edition of the *De Agricultura* is by H. Keil (1884–91), of the fragments of the *Origines* by H. Peter (1883) in *Historicorum Romanorum Fragmenta,* of the fragments generally by H. Jordan (1860); *see* also J. Wordsworth *Fragments and Specimens of Early Latin* (1874); Mommsen *Hist. of Rome* (Eng. trans.) bk. iii. ch. xi. and xiv.; Warde Fowler *Social Life at Rome* (1909).

CATO, PUBLIUS VALERIUS, Roman poet and grammarian, was born about 100 B.C. He was the leader of the "new" school of poetry (*poetae novi,* as Cicero calls them). Its followers rejected the national epic and drama in favour of the artificial mythological epics and elegies of the Alexandrian school. The great influence of Cato is attested by the lines:—

Cato grammaticus, Latina Siren
Qui solus legit ac facit poetas.[1]

Our information regarding his life is derived from Suetonius (*De Grammaticis,* 11). He was a native of Cisalpine Gaul, and lost his property during the Sullan disturbances before he had attained his majority. He lived to a great age and during the latter part of his life was very poor. In addition to grammatical treatises, Cato wrote a number of poems, the best known of which were the *Lydia* and *Diana.* In the *Indignatio* (perhaps a short poem) he defended himself against the accusation that he was of servile birth. It is probable that he is the Cato mentioned as a critic of Lucilius in the lines by an unknown author prefixed to Horace, *Satires,* i. 10.

Among the minor poems attributed to Virgil is one called *Dirae* (or rather two, *Dirae* and *Lydia*). The *Dirae* consists of imprecations against the estate of which the writer has been deprived, and where he is obliged to leave his beloved Lydia; in the *Lydia,* on the other hand, the estate is envied as the possessor of his charmer. Joseph Justus Scaliger was the first to attribute the poem (divided into two by F. Jacobs) to Valerius Cato, on the ground that he had lost an estate and had written a *Lydia.* The balance of opinion is in favour of the *Dirae* being assigned to the beginning of the Augustan age, although O. Ribbeck supports the claims of Cato to the authorship. The best edition of these poems is by A. F. Näke (1847), with exhaustive commentary and excursuses; a clear account of the question will be found in M. Schanz's *Geschichte der römischen Literatur;* for the "new" school of poetry *see* Mommsen, *Hist. of Rome,* bk. v. ch. xii.; F. Plessis, *Poésie latine* (1909), 188.

CATS, JAKOB (1577–1660), Dutch poet and humorist, was born at Brouwershaven in Zeeland. He studied law at Leyden and at Orleans, and, returning to Holland, settled at The Hague, where he began to practise as an advocate. His pleading in defence of a wretched creature accused of witchcraft brought him many clients and some reputation. He had a serious love affair about this time, which was broken off on the very eve of marriage by his catching a tertian fever which defied all attempts at cure for some two years. For medical advice and change of air Cats went to England, where he consulted the highest authorities in vain. He returned to Zeeland to die, but was cured mysteriously by a strolling quack. He married in 1602 a lady of some property, Elisabeth von Valkenburg, and thenceforward lived at Grypskerke in Zeeland, where he devoted himself to farming and poetry. His best works are: *Emblemata* or *Minnebeelden* with *Maegdenplicht* (1618); *Spiegel van den ouden en nieuwen Tijt* (1627); *Houwelijck . . .* (1625); *Selfstrijt* (1620); *Ouderdom en Buytenleven op. Zorgh-Vliet* (1655); and *Gedachten op. slapelooze nachten* (1661). In 1621, on the expiration of the 12 years' truce with Spain, the breaking of the dykes drove him from his farm. He was made pensionary (stipendiary magistrate) of Middelburg; and two years afterwards of Dort. In 1627 Cats came to England on a mission to Charles I., who made him a knight. In 1636 he was made grand pensionary of Holland, and in 1648 keeper of the great seal; in 1651 he resigned his offices, but in 1657 he was sent a second time to England on what proved to be an unsuccessful mission to Cromwell. In the seclusion of his villa of Sorgvliet, near The Hague, he lived from this time till his death, occupied in the composition of his autobiography (*Eighty-two Years of My Life,* first printed at Leyden in 1734) and of his poems. He is still spoken of as "Father Cats" by his countrymen.

Cats was contemporary with Hooft and Vondel and other distinguished Dutch writers in the golden age of Dutch literature, but his Orangist and Calvinistic opinions separated him from the liberal school of Amsterdam poets. He was intimate with Constantin Huygens, whose political opinions were more nearly in agreement with his own. For an estimate of his poetry *see* DUTCH LANGUAGE AND LITERATURE. Hardly known outside Holland, among his own people for nearly two centuries his work enjoyed an enormous popularity.

See G. Derudder, *Un poète néerlandais: Cats, sa vie, son oeuvre* (Calais, 1898); G. Kalff, *Jakob Cats* (1902).

CATS AND DOGS, a term used in the U.S.A. to apply to securities of a highly speculative character, having uncertain value or no value at all. They are often securities of undeveloped schemes and offer fields for speculation of the wildest type. The Securities Act of 1933 was designed to prevent the "unloading" of such securities by unscrupulous promoters upon gullible buyers.

CAT'S-EYE, a name given to several distinct minerals, their common characteristic being that when cut with a convex surface they display a luminous band, like that seen by reflection in the eye of a cat. (1) Precious, oriental or chrysoberyl cat's-eye. This, the rarest of all, is a chatoyant variety of chrysoberyl (*q.v.*), showing in the finest stones a very sharply defined line of light. (2) Quartz cat's-eye. This is the common form of cat's-eye, in which the effect is due to the inclusion of parallel fibres of asbestos. It is obtained chiefly from Ceylon, but, though coming from the East, it is often called "occidental cats-eye"—a term intended simply to distinguish it from the finer oriental stone. It is readily distinguished by its inferior density, its specific gravity being only 2·65, while that of oriental cat's-eye is as high as 3·7. A greenish fibrous quartz, cut as cat's-eye, occurs at Hof and some other localities in Bavaria. (3) Crocidolite cat's-eye, a beautiful golden brown mineral, with silky fibres, found in Griqualand West, and much used in recent years as an ornamental stone, sometimes under the name of "South African cat's-eye." It consists of fibrous quartz, coloured with oxide of iron, and results from the alteration of crocidolite (*q.v.*). (4) Corundum cat's-eye. In some asteriated corundum (*see* ASTERIA) the star is imperfect and may be reduced to a luminous zone, producing an indistinct cat's-eye effect. (F. W. R.)

CATSKILL, a village of New York, U.S.A., on the west bank of the Hudson river, 35 mi. S. of Albany; the county seat of Greene county. It is on Federal highway 9W, and is served by the West Shore railroad and by river steamers. The population in 1940 (federal census) was 5,429. Catskill is itself a summer resort, and is the gateway to the Catskill Mountain region. Near by is the spot where Rip Van Winkle had his fabled sleep of 20

[1] "Cato, the grammarian, the Latin siren, who alone reads aloud the works and makes the reputation of poets."

years. At Leeds, on the Mohican Trail just northwest of the village, is a beautiful stone arch bridge of the 18th century. The bridge was reconstructed after an old design in 1939 by the highway department of the state. The first settler here was Derrick Teunis van Vechten, in 1680. The village was incorporated in 1806.

CATSKILL MOUNTAINS, a group of moderate elevation pertaining to the Allegheny plateau and not included in the Appalachian system because they lack the internal structure and general parallelism of topographic features which characterize the Appalachian ranges. They are situated mainly in Greene and Ulster counties in the state of New York, with minor sections extending into Delaware and Schoharie counties. The Catskills rise to about the general height of the Highlands of Scotland or the Harz mountains of Germany, the group containing many summits above 3,000 ft. elevation and half a dozen approaching 4,000, Slide Mountain (4,204 ft.) and Hunter Mountain (4,025 ft.) being the only ones exceeding that figure.

The Catskills were not subject to the general folding which marked the elevation of the main ridges of the Appalachians. This gives the mountains the features of a carved plateau with scenery of a subdued type. There are, however, a number of rugged precipices on their outer faces and a number of deeply worn gorges called "cloves." Stony clove and Kaaterskill clove are picturesque gorges, the latter containing three cascades having a total fall of about 300 feet. The Devassego falls of the Schoharie are also strikingly picturesque. Some of the views which have become noted for their magnificent panorama are Pine Orchard ledge, where there is an unobstructed view of the mountain region of Massachusetts, Vermont, and New Hampshire; Kaaterskill Knob, North Mountain outlook, Sunset rock, Prospect rock, and others. The mountains are, as a whole, well wooded quite up to their summits—pine, spruce, oak, hickory, beech, maple, rhododendron, and mountain laurel being common. The almost total absence of lakes is remarkable.

The pure and cool atmosphere attracts a multitude of summer visitors, for whose accommodation many hotels and cottages have been built. Access to all parts of the mountains is made possible by a railway and numerous motor highways. The growing use of the region for a vacation ground has led the state of New York to acquire a forest reserve, which in 1927 amounted to over 155,000 acres. The Catskill reservoirs are the principal source of New York city's water supply.

CATT, CARRIE CHAPMAN (1859–), American suffragist leader, was born at Ripon, Wis., on Jan. 9, 1859. She was educated at the State college of Iowa and took a special course in law. She then became the high school and general superintendent of schools at Mason City, Iowa. In 1890 she enlisted in the cause of woman suffrage, in furtherance of which she lectured throughout the United States and in Europe. She held the office of president of the National American Woman Suffrage Association from 1900 to 1904 and from 1915 until the close of the campaign which resulted in the passing of the woman-suffrage amendment (1920) to the U.S. Constitution. She organized and was president of the International Woman Suffrage Alliance from 1904 to 1923. After the enfranchisement of women she devoted herself to the cause of peace and served as chairman of a national committee on the cause and cure of war, which represented nine women's organizations of the United States. She wrote *Woman Suffrage and Politics.*

CATTANEO, CARLO (1801–1869), Italian philosopher and republican, was the founder of the review *Il Politecnico.* He was the heart and soul of the Five Days of Milan (March 18–22, 1848), and bitterly opposed the hegemony of Piedmont in Italy. On the return of the Austrians he fled to Lugano, and there he wrote his *Storia della Rivoluzione del 1848* and the *Archivio triennale delle cose d'Italia* (3 vols., 1850–55). An uncompromising opponent of Cavour, he steadfastly refused to stand for election to the Italian parliament owing to his inability to take the oath of allegiance to the monarchy.

See his *Opere edite ed inedite* (7 vols., ed. by A. Bertani, Florence 1881–92), *Scritti politici ed epistolari* (ed. by G. Rosa and J. W. Mario, Florence, 1892), and *Scritti storici, letterari, etc.* (ed. by C. Romussi, Milan, 1898). *See* also A. and J. Mario, *Carlo Cattaneo* (Florence, 1884); E. Zanoni, *Carlo Cattaneo nella vita e nelle opere* (1898); G. Nolli, *La Filosofia di Carlo Cattaneo* (Crema, 1901); G. Salvemini, *Le più belle pagine di Carlo Cattaneo* (Milan, 1922).

CATTANEO, DANESE DI MICHELE (1509–1573), Italian sculptor, born at Colonnata, near Carrara, pupil of Jacopo Sansovino in Rome. It is said he was taken prisoner three times by the Imperialists during the "Sacco di Roma" in 1527. He fled to Florence, where he carved the marble bust of Alessandro de Medici; and then joined Sansovino in Venice. He was employed by his master on sculptures for the Libreria di San Marco and the Zecca. Among his works in Venice are the "Apollo" crowning the fountain in the Zecca; the "St. Jerome" in San Salvatore, the figures on the tombs of Leon Loredano in SS. Giovanni e Paolo, and of Andrea Badoer in the Scuola di S. Giovanni Battista. He also worked in Padua for the church of Sant' Antonio. The fine bust of Cardinal Pietro Bembo (1547) placed on the tomb in that church is by his hand. At Verona he built the tomb of Gian Fregoso in S. Anastasia with the help of his distinguished pupil Gerol. Campagna. He returned to Padua in 1572, but death cut short his work on the reliefs for the Capella del Santo, which were completed by Campagna. Cattaneo was also a poet; his poems *Gli Amori di Marfisa* (1562) were praised by Torquato Tasso. His writings were collected by his grandson Niccolo.

CATTARO (Serbo-Croatian *Kotor*), a seaport of the former kingdom of Montenegro, Yugoslavia. Pop. (1931) 5,011. The town, which is Venetian in appearance, occupies a ledge between the Montenegrin mountains and the Bocche di Cattaro, a beautiful inlet of the Adriatic, which expands into five broad gulfs united by narrower channels, and forms one of the finest natural harbours in the world.

Cattaro is strongly fortified; on the seaward side Castelnuovo (Serbo-Croatian, *Erceg-novi*) guards the main entrance to the Bocche; on the landward side, long walls run from the town to the castle of San Giovanni, far above, while the barren heights of the Krivosie, towards Montenegro, are crowned by small forts.

Cattaro is a Yugoslav city, divided almost equally between the Roman Catholic and the Orthodox creeds. It is the seat of a Roman Catholic bishop with a Cathedral containing some beautiful marble sculptures, a collegiate church and several convents. There is a secondary school, a naval college, an interesting naval museum, and a forest school. Cattaro is famous for its lace-making, and also does an extensive trade in cheese. It is the chief port for Montenegro and Cetinje. Castelnuovo is a picturesque town which rose round the citadel built in 1377 by a Bosnian king.

It has at various times been occupied by Turks, Venetians, Spaniards, Russians, French, English and Austrians. The Orthodox convent of St. Sava, standing amid beautiful gardens, was founded in the 16th century and contains many fine specimens of 17th century silversmiths' work.

Rhizon, the modern port of Risano, from which a track leads into Montenegro, was a thriving "Illyrian" city as early as 229 B.C., and gave its name to the Bocche, then known as Rhizonicus Sinus. Rhizon submitted to Rome in 168 B.C. and about the same time Ascrivium, or Ascruvium, the modern Cattaro, is first mentioned as a neighbouring city. Justinian built a fortress above Ascrivium in A.D. 535, after expelling the Goths, and a second town probably grew up on the heights round it. The city was plundered by the Saracens in 840 and by the Bulgarians in 1102. In the next year it was ceded to Serbia by the Bulgarian tsar Samuel, but revolted, and only submitted in 1184 as a protected state. It was already an episcopal see, and in the 13th century Dominican and Franciscan monasteries were established to check the spread of Bogomilism. In the 14th century it was one of the capitals of the Serbian state of Dioklitiya, and Stephen Dushan (1331–55) had his mint here, while its commerce, rivalling that of Ragusa, provoked the jealousy of Venice. After the downfall of Serbia in 1389, it was seized and abandoned by Venice and Hungary in turn, and finally passed under Venetian rule in 1420. It was besieged by the Turks in 1538 and 1657, visited by plague in 1572, and nearly destroyed by earthquakes in 1563 and 1667. In

1707 it passed to Austria; in 1805 it was assigned to Italy; in 1806 the Russians occupied it and Napoleon, to whom it had been ceded, took Ragusa in its stead. From 1807–13 it was united to the French empire; in the latter year, the Montenegrins aided by the British fleet held it for 5 months, and in 1814 it was restored by the Congress of Vienna to Austria, with whom it remained until 1918. During World War I the Montenegrins arrived before Cattaro, which was a centre of submarine activity. The Slav sailors mutinied in 1918 and many of them were shot or imprisoned. In 1918 it became part of Yugoslavia, but it was occupied in 1941 by Italy.

See G. Gelcich (Gelčić), *Memorie storiche sulle Bocche di Cattaro* (Zara, 1880).

CATTEGAT or **KATTEGAT** (Scand. "cat's-throat"), a strait forming part of the connection between the Baltic and the North seas. It lies north and south between Sweden and Denmark, and connects north with the Skaggerak and south through the Sound, Great Belt and Little Belt with the Baltic sea. Length about 150 mi., extreme breadth about 88 mi., area 9,840 sq.mi., mean depth not more than about 14 fathoms. (*See* BALTIC SEA.)

CATTELL, JAMES McKEEN (1860–1944), American psychologist and editor, was born at Easton, Pa., on May 25, 1860. He graduated at Lafayette college in 1880, and took his degree at Leipzig in 1886. After having been lecturer at the University of Pennsylvania, Bryn Mawr college and the University of Cambridge, he was from 1888 to 1891 professor of psychology at the University of Pennsylvania, this having been the first professorship of psychology in any university. From 1891 to 1917 he was professor at Columbia university, and later president of the Psychological corporation. He was editor of the *Psychological Review* (1894–1904); *Science* (1894–1944); the *Scientific Monthly* (1900–44); *School and Society* (1915–39); the *American Naturalist* (1907–44); *American Men of Science* (1906–44); and *Leaders in Education* (1932–44). He wrote research works on psychological measurements, individual differences and applications of psychology and was the author of many publications on psychology, scientific organization and education. He was president of the first American International Congress of Psychology. He died in Lancaster, Pa., Jan. 20, 1944.

CATTERMOLE, GEORGE (1800–1868), English painter, chiefly in water colours, was born at Dickleburgh, near Diss, Norfolk, in August 1800. At the age of 16 he began working as an architectural and topographical draughtsman. Cattermole was a painter of no inconsiderable gifts; with great facility in picturesque resource. He was also a book illustrator. At the Paris exhibition of 1855 he received one of the five first-class gold medals awarded to British painters. He died on July 24, 1868. Among his leading works are "The Murder of the Bishop of Liége" (15th century), "The Armourer Relating the Story of the Sword," "The Assassination of the Regent Murray by Hamilton of Bothwellhaugh," and (in oil) "A Terrible Secret."

CATTLE. The word "cattle," which etymologically merely denotes a form of property and is practically synonymous with "chattel," is by common usage a generic term for animals of the bovine race. The several animals that may be included under the term are usually divided into the following six groups: (1) buffaloes (India, Africa, etc.); (2) bison (Europe and North America); (3) the yak (Tibet, etc.); (4) the gaur, gayal and bantin (India and further India); (5) eastern and African domesticated cattle or zebu; and (6) western or European domesticated cattle. In addition to the two last-mentioned groups the India buffalo, yak, gayal and bantin have been domesticated. Apart from the buffaloes, which constitute a relatively primitive and rather distinct type, all the species enumerated are rather closely related. The buffaloes do not hybridize with the members of the other groups, but all the rest can be interbred without difficulty and the hybrids, or at least the female hybrids, are quite fertile. (*See* also AUROCHS; BANTIN; BISON; BOVIDAE; BUFFALO; GAUR; GAYAL; OX; YAK.)

The ox was one of the earliest of all animals to be domesticated for agricultural purposes. In western Europe there is no evidence of domestication in Palaeolithic times but there are plentiful remains in the Swiss lake dwellings and other deposits of Neolithic age. Domesticated cattle existed in Egypt about 3500 B.C., and possibly much earlier, while Babylonian remains have been assigned to still more remote ages.

In all likelihood the wild ancestors of European domesticated cattle belonged to one or more of the sub-species of the auroch or urus (*Bos primigenius*) which were widely distributed in Europe, western Asia and northern Africa in prehistoric times. However, the earliest known domesticated ox in Europe was a very small, slenderly built animal, with short horns, bearing all the marks of a prolonged existence under the care of man and contrasting very markedly with the contemporary wild urus. The conclusion has been drawn that the original domestication did not occur in western Europe; probably the little ox (*Bos longifrons* or *Bos brachyceros*), together with corresponding types of sheep and pig, was brought from Asia by Neolithic man in his migrations. Later, in the Bronze age particularly, a new and larger type of cattle, showing a closer resemblance to the European wild ox, made its appearance. Probably the *Bos longifrons* had been "graded up" by crossing with the wild type. The process was, however, not universal, and even today breeds like the Shetland, Jersey, Kerry and Brown Swiss show a marked resemblance to the Neolithic type.

Whether the zebu had a separate origin from the western ox is not known; some authorities seek to relate it with the bantin or gayal. In shape, colour, habits and even in voice, it presents many points of difference from western cattle; but the most striking of these, such as the presence of a hump, or the upward inclination of the horns, are not constant. There exist in Africa, Spain, China, etc., breeds which are intermediate between zebu and European cattle, but it is likely that some, at least, of these have arisen from crossing. The economic value of cattle arose from the docility of the males for draught and the aptitude of the females for supplying milk in excess of the requirements of their offspring. Ultimately they were utilized as food but this was in a sense secondary, and among some races their flesh was regarded, for religious or other reasons, as unfit for human consumption. The breeding and rearing of cattle for the primary purpose of supplying meat is a modern development.

Cattle Population and World Trade.—Estimates in round numbers of the cattle population of the world as averages for the years 1931–35 (the latest estimates before the outbreak of World War II), are as follows:

TABLE 1.—*Cattle—Number in Principal Countries and by Continents*
(Average 1931–35*)

Country	Number	Country	Number
North America, Central America and West Indies	*Million Head*	Africa	*Million head*
United States	68	Union of South Africa	10
Mexico	11	Madagascar	6
Canada	9	Kenya	5
Cuba	4	Tanganyika	5
Other	5	Ethiopia	4
Estimated total	97	Other	30
		Estimated total	60
South America			
Brazil	44	Asia	
Argentina	32	India†‡	205
Colombia	8	China§	23
Uruguay	7	Thailand (Siam)†	10
Other	15	Netherlands Indies†	8
Estimated total	106	Turkey	6
		French Indo-China†	4
Europe		Philippine Islands	4
U.S.S.R.	44	Other	8
Germany	19	Estimated total	268
France	16		
Poland	9		
United Kingdom	8		
Italy	7	Oceania	
Czechoslovakia	4	Australia	13
Rumania	4	New Zealand	4
Eire	4	Estimated total	17
Yugoslavia	4		
Other	31	ESTIMATED WORLD TOTAL	698
Estimated total	150		

United States Department of Agriculture, agricultural statistics 1941. Compiled from reports of United States government representatives abroad, original official sources, and the International Institute of Agriculture.

*Average for 5-year period if available; otherwise for some year or years within or near.

†Buffaloes included.

‡Includes Burma, where cattle and buffaloes number about 6,000,000.

§Estimate for China based on official returns for provinces which supported over 90% of the total in 1914.

Before the days of refrigeration as applied to transportation, most of the beef exports had been in the form of canned and cured meat. The first cargo of refrigerated beef was sent from the United States to England in 1874.

United States shipments of beef rose from 37,000,000 lb. in 1875–76 to 461,000,000 lb. in 1900–01. The marked expansion of beef exports from the United States from 1875 to 1900 was due in large measure to the settlement of new regions and the attendant expansion of livestock production in the United States and to the growing industrialization of Europe with the increasing demand for imported foodstuffs. But early in the 20th century an expanding domestic market, rapidly increasing competition from the southern hemisphere, and some expansion of livestock and meat production in northern and central Europe were responsible for a sharp decline in United States beef exports. By 1905 Argentina had surpassed the United States as an exporter of refrigerated beef and by 1914 United States exports of fresh beef had fallen to 6,000,000 lb. Exports of cured beef amounted to 23,000,000 lb. in that year. From 1921 to 1940 imports of beef into the United States were larger than exports in most years.

In world exports live cattle had a higher value than beef and veal in 1929. Chilled and frozen meat may be carried around the globe whereas the greater difficulties of transportation have given trade in live animals a regional character.

From 1924 to 1938 the United Kingdom was by far the greatest importer of live cattle, buying mostly from Eire as it had not permitted imports from the continent for decades. However, the economic war waged by the two countries between 1931 and 1938 greatly reduced the number imported. Central Europe was a second deficit region for cattle. German supplies came chiefly from Denmark. Austria and Czechoslovakia, Italy and Greece were largely supplied from Bulgaria, Hungary, Rumania and Yugoslavia. United States imports came mostly from Canada and Mexico.

TABLE II.—*World Trade in Cattle, 1909–38*

(1,000 head)

Countries	Average 1909–13	Average 1924–28	Average 1929–33	Average 1934–38
Imports				
United States	338	304	203	361
Germany	218	231	153	156
United Kingdom	161	810	762	682
U.S.S.R.	132	49	114	121
Italy	112	99	182	101
Chile	91	80	56	23
Switzerland	86	32	13	9
Belgium	67	18	44	19
Brazil	51	4	2	21
France	30	14	64	8
Argentina	29	64	41	1
Austria	26	164	72	23
Greece	7	75	61	77
Japan	4	50	51	65
Union of South Africa	..	74	31	54
Czechoslovakia	..	98	46	0
British Malaya	..	42	28	27
Exports				
Eire	...	733	727	664
Hungary	359	82	96	76
Mexico	241	100	131	200
Argentina	158	164	76	81
Denmark	143	186	145	128
Canada	123	259	93	197
France	112	49	43	7
United States	108	40	5	6
Uruguay	94	103	33	66
Austria	80	29	18	8
Netherlands	75	30	25	3
China	74	24	30	33
Turkey	39	26	88	76
Yugoslavia	24	138	96	61
Rumania	16	79	76	49
Chosen (Korea)	12	50	50	67
French West Africa	..	..	99	79

In the terminology used to describe the sex and age of cattle, the male is first a "bull-calf" and if left intact becomes a "bull"; but if castrated he becomes a "steer" and in about two or three years grows to an "ox." The female is first a "heifer-calf," growing into a "heifer" and becoming after two or three years a "cow." A heifer is sometimes operated on to prevent breeding and is then a "spayed heifer." The age at which a steer becomes an ox and a heifer a cow is not clearly defined and the practice varies. Both in the male and female emasculation is practised because the animals are assumed to fatten more readily; in the case of bulls intended for use as working oxen the object of emasculation, as in the case of stallions, is to make them quieter and more tractable in work.

BREEDS

The exact definition of a "breed" of cattle is difficult, although the term is commonly used and in practice well understood. It may be said generally to connote a particular type of animal which has for a long period been bred only with those of the same, or closely similar, type, and has hereditary characteristics which are transmissible to its offspring. In every breed, however long established, instances of atavism may and do occur, but these are eliminated and do not affect its general purity. Breeds have been established by generations of cattle breeders aiming at the attainment and preservation of a particular type and working on the principle that "like begets like." It is only within very recent times that the laws of heredity founded on the researches of Mendel have been studied as a science. There are many old-established breeds on the continent as for example the Charolais and Normande of France, the Holsteins of Holland, the Campagna di Roma of Spain, and many others, but the British breeds are of particular interest because of their influence in building up the vast herds which furnish the supplies of beef on which other countries are largely dependent. (*See* BEEF.)

Beef Breeds.—*The Shorthorn.*—The Shorthorn is an example of improvement of beef cattle by selection within a breed. In the last quarter of the 18th century two brothers, Charles and Robert Colling, farming in Durham county, England, began to improve the local cattle of the Teeswater district of that county. Their efforts were supplemented by other constructive breeders, notably Thomas Bates and Thomas Booth in Yorkshire. As many cattle of this breed have been exported to other countries from Durham, they are often called by that name.

Shorthorns are distinguishable from other breeds principally by their colour markings. Roans are most numerous, but a considerable number of Shorthorns are red with small white markings, usually about the forehead and lower parts of the body. Some individuals are also pure white. The Shorthorn is one of the largest breeds of beef cattle and a rectangular shape is characteristic of the breed.

Shorthorns are to be found in practically every country of the world. They are numerous in North America, in South America, particularly in Argentina, in Europe, being the most popular breed in the British Isles, and are bred to some extent on the continent; in Australia they have long met with favour and have also been bred quite extensively in South Africa. In the United States, Shorthorns are most numerous in the corn belt states and have been used rather extensively in other areas for grading up native or scrub cattle.

The *Shorthorn Herdbook,* the first of its kind for cattle, was begun in 1822 by George Coates. It was published as a private compilation until 1876 when it was taken over by the Shorthorn society. The first U.S. *Shorthorn Herdbook,* which registers all types of Shorthorns in the United States, was published in 1846 and in 1867 the first Canadian *Shorthorn Herdbook* was begun.

Strains of Shorthorns have been selected for milk and butterfat production, as well as beef, and in the United States are called Milking Shorthorns; in Canada, Dual-Purpose Shorthorns; in England and Australia, Dairy Shorthorns. In England many herds of Shorthorn cattle still show the beef and milk combination developed by the early improvers of the breed. In the United States throughout large areas in the middle west as well as in parts of

the New England states, Milking Shorthorns are popular.

The Polled Shorthorn, as the name implies, is a strain within the breed possessing all of the Shorthorn characteristics except horns. This strain of polled cattle was developed in the United States in the late 1880s and early 1890s through the use of naturally hornless registered Shorthorns found within the breed. While beef characteristics have been emphasized, many good milkers have been developed among Polled Shorthorns.

Lincolnshire Red Shorthorns are a specialized type of the original Shorthorn stock.

The Hereford.—The Hereford is the product of generations of intelligent breeding work on the part of landed proprietors and tenant farmers of the fertile valleys in the county of Hereford, England. The origin of the breed has been lost in obscurity but it is thought to have descended from the primitive cattle of the country. Herefordshire is noted for its luxuriant grasses, and in this district, for many generations, the Hereford was bred for beef and draught purposes. The characteristic colour, red with white face and white markings, has been fixed for only a comparatively short time. When the first herdbook was published in 1846, the editor grouped the breed into four classes: mottle faced; light gray; dark gray; and red with white faces. Twenty-five years later all the colours but the last had practically disappeared. The outstanding characteristics of the breed are uniformity of colour, early maturity and ability to thrive under adverse conditions.

Herefords were first introduced into the United States in 1817 by Henry Clay, who imported a young bull, a cow and a heifer to his home in Kentucky. In 1860 Herefords were introduced into Canada by F. W. Stone of Guelph, Ontario. In the range areas of North America, it has become the predominating breed from Canada on the north, to Mexico on the south. In Great Britain it is chiefly bred in Herefordshire and vicinity although herds of this breed are found in Scotland, Ireland and Wales. The Hereford has met with much success also under range conditions of Australia, New Zealand, Argentina, Uruguay and southern Brazil.

The first *Hereford Herdbook*, published in 1846 as a private enterprise, was taken over by the Hereford Cattle Breeders' Association of England in 1884. The American Hereford Cattle Breeders' association was organized in 1881, and in 1934 the official name was changed to American Hereford association.

In the United States there has been developed within the Hereford breed a strain without horns. This strain was developed by Warren Gammon of Iowa by selecting naturally hornless registered Herefords that differed from the standard Hereford only in the polled character. The number of Polled Herefords has increased very rapidly and herds are to be found throughout the United States. Polled Herefords have been exported to Canada, Mexico, South America, Hawaii, the Philippines and Australia. The American Polled Hereford Breeders' association is the national organization in the United States.

The Aberdeen Angus.—This breed of black, polled beef cattle, commonly called "doddies," originated in the county of Aberdeen, in Scotland. Its ancestry is obscure. The breed was improved and the present type of the cattle fixed early in the 19th century by a number of constructive breeders among whom Hugh Watson and William McCombie were the most famous.

The characteristic features of the breed are black colour, polled head, compact and low-set body, fine quality of flesh and high dressing percent. The Aberdeen Angus is a beef breed of the highest rank and for years purebred or crossbred Angus steers have held high places of honour at the leading fat stock shows in Great Britain and in the United States. This breed was introduced into the United States in 1873 and after that date its influence spread widely in that and other countries. The first *Polled Herdbook* of Aberdeen Angus cattle was issued in Scotland in 1862. The American Aberdeen Angus Breeders' association was organized in 1883.

The Devon.—Devons are assumed to have descended from the smaller type of aboriginal cattle of Britain. Their neat, compact, symmetrical form and deep red colour—"rubies" as they are often called—make an attractive appearance in their native home in the hills of north Devon. For centuries they were bred primarily for draught purposes but early in the 19th century Francis Quartly, a north Devon breeder, is credited with having improved the breed for beef production. His herd became the chief source of supply of stock bulls for the entire district. John Tanner Davy continued the work of improvement and numerous famous Devons descended from his herd. A grandson, Colonel Davy, founded the *Devon Herdbook* in 1851 and brought the merits of the breed to the attention of other breeders. The first authentic record of registered Devons in America was a present of seven head of registered cattle of this breed sent to Robert Patterson of Baltimore by Mr. Coke (later Earl of Leicester) of Holkham, England. Most of the early Devons in America descended from this shipment in 1817 and later shipments to the Patterson family. Because of its adaptability and hardiness the Devon breed has found favour in many other parts of the world —in New South Wales, South Africa, southern Brazil, Uruguay and the West Indies. The greatest number of Devons in the United States are found in New England.

In south Devon where the breed is also known as South Hams, the cattle are lighter coloured, larger, less active and also less symmetrical in conformation than the cattle of hilly north Devon. The South Devon is bred primarily for dairy purposes, producing a plentiful supply of milk of high quality, from which the well-known Devonshire cream is obtained.

The Galloway.—The origin of this breed of polled black cattle originating in Scotland is involved in the same obscurity as the Aberdeen Angus. Although its native home is the ancient province or kingdom of Galloway in southwestern Scotland, it probably had a common origin with the Aberdeen Angus. The two breeds have much in common but the Galloway is to be distinguished from the Angus by its coat of curly black hair. The breed has never attained the prominence of other beef breeds but has been used quite extensively in producing "blue-gray" crossbred cattle, obtained by breeding white Shorthorn bulls to Galloway cows. The resulting crossbred animals produce unsurpassed and extremely popular beef carcasses. Organized effort to promote Galloway cattle first took place in 1862 in Scotland when the *Polled Herdbook* was begun. The first four volumes of this book included both Galloway and Aberdeen Angus cattle. In 1877 an independent Galloway Cattle society was formed which has been in existence ever since. The American Galloway Breeders' association was organized in 1882.

The Highland or West Highland.—The native home of this breed of cattle, sometimes called "Kyloes," is the upland region of western Scotland. Little is known of their early history though it is generally believed they are the aboriginal cattle in that district. A typical West Highland animal with wide spreading horns, long shaggy coat, sturdy frame, thick mane and heavy dewlap makes an impressive picture. The colour is variable, being yellow, red, black, brindle and a mixture of red and black with a tawny red predominating. No other breed of British ancestry equals the West Highland for hardiness and ability to thrive on scanty pasturage. Cattle of this breed are comparatively small and slow in maturing, but they make beef of fine grain and unsurpassed flavour. The breed is not distributed widely outside its native home although some exportations have been made to other countries.

The Longhorn.—The Longhorn breed of Britain is to be distinguished from longhorn cattle that were once numerous in the western range area of the United States. The latter were descended from cattle brought to America by the Spaniards and are now practically extinct. But a common characteristic of both is the excessive horn growth from which the name is derived. In England the Longhorn has been improved by selective mating. Shorthorns have largely displaced these cattle in almost every district, but a number of herds are still in existence.

The Sussex.—The Sussex breed, found in Sussex, Kent, Surrey and Hampshire, is descended from the original stock of the country and has probably undergone little change in outward appearance since the Middle Ages. The district in which it is bred has large areas of stiff, heavy soils, calling for great strength at the

plow, a requirement for which oxen of this breed are admirably suited. The Sussex is a heavy muscular animal, dark red in colour and is valued as a good grazer where beef rather than milk is sought. It has not attained wide distribution and even in England is not widely bred outside of its own county.

The Red Poll.—The Red Poll breed represents a blending of the cattle which were common in Norfolk and Suffolk counties, England, for centuries. The horned, red, hardy Norfolk cattle were noted for their fleshing qualities while the larger-framed, hornless Suffolks were exceptionally good milkers. The merging of these two bloodlines about 1846 provided the foundation for the present breed. The aim of breeders has been to produce medium-sized, hardy, hornless cattle, red in colour, smooth and compact, and equally good as producers of beef and milk. The usefulness of the breed is now well known the world over. Exportations have been made to the United States, Canada, South Africa, Australia, New Zealand and South and Central America.

The Welsh.—The Welsh breed is black with fairly long horns. Until the beginning of the 20th century there were two types known as North and South Welsh, but they were amalgamated in 1904 when the Welsh Black Cattle society was formed and a common herdbook established. The cattle mature rather slowly but grow to a large size and furnish beef of high quality.

The Africander.—The Africander is widely distributed throughout the Union of South Africa. Although the origin of the breed is not definitely known it probably goes back to the Indian (*Bos Indicus*) species and not to European (*Bos taurus*) cattle. The foundation of the breed was laid by the voortrekkers who valued their oxen above all other farm possessions. Before and after the Great Trek (1836) there existed a friendly rivalry among the farmers of South Africa to possess oxen that were uniform in conformation, shape of horns and colour markings, and that had hard, flinty feet and the straight easy action so desirable for trekking long distances.

The Africander has a hump over and slightly in front of the shoulders. This hump is more rounded, and blends more smoothly into the shoulder than that of zebu cattle. The colour may vary from dark to light red but dark red is preferred. After the days of the voortrekkers little attention was given to the development of milk production, but the Africander cow seldom fails to supply enough milk for her calf under the most adverse conditions. While the breed was developed primarily to produce trek oxen that would subsist entirely on the veld and survive droughts, later requirements have been for an early maturing, uniformly-fleshed beef animal that maintains the hardiness of the earlier type. The Africander Cattle Breeders' society was formed in 1912 for the regulation and control of registrations of Africander cattle in the South African *Studbook*.

The first and only importation of Africander cattle into the United States was made in 1931 by the estate of Henrietta M. King (King ranch), Kingsville, Tex. The shipment consisted of 16 bulls and 13 cows and heifers.

Brahman (Zebu) Cattle.—The term Brahman (Zebu) has been selected by the United States department of agriculture as the name of all breeds of Indian cattle in the United States. In South America and in Europe these cattle are known as Zebus. Brahman cattle are characterized by a prominent hump above the shoulders, and an extreme development of loose, pendulous skin under the throat, on the dewlap, navel and the sheath of males. The rump is drooping. The head is long and narrow, ears are long and carried in a drooping manner, and horns differ widely according to sex and strain. The colour varies from shades of gray to black. Indian cattle, like those of Europe, vary in size, form and symmetry under the influence of local differences in climate, soil and available feed. In their native home, Indian cattle are used primarily for work and milk production. The vast majority of people of India are averse to killing them for food. Humped cattle of India were imported into the United States as early as 1849, but the importations that had the widest influence were made in 1906 and in 1924. These cattle have been used in the gulf coast area of the United States for crossing with the improved breeds of beef cattle to produce a type adapted to the hot, humid conditions prevailing in that region.

The Santa Gertrudis.—This breed of cattle had its origin in the United States, having been developed by the King ranch in the state of Texas. It resulted from crossing Brahman bulls of about seven-eighths pure breeding, and purebred Shorthorn cows. Over a period of years, beginning in 1920, selective breeding was practised in which preference was given to red colour without sacrificing type and conformation. Santa Gertrudis cattle are, for the most part, solid red in colour with occasional small white markings, usually on the forehead or in the region of the flanks. They possess a slightly higher percentage of Shorthorn breeding than of Brahman.

The breed is named for one of the bulls that contributed much to its development. Santa Gertrudis cattle are the heaviest of the beef breeds when raised under similar conditions. They have great depth and length of body, with more loose skin about the neck, brisket and navel than the breeds of strictly British origin. They have proved to be highly adaptable to the gulf coast country where conditions are semi-tropical.

Dairy Breeds.—*The Holstein-Friesian.*—The Holstein-Friesian breed of cattle originated in north Holland and Friesland. Its chief characteristics are large size and black and white spotted markings, sharply defined rather than blended. These cattle are believed to have been selected for dairy qualities for about 2,000 years. They have long been widely distributed over the more fertile lowlands of continental Europe where they are valued highly for their milk-producing ability. However the milk has a relatively low butterfat content. When the Dutch colonized New York, they brought their cattle with them, but after the colony was ceded to the British crown and English settlers brought their own cattle, the Dutch cattle disappeared. The first exportation from Holland to the United States was in 1795, but the largest importations were made between the years 1879 and 1887. These cattle were registered in the *Holstein Herdbook* and the *Dutch Friesian Herdbook*. In 1885 the two associations united in the Holstein-Friesian Association of America, the largest dairy breed association in the United States.

The breed is widely distributed although not so well adapted to rough, poor lands as some dairy breeds. Besides being well established in the lowland countries of western Europe, in England, and throughout the United States, cattle of this breed are found in Canada, Australia, South America and South Africa.

The Jersey.—Within sight of the coast of Normandy in the English channel is a group of four small islands that have long been noted as the native home of two distinct breeds of dairy cattle—the Jersey and Guernsey. The Island of Jersey, the largest of the group, has an extremely mild climate and cattle can be outdoors most of the year. It is believed that the Jersey is descended from French cattle. Its colour is usually a shade of fawn or cream but darker shades are common. The fawn or cream has been attributed to the cattle of Normandy and the darker colour to those of Brittany. Jersey cattle are relatively small in size. The purity of the breed was recognized as early as 1763, and in 1789 a law was passed prohibiting the importation of cattle into Jersey except for immediate slaughter. They have been introduced in large numbers into England, one of the earliest herds being formed in 1811. The first exportation to the United States was in 1850. The Jersey is adaptable to a wide range of conditions and its distribution is world-wide. Jersey milk is remarkably rich in butterfat, and for that reason animals of this breed are in demand for crossing with native stock to improve the quality of milk. The Royal Jersey Agricultural society, founded in 1833, assumed supervision of the breed on the Island of Jersey, while the English Jersey Cattle society, organized in the '70s, is the registry association in Great Britain. The American Jersey Cattle club was organized in 1868, and under the supervision of this organization a register-of-merit system was established in 1903.

The Guernsey.—The Island of Guernsey, another of the Channel islands, is the home of the Guernsey breed. Like the Jersey, this breed is thought to have descended from the cattle of nearby Normandy and Brittany. All of the cattle of the Channel Islands

were at one time known as Alderneys. After laws had been enacted prohibiting the importation of cattle to the islands except for slaughter, the two distinct breeds—Jerseys and Guernseys—came to be recognized. Guernsey cattle are fawn-coloured, marked with white, and are larger than their widely distributed sister breed, the Jersey. Guernseys are noted for the production of milk of a pronounced yellow colour. The first Guernseys were exported to the United States in 1830, but it was not until 1870 that the export business became extensive. Numbers of Guernsey cattle are to be found also in England, Australia and Canada. The Royal Guernsey Agricultural and Horticultural society supervises the breed on the Island of Guernsey, maintaining two herdbooks, one for general registration and the other for advanced registry. The American Guernsey Cattle club was organized in 1877 and supervises the advanced registry system and pedigree registration of Guernseys in the United States.

The Brown Swiss.—The native home of the Brown Swiss is Switzerland. The breed is probably one of the oldest in existence. While these cattle are classified as a dairy breed in the United States, they are often considered as a dual-purpose breed for they are heavier boned and thicker fleshed than the cattle of the Channel Islands breeds. The colour of the Brown Swiss varies from light brown or gray to a dark shade of these colours. Brown Swiss cows are good, persistent milkers, producing milk of average quality as compared with other breeds of dairy cattle.

This breed has found favour in Italy, Austria, Hungary, United States, Mexico and the South American countries. Brown Swiss were first introduced into the United States in 1869. The Brown Swiss Cattle Breeders' Association of America, organized in 1880, supervises the registration of pedigrees and the register of production of Brown Swiss cattle in the United States.

The Ayrshire.—The Ayrshire breed originated in the county of Ayr in southwestern Scotland in the latter part of the 18th century and is considered to be the only special dairy breed to have originated in the British Isles. Native cattle of the county from which the breed takes its name appear to have been improved by crossing with other breeds to develop a type that would meet local conditions. Further mating and selection moulded the breed into its present form. The Ayrshire has very distinctive horns, which are long and curve outward, upward and slightly backward. The body colour varies from almost pure white to nearly all cherry red or brown with any combination of colours. The beef qualities of the breed are of secondary importance but among dairy breeds the Ayrshire ranks high as a beef producer. The distribution of the Ayrshire is wide, and exportations have been made to many countries. The breed is strongly represented in Canada and the northeastern part of the United States and is found also on the continent of Europe, in South Africa, Australia, New Zealand, Puerto Rico, Mexico and Central America. The Ayrshire Breeders' Association of the United States of America has been instrumental in fostering herd testing and a system of selective registration for approved sires of the breed.

BIBLIOGRAPHY.—U. S. Dept. of Agri. *Yearbook* (1900), p. 700; C. W. Plumb, *Types and Breeds of Farm Animals,* rev. ed. (1920); C. H. Eckles, E. L. Anthony, L. S. Palmer, *Dairy Cattle and Milk Production,* rev. ed. (1939); A. H. Sanders, *The Cattle of the World, Their Place in the Human Scheme—Wild Types and Modern Breeds in Many Lands* (1926), *Shorthorn Cattle* (1918) and *The Story of the Herefords* (1914); A. M. Bosman, *Cattle Farming in South Africa* (1932); W. H. Peters, *Livestock Production* (1942); E. L. Potter, *Western Livestock Management* (1917).

Pedigree Cattle Breeding.—Many breeds and sub-breeds of cattle are distributed throughout the world. On the continent of Europe alone, between 40 and 50 distinct breeds are described by French and German writers. Great Britain is the home of 11 breeds which have been exported to the United States, and in addition as many more minor breeds of local importance are described by English writers. The art of breeding seems to have begun in England about 1770 as the result of the work of Robert Bakewell. Bakewell was not only a pioneer breeder but is reported to have kept records and notes on the progeny of his cattle in order to show the progress made. The activities of the Collings brothers in improving the Shorthorn breed rank next to those of Bakewell in livestock improvement. The work begun by these breeders spread over Great Britain and had a lasting influence on livestock improvement throughout the civilized world. As the fame of British cattle spread to other countries, a demand was created for these improved breeds. Cattle were exported to other countries to found new herds and to improve the native cattle. Practically all present day pure breeds of farm animals became breeds before the practice of registration, issuing of pedigrees and publication of their respective herdbooks was begun.

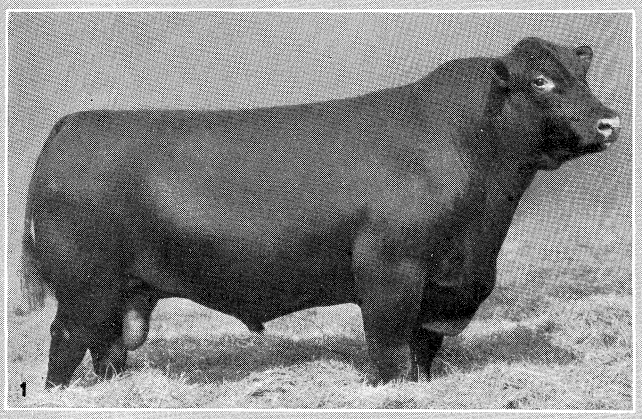
The development of breed registry associations in the United States differs somewhat from that of Great Britain where herdbooks remained open, for a time at least, to all animals that met certain requirements as to breed characteristics. The British practice tended to broaden the base of the breed. Cattle breeders continue to direct their efforts toward further improvement of breeds. Individual excellence and pedigree are accepted as only a part of breed improvement, as the essential test of an animal's breeding ability is in the performance of its progeny. Non-selective testing and the use of progeny-tested animals for breed improvement have received increasing attention by constructive breeders. The herd test and advanced register, or record-of-merit testing introduced by breeders of dairy cattle, the get-of-sire class, and slaughter test of the progeny of beef breeds are all useful tools in determining the utility value of registered cattle.

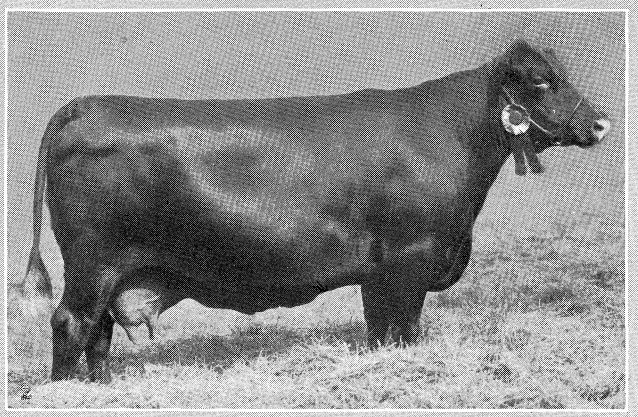
Conflicts of opinion on the use of impartial ratings with pedigrees are usually based on whether the information gained by such measures has enough practical usefulness to be worth the cost. Animal breeding is still practised largely as an art, with greater emphasis placed on selection by observation than on any other procedure. The setting up of well-defined types by early breeders, followed by rigid selection of breeding stock, was the basis of present breeds. Most of the subsequent improvement in the common livestock of the world has been accomplished by the mating of purebred sires to common females. Even in this procedure best results are obtained when the females are selected with care and a high-quality registered sire is used. The effectiveness of this system of breeding is shown by the type of cattle found in the range area of the United States where most breeders have used registered bulls of the same breed for many generations. The result has been a uniform type of cattle in demand by feeders of the corn belt states. The mating of closely related animals has been highly successful in some cases and disastrous in others. Bakewell followed this practice, using animals of high merit, whereas Bates was not so successful. Twentieth-century breeders have followed this breeding practice only after using a sire so superior that a successor of equal or superior merit was difficult or impossible to find. Maintaining this standard of excellence by close breeding may also be possible when both parents are of high individual merit. Instances have occurred in which a new breed has been produced by crossing two or more well-established strains. In theory, the object of crossing two strains is to combine desirable characteristics possessed by each. Limiting factors are time and the expense of keeping the large numbers of animals necessary to fix the type. This system of breeding was followed in developing Polled Herefords, Polled Shorthorns, and the Santa Gertrudis breeds. A purebred sire has often been mated to purebred or high-grade females of another breed for the production of market animals. Crossing of two breeds generally produces offspring possessing greater vigour, ability to grow more rapidly, and ability to use feed somewhat more efficiently than either of the component purebred bloodlines.

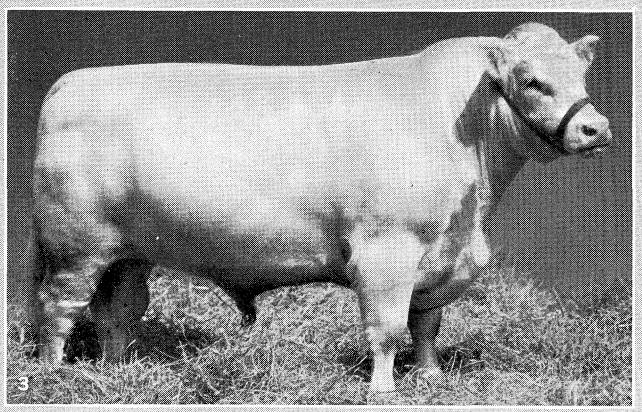
After 1908 a number of co-operative dairy breeding associations were organized in the United States, the main purpose being to obtain for the members the services of registered proved sires at a reasonable cost. Another method of making extensive use of superior sires is by means of artificial insemination. This practice has been widely used in Russia, and where cattle-breeding associations have been organized in the United States and trained technicians are available, there is possibility for its increased usefulness.

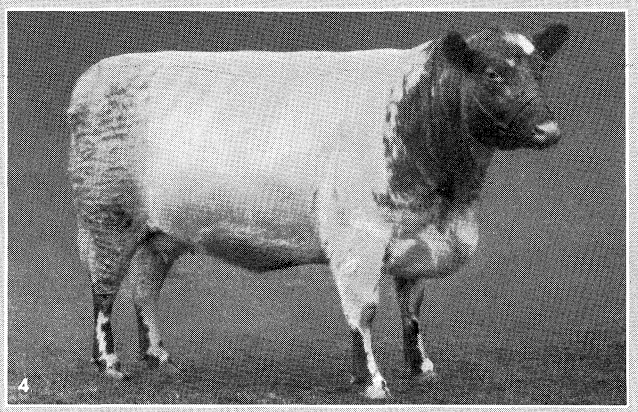
After 1900 there was growing appreciation of the value of scientific knowledge in breeding plans. A scientific approach to

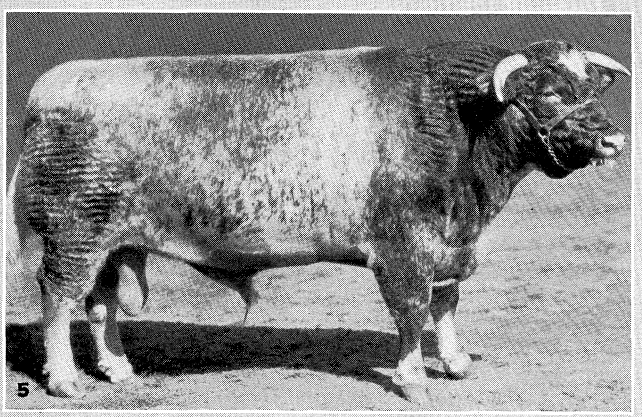
CATTLE

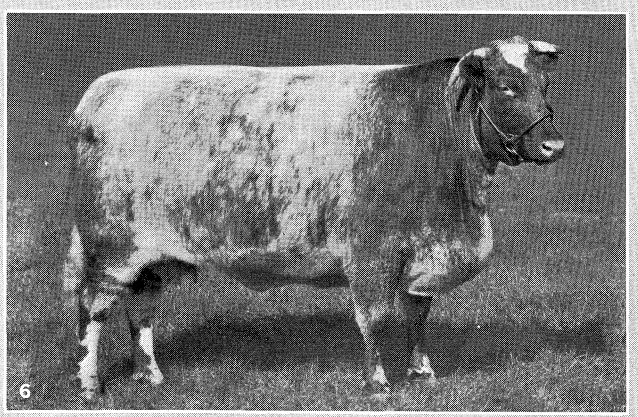














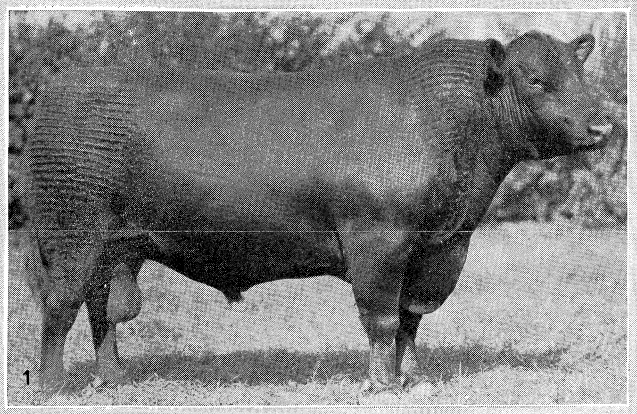


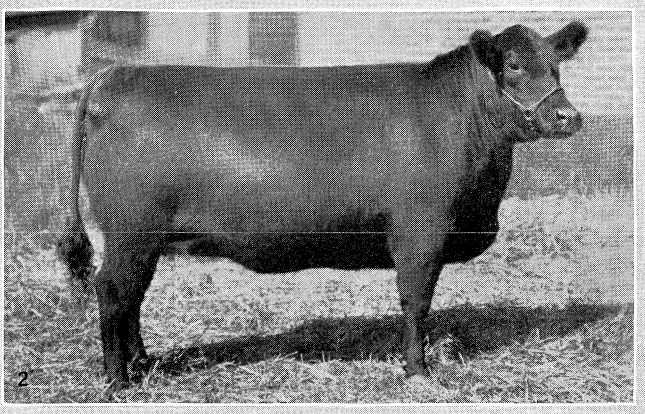
PHOTOGRAPHS, (1, 2, 3, 4, 7, 8) ROBERT F. HILDEBRAND, (5, 6) H. A. STROHMEYER, JR.

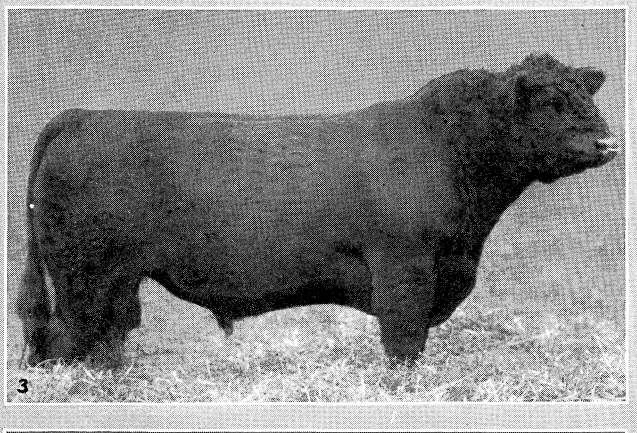
BREEDS OF CATTLE

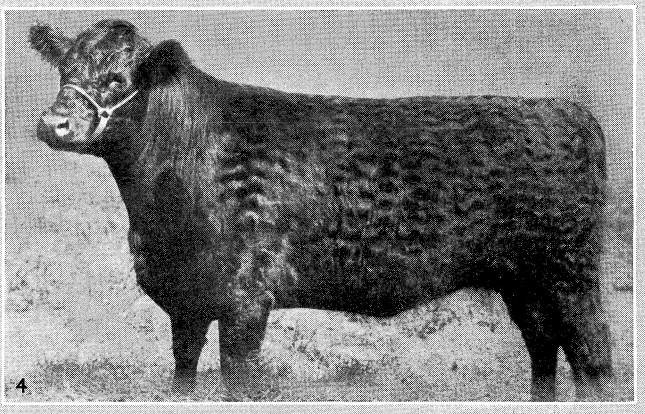
1. Red poll bull
2. Red poll cow
3. Polled shorthorn bull
4. Polled shorthorn cow
5. Shorthorn bull
6. Shorthorn cow
7. Dairy shorthorn bull
8. Dairy shorthorn cow

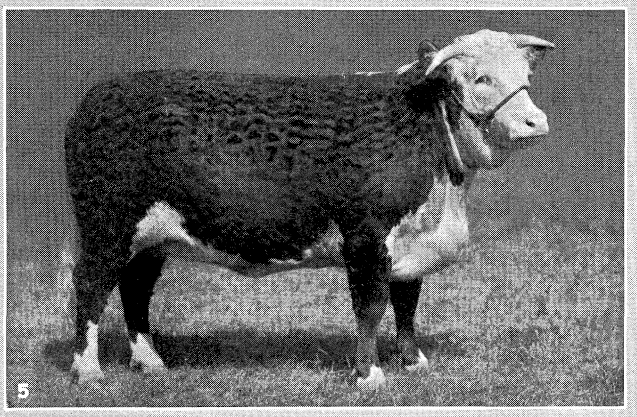
CATTLE

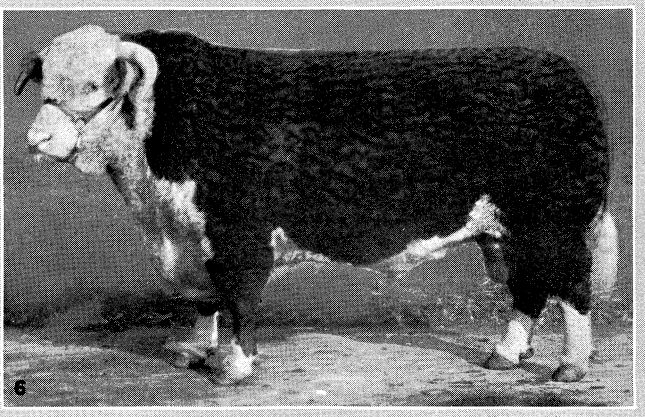

1

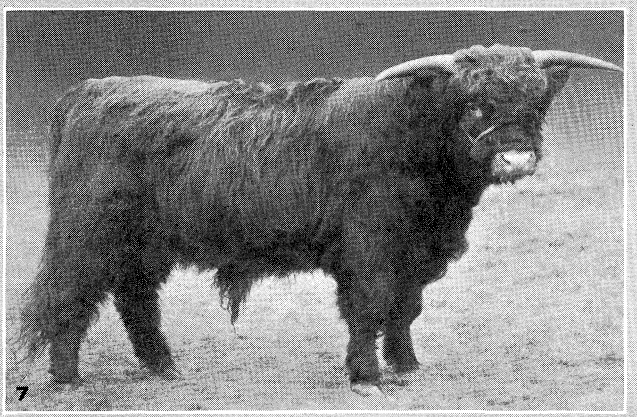

2

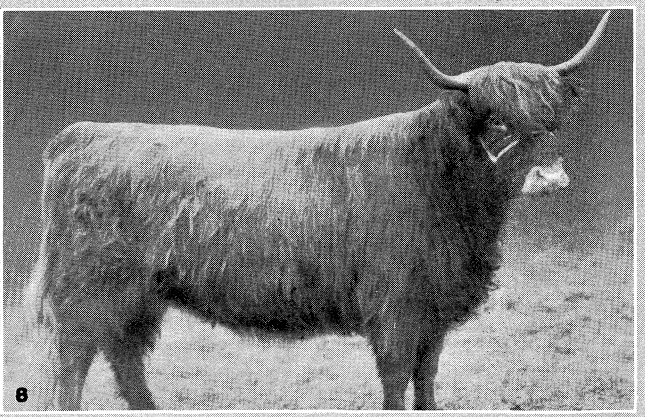

3


4


5


6


7

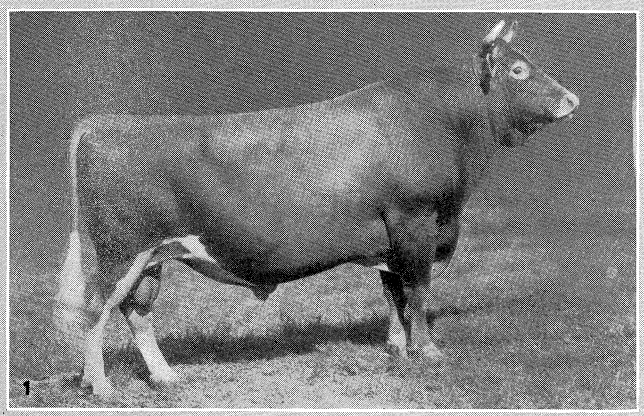

8

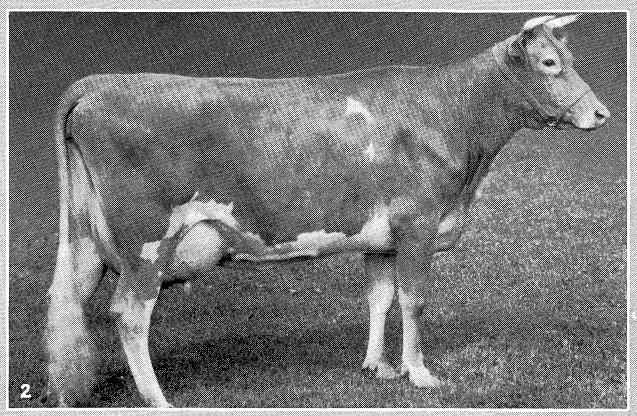
PHOTOGRAPHS, (1, 2) U.S. DEPARTMENT OF AGRICULTURE, (3, 4, 5, 6, 7, 8) HILDEBRAND PICTURES, INC.

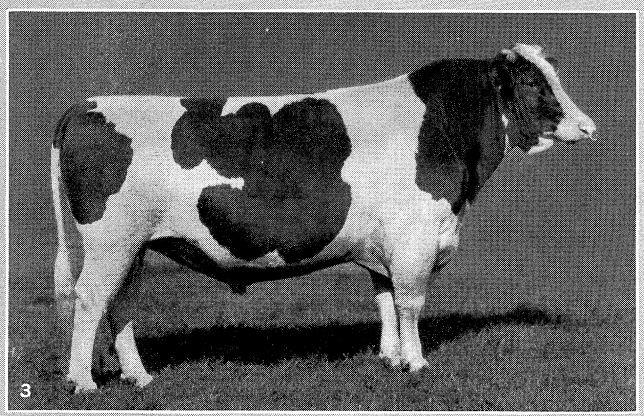
BREEDS OF CATTLE

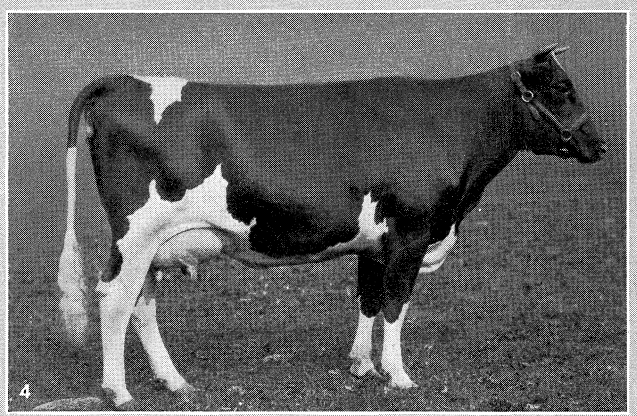
1. Aberdeen Angus bull
2. Aberdeen Angus cow
3. Galloway bull
4. Galloway cow
5. Hereford cow
6. Hereford bull
7. Highland bull
8. Highland cow

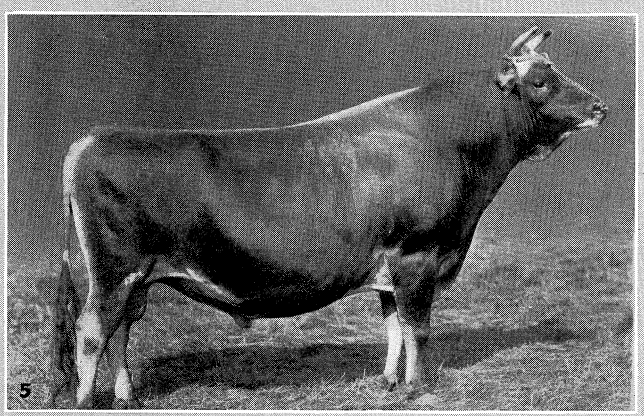
CATTLE

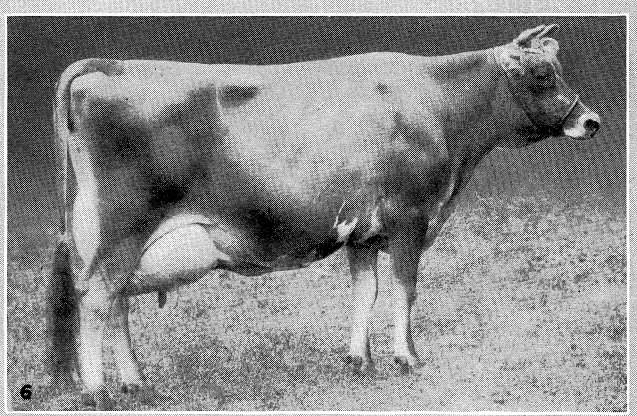


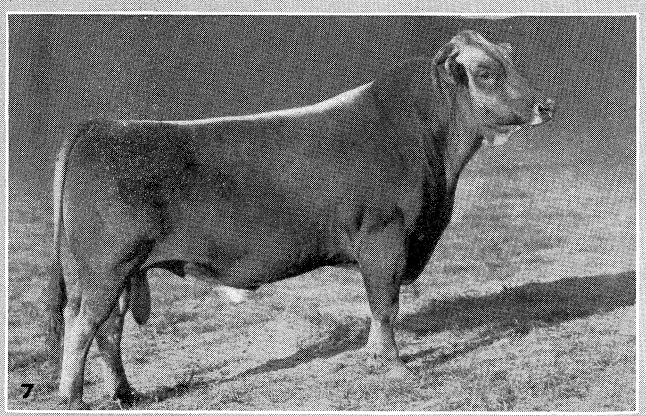


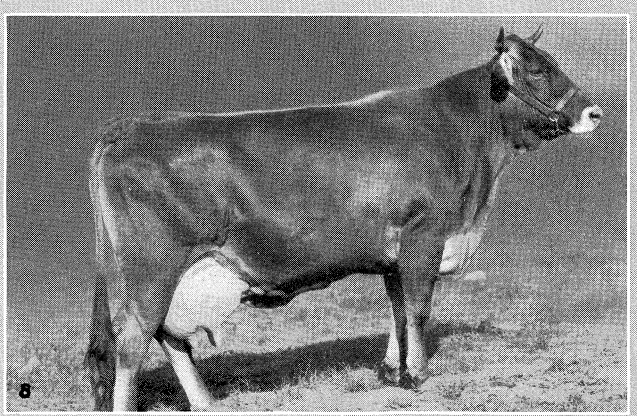










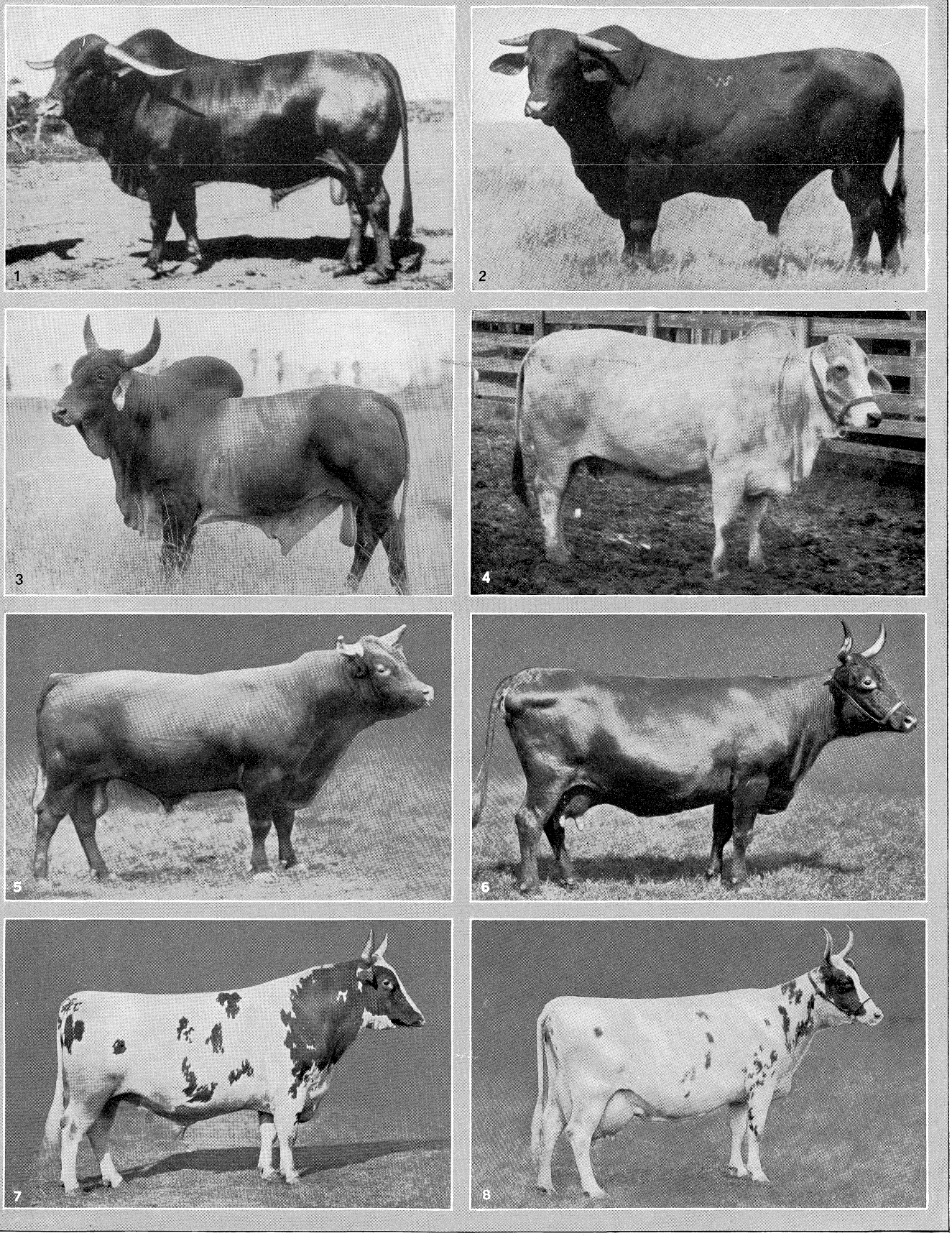


PHOTOGRAPHS, (1, 2, 5, 6, 7, 8) H. A. STROHMEYER, JR., (3, 4) ROBERT F. HILDEBRAND

BREEDS OF CATTLE

1. Guernsey bull
2. Guernsey cow
3. Holstein Friesian bull
4. Holstein Friesian cow
5. Jersey bull
6. Jersey cow
7. Brown Swiss bull
8. Brown Swiss cow

CATTLE



PHOTOGRAPHS (1, 2, 3, 4) U.S. DEPARTMENT OF AGRICULTURE, (5, 6) HILDEBRAND PICTURES, INC., (7, 8) H. A. STROHMEYER, JR.

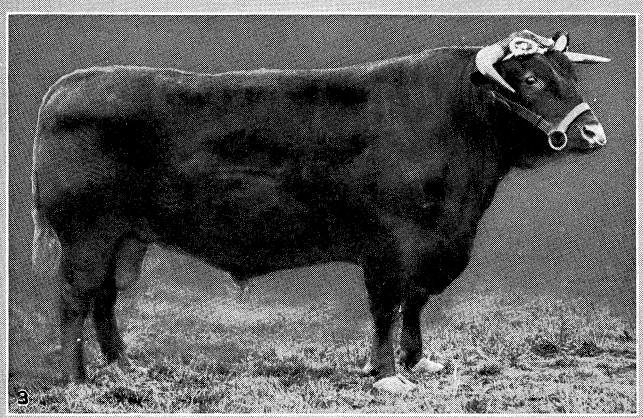
BREEDS OF CATTLE

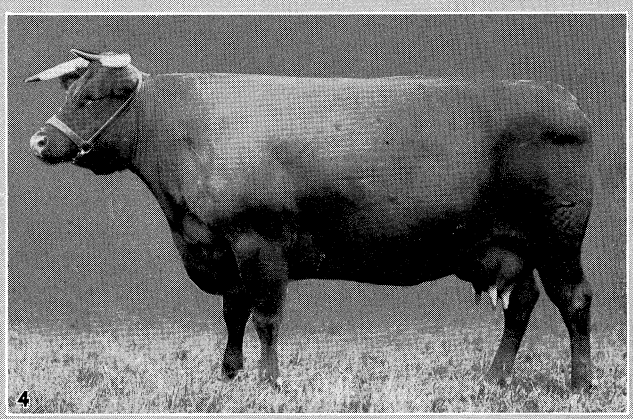
1. Africander bull
2. Santa Gertrudis bull
3. Brahman (zebu) bull
4. Brahman (zebu) cow
5. Devon bull
6. Devon cow
7. Ayrshire bull
8. Ayrshire cow

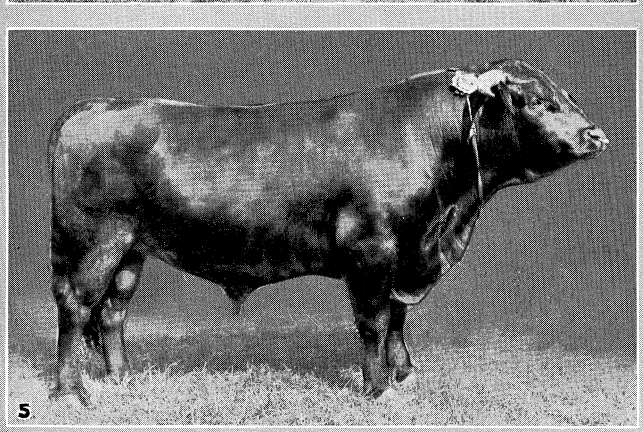
CATTLE

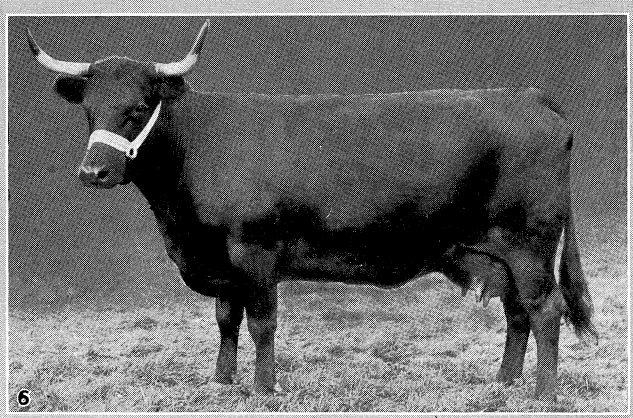


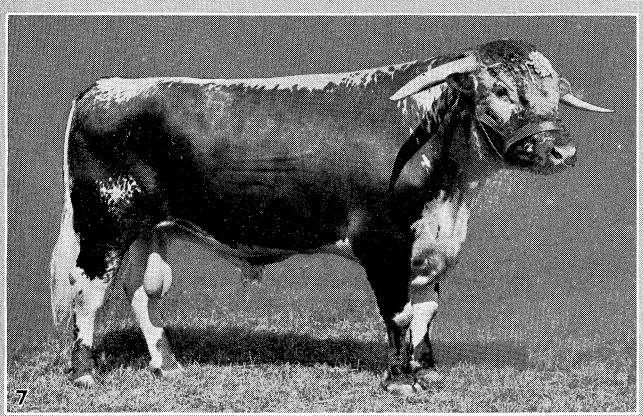


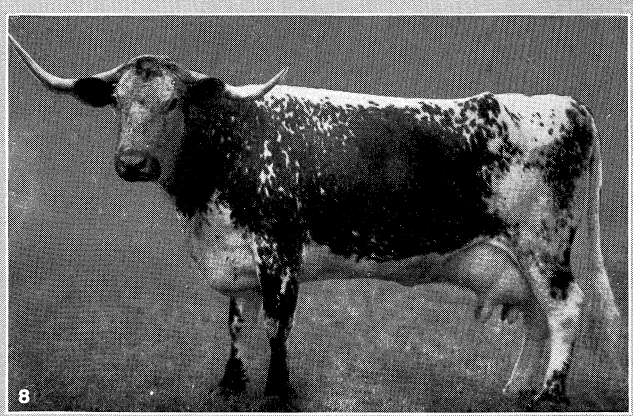












PHOTOGRAPHS, (1, 2, 3, 5, 7) SPORT AND GENERAL PRESS AGENCY, (4, 6, 8) "THE FARMER AND STOCKBREEDER"

BREEDS OF CATTLE

1. South Devon bull
2. South Devon cow
3. Sussex bull
4. Sussex cow
5. Welsh bull
6. Welsh black cow
7. Longhorn bull
8. Longhorn cow

the study and practice of animal breeding has been made through the knowledge that the cell is the physical basis of inheritance and that all inheritance occurs in an orderly manner.

BIBLIOGRAPHY.—V. A. Rice, *The Breeding and Improvement of Farm Animals* (1942); L. M. Winters, *Animal Breeding* (1939); J. L. Lush, *Animal Breeding Plans,* 2nd ed. (1943); John Hammond, *Farm Animals, Their Breeding, Growth, and Inheritance* (1940).

Nutritive Requirements.—The feed consumed by cattle is used for a number of functions, depending to some extent on the purpose for which the animal is maintained. The larger part of the feed is required for normal body functions; the remainder is available for growth, fattening, reproduction and lactation. Sources of nutritive energy, protein, fat, minerals and vitamins are essential for the proper nutrition of cattle. Investigations of maintenance and production requirements have been of a highly technical nature and the results have provided feeding standards. As good pasture has a high content of protein, minerals and carotene, and is an economical source of nutritive elements, pasture improvement has received much attention in the United States. Pasture not only tends to maintain fertility in the herd, but also provides the cows with a surplus of various known and unknown nutritive essentials that can be stored in their bodies and thus ensure them against such deficiencies that might occur from the feeding of low-quality roughage during the winter. Experienced feeders have found that a liberal feeding of protein is necessary for high milk production, with a tendency to supply this element in the form of a vegetable protein from green leafy legumes. Vitamin and mineral requirements have also received considerable attention. The minerals most likely to be needed to supplement feeds are common salt, calcium, phosphorus, iodine and iron. Other minerals are sometimes required. Calcium and phosphorus requirements are closely associated, since the two elements are stored together in nearly fixed proportions in the bones and secreted together in nearly fixed proportions in the milk. If either element is deficient in the feed, both bone building and milk secretion are hindered. Phosphorus deficiency is a more common cause of nutritive trouble with cattle than calcium deficiency, since the soil in some parts of the world is deficient in phosphorus, and the forage of these areas is deficient in this element. Where cattle subsist almost entirely on the range it is practical and sometimes less expensive to supply phosphorus and perhaps other minerals from sources other than grain and forage crops.

As with minerals, vitamins are perhaps of greater concern in rations for growing and breeding stock than for fattening cattle. Vitamin A appears to be the one most likely to be deficient in feeds for dairy cows, or for steers fattened in areas where green leafy forage and yellow grain are limited. Newborn calves have no reserve of this element but it is supplied by colostrum. Carotene, the yellow pigment of the plant from which vitamin A is formed in the animal body, occurs in close association with the green colouring matter of pasture plants and other green forage. As a rule, the greener the colour of the hay, the greater the amount of carotene, but hay stored for long periods tends to lose much of its carotene though still retaining most of its colour. Cattle must have an adequate supply of vitamin D to enable them efficiently to assimilate and utilize the calcium and phosphorus in their feed. It is believed that farm animals of all types generally receive an adequate supply of this vitamin by exposure to the sun's rays, depending on the intensity of the sunlight and its concentration of ultraviolet rays. Knowledge of nutritional requirements of cattle is very rapidly changing and still incomplete, and must constantly be reappraised as newer knowledge is obtained. (*See* also FEEDING STUFFS AND LIVESTOCK FEEDING.)

BIBLIOGRAPHY.—F. B. Morrison, *Feeds and Feeding* (1936); L. A. Maynard, *Animal Nutrition* (1937); R. R. Snapp, *Beef Cattle, Their Feeding and Management in the Corn Belt States,* rev. ed. (1930).

Management, Care and Handling.—The management and care of beef and dairy cattle are highly specialized practices. In the United States, for example, the feeding of beef cattle in the corn belt states, the production of feeder and grass-fat cattle on the ranges of the west, and the production of milk in the dairy sections of the northeast and middle western states, all require a high degree of skill with different equipment and management practices. The range area is composed of plains and mountainous areas useful for grazing purposes. Practical ranch operation commonly involves attention to deferred and selective grazing to maintain the supply of forage, selection and culling of the breeding herd, controlled breeding, a well-arranged water supply and the production of winter feed where necessary. All of these practices are conducive to good condition of the breeding herd and a satisfactory crop of vigorous calves capable of making good gains.

On a well-managed ranch, a relatively high percentage of the investment is in the livestock rather than equipment. The range may be fenced or not, depending on the type of ranch. Corrals are used where large numbers of cattle are handled. In connection with the corral, a chute for holding cattle while being branded or vaccinated is usually a desirable investment. Range cattle are branded as a means of identification. Brands are recorded by the owner in the state where the ranch is located. Rounding up cattle or working the range is a time of great activity, especially when fat cattle are to be shipped, the breeding herd shifted to winter range, and calves separated from their dams to be sold as feeders or held on the ranch. The winter range is usually a pasture or range that offers some natural protection from winter storms and provides grass or browse that is suitable for winter grazing. When necessary, maintenance rations of cheap roughages or small amounts of protein supplement are fed during the winter or early spring.

The fattening of beef cattle in the United States is closely related to the production of calves and yearlings in the range area. The most important feeding area is the corn belt states of the middle west where calves or yearlings from the western ranges are fattened in dry lots. These cattle are fed corn and hay in feed bunks with some silage, salt, and minerals. Most cattle feeders take it as a matter of course that cattle feeding can not be made a successful enterprise without having hogs in the feed lot with the cattle. Inexpensive barns or sheds, feed racks and an adequate water supply are the most important items of equipment which with feed and labour go to make up the feeding operation.

While the production of feeder and grass-fat cattle in the range states is a highly specialized form of beef-cattle production in the United States, the maintenance of comparatively small breeding herds of registered cattle in many of the other states, as well as in the range area, requires a high degree of skill. Their care, management, and breeding differ from those under which commercial range herds are handled. The registered cattle are produced primarily for breeding purposes and receive more attention and are fed more liberally as a rule than cattle produced primarily for slaughter. Breeding herds are made up of highly selected individuals conforming to the standards of the breed. Cows are bred to calve throughout the year, but most of the calves are born late in winter or early in the spring. During the summer months these calves run with their dams and may be fed grain in creeps while on pasture. Cows are usually maintained on pasture and roughage produced on the farm. Young cattle are given every opportunity to develop as considerable income is derived from the sale of young cattle, especially bulls, either at private sale or auction.

Dairy farming in the United States is usually distinct from the production of beef, but a certain amount of overlapping occurs. Approximately two-thirds of the dairy cows are cattle of specialized dairy breeds; the remainder consist of cattle of beef, dual-purpose, and mixed breeding. In commercial herds, replacements are commonly bought but some breeders grow their own replacements in order to improve production and lessen the danger of disease. Good cattle and modern methods of care and management are important elements in profitable dairying. Barns and equipment should be designed for producing and caring for milk efficiently and in a sanitary manner. The most common type of dairy barn in northern states is the two-story type with a loft for hay storage above the cows, whereas in the south where stor-

age capacity is not so necessary, the one-story barn is more widely used. Practically every dairy farmer having a sufficient number of cattle to make the use of a silo profitable has one. Floors of dairy cattle barns are preferably of concrete, and the most common method of confining cows is with swinging stanchions. Water is often provided by means of automatic drinking fountains. Cows are milked twice daily, except in cases of advanced register or register of merit where three- and four-time milking may be practised. Milking machines are used successfully, especially where there is a labour shortage. On well-managed dairy farms each milking is weighed and butterfat tests are made at regular intervals. Most of the dairy breed associations have adopted herd-test plans under which all registered cows of the herd are tested. All these records are used as a part of the plan to show which cows are the most profitable. As feed is an important item in the cost of production, attention is given to the maintenance of pastures for summer feeding and the production of good-quality roughage for winter feeding. Good feeding, good breeding and the production of a sanitary product are the aims of the progressive dairyman.

BIBLIOGRAPHY.—R. R. Snapp, *Beef Cattle, Their Feeding and Management in the Corn Belt States,* rev. ed. (1930); C. H. Eckles, E. L. Anthony, and L. S. Palmer, *Dairy Cattle and Milk Production,* rev. ed. (1939). (A. C. CK.)

Diseases of Cattle.—The greatest hazard to success in rearing cattle, practically anywhere, is disease. The most destructive diseases are caused by infections with filterable viruses and bacteria, but fungi, parasites, poisons, malnutrition and disturbances of metabolism also exact heavy tolls.

Foot-and-mouth disease, or aphthous fever, probably is the most widespread and contagious of all infectious maladies of animals. Cattle and other cloven-footed animals, including swine, sheep and goats, are susceptible. As the name indicates, the principal lesions occur in the mouth and on the feet. Heavy death losses are infrequent except in extremely virulent outbreaks. Generally, however, great losses accrue from impaired growth, reduced milk flow, loss of body weight, and secondary infections. Even the most rigid quarantines and restrictions of movements of animals and animal products sometimes fail to control the spread of the malady. In the United States, the immediate slaughter of affected and exposed animals effected complete eradication of the infection on six occasions after 1900. This procedure has been adopted from time to time in England and some of the countries on the European continent, but the proximity of areas in which the disease has become established is a constant hazard. The disease is prevalent in most of Europe, Asia, Africa and South America but (1945) had not occurred in the United States after 1929.

Rinderpest, or cattle plague, a highly fatal, contagious, filterable-virus disease, was widespread in the 19th century practically all over the world but has not occurred in North America. Vigorous eradication measures were widely applied, and it remains only in Asiatic countries and parts of Africa. The disease is characterized chiefly by severe gastrointestinal involvement, but in some cases it may be readily confused with foot-and-mouth disease.

Contagious pleuro-pneumonia, or lung plague, was prevalent in many countries before the 20th century. By means of quarantines and slaughter of affected animals, the disease has been eradicated from Europe and North America. It persists in Asia, Australia, and parts of Africa.

Tuberculosis in cattle is a widespread, chronic, bacterial disease caused by an organism closely related to that of human tuberculosis. Almost all mammals, including man, are susceptible to bovine tuberculosis. Cattle are relatively insusceptible, however, to the human and avian types of the infection. The bovine infection may be readily conveyed by infected milk and milk products. Pasteurization is an effective safeguard. The disease may be successfully controlled by repeated application of the tuberculin test. Tuberculin, discovered by Robert Koch in 1890, is a refined, noninfective product of the growth of the tubercle bacillus, *Bacillus* (*Mycobacterium*) *tuberculosis,* on an artificial medium. When tuberculin is injected into an infected animal a characteristic reaction results by which the disease may be diagnosed even in very mild cases. The infected animals may then be placed in quarantine, thus reducing spread of the disease, or they may be slaughtered at once. The latter procedure has been followed in the United States and the extent of bovine tuberculosis, formerly averaging about 5% and much higher in some areas, has been reduced to less than 0.5% in all parts of the country.

Brucellosis, or Bang's disease, which is characterized by abortion and sterility, is a serious problem wherever intensive breeding operations are conducted. In Europe, as many as 40% to 60% of the cattle in some regions are infected. The disease is also prevalent in North and South America and elsewhere. Man frequently contracts the infection, which is then referred to as undulant fever. Diagnosis is accomplished by blood tests. Control may be effected by segregation of affected animals and by vaccination procedures, applied particularly to calves.

Mastitis, or inflammation of the udder, rivals all bacterial diseases of dairy cattle in the aggregate loss it causes. It occurs in acute and chronic forms. Death rarely results but the infection causes alteration and material reduction of the milk secretion. Since the development of the sulfonamides and other modern therapeutic products, considerable success has been achieved in treatment. Control by segregation of affected animals and the adoption of careful sanitation are of great importance, however.

Johne's disease, or paratuberculosis, is a chronic disease of cattle, which causes considerable loss in Great Britain, North America and other parts of the world. The causative organism, *Bacillus* (*Mycobacterium*) *paratuberculosis,* produces a chronic dysentery which results in progressive emaciation and death in many cases.

Two very acute, fatal, bacterial diseases of cattle are anthrax and black quarter (blackleg). These occur in quite definitely defined districts in widely separated parts of the world. In these areas, vaccination with biological products prepared from the respective causative bacteria is generally effective in control. Anthrax may be acquired by other animals and also by man.

Bovines, like other ruminants, possess a complex stomach having four compartments, the largest of which, the rumen, or paunch, has a capacity of as much as 50 gal. This anatomical peculiarity is responsible for frequent digestive disturbances. Bloat and impaction are common. Cattle also frequently suffer from perforations of the stomach by foreign metallic objects which are commonly ingested with the feed and cause death if they penetrate the heart sac.

Calves, especially those of the dairy breeds, commonly develop fatal enteric disorders unless special care in feeding and sanitation is taken.

Dairy cows are prone to develop metabolic diseases. Milk fever, or parturient paresis, is the commonest of these. It occurs usually just after parturition and invariably results in death if treatment is not given. Another such disease is acetonaemia, or ketosis, in which there are acidosis, subnormal quantities of sugar in the blood and faulty fat metabolism, with excess formation of ketones in the body.

Cattle may be afflicted with other diseases, infectious and otherwise, which cause considerable losses under certain conditions. These include actinobacillosis and actinomycosis, both commonly referred to as lumpy jaw; cowpox, which is closely related to smallpox; epithelioma (cancer eye); pasteurellosis (haemorrhagic septicaemia); infectious keratitis (pink eye); leukaemia; rabies; and rickets.

BIBLIOGRAPHY.—Hutyra, Marek and Manninger, *Special Pathology and Therapeutics of the Diseases of Domestic Animals* (1938); U. S. Department of Agriculture Yearbook, "Keeping Livestock Healthy" (1942). (M. S. SN.)

Parasites of Cattle.—Parasites of cattle, belonging to such zoological groups as protozoa, worms and arthropods, cause extensive economic loss. Successful control measures generally consist in attacking the various parasites at vulnerable points in their life cycles.

The diseases caused by protozoa, or one-celled animals, are especially important in tropical and subtropical countries. Among the most destructive are piroplasmosis or tick fever, anaplasmosis, surra and nagana. All these diseases are caused by minute parasites that live in the red blood cells or in the blood stream, and are usually transmitted by blood-sucking arthropods such as ticks and flies; they are generally characterized by fever and destruction of the red cells. The monetary loss from these diseases is very great, *e.g.*, in the United States the estimated losses from piroplasmosis about 1900 were $40,000,000 annually. However, by the end of 1943 more than 99% of these losses had been eliminated through eradication of cattle ticks by systematic dipping of ticky cattle in standardized arsenical dips. Control of other protozoan blood diseases, especially those transmitted by flies, has been less satisfactory.

Other protozoan diseases of cattle are coccidiosis and venereal trichomoniasis. Coccidiosis is an intestinal disease characterized by bloody diarrhoea and emaciation. It is caused by sporozoan parasites that infect the inner lining of the intestine. The infection is largely in calves and is controlled by strict sanitation. Venereal trichomoniasis is caused by a small flagellate organism that is transmitted through coitus. Infection results in early abortion, sterility, and other breeding difficulties.

The worm parasites are flukes, tapeworms and roundworms. The common liver fluke (*Fasciola hepatica*) lives in the bile ducts; it causes extensive damage to the liver and general unthriftiness of the infected animal. The complicated life history and control measures are the same as those discussed under diseases and parasites of sheep. (*See* SHEEP: *Parasites of Sheep.*)

Several species of tapeworms infest the digestive tract but these worms do not appear to cause extensive injury. The larval or bladderworm stage of the common tapeworm (*Taenia saginata*) of man occurs in the muscles and causes a condition known as "measly beef." Cattle acquire the infestation by swallowing the eggs while grazing on pastures that have been contaminated by excrement from tapeworm-infested persons.

Important roundworm parasites are lungworms, stomach worms, and intestinal threadworms of which there are numerous species. All these worms are acquired by picking up the infective larvae while grazing. Roundworms cause unthriftiness, anaemia and digestive disturbances, especially diarrhoea. The injurious effects are most pronounced in calves and in animals under two years of age. Sanitation, pasture rotation and avoidance of overstocking tend to control worm parasites. Medicinal treatment with anthelminthic drugs, especially phenothiazine, is of value in controlling stomach and intestinal roundworms.

The arthropod parasites include the ticks, mites, lice and flies. Aside from ticks and certain flies that transmit tick fever, anaplasmosis and other protozoan blood diseases, the most injurious arthropod parasites are the warble flies, *Hypoderma lineatum* and *H. bovis*. These flies lay their eggs on the legs of cattle. In a few days the eggs hatch and the young larvae penetrate the skin. They then migrate through the tissues of the body and eventually reach the back. Here the larvae or grubs, as they are sometimes called, complete their growth and produce swellings. The skin over each swelling becomes perforated and the holes so formed permit the larvae to breathe and to escape when they have completed their growth. The annual loss caused by ox warbles is estimated at $50,000,000 for the United States and £160,000,000 for the entire British empire. A somewhat similar fly larva (*Dermatobia hominis*), commonly referred to as nuche or gusano, infests cattle in Central and South America. The adult fly does not deposit its eggs directly on the skin as do the warble flies, but lays them on the bodies of mosquitoes and other blood-sucking insects. The eggs hatch and the larvae crawl onto the skin when the insect is feeding. Hatching is stimulated by the warmth of the victim's body. Ox warbles may be controlled to some extent by manual extraction of the grubs or by the use of dusts, dips or washes containing insecticidal substances such as rotenone.

Other arthropods such as ticks, mites, lice and flies inflict considerable injury to animals by abstracting blood and causing irritation to the skin. Such parasites living habitually on their hosts may be controlled by the use of insecticidal dips, washes or dusts; flies are best controlled by destruction of their breeding places.

BIBLIOGRAPHY.—"Diseases of Cattle," U.S. Dept. Agric., Washington (1942); "Keeping Livestock Healthy," Yearbook, U.S. Dept. Agric., Washington (1942). (E. W. PE.)

CATULLUS, GAIUS VALERIUS (84?–54 B.C.), the greatest lyric poet of Rome. As regards his names and the dates of his birth and death, the most important external witness is that of Jerome, in the continuation of the Eusebian *Chronicle*, under the year 87 B.C., "Gaius Valerius Catullus, scriptor lyricus Veronae nascitur," and under 57 B.C., "Catullus xxx. aetatis anno Romae moritur." There is no controversy as to the gentile name, *Valerius*. Suetonius, in his *Life of Julius Caesar* (ch. 73), mentions the poet by the names "Valerium Catullum." Other persons who had the *cognomen* Catullus belonged to the Valerian gens, *e.g.* M. Valerius Catullus Messalinus, a *delator* in the reign of Domitian, mentioned in the fourth satire of Juvenal (l. 113).

Inscriptions show, further, that *Valerius* was a common name in the native province of Catullus, and belonged to other inhabitants of Verona besides the poet and his family (Schwabe, *Quaestiones Catullianae*, p. 27). Scholars have been divided in opinion as to whether his *praenomen* was *Gaius* or *Quintus*, and in the best MSS. the volume is called simply *Catulli Veronensis liber*. For *Gaius* we have the undoubted testimony, not only of Jerome, which rests on the much earlier authority of Suetonius, but also that of Apuleius. In support of *Quintus* a passage was quoted from the *Natural History* of Pliny (xxxvii. 6, 81). But the *praenomen* Q. is omitted in the best MSS., and in other passages of the same author the poet is spoken of as "Catullus Veronensis." The mistake may have arisen from confusion with Q. Catulus, the colleague of Marius in the Cimbric War, himself also the author of lyrical poems.

Internal evidence shows that certain poems were written two or three years after 57 B.C., the date of Catullus' death according to Jerome. Thus cxiii. was composed in 55 B.C., lv. either in that year or later, while xi., xxix., xlv. all appear to be written after Caesar's first invasion of Britain (55 B.C.). He is described by Ovid as "hedera juvenalia cinctus Tempora,"—a description somewhat more suitable to a man who dies in his thirtieth year than to one who dies three or four years later. Since no poem is certainly later than 54 B.C., it is best to retain Jerome's reckoning of Catullus' age as 30 years but to suppose him to have lived from 84 to 54 B.C.

Jerome's statement that Catullus was born at Verona is confirmed by other authorities. His father was important enough to act as Caesar's host, and it was probably at or near Verona that Caesar accepted the poet's apologies for the attacks on himself and Mamurra (xxix. and lvii.: *see* Suetonius *Jul.* 73); xciii. may represent Catullus' reply to earlier advances on Caesar's part. The poet's attitude was not due to republican sentiment, but the result of personal animosities. In xxix. he arraigns Pompey along with Caesar, and in xi. he recognizes the latter's greatness.

Catullus' complaints of poverty are not to be taken very seriously. He possessed a villa at Tibur as well as a retreat at Sirmio on Lake Garda, and the poems prove that he had the means to figure in the best society. Still his purse was often no doubt, as he says, "full of cobwebs" (xiii. 8).

On reaching manhood Catullus was sent to try his fortune at Rome. The premature death of his brother in Asia Minor seems to have recalled him to Verona (*cf.* lxviii.). In 57 B.C. he made a belated attempt at a public career by accompanying Memmius, the patron of Lucretius, to Bithynia, of which province Memmius had been appointed governor. His hopes of lining his purse at the expense of the provincials were not realized, and in the spring of 56 B.C. he left Nicaea (xlvi.) and returned to Italy, perhaps on his own yacht (*cf.* iv.); *en route* he visited his brother's tomb in the Troad (ci.). His delight at seeing Sirmio once more is charmingly expressed in xxxi. The poems show that his last years were divided between Verona and Rome. As a Transpadane, Catullus found many compatriots in the capital, and among them several representatives of the new movement in poetry led by Valerius Cato,

himself a native of Cisalpine Gaul. The poems reveal him on terms of intimate friendship with certain of the younger members of this circle; *e.g.,* Calvus (xiv., l., liii., xcvi.), Cinna (x., xcv., cxiii.), Cornificius (xxxviii.). He appears to have been acquainted with the two leading orators of the day—Cicero (xlix.), and Hortensius (lxv. and xcv.). Among friends of less eminence he counted a Caelius (lviii.) whom some identify with Cicero's protégé M. Caelius Rufus, thinking that lxix. and lxxvii. addressed to a Rufus, refer to the same man; this is possible, but in that case another Caelius must be meant in c., since Cicero's friend was not a native of Verona. Particularly dear to Catullus, but otherwise unknown to us, were two friends Veranius and Fabullus (ix., xii., xiii., xxviii., xlvii.), while in i. he dedicates his *libellus* to the biographer and historian Cornelius Nepos, who in after years left it on record that in his opinion Catullus and Lucretius were the two greatest poets of that period (Nepos, Life of Atticus xii., 4). Among Catullus' enemies the most furiously attacked in the poems—apart from Caesar and his lieutenant—are the pair Furius and Aurelius (xv., xvi., xxi., xxiii., xxiv., xxvi.), and one Gellius, who is the target of no fewer than seven epigrams. Other victims of his invective are Ravidus (xl.) and Rufus (*see* above), his rivals in love; a freedman Thallus (xxv.); a ridiculous fop Egnatius (xxxvii., xxxix.). To a false friend Alfenus he writes more in sorrow than in anger (xxx.). The most important influence in Catullus' life was that of his mistress Lesbia. Her real name was Clodia (Apuleius, *Apol.* 10); Catullus chose the pseudonym for its connection with Sappho (li., a translation of a famous ode of Sappho, was perhaps a first tribute to his mistress' charms). There can be little doubt that Clodia was the notorious sister of the demagogue, married in 63 B.C. to Q. Metellus Celer and suspected of responsibility for his death in 59 B.C. Cicero mentions her several times in his Letters, and has left a graphic picture of this dangerous beauty in the speech (*Pro Caelio*), in which he defended M. Caelius Rufus (*see* above), also one of her lovers, against the charge of having tried to poison her. Though Cicero writes as an advocate and Catullus as a lover, their descriptions are not inconsistent, and the final proof of identity is contained in lxxix., the *Lesbius* of which poem clearly covers a Clodius, not, however, the demagogue P. Clodius, but Sex. Clodius, a kinsman and associate of Publius, whom rumour represented as having relations with Clodia (Cicero, *De Dom.* 25) similar to those attributed to *Lesbius* by Catullus. A recent attempt to identify Lesbia with a younger sister and namesake of Metellus' wife, who married L. Lucullus and was divorced by him for alleged relations with her brother, appears unconvincing. Catullus was Clodia's lover during Metellus' lifetime (*cf.* lxxxiii.); the husband's death apparently brought other rivals on the scene, and Catullus' allegiance had been sorely tried before he left for Bithynia, but xi., the final renunciation, is subsequent to his return (*see* above). The data do not suffice to fix the course of the liaison more exactly.

Catullus' poetical activity began soon after his assumption of the *toga virilis* (*cf.* lxviii. 15–17); references in the poems suggest that he sometimes published his pieces separately or in small groups (*cf.* i. 4; xvi. 3.; xlii.; xliii. 7; liv. 6). Later (*cf.* i.) he formed a collection of his compositions and dedicated it to Cornelius Nepos, but it is a moot point what this *libellus* contained, whether it was identical with the present collection, and, if not, how the latter was formed. As arranged in the mss., the poems fall into three sections, viz., (1) i.–lx., shorter lyric pieces, (2) lxi.–lxviii., longer poems in a variety of metres, (3) lxix.–cxvi., elegiac epigrams. The hypothesis most in favour recently is that our present collection was formed in outline by Catullus himself before his death, and that afterwards his literary executors inserted in the groups so arranged sundry other material discovered among his remains, including unfinished pieces like xiva. and lx.

Though Catullus was an Italian of the Italians in character and temperament, it is impossible to appreciate his poetry correctly except in relation to Greek and more particularly Alexandrian poetry. Like that of the other *novi poetae,* his work has two aspects. On the one hand we have the shorter pieces in which any and every emotion of the moment finds instant expression, on the other the poems which earned Catullus the title of *doctus,* considerably longer than his *nugae* but short when compared with the Annales of a Volusius (xxxvi., xcv.). The poet's debt to Alexandrian models in these longer compositions, though hard to control to-day owing to the fragmentary survival of later Greek poetry, is universally admitted. Catullus himself declares lxvi. to be a translation from Callimachus (*cf.* lxv. 16); lxiv. is cast in the mould of a Hellenistic *epyllion;* lxviii., a mixture of the personal and narrative elegy, framed as a letter to a friend, also has Alexandrian forbears; lxii. adapts an epithalamium of Sappho after the manner of the later Greeks; even lxiii. (the *Attis*) which gives an impression of striking originality probably follows in the track of Callimachus or some other Alexandrian. The most original of these longer poems is probably lxi., the epithalamium for Manlius Torquatus and Vinia (or Iunia) Aurunculeia, since here Catullus has tried to fuse the native *versus Fescennini* with the Greek *hymenaeus;* it contains touches, *e.g.,* 216–220, marked by a tenderness unknown otherwise before Virgil. Even in the *nugae* Catullus' debt to Greece is greater than was realized till recently. Just as the life of the γεώτεροι with its interest centred on love and letters had been anticipated by that of the later Greeks (compare l. with the lines of Hedylus [*flor. circ.* 290 B.C.] preserved in Athenaeus xi. 473a; *see* also xxxv. and xxxviii.), so the forms, lyric παίγνιον and elegiac epigram, to express these emotions, had been fixed by the same predecessors. Hellenistic lyric only surviving in meagre fragments, Catullus' originality appears greater here than in his elegiacs which we can compare with the epigrams of the Greek Anthology, but metre (especially the scazon iambic and phalaecan hendecasyllabic), subject-matter, and often phrasing indicate his obligations. The poems on Lesbia's sparrow (ii. and iii.) and that on the yacht (iv.) had Hellenistic prototypes, and an Alexandrian element crops up even in such an ardent love-poem as vii. (*cf.* ll. 3–6). Nevertheless it is in these shorter pieces that Catullus is most Roman and most himself. The attacks on the smaller fry who had incurred his displeasure often revolt us to-day by their gratuitous obscenity, but the *iambi* on Caesar and his associates, which recall but far surpass in bitterness the popular lampoons current at the expense of the *imperator unicus,* were justly considered by their chief victim to have branded him with *perpetua stigmata.* On the other side the Lesbia cycle cannot be paralleled in ancient literature for sincerity of passion, passing through all the stages of joyous contentment, growing distrust, and wild despair to the poignant adieu of the disillusioned lover.

The best edition of Catullus is that by W. Kroll (Leipzig, 1923). The best English commentary is that by R. Ellis (2nd ed., 1889). Neither the current Oxford text (1904) nor the Teubner (1923) can be considered satisfactory. Volume vi. of the Loeb Classical Library (1912) contains a text and translation of Catullus along with Tibullus and the *Pervigilium Veneris.* The most recent translations into English are by Sir William Marris (1924) and F. A. Wright (n.d.). *See* also H. A. J. Munro, *Criticisms and Elucidations of Catullus* (2nd ed., 1905); K. P. Harrington, *Catullus and his Influence* (1923); Frank Tenney, *Catullus and Horace* (1928). (E. A. B.)

CATULUS, the name of a distinguished family of ancient Rome of the gens Lutatia. The following are its most important members:

1. GAIUS LUTATIUS CATULUS, Roman commander during the first Punic War, consul 242 B.C. With a fleet of 200 ships, he occupied the harbours of Lilybaeum and Drepanum. The Carthaginian relieving fleet was totally defeated off the Aegates Islands, March 10, 241, and Catulus shared in the triumph, though, owing to a wound, he took no part in the operations. (*See* PUNIC WARS: First, *ad fin.*)

2. QUINTUS LUTATIUS CATULUS, Roman general and consul with Marius in 102 B.C. In the war against the Cimbri and Teutoni (*qq.v.*) he was sent to hold the passage of the Alps, but was forced back over the Po (*see* MARIUS, GAIUS). In 101 the Cimbri were defeated on the Raudine plain, near Vercellae, by the united armies of Catulus and Marius. The chief honour being ascribed to Marius, Catulus became his bitter opponent. He sided with Sulla in the civil war, was included in the proscription list of 87, and committed suicide. He was distinguished as an orator and writer, and is said to have written the history of his consulship and the

Cimbrian War. Two epigrams by him have been preserved and are published in W. W. Merry's *Fragments of Roman Poetry* (Oxford, 1898, p. 173). *See* Plutarch, *Marius, Sulla;* Appian, *B.C.* i, 74; Vell. Pat. ii, 21; Florus iii, 21; Val. Max. vi, 3, ix, 13; Cicero, *De Oratore*, iii, 3, 8; *Brutus,* 35.

3. QUINTUS LUTATIUS CATULUS (*c.* 120–61 B.C.), son of the above, was a consistent supporter of the aristocracy. In 78 he was consul with Marcus Aemilius Lepidus, who proposed the overthrow of the Sullan constitution. Catulus vigorously opposed this, but Lepidus marched on Rome at the head of an army. He was defeated by Catulus and Pompey and fled to Sardinia. In 67 and 66 Catulus unsuccessfully opposed the Gabinian and Manilian laws, which conferred special powers upon Pompey. He consistently opposed Caesar, whom he tried to implicate in the Catilinarian conspiracy. Caesar, in return, accused him of embezzling public money during the reconstruction of the temple on the Capitol. Catulus's supporters rallied round him, and Caesar dropped the charge. Although not a man of great abilities, Catulus exercised considerable influence through his political consistency and his undoubted solicitude for the welfare of the state.

See Sallust, *Catilina,* 35, 49; Dio Cassius xxxvi. 13; Plutarch, *Crassus;* Suetonius, *Caesar,* 15.

CAUCA, a department of Colombia, South America, lying on the Pacific coast. Pop. (1938) 356,040; area 11,660 sq.mi. The Western Cordillera, traversing nearly its whole length from south to north, and the Central Cordillera, forming a part of its eastern frontier, give a very mountainous character to the region. It includes, besides, the fertile and healthful valley of the upper Cauca, and a part of the coastal plain. The region is rich in mines and valuable forests, but its inhabitants have made very little progress in agriculture because there are not adequate transportation facilities. Capital of department is Popayán, pop. (1938) 18,292.

CAUCASIAN AREA, NORTH. A natural area and former province in the Russian Soviet Federated Socialist Republic. Boundaries are: W., the Ukraine, the Sea of Azov and the Black sea; S., the Azerbaijan and Georgian republics; E., the Caspian sea; N., the Stalingrad and Voronezh regions. Area, 110,969 sq.mi. Pop. 8,324,788; urban 1,408,085, rural 6,916,703. The following are linked to it administratively: the Kabarda-Balkaria, North Ossetian, Checheno-Ingushetia and Daghestan autonomous republics, and the Adygei, Cherkess and Karachaev autonomous regions. Most of the area is a fertile plain, which has always been a zone of movement of peoples, owing to its situation between the Black sea and the Caspian, with the Caucasus on its southern flank. It formed a link between the Mediterranean civilizations which established trading colonies there, the Persian and Turkish empires of Asia Minor, the Tatar and Mongol steppe peoples, and the Russians from the northwest, all attracted by its fertility and its trading possibilities. In 1926 the varying elements in the population included Russians (Great Russians, Ukrainians and White Russians) 83.38%, Chechens, 2.72%, Ossetians 2.03%, Armenians 1.98%, Kabardians 1.85%, Greeks 1.14%, Germans 1.06%, Cherkess 1.03%, with Ingushes, Karachaevs, Jews, Poles, Kalmucks, Georgians, Tatars, Turks, Persians, Moldavians, Estonians, Czechs and Lesgians. In spite of these varied elements, the area has a certain economic unity: it is essentially an agricultural area undergoing a process of industrialization, and has an important export trade. In varying forms this export trade dates from a great antiquity. The west and southwest, with rich black earth soils, have intensive agriculture, market gardening and dairying, and a good net of communications; proximity of the Black sea and the Caucasus leads to increased rainfall and modification of summer heat and winter cold, abundance of streams and a longer vegetative period (*i.e.,* number of days with a temperature above 40° F.); in the Black sea area there are 275 days, and in Krasnodar, Maikop and Armavir 250, as against 200–210 days in the Donetz and Shakhtinsk areas. Towards the north and in the east the climatic influences are Continental, with drought conditions, and in the east the soils are chestnut-coloured (favourable to the growth of summer wheat in wet years), with about 10% saline and arid sands unfit for agriculture. The chief crops are summer wheat in the northern provinces, a hard variety in demand on the world market for flour and macaroni, etc., winter wheat in the wetter southwest districts, barley, maize, rye, millet and oats. Sunflower seed, providing food, oil, fuel and potash is increasingly cultivated in the Kuban area, as are crops new to the region such as cotton, soybeans, castor-oil plants and kenaf. Swampy tracts along the Kuban are being reclaimed and sown to rice, a crop also new to the region. There are vineyards in the Don, Black sea, Kuban and Terek areas: the Don wines are good, but the Kuban and Terek wine is sharp. Vineyards are being extended in the sandy areas along the Don. Tobacco is cultivated in the Kuban and Black sea regions. In the southwest Kuban and near the great cities and health resorts market gardening (especially of melons, pumpkins and potatoes) is prosperous. Agriculture suffered severely during World War I and was slowly recovering during the post-World War I years.

Cattle rearing is decreasing, and is mainly limited to the dry steppe and the hill pasture meadows. The stock of horses greatly diminished between 1914 and 1921. Horses are bred in Kuban and Kabardia and by the steppe nomads. In Kuban they are used as working animals. The gray Black sea cattle, related to the Ukrainian cattle, are the best working oxen, and are bred and used in the north and near Maikop. Dairy cattle (German) are in demand near the cities, while the Kalmucks breed the best cattle for meat. Formerly in the Stavropol steppe and the Salsk area there were 4,000,000 head of merino sheep, but they were catastrophically destroyed between 1914–21 and the number dropped to only 300,000 or 400,000. Goats are kept for milking, especially in the hill areas. Pig breeding recovered its pre-World War I level, especially in the Kuban and the maize zone of the foothills. Hens, geese, ducks and turkeys numbered 11,000,000 before World War II, and eggs, feathers, down and live and dead birds are exported (mainly to the home Russian markets). In Kuban, Terek and the foothills the long, warm summer and the flora favour beekeeping, and much good wax is exported.

The steppe and much of the plain is treeless, except near the streams and along the Don valley (oak and elm). On the foothills patches of mixed steppe and forest lead to the continuous beech, oak, hornbeam, ash, maple, lime and elm forest, above which are pines, birches and silver firs, with Alpine meadows higher still. The Black sea slopes yield yew and chestnut. The government is controlling timber felling on the foothills in view of the importance of tree growth in regulating the streams and in fixing the soil. In the higher regions much timber is neglected because of lack of labour and lack of transport. Of the timber, most goes to the treeless steppe, the markets of the near east and the Mediterranean. The silver fir is used in the home region for cellulose manufacture.

Fishing for bream, carp, herring, mackerel, sturgeon and anchovy is carried on in a primitive way, but suffers from lack of refrigerators and of quick transport. The mineral wealth consists of the Grozny and Maikop-Taman naphtha beds, the silver, lead and zinc ores of Alagir, south of Orjonikidze, lead ore on the upper Kuban, anthracite in the Shakhtinsk area and south of Batalpashinsk, and coal and iron ore on the north shore of Azov. Some of the mines are worked by peasant artels. The chief manufactures are foodstuffs (flour and fish, fruit and vegetable preserves) especially in the Kuban, naphtha refining at Grozny, Tuapse, Maikop (aviation benzine), cement at Novorossiysk, tobacco at Rostov, Krasnodar, Armavir and Orjonikidze, agricultural machinery at Rostov, Taganrog and Sylin, leather at Taganrog and Maikop, sugar near Armavir and in the Kuban. Maize products (brandy, starch and flour), textiles (wool, cotton, stockings, ropes), soap, potash, bricks, glass, tiles and paper are also manufactured and there are printing works at Rostov and other towns. Side by side with the factory industries go the koustar (peasant) industries and in the flour milling and oil pressing they produce 45% of the total. The chief towns in order of size of population in 1939 are: Rostov-on-Don 510,253; Krasnodar 203,946; Taganrog, Grozny, Shakhty, Orjonikidze (Vladikavkaz), Novorossiysk, Armavir, Maikop, Voroshilovsk, Pyatigorsk, all over 50,000; and Batalpashinsk, Millerop and Salsk.

These towns and their population are an indication of the

marked industrial development of the area, as is the fact that naphtha and not wheat is now the chief export. But agriculture is still, as in the past, the chief occupation of the area. In the internal life of the area it affects directly the welfare of four-fifths of the population and indirectly its development affects the remaining one-fifth, regulating markets, causing seasonal over-freightage of the transport network (railways, ports, elevators and refrigerators) and supplying the raw material for the factories and the food for the workers. The importance of the North Caucasian area in the economy of the U.S.S.R. as a source of supply of wheat and raw material is recognized by the government.

A canal was being constructed in 1944 to transfer part of the waters of the Kuban, which has an oversupply, to the Manich, a tributary of the lower Don. This canal was to irrigate 2,500,000 ac. of land. Eventually the Manich waterway will be extended to the Caspian sea, 390 mi. away. Its level will be maintained by a canal from the Terek which will also generate water power and irrigate a large expanse of steppe land.

CAUCASIAN LANGUAGES. This term is applied to the languages used on the Caucasian isthmus which do not belong to the Indo-German, or to the Semitic, or to the Turco-Mongolian family. They are divided into three groups—the *East Caucasian,* the *West Caucasian* and the *South Caucasian.* The East Caucasian group can be divided into eight branches: 1. The Chechen branch (the chief being the Chechen language of the middle course of the Terek and Daghestan); 2. Avaro-Andi (12 languages in West Daghestan, the chief being the Avar language); 3. Darghi (East Daghestan); 4. Samur (South Daghestan, the chief being the Kuri language, near Derbent); 5. Lakk or Kasi-Kumuk (Central Daghestan); 6. Artchi (one village in Central Daghestan); 7. Hinalugh (one village near the mountain Shah-Dag); and 8. Udi (two villages near the town Nukha). The West Caucasian languages have three branches: 1. Abhaz—region of Sukhum-Kale; 2. Ubykh—formerly dominant in the region of Sotchi, but now spoken only by a few families in Asia Minor; 3. Adyghe, with two dialects—Kabardi (in the so-called Kabarda, principal town Naltchik) and Kiakh or Cherkess (region of Kuban and the Caucasian shore of the Black sea). The South Caucasian languages are: 1. Georgian with its dialects; 2. Mingrelian and Laz; 3. Svanetian.

East Caucasian and West Caucasian are related and may be considered as two branches of the North Caucasian group. The relationship between this and the South Caucasian group has not, as yet, been scientifically proved, and in the present state of our knowledge the North Caucasian and South Caucasian groups must be considered as separate.

The North Caucasian languages are distinguished by an extraordinary abundance of *consonants,* which in Cherkess are 57 in number. Very characteristic of the phonetic system of North Caucasian languages are the lateral consonants, which convey the impression of combinations *kl, gl, thl;* then a great number of consonants of the type *k,* pronounced in the deep back part of the palate, etc. This superabundance of consonants is moderated in the East Caucasian group where consonants rarely come into contact with each other; but in West Caucasian languages the contact and combination of consonants occur very frequently, and the most complicated combinations, very difficult to pronounce, are admitted.

In the East Caucasian languages substantives are divided into classes or "genders"; their number varies in different languages (from two to six). In most cases, neither from the meaning of the word nor from any outward formal symptom is it possible to know to which class the substantive belongs. Very often the same substantive belongs in the singular to one class and in the plural to another. A consonant, specific for each group (*w, b, d, r, y*) is added as prefix, infix or suffix to the adjectives, verbs, pronouns, adverbs, etc., connected with the substantive. For example, the Avars say: *"Dow tchi wugo roqow"*—this man is in the house; *"Dob keto bugo roqob"*—this cat is in the house; *"Doy thladi Yigo roqoy"*—this wife is in the house. Substantives, adjectives and pronouns are declined; an extraordinary number of cases is used to express ideas that in other languages are expressed by a combination of words with prepositions. The Tabassaran language has 35 cases. The system of declension is based on the opposition of *Casus Agens* to *Casus Patiens.* The Casus Agens is used for the logical subject of transitive verbs, and Casus Patiens for the logical object of transitive and logical subject of intransitive verbs. The outward distinction between Casus Agens and Casus Patiens is expressed in a different way by different substantives. Thus, in the Kuri language *Lam*—"ass"—has Agens *Lamra* and *ghum*—"smoke"— has Agens *ghumadi.* All other cases are derived from the Agens by adding different endings. The plural is also formed differently from different substantives, so that the declension of substantives in East Caucasian languages is full of irregularities. The same is true of conjugation in most of these languages. The verbal root, *i.e.,* the invariable part of all verbal forms, consists mostly of one consonant. Before it are the prefixes, indicating the aspect of the verb (*i.e.,* whether the action is considered as a lasting process or as a concluded action) and the gender signs mentioned above agree with the Patiens of the sentence. After the root consonant come the elements, indicating time, mood and sometimes the person. There are many verbal forms and the difference of their meaning is often very subtle and difficult to define. The East Caucasian languages have therefore a complicated grammar with a great abundance and prodigality of forms. The same prodigality is found in the vocabulary; there are for instance special adverbs to indicate such notions as "five years ago," "four days later," etc.—these words having nothing in common with the corresponding numerals.

In the West Caucasian languages, declension is reduced to a minimum; the Adyghe and Ubykh languages have only three cases, the Abhaz has no declension at all. There are fewer verbal forms than in the East Caucasian languages. The vocabulary is poor, so that the simplest notions are expressed by compound words, *e.g.,* in Adyghe the beard is designated as "tail of the mouth," etc. The characteristic peculiarity of West Caucasian languages is a fondness for combining words. Notwithstanding these differences between East and West Caucasian languages, there are still important similarities in both these groups—viz., in the most elementary words, personal pronouns, numerals, simple verb roots, etc., so that there can be no doubt as to their relationship. There are also isolated similarities in the grammar, for instance the opposition of Casus Agens to Casus Patiens, traces of the different classes of substantives, etc.

The phonetic system of South Caucasian languages is simpler than that of the North Caucasian; there is a striking fondness for the agglomeration of consonants (*e.g.,* the Georgian, *mghwdl* is genit. for "priest"). There is only one gender. The declension is rich in case forms, but their formation is regular. The verb has a developed conjugation; the means of expressing personal forms through combination of certain prefixes and suffixes is complicated. In the South Caucasian languages the agreement of the verb with its subject and object varies with the tenses of the verb. In the present the subject is in the nominative and the object in the dative-accusative. In the Aorist the subject is in a special case (Agens?) and the object in the nominative, in the perfect the subject is in the dative and the object in the nominative.

Georgian alone has an ancient written literature, beginning with the 5th century A.D., and in recent years books and newspapers have begun to appear in other Caucasian languages.

BIBLIOGRAPHY.—Literature on North Caucasian languages is to be found in Meillet and Cohen's, *Les Langues du Monde* (Paris, 1924) and A. Dirr, *Einführung in das Studium der Kaukasischen Sprachen* (Leipzig, 1928). For *Georgian,* A. Dirr, *Theoretisch-praktische Grammatik der modernen Georgischen (Grusinischen) Sprache* (No. 81, Hartleben's *Kunst der Polyglottie* Series); F. N. Fink, *Die Haupttypen des Sprachbaues,* p. 132–149 (Leipzig, 1910). (N. S. T.)

CAUCASUS, a mountain range, stretching north-west to south-east from the Strait of Kerch (between the Black sea and Sea of Azov) to the Caspian sea, over 900m. long and varying from 30 to 140m. in width. In its general uniformity of direction, its comparatively narrow width, and its well-defined limits towards both south and north, it presents a closer analogy with the Pyrenees than with the Alps. The range, like the Pyrenees, maintains for considerable distances a high elevation, and is not cleft by

natural passes, as in the Alps. In both ranges some of the highest summits stand on spurs of the main range, not on the main range itself, *e.g.*, Mts. Elbruz and Kasbek, Dykh-tau, Koshtan-tau, Janga-tau and Shkara. For purposes of description it is convenient to consider the range in four sections, a western, a middle with two subsections and an eastern.

Western Caucasus.—This section, extending from the Strait of Kerch to Mt. Elbruz in 42° 40′ E., is over 420m. long, and runs parallel to the north-east coast of the Black sea and only a short distance from it. Between the main range and the sea there intervene at least two parallel ranges separated by deep glens, and behind it a third subsidiary parallel range, likewise separated by a deep valley, and known as the Bokovoi Khrebet. All these ranges are crossed by numerous glens and gorges, and the rainfall being heavy and the exposure favourable, they are densely clothed with vegetation. Many of the spurs abut steeply upon the Black sea, so that this littoral region is very rugged and not readily accessible. The seaward flanking ranges run up to 4,000ft. and more, and in many places form cliffs which overhang the coast some 2,000–3,000ft., while the main range gradually ascends to 10,000–12,000ft. as it advances east, the principal peaks being Fisht (8,040ft.), Oshten (9,210ft.), Shuguz (10,640ft.), and Psysh (12,425ft.). The main range is built up of hard crystalline rocks, and the subsidiary chains are composed of softer strata (Cretaceous and Tertiary) which are more easily disintegrated. The snowline is about 9,000ft. on the loftiest summits, and east of Oshten the crest of the main range is capped with perpetual snow and carries many hanging glaciers, while larger glaciers creep down the principal valleys. The few passes lie at relatively great altitudes, so that although the northern versants of the various ranges all have a gentle slope, communication between the Black sea and the valley of the Kubañ, and the low steppe country beyond, is not easy. The more important passes, proceeding from west to east are Pshekh (5,435ft.), and Shetlib (6,060ft.), Pseashka (6,880ft.), Sanchar (7,990ft.); between the last-named and Elbruz are the passes of Marukh (11,500ft.), Klukhor (9,450ft.) and Nakhar (9,615ft.).



BY COURTESY OF NEAR EAST RELIEF

NATIVE OF THE CAUCASUS

Owing to topographical and climatic conditions the southern exposure fosters a luxuriant and abundant vegetation. The most distinguishing feature of the flora is the predominance of arborescent growths; forests cover 56% of the area and are not only dense but laced together with climbing and twining plants. The commonest species of trees are such as grow in central Europe, viz., ash, fir, pine, beech, acacia, maple, birch, box, chestnut, laurel, holm-oak, poplar, elm, lime, yew, elder, willow, oak. The common box is especially prevalent, but the preponderating species are *Coniferae*, including the Caucasian species *Pinus halepensis and P. insignis*. The commonest firs are *Abies nordmannia* and *A. orientalis*. There are two native oaks, *Quercus ponticus* and *Q. sessiliflora*. A great variety of shrubs grow on these slopes of the western Caucasus, chiefly the following species, several of which are indigenous—*Rhododendron ponticum, Azalea pontica, Aristotelia maqui, Agave americana, Cephalaria tatarica, Cotoneaster pyracantha, Citrus aurantium, Diospyros ebenum, Ficus carica, Illicium anisatum, Ligustrum caucasicum, Punica granatum, Philadelphus coronarius, Pyrus salicifolia, Rhus cotinus* and six species of *Viburnum*. A great variety of aquatic plants thrive excellently. The following purely Caucasian species also grow on the coast—five species of spearwort, three of saxifrage, *Aster caucasica, Dioscorea caucasica, Echinops raddeanus, Hedera colchica, Helleborus caucasica* and *Peucedanum caucasicum*. Here too are found magnolia, azalea, camellia, begonia and paulownia. Among the cultivated trees and shrubs the most valuable are the vine, peach, pomegranate, fig, olive (up to 1,500ft. above sea-level), chestnut, apricot, apple, pear, plum, cherry, melon, tea (on the coast between Sukhum-Kaleh and Batum), maize (yielding the staple food of the inhabitants), wheat (up to 6,000ft.), potatoes, peas, currants, cotton, rice, colza and tobacco. After the Russian conquest half a million of the inhabitants of this region being Mohammedans, and refusing to submit to the yoke of Christian Russia, emigrated into Turkish territory, and the country where they had lived remained for the most part unoccupied until after the beginning of the 20th century. The coast-line is remarkably regular, there being no deep bays and few seaports. The best accommodation that these latter afford consists of more or less open roadsteads, *e.g.*, Novorossiisk, Gelenjik, Anapa, Sukhum-Kaleh, Poti and Batum. Along the coast are summer bathing resorts similar to those of the south-east coast of the Crimea. The largest are Anapa, Gelenjik and Gagry.

Middle Caucasus: (*a*) **Western Half.**—This sub-section, having a length of 200m., reaches from Mt. Elbruz to Kasbek and the Pass of Darial. It contains the loftiest peaks of the whole range, of which those above 15,000ft. are:—Elbruz (west peak) 18,465ft. and (east peak) 18,345ft., Jaikyl 17,780ft., Dykh-tau 17,050ft., Shkara 17,040ft., Koshtan-tau 16,875ft., Janga-tau 16,660ft. (west peak) and 16,525ft. (east peak), Kasbek 16,545ft., Mishirghi-tau 16,410ft. (west peak) and 16,350ft. (east peak), Adish or Katuyntau 16,295ft., Gestola 15,940ft., Tetnuld 15,920ft., Gimarai-Khokh 15,670ft., Ushba 15,410ft. (south-west peak) and 15,400ft. (north-east peak), Ullu-auz 15,350ft., Adai-Khokh 15,275ft., Tikhtengen 15,135ft., Tiutiun-tau 15,115ft.

The crest of the main range runs at an altitude exceeding 10,000ft., but is surpassed in elevation by the secondary range to the north, the Bokovoi Khrebet. These ranges are connected by more than half a dozen short transverse spurs enclosing as many cirques. Besides the Bokovoi Khrebet several other short subsidiary ranges branch off from the main range at acute angles, with high glens between them. Down all these glens glacier streams descend, until they find an opportunity to pierce through the flanking ranges, which they do in deep gorges, and then race down the northern slopes of the mountains to enter the Terek or the Kubañ, or down the southern versant to join the Rion or the Kura. Amongst all these high glens there is a remarkable absence of lakes and waterfalls; nor are there down in the lower valleys, as one would expect in a region so extensively glaciated, any sheets of water corresponding to the Swiss lakes. In this section of the Caucasus the loftiest peaks do not as a rule rise on the main range, but in many cases on the short spurs that link it with the Bokovoi Khrebet and other subsidiary ranges.

Glaciers.—The snow-line runs at 9,500 to 10,000ft. on the northern face and 1,000ft. higher on the southern face. There are over 900 glaciers in this section, and although they often rival those of the Alps in size, they do not descend generally to such low altitudes. The best known are the Bezingi or Ullu, between Dykh-tau and Janga-tau, 10½m. long, and descending to 6,535ft. above sea-level; Leksyr, situated south of Adyr-su-bashi, 7½m. long, and its end at 5,690ft., the lowest point to which any glacier descends on the south side of the range; Tseya or Zea, descending 6m. from the Adai-khokh to 6,730ft.; Karagom, from the same mountain, 9½m. long, and reaching down to 5,790ft., the lowest on the northern side; Dyevdorak or Devdorak, from Kasbek, 2½m. long, its end at 7,530ft.; Khaldeh or Geresho 4¼m. long, from Shkara and Janga-tau; Tuyber from Tetnuld, 6½m. long, and reaching down to 6,565ft.; Tsanner or Zanner, the same length, but stopping short 240ft. higher, likewise given off by Tetnuld; while between that peak, Adish and Gestola originates the Adish or Lardkhat glacier, 5m. long and terminating at 7,450ft. The total area covered by glaciers in the central Caucasus is estimated at 625 to 650sq.m., the longest being the Maliev on Kasbek, 36m. long; but according to M. Rossikov several of the largest glaciers are retreating, the Tseya at the rate of something like 40–45ft. per annum.

Passes.—It is in this section that the mountain system is narrowest, and here (apart from the "gate" at Derbent close beside the Caspian) are the principal north to south communications, between south Russia and Armenia and Asia Minor. These are the passes of Darial and Mamison. Over the former, which lies

immediately east of Kasbek, runs the Georgian military road (1811–64) from Vladikavkaz to Tiflis, cutting through the mountains by a beautiful gorge (8m. long), shut in by mountain walls nearly 6,000ft. high, and so narrow that there is only just room for the road and the river Terek side by side. The pass by which this road crosses the main range farther south is known as the Krestovaya Gora and lies 7,805ft. above sea-level. The Mamison pass, over which runs the Ossetic military road (made passable for vehicles in 1889) from the Terek (below Vladikavkaz) to Kutais in the valley of the Rion, skirting the eastern foot of the Adai-khokh, lies at an altitude of 9,270ft. and is situated a little south of the main range. Horses can traverse only the best of the other passes and only during a few weeks in summer. They range at altitudes of 9,000–12,500ft., and between the pass of Nakhar in the west and that of Mamison in the east there is not a pass below 10,000ft. The best known are Chiper (10,800–10,720ft.), Bassa (9,950ft.), Donguz-orun (10,490ft.), Becho (11,070ft.), Akh-su (12,465ft.), Bak (10,220ft.), Adyr-su (12,305ft.), Bezingi (10,090ft.), Shari-vizk (11,560ft.), Edena, Pasis-mta or Godivizk (11,270ft.), Shtulu-vizk (10,860ft.), Fytnargyn (11,130ft.), Bakh-fandak (9,570ft.), the two Karaul passes (11,680 and 11,-270ft.) and Gurdzi-vizk (10,970ft.). The most frequented pass in Svanetia is that of Latpari (9,260ft.), situated in the first of the southern subsidiary ranges mentioned above, and thus connecting the valleys of the Ingur and the Tskhenis-Tskhali.

Flora.—In this section of the range again the southern slopes are clothed with vegetation of remarkable luxuriance and richness, more especially in the region of Svanetia (42°–43° E.). Here again the plants are bigger and the blossoms more abundant than in the Alps, forests of *Coniferae* predominate, and gigantic male ferns (*Aspidium filix-mas*), *Paris incompleta* (a member of the Trilliaceae), *Usnea* or tree-moss, box, holly (*Ilex aquifolium*), *Lilium monadelphum* and many of the herbaceous plants which flower in English gardens, grow here to an extraordinary size—monkshoods, *Cephalaria, Mulgedia* and groundsels. Other species are *Campanula, Pyrethrum,* aconite, *Cephaëlis,* speedwell, *Alchemilla sericea, Centaurea macrocephala, Primula grandis* and a species of primrose. Flowers of great beauty and abundance blossom up to 13,000ft. on the northern slope and on the southern slope ascend 2,000ft. higher. Walnuts grow up to an altitude of 5,400ft., the vine and mulberry to 3,250ft., the lime and ash to 4,000ft. The forests extend to the upper end of the limestone gorges. Above that the crystalline schists are bare of tree vegetation. The upper limit of arborescent vegetation is 7,000–7,500ft., of shrubs, *e.g.,* rhododendrons, 8,500ft., and of pasture-lands up to 9,000ft. The principal cultivated varieties of plants in this section are wheat, rye, oats, barley, beans, millet and tobacco.

Middle Caucasus: (*b*) **Eastern Part.**—In this sub-section, which stretches from Kasbek and the Darial gorge to the Baba-dagh in 48° 25′ E., a distance of 230m., the Caucasus attains its greatest breadth. For the whole distance the main range keeps an average elevation of 10,000ft., though the peaks are 2,000 to nearly 5,000ft. higher, the altitudes increasing towards the east. The glaciers decrease in the same proportion. Here the principal peaks, again found chiefly on the spurs and subsidiary ranges, are the Tsmiakom-khokh (13,570ft.), Shan-tau (14,530ft.), Kidenais-magali (13,840ft.), Zilga-khokh (12,645ft.), Zikari (12,565ft.), Choukhi (12,110ft.), Julti-dagh (12,430ft.), Alakhun-dagh (12,-690ft.) and Maghi-dagh (12,445ft.). On the main range stand Borbalo (10,175ft.), Great Shavi-kildeh (12,325ft.), Murov (11,-110ft.), Ansal (11,740ft.), Ginor-roso (11,120ft.), while farther east come Trfan-dagh (13,765ft.) and Bazardyuz or Kichen (14,-727ft.). In the same direction, but again outside the main range, lie Shah-dagh (13,955ft.), Shalbuz (13,675ft.) and Malkamud (12,750ft.).

The most noteworthy feature of this section is the broad *highland region of Daghestan,* which flanks the main range on the north and sinks down to the Caspian sea (east), and to the valley of the Terek (north). On the north-west this rugged highland region is well defined by the transverse ridge of Andi, which to the east of Kasbek strikes off from the Caucasus range almost at right angles. The rest of the Daghestan region consists of a series of roughly parallel folds, of Jurassic age, ranging in altitudes from 7,500 up to 12,500ft., separated by deep river glens which cut it up into a number of arid, treeless plateaus. The most prominent of these tablelands is Bash-lam, which stretches east and west between the Chanti Argun and the Andian Koisu. Upon it rise the conspicuous peaks of Tebulos-mta (14,775ft.), Tugo-mta (13,795ft.), Komito-tavi or Kachu (14,010ft.), Donos-mta (13,560ft.), Diklos-mta (13,740ft.), Kvavlos-mta or Kolos-mta (13,080ft.), Motshekh-tsferi (13,140ft.) and Galavanas-tsferi (13,260ft.). Farther east is the Bogos tableland, stretching from south-south-west to east-north-east between the Andian Koisu and the Avarian Koisu and rising to over 13,400ft. in several peaks, *e.g.,* Antshovala (13,-440ft.), Botshokh-meër (13,515ft.), Kosara-ku (13,420ft.) and Addala-shuogchol-meër (13,580ft.); and the Dyulty tableland reaching 12,400ft. between the Kara Koisu and the Kazikumukh Koisu. Névé and glaciers occur on some of these peaks, particularly on the slopes of Diklos-mta, where the glaciers descend to 7,700ft. (north) and to 8,350ft. (south). Here the passes are lower than those between Elbruz and Kasbek, though at appreciable heights, fully equal to those that lead up from the Black sea to the valley of the Kubañ in the western section of the range. The best known are the Krestovaya Gora (7,805ft.) on the Georgian military road south of Darial; Kodor (9,300ft.) and Satskheni, and Gudur (10,120ft.) and Salavat (9,280ft.), carrying the Akhty military road.

The *flora* of this section bears a general resemblance to that farther west. Ample details will be found in Dr. G. Radde's (1831–1903) monographs on Daghestan.

Eastern Caucasus.—This section of the Caucasus gradually dies away east of Baba-dagh (11,930ft.) towards the Caspian, terminating finally in the peninsula of Apsheron. It is, however, continued under the waters of the Caspian and reappears on its eastern side in the Kopet-dagh, which skirts the north-eastern frontier of Persia. In this section of the Caucasus no peak exceeds 9,000ft. in altitude and the crest of the main range retains no snow. The most frequented pass is Alty-agach (4,355ft.).

Between the northern and the southern sides of the range there is a great difference in climate, productions and scenery. In the south-western slopes and valleys where a heavy rainfall is combined with a warm temperature, magnificent forests clothe the mountain-sides and reach the waters of the Black sea. There the littoral from, say, Sukhum-kaleh to Batum, and the inland parts of the basin of the Rion, will bear comparison with any of the provinces of Italy in richness and variety of products. But farther inland, east of Tiflis, a great change becomes noticeable on the other side of the transverse ridge of the Suram or Meskes mountains. Arid upland plains and parched hillsides take the place of the rich verdure and luxuriant arborescent growth of Imeretia, Svanetia and Mingrelia, the districts which occupy the valleys of the Ingur and Rion and the tributaries of the latter. A very similar change likewise becomes noticeable in the higher regions of the Caucasus mountains north of the pass of Mamison. The valleys of the Rion and Ardon and of others that flow in the same direction, are almost wholly destitute of trees, but where the bare rock does not prevail, the mountain slopes are carpeted with grass. "Treeless valleys, bold rocks, slopes of forbidding steepness (even to eyes accustomed to those of the Alps), and stone-built villages, scarcely distinguishable from the neighbouring crags" (Freshfield). Austere and unattractive though those valleys are, the same epithets cannot be applied to the deep gorges by which in most cases the streams make their escape through the northern subsidiary range. These defiles are declared to be superior in grandeur to anything of the kind in the Alps. That of Darial (the Terek) is fairly well known, but those of the Cherek and the Urukh, farther west, are stated to be still more magnificent. Not only do the snow-clad ranges and the ice-panoplied peaks surpass the loftiest summits of the Alps in altitude; they also in many cases excel them in boldness and picturesqueness of outline, and equal the most difficult of them in steepness and relative inaccessibility.

Hydrography.—Nearly all the larger rivers of Caucasia have their sources in the central parts of the Caucasus range. The torrential streams of Mdzimta, Pzou, Bzyb and Kodor drain the

country west of Elbruz. The Ingur, Tskhenis-Tskhali, Rion and its tributaries, *e.g.*, the Kvirila, are longer but also in part torrential; they drain the great glacier region between Elbruz and Kasbek. The Rion is the *Phasis* of the ancients and flows through the classic land of Colchis. The Lyakhva and Aragva, tributaries of the Kura, carry off the waters of the main range south of Kasbek, and other tributaries, such as the Yora and the Alazan, collect the surplus drainage of the main Caucasus range farther east. The other large river of this region, the Aras, has its sources, not in the Caucasus range, but on the Armenian highlands a long way south-west of Ararat. The rivers which go down northwards from the central Caucasus have longer courses than those on the south. The most important of these are the Kubañ and the Terek; most of the streams which have their sources among the central glaciers draining into the latter, *e.g.*, the Malka, Baksan, Chegem, Cherek, Urukh, Ardon. The Kuma, which alone pursues an independent course through the steppes, farther north than the Terek, has its sources, not in the main ranges of the Caucasus, but in a group of mountains near Pyatigorsk. Its waters become absorbed in the sands of the desert steppes before they reach the Caspian. Of the streams that carve into chequers the elevated plateau of Daghestan, four, known by the common name of the Koisu, unite to form the Sulak. The only other stream deserving of mention in this province is the Samur. Both rivers discharge their waters into the Caspian, as also does the Zumgail, a small stream which drains the eastern extremity of the Caucasus range.

Volcanic Evidences.—Ancient but now extinct volcanic centres occur frequently at the intersections of the main range with the transverse ranges; of these the most noteworthy are Elbruz and Kasbek. The town of Shemakha near the eastern end of the system was the scene of volcanic outbreaks as late as 1859, 1872 and 1902; while in the adjacent peninsula of Apsheron mud volcanoes exist in large numbers. All along the northern foot of the system hot mineral springs gush out at various places, such as Pyatigorsk, Zhelesnovodsk, Essentuki and Kislovodsk; and the series is continued along the north-eastern foot of the highlands of Daghestan, *e.g.*, Isti-su, Eskiendery, Akhta. Also similar evidences of volcanic activity characterize the northern border of the Armenian highlands on the southern side of the Rion-Kura depression, in the mountains of Ararat, Alagöz, Akmangan, Samsar, Godoreby, Great and Little Abull, and in the mineral springs of Borzhom, Abbas-tuman, Sleptzov, Mikhailovsk and Tiflis.

Geology.—The structure of the Caucasus is comparatively simple, and in the form of a fan. In the centre are crystalline rocks which disappear towards the east. Beneath them, on both sides, plunge the strongly folded Palaeozoic and Jurassic schists. On the north the folded beds are followed by a zone of Jurassic and Cretaceous beds which rapidly assume a gentle inclination towards the plain. On the south the corresponding zone is affected by numerous secondary folds which involve Upper Miocene deposits. In the east, the structure is somewhat modified. The crystalline band is lost. The northern Mesozoic zone is very much broader, and is thrown into simple folds like those of the Jura mountains. The Mesozoic zone is absent in the south, and the Palaeozoic zone sinks abruptly in a series of faulted steps to the plain of the Kura, beneath which no doubt the continuation of the Mesozoic zone is concealed.

The geological sequence begins with the granite and schists of the central zone, which extend from Fisht (west) to some distance beyond Kasbek (east). Then follow the Palaeozoic schists and slates. Fossils are extremely rare in these beds; *Buthotrephis* has long been known, and traces of *Calamites* and ferns, and in the west fossils which appear to indicate a Devonian age. Upon the Palaeozoic rest Mesozoic deposits (Lias to Upper Cretaceous). Different views exist as to the position of unconformities, but important ones occur at the base of the Tithonian (Upper Jurassic) and at the base of the Trias. In general the Upper Jurassic beds are much more calcareous on the north than they are on the south. The Mesozoic are followed by Tertiary deposits, which on the north are nearly horizontal but on the south are in part included in the folds—the Eocene and Miocene being folded, while later beds, though sometimes elevated, may not be affected by the folding. The final folding of the chain, proceeding from north-east, undoubtedly occurred at the end of the Miocene period. Folding also occurred probably during the Permian and again during the Upper Jurassic (direction south-west). Also the difference in character of the Jurassic beds on the two sides of the chain appears to indicate that a ridge existed in that period. The last phase in the history of the Caucasus was the growth of the great volcanoes of Elbruz and Kasbek, which stand upon the old rocks of the central zone, and by the outflow of sheets of lava upon the sides of the chain. The cones are composed largely of acid andesites, but many of the lavas are augite andesites and basalts. There seem to have been two periods of eruption, and as some of the lavas have flowed over Quaternary gravels, the latest outbursts must have been of very recent date.

Near the northern foot of the Caucasus, especially near the hot mineral springs of Pyatigorsk, a group of igneous rocks rises above the plain. They are laccolites of trachytic rock, and raised the Tertiary beds above them in the form of blisters. Subsequent denudation has removed the sedimentary covering and exposed the igneous core. Petroleum occurs in the Tertiary beds at both ends of the chain.

BIBLIOGRAPHY.—The following is a selection of the more recent works. A. F. Mummery, *My climbs in the Alps and Caucasus* (1895); D. W. Freshfield, *Exploration of the Caucasus* (2nd ed., 1902, 2 vols.); H. Abich, *Aus Kaukasischen Ländern* (2 vols., 1896); C. von Hahn, *Kaukasische Reisen und Studien* (1896) and *Bilder aus dem Kaukasus* (1900); G. Merzbacher, *Aus den Hochregionen des Kaukasus* (2 vols., 1901); J. Mourier, *L'Art au Caucase* (new ed., 1912); E. A. Martel, *La Côte d'Azur russe* (1909); S. Graham, *A Vagabond in the Caucasus* (1911); A. Herbert, *Casuals in the Caucasus* (1912); M. Rikli, *Natur und Kulturbilden der Eiszeit im Kaukasus* (1914); M. Varandian, *La conflit arméno-géorgien et la guerre du Caucase* (1919); A. Dirr, *Caucasian folk-tales* (1925). The geology of the Caucasus is dealt with in E. Fournier, *Description géologique du Caucase central* (1896); F. Löwinson-Lessing, *Guide des Excursions du VIIe Congrès géol. internat.* (1897); and F. Oswald, *Notes on the Geological Map of the Caucasus* (1914). *A travers le Caucase* (1905) by E. Levier is especially valuable for botany and N. Y. Dinnik writes on the fauna in *Bull. Soc. Impériale des Naturalistes de Moscou* (1901). Much valuable information about the Caucasus is preserved in *Izvestia* and *Zapiski* of the Russian and Caucasian geographical societies. V. Dingelstedt has a number of papers on this region in the *Scottish Geographical Magazine* (1889–1904). A useful geological map is by F. Oswald (1914), scale of 1:1,000,000; and the Russian general staff have a good map on the scale of 1:210,000. (J. I. P.)

HISTORY

To the ancient Greeks Caucasia, and the mighty range which dominates it, were a region of mystery and romance. It was there that they placed the scene of the sufferings of Prometheus (*vide* Aeschylus, *Prometheus Vinctus*), and there, in the land of Colchis, which corresponds to the valley of the Rion, that they sent the Argonauts to fetch the golden fleece. Outside the domain of myth, the earliest connection of the Greeks with Caucasia would appear to have been through the maritime colonies, such as Dioscurias, which the Milesians founded on the Black sea coast in the 7th century B.C. For more than two thousand years the most powerful state in Caucasia was that of Georgia (*q.v.*). The southern portion of Transcaucasia fell during the 1st century B.C. under the sway of Armenia, and with that country passed under the dominion of Rome, and so eventually of the Eastern empire. During the 3rd century A.D. Georgia and Armenia were invaded and in great part occupied by the Khazars, and then for more than a thousand years the mountain fastnesses of this borderland between Europe and Asia were the refuge, or the resting-place, of successive waves of migration. The Huns and the Avars appeared in the 6th century, and the Mongols in the 13th. In the 10th century bands of Varangians or Russified Scandinavians sailed out of the Volga and coasted along the Caspian until they had doubled the Apsheron peninsula, when they landed and captured Barda, the chief town of Caucasian Albania.

But, apart from Georgia, historical interest in Caucasia centres in the long and persistent attempts which the Russians made to conquer it, and the heroic, though unavailing, resistance offered by the mountain races, more especially the Circassian and Lesghian tribes. Russian aggression began early in the 18th cen-

tury, when Peter the Great, establishing his base at Astrakhan on the Volga, and using the Caspian for bringing up supplies and munitions of war, captured Derbent from the Persians in 1722, and Baku in 1723. But these conquests, with others made at the expense of Persia, were restored to the latter power after Peter's death, a dozen years later. At that period the Georgians were divided into various petty principalities, the chief of which were Imeretia and Georgia (Kharthlia), owing at times a more or less shadowy allegiance to the Ottoman sultan. In 1770, when at war with Turkey, the Russians crossed over the Caucasus and assisted the Imeretians to resist the Turks, and from the time of the ensuing peace of Kuchuk-kainarji the Georgian principalities looked to Russia as their protector against the Turks. In 1783 George XIII., prince of Georgia and Mingrelia, formally put himself under the suzerainty of Russia, and after his death Georgia was converted (1801) into a Russian province. The same fate overtook Imeretia nine years later. Meanwhile the Russians had also subdued the Ossetes (1802) and the Lesghian tribes (1803) of the middle Caucasus. By the peace of Gulistan in 1813 Persia ceded to Russia several districts in Eastern Caucasia, from Lenkoran northwards to Derbent. Nevertheless the mountain tribes were still independent, and their subjugation cost Russia a sustained effort of thirty years. At first the Russians were able to continue their policy of conquest and annexation without serious check. After acquiring the northern edge of the Armenian plateau, partly from Persia in 1828 and partly from Turkey in 1829, Russia in 1832 crushed a rising in Daghestan. The next seven years were occupied with the subjugation of the Abkhasians along the Black sea coast, and of other Circassian tribes in the west. Meanwhile Shamyl, a chief and religious leader of the Lesghians, had roused the Lesghian tribes farther east. His resistance was finally broken after 20 years of warfare by Prince Baryatinsky, who succeeded in capturing Shamyl's stronghold of Weden, and then in surrounding and capturing (1859) that chieftain himself on the inaccessible rocky platform of Gunib in the heart of Daghestan. But it was not until 1864 that the Russians finally stifled all opposition. Then followed a wholesale emigration of the Circassians, who sought an asylum in Turkish territory, leaving their native region almost uninhabited and desolate. During the Russo-Turkish War of 1877–78 the self-exiled Circassians and other Caucasian mountaineers, supported by a force of 14,000 Turks, made a determined attempt to wrest their native glens from the power of Russia; but, after suffering a severe defeat at the hands of General Alkhazov, the Turks withdrew, and were accompanied by some 30,000 Abkhasians, who settled in Asia Minor. A few months later the Lesghians in Daghestan, who had risen in revolt, were defeated and their country once more reduced to obedience. By the peace of Adrianople, Russia still further enlarged her Transcaucasian territories by the acquisition of the districts of Kars, Batum and Ardahan. After a peaceful period of a quarter of a century the Armenian subjects of Russia in Transcaucasia were filled with bitterness and discontent by the confiscation of the properties of their national (Gregorian) Church by the Russian treasury. Nor were their feelings more than half allayed by the arrangement which made their ecclesiastics salaried officers of the Russian state. This ferment of unrest, which was provoked in the years 1903–04, was exacerbated by the renewed outbreak of the century-long racial feud between the Tatars and the Armenians, at Baku and other places. Nearly the whole of the region between the Caucasus and the Perso-Turkish frontier on the south, from the Caspian sea on the one side to the Black sea on the other, was embroiled in a civil war of the most sanguinary and ruthless character, the inveterate racial animosities of the combatants being in both cases inflamed by religious fanaticism. An end was put to these disorders only by the mutual agreement of the two contestants in Sept. 1905.

The Revolution of 1905 in Russia aroused the desire for self-government that has never long been dormant in the Caucasus. The agrarian policy of the Tsarist Government added fuel to the fire of discontent, and the refusal to recognize their individual national languages was a further source of grievance to Armenians, Tatars and Georgians alike. Nevertheless the Russian Government ruthlessly pursued its repressive policy. On the outbreak of the World War in 1914, when they had learnt that Russia was the ally of France and Great Britain, the Caucasian nationalities eagerly responded to the call to arms. But even this action had no effect upon the Russian Government, and the governship of General Yudenitch was specially noteworthy for its severity. Hence the February Revolution of 1917 was hailed with joy throughout the Caucasus when the individual nationalities attempted to establish a Federal republic that should be governed by a Transcaucasian diet. But the failure of Kerensky's administration and the triumph of Bolshevism spelt failure for the Caucasian Republic also. The component states made a brief attempt to preserve their independence of Moscow under mildly socialistic forms of government, but the military strength of the Soviet soon overcame their resistance. First one and then another was overrun and conquered, and Soviet republics set up under the guidance of Moscow. Despite the maintenance by the Moscow Government of these republics in the Caucasus, the desire amongst some of the population for complete independence of the U.S.S.R. has not been extinguished.

CAUCASUS, CAMPAIGN IN THE. Though both Russian and Turk spoke of a "Caucasus front" and gave to their armies engaged on this front the designation "Caucasian," in the World War, the operations actually took place at a considerable distance from the Caucasus.

The Terrain Described.—The main theatre of these operations may be defined as lying within the following limits; on the east, Batum (on the Black sea)-Kars-Mount Ararat; on the south, Lake Van-Mush-Kharput; on the west, Kemath-Erzinjan-Kiresün; and on the north, the south coast of the Black sea. The whole of this region is covered by the historical term Armenia—not merely the present republic of that name, but, in the wider sense of the term, the country which was inhabited in 1914 largely by the ill-starred Armenian nation. Outside this main theatre of operations, a somewhat desultory warfare was carried on by detachments from the main forces up and down the western parts of Persia. Though some of the valleys are fertile, the area as a whole is bleak, sparsely populated and almost undeveloped.

The poverty of the communications and the severity of the climate render military operations on a large scale difficult and arduous. In 1914, on the Russian side, railway communication ended at Sari Qamish, some 40m. southwest of Kars and 15 from the frontier; on the Turkish side, 60om. of indifferent roads and tracks separated their armies operating in the Erzerum area from the nearest railhead at Angora or Ulu Qishla, on the Baghdad railway northwest of Adana. Thus the advantage in land communications lay, at the outset, very decidedly with the Russians, who had also, except for a short period after the outbreak of War, command of the Black sea. On neither side, however, could the communication be considered in any way adequate for operations on the grand scale.

Few commanders would welcome a campaign in such extreme conditions of climate and difficulties of movement and supply. Neither army was up-to-date in its technical organization. The higher leading and staff work in both armies was rough and ready rather than scientific, though there were a number of German staff officers with the Turk and many highly educated and intelligent men in the Russian General Staff. Given the characteristics of the two armies and the restrictions to manoeuvre which the terrain imposed, it was sufficiently obvious that the campaigns were likely to be marked by hard, straightforward fighting rather than any striking display of military art. Only the hardiest of soldiers could have come to grips with each other at all in that waste of snow-clad hills, in the depths of winter when the campaign opened. It was at the end of October 1914, that Turkey definitely entered the World War on the side of the Central Powers, and opened hostilities by naval bombardment of Russian ports in the Black sea.

The strategy of the Central Powers would have naturally dictated as the most useful contribution of her new ally to the common effort a diversion likely to withdraw most Russian troops from the hard-pressed Austrians; and Liman von Sanders, the

chief of the German Military Mission in Turkey, is known to have proposed a scheme for the landing of a Turkish force at Odessa with this object. But this scheme, even apart from doubts whether command of the Black sea could be effectively secured, was, perhaps not unnaturally, viewed with disfavour by the Turks, who preferred the hope of reconquest of some of the territory, notably the fortress of Kars, lost to Russia in previous wars. The III. Turkish Army had been assembling during Sept. and Oct. in the neighbourhood of Erzerum. It consisted of the IX. and XI. Corps, the 2nd Cav. Div. and some mounted irregulars. During Nov. the X. Corps was added, bringing the fighting strength of the army up to approximately 100,000 men. All three corps were composed mainly of Anatolians, the best fighting material in Turkey.

The Turkish Plan of Campaign.—The plan evolved by Enver, whose megalomaniac mind seems to have dreamed of campaigns rivalling those of Alexander and extending even up to India, was a wide enveloping movement with Kars as the objective. The XI. Corps was to attack frontally toward the Russian railhead at Sari Qamish, while the IX. and X. Corps moved north from Erzerum, swept by difficult hill passes through Olti, on toward Kars and Sari Qamish. Still further north, a detachment which had landed at Trebizond was to advance on Ardahan. This grandiose plan wholly ignored the absence of communications and the climatic conditions. The Russian attitude was, at the outset, purely defensive; their main preoccupation was on their Western Front, which had absorbed nearly all the available forces; two of the three regular corps, stationed in the Caucasus in peace, had been sent on mobilization to defend the Western Front against Austria and Germany. Only two complete corps, the I. Caucasian and II. Turkestan, were at first available for the defence of the Caucasus. Yet the Russians made the first advance, moving a force across the frontier in Köpri Köi on the road to Erzerum. This advance was made to secure room for manoeuvre in front of the important base at Sari Qamish. The Turks promptly attacked, and some fierce fighting took place between Nov. 8 and 20, which ended in the withdrawal of the Turks.

Enver now arrived from Constantinople and assumed personal command of the III. Army. He insisted, against the views of his German advisers, on putting into execution the ambitious plan he had conceived. The routes by which the turning movement was made were mere mountain tracks deep in snow; the greater part of the artillery and transport had to be left behind, and the attempt seemed madness. Yet such fortitude and endurance did the poorly equipped and ill-fed Turkish troops display that they almost achieved the impossible. While the main Russian body was engaged with the XI. Corps, the IX. Corps appeared, in the last days of Dec., on the heights above Sari Qamish, and the X. Corps on its left approached the railway between Kars and Sari Qamish; the detachment from Trebizond had already driven the Russians out of Ardahan.

The Russian commander's nerve failed him at the crisis; and the situation was saved only by his chief of the staff, Gen. Yudenich, a man of considerable ability and imperturbable resolution. He collected forces for a counter attack, which resulted in the complete defeat and practical annihilation of the two Turkish turning corps, worn out and disorganized by their formidable approach march; the XI. Corps was then in its turn driven back. The total losses of the Turkish III. Army are said to have approximated to 85%. Enver at once handed over the command to Hawis Hakki Pasha and returned to Constantinople. Hawis Hakki died shortly after, and the command was given to Mahmoud Kiamil. The alarm caused in Russia by the Turkish incursion was such that an appeal was made to Great Britain for a diversion against the Turks. This led to the first suggestion for the Gallipoli expedition.

During the whole of 1915 the fighting on the Caucasus front was of minor importance only. The main preoccupation of the Russians lay on their Western Front, of the Turks in Gallipoli. The shattered III. Army was gradually reconstituted, and the Russians raised fresh units to increase their strength. But neither side was yet in shape for a serious offensive. The detachment of Turks which in the previous winter had advanced to Ardahan and then had been driven back to Artvin, attempted in April a *coup de main* against Batum, but without success. On the other flank the Russians advanced their left wing into Armenia during May and June, occupied Van and threatened Bitlis. The Armenian rising which assisted the Russians led to bloody reprisals on their compatriots still in Turkish power. In Sept. 1915 the Grand Duke Nicholas took over command of the Caucasus front, an event which was to produce a marked enlargement of the Russian effort in this theatre. Grand Dukes in Imperial Russia could still obtain reinforcements in men and material denied to ordinary commanders. Nor did the character of the Grand Duke make it likely that he would adopt a passive rôle. Though not a great strategist, he was shrewd and energetic, as he had already shown while in command on the Western Front, a most loyal and unselfish supporter of the Allied cause. He found an able executive commander in Gen. Yudenich, already mentioned.

The Taking of Erzerum.—Once again an offensive on a large scale was made in the depth of winter. The Grand Duke wished to anticipate the arrival of Turkish reinforcements released by the British evacuation of Gallipoli. This enterprise was completely successful. The Russian capture of Erzerum was one of the finest feats of arms of the whole War. Its assault did not form part of the original plan, but the attacks up the Araxes valley, begun on Jan. 11, 1916, so completely surprised the Turk that it was decided to attempt it. The famous fortress, though many of the works and much of the armament were not modern, occupies a position of great natural strength, which the Turks under German supervision had improved with field works in addition to the existing forts. Its capture on Feb. 16 was mainly the result of a turning movement from the north, made by the II. Turkestan Corps under Przjevalski, the ablest of the Russian Corps commanders on the Caucasus front, who had an intimate knowledge of Erzerum, where he had spent 15 years as military attaché. The Turks retired in considerable disorder with heavy losses in men and material.

The next Russian objective was Trebizond; its capture in April considerably simplified the supply problem. Meanwhile, the Turkish Higher Command, alarmed at the fall of Erzerum and continued advance of the Russians, had decided on a counterstroke. They ordered the assembly of a new army, the II., under Izzet Pasha, in the Mush-Kharput region, to attack the Russian flank and rear and recapture Erzerum. The plan was sound enough, had the communications allowed of a speedy concentration and swift advance. But the assembly of the II. Army, begun in April, was not complete in July. The Grand Duke became aware of the Turkish intentions and anticipated their attack by a heavy blow at the III. Army, which eventually broke in complete rout. The Russians occupied Erzinjan in July. So heavy were the losses of the III. Army that it had subsequently to be completely reorganized. To do this divisions were formed out of army corps, regiments out of divisions, battalions out of regiments.

The defeat of the III. Army delayed and weakened the counterstroke of the II. Army, which did not take place till August, giving the Russians time to transfer troops from their right wing to meet it. After some heavy fighting on the Oghnat-Kighi front the II. Army's effort was definitely held. It had gained little ground at a considerable sacrifice in men. Both armies then took up defensive positions for the winter. The line now ran approximately from Tireboli on the Black Sea, west of Gumushkane to Kemakh, then south-east by Kighi, Oghnat, Mush and Bitlis to Lake Van. Further east, on the Turko-Persian border and in Persia, both armies had detachments to protect their flank, and fighting took place with varying fortune during 1915–16.

During the winter of 1916–17 no movements took place. The Turkish II. and III. Armies (Mustapha Kemal and Wahib Pasha respectively), now combined under Izzet Pasha, suffered terrible privations from lack of supplies and the weather. Nor were the Russians very much better off. A light line was being built from Sari Qamish to Erzerum, but progress was very slow and railhead was still some miles short of Erzerum in March 1917. Their command of the sea enabled them to feed their right wing from Trebizond; but from Erzerum and Trebizond to the front,

supply was dependent on horse transport over indifferent tracks, sometimes closed for days by blizzards of snow. The Russians, too, suffered severely from poor rations and typhus.

Attempted Russo-British Co-operation.—In Dec. 1916 the British Army in Mesopotamia, under Gen. Maude, commenced the attacks on the Turks at Kut, which were eventually to lead to the capture of Baghdad in March. Unsuccessful efforts had previously been made to concert the operations of the British in Mesopotamia and the Russians in the Caucasus; and now, with the approach of Maude's forces to Baghdad, an opportunity for effective combination seemed to have arrived. It was agreed that the Cavalry Corps of Baratov from Persia and of Chernozubov from between lakes Urmia and Van (both these corps, though composed mainly of cavalry, had a strong backing of infantry and artillery) should advance on Mosul; and thus, it was hoped, in co-operation with Maude, finally liquidate the Mesopotamian campaign. However, it was not to be. The Grand Duke adopted the plan whole-heartedly, and the Turk would not have been in a position to offer effective resistance. But, first of all, the weather conditions and the difficulty of organizing a line of supply through the mountains of the Persian border caused delay; then, before the movement had well begun, the Russian revolution broke out. With the recall of the Grand Duke toward the end of March—only to be described as an incredible blunder on the part of Kerenski—the best hope of energetic action had gone.

Collapse of the Russian Army.—Throughout the summer the Russian Army lay inactive, gradually disintegrating; by the early autumn it was sufficiently obvious that the troops would make no further forward movement, and could only be relied on to hold their positions so long as they were not attacked. Yudenich, who had succeeded the Grand Duke, gave up the command in August and was succeeded by Przjevalski. But the end was near. In December an armistice was concluded on the Caucasus front, and in Jan. 1918, after the peace of Brest-Litovsk, the Russian troops still remaining retired. The condition of the Turkish armies had been too wretched to allow them up till now to take advantage of the Russian collapse; but when the Russians finally retired, the Turks were once more fired with hopes of territorial gains; and advanced on the Caucasus with troops which from the military point of view would have been more profitably employed in strengthening their front in Palestine. They occupied Batum on April 14 and Kars on the 26th. All Russian regular troops had disappeared, and their only opponents were Georgian and Armenian bands defending their homes.

The British Expedition to Baku.—The British General Staff, alarmed at the prospect of a Caucasus under Turkish control being used as a base of propaganda and even operations against India, had meanwhile organized a group of British officers and non-commissioned officers under Gen. Dunsterville to be sent to the Caucasus to rally the local Armenian and Georgian populations against the Turk. But this force, dispatched through Persia from Mesopotamia, was delayed by the anarchic conditions which followed the collapse of the Russian forces in Persia, and arrived too late. When it reached Baku in August, things had gone too far; and after a short but gallant defence it was compelled to withdraw. But the Turkish control of Trans-Caucasia was short-lived, for Allenby's crushing victory in Palestine a month later spelt the loss of the war for the Turks.

Criticisms of the Campaign.—The operations of the so-called "Caucasus Front" described above thus led to no decisive results on either side. In view of the poor means of communication in the theatre of operations it is difficult to see how decisive results could have been expected. The lure of territorial conquest and false strategical conceptions led the Turks to attach an undue importance to this front, which had disastrous consequences for them from a military point of view. The unnecessarily heavy losses in their best troops caused by the offensives of the III. Army at the end of 1914 and of the II. Army in 1916 caused the weakness which proved their undoing on the Palestine and Mesopotamian fronts. Had the Turks been content with a defensive attitude on the Caucasus Front, British difficulties in these theatres might have been greatly increased.

The purely defensive attitude which the Russians took up at the outset was strategically correct; they had no other objective than the protection of their Transcaucasian provinces from invasion; the state of the communications would obviously never allow them to penetrate far enough into Asia Minor to produce any decisive effect on Turkey. That they advanced as far as they did—farther, perhaps, than was strategically wise—was due to the influence and energy of the Grand Duke. From the military point of view these campaigns are likely to be remembered only for one great feat of arms—the boldness and endurance displayed in the capture of Erzerum—and as affording to soldiers one more example of the dependence of strategy on communications.

(A. P. W.)

CAUCHON, PIERRE, French ecclesiastic, was born near Reims and became bishop of Beauvais in 1420. About ten years later he joined the English faction in France, and his chief title to fame is that he presided over the trial of Joan of Arc at Rouen. Recent researches show that he did so in a spirit of great justice and impartiality, and it must be remembered that he did not condemn the Maid to death but only to imprisonment for life. The death sentence was passed by the civil court. In 1432 he became bishop of Lisieux, and took part in the Council at Basle in 1435. He died in 1442, and was subsequently excommunicated by Calixtus IV.

BIBLIOGRAPHY.—*See* Cerf, *Pierre Cauchon de Sommièvre, chanoine de Reims et de Beauvais, évêque de Beauvais et de Lisieux, son origine, ses dignités, sa mort et sa sépulture,* in the Transactions of the Academy of Reims (1896–98); A. Sarrazin, *Pierre Cauchon* (1901); Anatole France, *Jeanne d'Arc* (1908).

CAUCHY, AUGUSTIN LOUIS, BARON (1789–1857), French mathematician, was born in Paris, on Aug. 21, 1789, and died at Sceaux (Seine) on May 23, 1857. He studied at the École Polytechnique and the École des Ponts et Chaussées, and practised for some time as an engineer. His health failed in 1813, and his father's friends, Lagrange and Laplace, persuaded him to devote himself entirely to mathematics. From 1816 onwards he held three professorships in Paris, which he lost at the revolution of 1830, on declining to swear allegiance to Louis Philippe. A chair of mathematical physics was created for him at the University of Turin. He spent some time travelling with the duke of Bordeaux, grandson of Charles X, and in 1838 returned to France, resuming his chair at the École Polytechnique. Although acting only from the highest motives, Cauchy made himself objectionable to his colleagues by a self-righteous obstinacy and an aggressive religious bigotry.

The genius of Cauchy was promised in his simple solution of the problem of Apollonius; *i.e.,* to describe a circle touching three given circles, which he discovered in 1805, and in his generalization of Euler's theorem on polyhedra in 1811, etc. More important is his memoir on wave propagation which obtained the *grand prix* of the Institut in 1816. His greatest contributions to mathematical science are characterized by the clear and rigorous methods which he introduced and are mainly embodied in his three great treatises, *Cours d'analyse de l'École Polytechnique* (1821); *Le Calcul infinitésimal* (1823); *Leçons sur les applications du calcul infinitésimal à la géométrie* (1826–28). He clarified the principles of the calculus by developing them with the aid of limits and continuity, and was the first to prove Taylor's theorem rigorously, establishing his well-known form of the remainder. Thus the first phase of modern rigour, giving a satisfactory basis for the calculus, originated in Cauchy's lectures and researches of the 1820s in analysis. To the same period belongs his development of his (the first) version of the theory of functions of a complex variable, today indispensable in applied mathematics from physics to aeronautics. With equal originality, he made substantial contributions to the theory of numbers where, however, he went astray on Fermat's last theorem. He was one of the originators of the theory of permutation groups. In astronomy, he gave a shorter account than Leverrier's of the motion of Pallas. In mechanics, he made many researches, substituting the notion of the continuity of geometrical displacements for the principle of the continuity of matter. In optics, he developed the wave theory, and his name is associated with the simple dispersion formula. In elasticity, he

originated the theory of stress, and his results are nearly as valuable as those of S. D. Poisson. His collected works, *Œuvres complètes d'Augustin Cauchy,* have been published in 27 volumes.

See C. A. Valson, *Le Baron Augustin Cauchy: sa vie et ses travaux* (1868).

CAUCUS, a political term used in the U.S.A. of a special form of party meeting, and in Great Britain of a system of party organization. The word originated in Boston (Mass.), in the early part of the 18th century, when it was used as the name of a political club, the "Caucus" or "Caucas" club. Here public matters were discussed, and arrangements made for local elections and the choosing of candidates for offices. A contemporary reference to the club occurs in the diary of John Adams in 1763; but William Gordon (*History of the Independence of the United States of America,* 1788) speaks of the Caucus as having been in existence some fifty years before the time of writing (1774) and describes the methods used for securing the election of the candidates. The derivation of the word has been much disputed. The most plausible origin is an Algonquin word, *kaw-kaw-was,* meaning to talk, Indian words and names having been popular in America as titles for societies and clubs; *cf.* "Tammany." In the United States "caucus" is used strictly of a meeting either of party managers or of duty voters, as for instance, a "nominating caucus," for nominating candidates for office or for selecting delegates for a nominating convention. The caucus of the party in congress nominated the candidates for the offices of president and vice-president from 1800 till 1824, when the convention system was adopted. At the same time, the candidates for governor and lieutenant governor were nominated by the party members of the state legislatures in what was known as the "legislative nominating caucus." Occasionally districts unrepresented in the legislature sent delegates to sit in with the members of the legislature when these nominations were made and this was termed the "mixed legislative nominating caucus." (*See* PRIMARIES.)

The word is used in the United States to denote meetings of the members of a party in Congress or in a legislature or a city council, to determine matters of party policy on proposed legislation or legislative offices. "Caucus" first came into use in Great Britain in 1878 in connection with the organization of the Liberal Association of Birmingham by Joseph Chamberlain and F. Schnadhorst on strict disciplinary lines, more particularly with a view to election management and the control of voters, which became the model for other Liberal associations throughout the country. It was to this supposed imitation of the U.S. political "machine" that Lord Beaconsfield gave the name "caucus," and the name came to be used, not in the U.S. sense of a meeting, but of a closely disciplined system of party organization, chiefly as a stock term of abuse applied by politicians of one party to the controlling organization of its opponents.

CAUDINE FORKS, the *furculae Caudinae* (Casale di. Forchia?), narrow passes in the mountains near Caudium in Samnium, and the scene of a famous Roman defeat in the Samnite wars. (*See* ROME: *Ancient History.*)

CAUL, a close-fitting woman's cap, especially one made of network worn in the 16th and 17th centuries; hence the membranous covering to the heart, brain, or the intestines, and particularly, a portion of the *amnion,* which is sometimes found remaining round the head of a child after birth. To this, called in Scotland "sely how," holy or lucky hood, many superstitions have been attached; it was looked on as a sign of good luck, and when preserved, was kept as a protection against drowning.

CAULAINCOURT, ARMAND AUGUSTIN LOUIS, MARQUIS DE (1772–1827), French general and diplomatist, was born at Caulaincourt on Dec. 9, 1772, of a noble family. He early entered the army, did not emigrate in the revolution, but was deprived of his grade as captain in 1793, and served in the ranks. In 1795, through the protection of L. Hoche, he became captain again, was colonel in the Army of the Rhine in 1799–1800, and after the peace of Lunéville (1801) was sent to St. Petersburg (Leningrad) to negotiate an understanding between Russia and France. On his return he was named aide-de-camp of the First Consul. He was employed to seize some agents of the English government in Baden in 1804, which led to the unfounded accusation that he was concerned in the arrest of the duc d'Enghien. He received the title of duke of Vicenza (1808). Napoleon sent him in 1807 as ambassador to St. Petersburg (Leningrad), where Caulaincourt tried to maintain the alliance of Tilsit, and succeeded in maintaining the peace for some years. He accompanied Napoleon during the invasion of Russia, from which he had in vain sought to dissuade him. During the last years of the empire, Caulaincourt was charged with all the diplomatic negotiations. He signed the armistice of Pleswitz, June 1813, represented France at the congress of Prague in Aug. 1813, at the congress of Chatillon in Feb. 1814, and concluded the treaty of Fontainebleau on April 10, 1814.

When Napoleon returned from Elba, he became minister of foreign affairs. After the second Restoration, Caulaincourt's name was on the proscription list, but it was erased on the personal intervention of Alexander I with Louis XVIII.

Caulaincourt's memoirs appeared under the title of *Souvenirs du duc de Vicence* in 1837–40.

CAULICULUS, in architecture, a form like a stalk, crowned with leaves, but which grow scrolls, leaves or other stalks; especially in the Corinthian capital, and in the branching scroll or *rinceau.*

CAULIFLOWER: *see* CABBAGE.

CAULONIA, a town of the district of the Bruttii, Italy, on the east coast, on the promontory Capo Stilo, near Monasterace (Gr. Καυλωνία). It was the southernmost Achaean colony founded as an outpost of Croton or direct from Greece itself. In the 7th century it was allied with Croton and Sybaris, and coins, going back to 550 B.C., prove its importance. It took the side of Athens in the Peloponnesian War. In 389 B.C. it was destroyed by Dionysius, but soon afterwards restored. It was captured during the invasion of Pyrrhus by Campanian troops. Strabo speaks of it as deserted in his time. Excavations have revealed remains of the fortifications, with towers of the 7th–6th century B.C. A small temple must have stood near the lighthouse, and to it belonged architectural terra-cottas, and votive objects in the same material, especially small altars. The houses that have been found belong to a later period. Near the shore scanty remains of a large Doric temple (first half of 5th century B.C.) were found: also a trench full of architectural terra-cottas of this period. The tombs date from the 7th–3rd century B.C. but are poor.

See P. Orsi in *Monumenti dei Lincei,* xxiii. (1914) 685 *seq.;* xxix. (1924) 409 *seq.*

CAUSALITY or **CAUSATION** signifies the relation of cause and effect. Common sense assumes that things and events are the products or results of certain other things or events—the result is called the effect, and that which produces it is called the cause. The attempt to understand things usually takes the form of trying to discover their causes and effects. The belief in causes and effects is most probably derived partly from the human experience of exercising various activities in order to produce certain results or to achieve certain ends, and partly from the experience of suffering the effects of the actions of others. In the early stages of human thought natural phenomena were (and in the case of the young or the undeveloped still are) conceived after the analogy of such human experiences of doing things and of being acted on, of causing effects or suffering them. The mythological accounts of natural phenomena abundantly illustrate the anthropomorphic tendencies in the early attempts to explain or to understand reality. With the growth of rational knowledge the anthropomorphic elements in the interpretation of natural phenomena have gradually been eliminated, and a certain amount of suspicion has fallen upon the concept of causality. Some scientists, indeed, have gone so far as to reject it altogether from the realm of science. How this has come about will be explained presently. But it may be stated at once that this extreme attitude seems to be unwarranted, even if we admit the importance of checking one's conception of the causal relationship so as to purge it of anthropomorphic suggestions when applied to inanimate natural phenomena. Except among believers in magic, at the one extreme, and among thorough-going sceptics, at the other extreme, it is usually assumed,

either explicitly or at least implicitly, that every event has a cause, and that the same kind of cause has the same kind of effect. This assumption is commonly known as *the Postulate or Principle of Universal Causation.*

The Rationale of the Concept of Causality.—Let the attempt be made to dispense with the idea of causal connection. The resulting view of the world would be one of a mere sequence of disconnected phenomena. Now, some people are quite content to regard the world in that way—to view the ever-changing phenomena of nature as a mere sequence of new happenings in which each successive stage is in no sense the outcome of the preceding stage, but a new creation so to say. In a sense this was a favourite thought of certain scholastics, and even Descartes shared this view. Most people, however, find such a world of disconnected changes, or rather displacements, theoretically unintelligible and practically bewildering. Even the supporters of the aforementioned view of incessant new creations could not entirely abandon the conception of causality. For they regarded God as the Creator (or Cause) of each successive creation in the sequence of mutually disconnected events. But the thought of such supernatural interference at every moment in the flow of events is not likely to appeal to many men of science. Even on religious grounds some people would object to the conception of a world, or rather of innumerable worlds, so ill-constructed by the Maker as to have to be scrapped and replaced every moment. It seems to be more satisfying to human intelligence, and more in accordance with human experience, to suppose an orderly continuity in each sequence of changes. And the causal concept gives expression to this implicit faith in the connected continuity of events. The scientific conception of the conservation of matter or energy is prompted very largely by the same kind of consideration, namely, the belief that there are no phenomena arising suddenly out of nothing as it were, but that in some sense each event is the outcome of preceding events, that each event is in fact only a new manifestation of the matter or energy of some preceding event or events. The rationale or logical motive of the concept of causality is, in short, to be found in the effort to see orderly continuity in the world of reality. And the sense of, or feeling for, continuity may itself be derived psychologically from man's consciousness of his own continuity under normal conditions.

The Inferential Character of Causal Connections.—The causal relation between events is not something that can be perceived by means of the senses. What we perceive is *sequence* of events; and it is from their sequence that we feel justified in inferring their causal connection, provided certain conditions are satisfied (for these conditions *see* the article SCIENTIFIC METHOD). The inferential character of our beliefs in causal connections exposes them to adverse criticisms of an easy kind. It may be argued, indeed it has been argued, that the inference to causal connection may be wrong, or that it is highly speculative, so why not confine ourselves to the description of the bare sequence and ignore the question of causation? Such, for instance, was the view of David Hume (*q.v.*), who contended that the alleged causal necessity in the sequence of the so-called causes and effects is just the hypostasis or projection of our habit of expecting certain consequents to follow certain antecedents merely because we had observed those sequences on previous occasions. It was largely in consequence of Hume's criticism that Kant concluded that causality is a category, that is, one of the ultimate *a priori* forms in which the understanding spontaneously orders its experiences (*see* CATEGORY)—something that is not derived from experience, but on the contrary is required to make orderly experience itself possible. It is noteworthy that Hume's attempt to explain away causality made use of this very category. For if there were no causal connection between the repeated observation of a certain sequence and the formation of a corresponding habit of expectation, Hume's adverse criticism of causality would have no basis in fact. Moreover, if Hume were taken literally we should have no ground for supposing any connection between his thoughts and his utterances, and so could not surmise what he really thought about causality or anything else. Common sense revolts against the attempt to reduce causality to bare sequence. The attempts offend the active nature of man. Moreover, not every sequence is a causal sequence. Many beliefs that common sense condemns as superstitious are beliefs that result from an inability to distinguish between mere sequence and connection, so that if one event follows another (say, illness or death after being one of a party of thirteen) it is regarded as its effect. At the stage of logical reflection this slovenly way of thinking is condemned as the fallacy *post hoc, ergo propter hoc* (after this, therefore because of it).

Cause and Law.—Prompted partly by Hume's criticism, partly by Kant's apparently subjective interpretation of causality, and partly by the anthropomorphic origin of the conception of causation, some modern thinkers (Helmholtz, Mach, Pearson and others) have urged that science should discard it in favour of the concept of law. This movement is intimately connected with the tendency to make science purely descriptive without any pretence to be explanatory. The causal concept, it is urged, is an explanatory concept with a tincture of fetishism about it, why not confine the business of science to the discovery of descriptive laws expressing uniform sequences, without pretending to explain these by reference to alleged causes? This trend of thought fits in very well with the main tendency of the more exact sciences in modern times. Under the influence of Copernicus, Galilei, Descartes and Newton the aim of the physical sciences has come to be regarded as that of discovering descriptive equations expressing quantitative correlations of phenomena. Correlated phenomena are treated like mathematical functions. Causal connections tend to be ignored, in fact everything tends to be ignored that cannot be expressed in equations. This movement is really a legacy from ancient Pythagoreanism, which identified the essence of things with numbers. That philosophy has indeed been abandoned long since, but its consequences have been retained. And this notwithstanding the growing realization that mathematical equations, after all, tell us extremely little about the real nature of things, apart from their comparatively external quantitative correlations. So marked is this tendency to let equations supplant causal connections that it has actually been urged that there is no good reason for the customary restriction of the term cause to antecedents only, and of the term effect to consequents only, seeing that antecedents and consequents are mutually inferable. This is to save the name and kill the meaning of cause—causality is not the same as law or uniformity. It may be found in unique events (such as the biographer and the historian are mostly concerned with) that are not formulated in laws at all. On the other hand, there are laws, even laws of sequence, that are either not causal at all (say, the sequence of a mathematical progression) or at least are not directly causal (say, the sequence of day and night, or of the seasons). Even when expressible in laws or uniformities of sequence, the causal connection is something more than the bare uniformity of sequence. No doubt it is objectionable to introduce anthropomorphism or animism into the study of inanimate phenomena. No doubt it is well to remember the obstruction to science caused by "substantial forms," etc. But caution may be carried too far. After all, even human beings are natural phenomena, and their experiences may be used as a clue to the interpretation of nature, provided due care is exercised. It would certainly be extravagant to project into the causal sequences of inanimate phenomena anything analogous to the sense of effort or of constraint that is experienced in human activity or passivity respectively. But that is no reason for discarding causality altogether. Carried through consistently, this can only end in the conception of the world as a series of independent miracles—a view even more irrational than the anthropomorphism which it is intended to correct. The principle of conservation of matter or energy would lose all significance without the idea of causal continuity, according to which certain successive events not only *follow,* but *follow from* one another. In fact, mere laws of sequence are only intelligible in the last resort, when they can be shown to result from direct or indirect causal connections.

Cause and Condition.—To explain adequately the term cause, it is necessary to show its relation to the term condition. A condition is anything that is necessary to a certain result—anything in the absence of which that result would not be achieved. A thing

may, however, be indispensable to a certain result and yet be insufficient to produce it. For instance, a damp atmosphere is necessary for fine cotton-spinning; but other things are required besides—cotton, machines, workers, etc. Now the cause of a certain effect is that totality of conditions that is sufficient to produce it. As a rule a cause is complex—it consists of a number of conditions each of which is only a part of the cause. Popularly some one condition is selected and called the cause. This is frequently legitimate, inasmuch as the presence of the other conditions is obviously assumed, and it would be pedantry to name them all. But at other times it is due to oversight—many rival remedies for social ills are each but a condition rather than a likely cause of the effect aimed at. Another fact to be noted is that the expected result does not always follow when all the necessary conditions appear to be operative. This happens when there are counteracting forces at work that thwart the expected result. For example, the sunshine that would normally flood a room with light and warmth may be excluded by closed shutters. To secure a certain effect it is therefore necessary to secure the absence of counteracting conditions as well as the presence of all the *positive* or contributory conditions. The absence of all hindrances to an effect is usually described as its *negative* condition. So that the complete cause will consist of negative as well as positive conditions. Negative conditions may play a very important rôle, as when armies or taxpayers suffer through insufficient vigilance.

A word may be added about *Plurality of Causes,* or the view that the same kind of effect may in different instances be produced by different kinds of causes. In a general way different causes may produce results that may serve the same practical purpose—light, warmth, satisfaction, death, etc., may be produced in a large variety of ways, and yet make no serious practical difference. Strictly speaking, however, the effect is always different in some way when the cause is different in any way. Although death, *e.g.,* may result from any of the thousand ills that flesh is heir to, and it may make little or no practical difference which of them actually caused it, yet when the occasion requires it coroners' inquests are held in the just belief that differences in the cause of death can be inferred from differences in the state of the dead body. So that, strictly speaking, not only does the same cause always produce the same effect, but the same effect can only be produced by one kind of cause.

Historical.—The category of causality must have been used implicitly from the very dawn of human intelligence. But the implicit use of a category is one thing, its explicit formulation is another thing. The oldest formulation on record is that of Leucippus (5th century B.C.), who formulated the principle that "nothing happens without a cause, everything has a cause and is necessary." Plato distinguished various kinds of causes. But the distinctions best known and most widely accepted during many centuries are those made by Aristotle, who recognized *material, formal, efficient* and *final causes.* He maintained that in order to understand some things completely we must know (1) the *material* of which they are made, (2) the *form* or law of their structure, (3) the active agent or *agency* that effected the imposition of the form upon the matter, and (4) the *final purpose* or end that the effect is adapted to serve. These four types of causes were elaborated during the middle ages, and the text-books on Logic that were in vogue in the 17th century (*e.g.,* Burgersdijck's or Heereboord's *Logic*) distinguish some 40 kinds of causes (a summary of these will be found in A. Wolf, *Spinoza's Short Treatise,* pp. 190–195). These distinctions were not as extravagant as may be supposed. Interpreted as kinds of *conditions,* rather than causes, many of them are still worthy of consideration, and some of them are actually still in use in law and medicine. The less known distinctions that are of importance in the history of philosophy are those of *immanent* and *occasional causes.* An immanent cause is one the effects of which remain within it, as distinguished from a *transitive cause,* which operates on things outside itself. For instance, God, according to Spinoza, is an immanent cause, for, according to pantheistic philosophy, there is nothing outside God; on the other hand, the popular conception of God is mostly that of a transitive Cause, creating and maintaining a world outside Himself. An *occasional cause* is simply the occasion of an occurrence, whereas an efficient cause is what produces it. According to Occasionalism (*q.v.*), bodily changes do not produce mental ones, or vice versa, but a change of either kind is the occasion for the occurrence of a change of the other kind, through the intervention of God as efficient cause.

BIBLIOGRAPHY.—J. S. Mill, *System of Logic* (1875); J. Ward, *Naturalism and Agnosticism* (1907); K. Pearson, *Grammar of Science* (1911); E. Wentscher, *Geschichte des Kausalproblems* (1921); C. Prantl, *Geschichte der Logik* (1926); A. Wolf, *Essentials of Scientific Method* (1928). (A. Wo.)

CAUSE AND EFFECT: *see* CAUSALITY.

CAUSEWAY. A path on a raised dam or mound across marshes or low-lying ground; the word is also used of old paved highways, such as the Roman military roads. "Causey" is still used dialectically in England for a paved or cobbled footpath. The word is properly "causey-way," from *causey,* a mound or dam which is derived, through the Norman-French *caucie* (*cf.* modern *chaussée*), from the late Latin *via calciata,* a road stamped firm with the feet (*calcare,* to tread).

CAUSSES, a natural region in the south of the central plateau of France, chiefly in the departments of Lozère and Aveyron, west of the curving Cevennes and south of the Lot valley. This vast plateau of Jurassic limestone, sloping westwards, is divided into several sections by deep-cut river channels. These smaller plateaux, barren and deserted, are called the *Causses* from *cau,* the local form of the French *chaux, i.e.,* lime. The most typical is the Causse Méjan, south of the Tarn between Florac and Millau, a sterile sparsely-peopled table-land lying between 3,000 and 4,000ft. above sea-level. To the north lies the Causse de Sauveterre prolonged westwards by the Causse de Sévérac. Those of Quercy, Gramat and Rouergue are lower and less arid. Drainage features such as underground streams, fissures and pot-holes (*avens*) are characteristic. The inhabitants (Caussenards) cultivate rye and potatoes where possible, but subsist for the most part on the sheep from whose milk Roquefort cheese is made. Similar dry limestone areas elsewhere are designated under the cognate German *Karst* or Italian *Carso* (*q.v.*).

CAUSSIN DE PERCEVAL, ARMAND-PIERRE (1795–1871), French Orientalist, was born in Paris, where he died during the siege.

His father, Jean Jacques (1759–1835), was professor of Arabic at the Collège de France, and his son, after extended travels in Asia Minor, succeeded to his chair.

His works include a useful *Grammaire arabe vulgaire* (4th ed., 1858), and an enlarged edition of Élie Bocthor's *Dictionnaire français-arabe* (3rd ed., 1864); but his great reputation rests on his *Essai sur l'histoire des Arabes avant l'Islamisme, pendant l'époque de Mahomet* (3 vols., 1847–49), in which the native traditions as to the early history of the Arabs, down to the death of Mohammed and the complete subjection of all the tribes to Islam, are set forth with much learning and lucidity.

CAUSTIC. That which burns (Gr. *καυστικός,* burning). In *surgery,* the term given to substances which destroy living tissues and so inhibit the action of organic poisons, as in bites, malignant disease and gangrenous processes. Such caustic substances include silver nitrate (Lunar caustic), Potassium and Sodium Hydrates (the Caustic Alkalis) (*see* ALKALI), Zinc chloride, an acid solution of mercuric nitrate, and pure carbolic acid (Phenol).

In *mathematics,* the "Caustic Surfaces" of a given surface are the envelopes of the normals to the surface, or the loci of its centres of curvature.

In *optics* (geometrical optics) the term "Caustic" is applied to the envelope of luminous rays after reflection or refraction. In the first case the envelope is termed a cata-caustic, in the second a dia-caustic. Cata-caustics are to be observed as bright curves when light is allowed to fall on a polished cylindrical surface as a napkin ring or a curved polished riband of steel placed on a table. By varying the curvature of the riband of steel or moving the source of light a variety of patterns can be obtained. The investigation of caustics, based as it is on the assumption of the law of the rectilinear propagation of light and the validity

of the experimental laws of reflection and refraction, is essentially of a geometrical nature, and as such attracted the attention of mathematicians of the 17th and succeeding centuries, more notably John Bernoulli, G. F. de l'Hopital, E. W. Tschirnhausen and Louis Carre.

See Arthur Cayley's *Memoirs on Caustics* in Phil. Trans. for 1857 and 1867.

CAUSTIC SODA (sodium hydroxide, NaOH) is a solid, white, deliquescent chemical compound much used as an intermediate material in the production of many chemicals. It is generally made by one of two methods, either through exchange of base by the causticizing of soda-ash (Na_2CO_3) with hydrated lime or directly, through the action of an electric current upon a solution of common salt (NaCl). The latter newer process is tending to supersede the former, especially where cheap electric power is available or where a ready market for chlorine and hydrogen, by-products of the electrolytic process, exists. Because of its large production, caustic soda is classed as a "heavy chemical." It is used as an alkaline reagent, in the manufacture of soap, sodium salts, rayon, paper, medicines, textile products, in petroleum and vegetable oil refining, in tanning and in the synthesis of many organic compounds such as indigo, alizarin, resorcin, formates and oxalates.

CAUTERETS, a watering-place of south-western France in the department of Hautes-Pyrénées, 20m. S. by W. of Lourdes by rail. Pop. (1936) 1,020. It lies in the beautiful valley of the Gave de Cauterets, and is well known for its thermal springs, and as a station for winter sports. Some 50,000 visitors are attracted annually. The 22 springs produce copious supplies of sulphuretted water and serve nine *établissements.* Their temperature varies between 75° and 137°. Cauterets is a centre for excursions, the Monné (8,937ft.), the Cabaliros (7,155ft.), the Pic de Chabarrou (9,550ft.), the Vignemale (10,820ft.), and other summits being in its neighbourhood. The properties of the waters have been known at least since the 10th century: they became famous in the 16th century when Marguerite de Valois composed the "Heptameron," on the model of Boccaccio's "Decameron," while visiting the spa with her court.

CAUTÍN, a province of southern Chile, bounded N. by Malleco and Arauco, E. by Argentina, S. by Valdivia, and W. by the Pacific. Area 6,707 sq.mi.; pop. (1940) 374,659, including many European immigrants, principally Germans. Cautín lies within the temperate rain forest region of the south, its chief products being timber, cattle, grain and apples. The State railway from Santiago to Puerto Montt crosses the province from north to south; branch lines to such places as Cherquenco, Cunco, Tolten and Carahue provide good rail service to most parts of the province. Two partially navigable rivers cross the province from east to west: the Tolten and the Cautín, the lower reaches of the latter being known as the Río Imperial. The province once formed part of the territory occupied by the Araucanian Indians, and Temuco, the capital of the province, is today the center of greatest concentration of these people. Temuco, a city of 39,217 inhabitants in 1940, is on the Río Cautín. It is an important rail center, market town, and gateway to the famous lake district of south Chile.

CAUTLEY, SIR PROBY THOMAS (1802–1871), English engineer and palaeontologist, was born in Suffolk in 1802. After some years' service in the Bengal artillery, which he joined in 1819, he was engaged on the reconstruction of the Doab canal. He had charge of the completed canal for 12 years (1831–43). In 1840 he reported on the proposed Ganges canal, for the irrigation of the country between the rivers Ganges, Hindan, and Jumna. This project was sanctioned in 1841, but the work was not begun till 1843, and even then Cautley found himself hampered in its execution by the opposition of Lord Ellenborough. For want of competent help he had to do the drudgery of surveying and levelling himself, for some time. From 1845 to 1848 he was absent in England owing to ill-health, and on his return to India he was appointed director of canals in the North-western Provinces. After the Ganges canal was opened in 1854 he spent some time in England, and from 1858 to 1868 he occupied a seat on the council of India. He died at Sydenham, near London, on Jan. 25, 1871. Cautley was a distinguished palaeontologist and contributed numerous memoirs, some written in collaboration with Dr. Hugh Falconer, to the *Proceedings* of the Bengal Asiatic Society and the Geological Society of London on the geology and fossil remains of the Sivalik hills.

CAUVERY, a river of southern India. Rising in Coorg, high up amid the Western Ghats, in 12° 25′ N. lat. and 75° 34′ E. long., it flows generally south-east across the plateau of Mysore, and finally enters the bay of Bengal through two principal mouths in Tanjore district. Its length is 472 m. Its course in Coorg is tortuous, and its bed generally rocky with high banks covered with luxuriant vegetation. On entering Mysore it passes through a narrow gorge, but presently widens to a breadth of 300 to 400 yd. The bed is too rocky for navigation. In its course through Mysore the channel is interrupted by a number of anicuts or dams for irrigation. In Mysore state the Cauvery forms the two islands of Seringapatam and Sivasamudram, which vie in sanctity with the island of Seringam lower down in Trichinopoly district. Around the island of Sivasamudram are the celebrated falls of the Cauvery, where the river branches into two channels, each of which makes a descent of about 320 ft. After entering the Madras presidency, the Cauvery forms the boundary between the Coimbatore and Salem districts, until it reaches Trichinopoly district. Sweeping past the historic rock of Trichinopoly, it breaks at the island of Seringam into two channels, which enclose between them the delta of Tanjore, the garden of southern India. The northern channel is called the Coleroon (Kolidam). On the seaward face of its delta are the open roadsteads of Negapatam and French Karikal. The only navigation on any portion of its course is carried on in boats of basket-work. There is an extensive irrigation system in the delta. The most ancient work is a massive dam of unhewn stone, across the stream of the Cauvery proper, which is supposed to date back to the 4th century, but is still in excellent repair. The chief modern work is the anicut across the Coleroon, 2,250 ft. long, which irrigates an area of some 600,000 acres. Altogether a total of about a million acres are irrigated from the Cauvery, and the Cauvery falls have been utilized for an electric power plant, which supplies power to the Kolar goldmines and light and power to Bangalore and Mysore.

The Cauvery is known to devout Hindus as Dakshini Ganga, or the Ganges of the south, and the whole of its course is holy ground. The Cauvery reservoir project, which will largely improve and extend the irrigation facilities, was sanctioned in 1925. It will include a dam at Metur and a canal 88 m. long.

CAVA DEI TIRRENI, a town and episcopal see of Campania, Italy, in the province of Salerno, 6 mi. N.W. by rail from the town of Salerno. Pop. (1936), town, 12,214; commune, 33,051. It lies fairly high in a richly cultivated valley, surrounded by wooded hills, and is a favourite resort. A mile to the south-west is the village of Corpo di Cava (1,970 ft.), with the Benedictine abbey of La Trinità della Cava, founded in 1025 by St. Alferius. The church and the greater part of the buildings were entirely modernized in 1796. The old Gothic cloisters are preserved. The archives, now national property, include documents and MSS. of great value.

M. Morcaldi, *Codex Diplomaticus Cavensis* (1873–1893) has published many important documents relating to the abbey.

CAVAEDIUM, in architecture, a synonym for atrium (*q.v.*), the central hall or court of a Roman house. Vitruvius lists five types: 1. The Tuscanicum. This, the most common type, was without columns, the hole in the roof being supported by the framing of the roof timbers. 2. The Tetrastylon, in which four columns supported the roof at the corners of its opening. 3. The Corinthian, in which more than four columns are employed, so that the cavaedium becomes, in essence, a peristyle (*q.v.*). 4. The Displuviatum, where the roof sloped down, away from the opening, instead of towards it. 5. The Testudinatum, in which the entire area was covered by a continuous roof.

CAVAGNARI, SIR PIERRE LOUIS NAPOLEON (1841–1879), British military administrator, the son of a French general by his marriage with an Irish lady, was born at Stenay,

Meuse, on July 4, 1841. He obtained naturalization as an Englishman, and entered the military service of the East India Company. He served through the Oudh campaign against the mutineers in 1858 and 1859. In 1861 he was appointed an assistant commissioner in the Punjab, and in 1877 became deputy commissioner of Peshawar and took part in several expeditions against the hill tribes. In 1878 he was attached to the staff of the British mission to Kabul, which the Afghans refused to allow to proceed. In May 1879, after the death of the amir Shere Ali, Cavagnari negotiated and signed the treaty of Gandamak with his successor, Yakub Khan. By this the Afghans agreed to admit a British resident at Kabul, and Cavagnari was appointed. He took up his residence in July, and for a time all seemed to go well, but on Sept. 3 Cavagnari and the other European members of the mission were massacred in a sudden rising of mutinous Afghan troops. (*See* AFGHANISTAN.)

CAVAIGNAC, LOUIS EUGÈNE (1802–1857), French general, born in Paris on Oct. 15, 1802, belonged to a family famous in French revolutionary annals. He was the son of JEAN-BAPTISTE CAVAIGNAC (1762–1829), who was a member of the Convention, and acted as its commissioner in the repression of the opponents of the Revolution in various parts of France. At the Restoration he was proscribed as a regicide. Jean-Baptiste's brother, JACQUES MARIE, VICOMTE CAVAIGNAC (1773–1855), was one of Napoleon's generals and commanded the cavalry of the 11th Corps in the retreat from Moscow (1812). GODEFROY CAVAIGNAC (1801–1845), elder brother of Louis Eugène, took part in the Parisian risings of Oct. 1830, 1832 and 1834, and was one of the founders of the Société des Droits de l'Homme. Very highly esteemed for his chivalrous character among the republicans, he was probably personally both the most estimable and able of the old guard of republicans. His reputation was largely, if not wholly, responsible later for the advancement of Louis Eugène, who entered the army.

In 1831 Louis Eugène was removed from active duty in consequence of his declared republicanism, but in 1832 he was recalled to the service and sent to Algeria, where he held a series of commands during the next 16 years. In 1848, the revolutionary Government promoted him governor-general. He refused the post of minister of war because the Government would not fall in with his plan to occupy Paris by troops. Like L. A. Thiers, Cavaignac conceived the idea of drawing the "red republicans" of Paris out into open insurrection, in order that they might be crushed and the domination of the moderates secured. After the National Assembly had eliminated the Socialist members Louis Blanc and Albert (*qq.v.*) from the Government, Cavaignac was made minister of war. The revolt on which he had calculated broke out on June 22, 1848 (*see* NATIONAL WORKSHOPS). Cavaignac withdrew his troops from the affected parts of Paris, till, in his opinion, the revolt had gained sufficient head. He took advantage of the general panic, further, to insist on the resignation of the Government and the granting of dictatorial powers to himself, which was agreed on June 25. His attack on the Parisian rebels, who were exclusively working class, led to the bloodiest and most obstinate conflict that had up till then occurred in Paris; at its end, in his victory on the 26th, Cavaignac permitted, in accordance with his plan, the severest reprisals which decimated the ranks of the Socialists and broke their power.

Both he and his adversaries expected that after laying down his dictatorship he would be elected president. But they had not allowed for the magic of the name of "Louis Napoleon Bonaparte"; a "landslide" of peasant and proletarian votes gave 5,434,226 to the future Napoleon III. and only 1,448,107 to Cavaignac. The disappointed general went into opposition and at the time of the *coup d'état* (Dec. 2, 1851) was even imprisoned for a short while. After his release he abandoned politics and died in retirement on Oct. 28, 1857.

See Louis Menard, *Prologue d'une Révolution* (reprinted 1904); Ch. Schmidt, *Les Journées de juin 1848* (1926); P. de la Gorce, *Histoire de la 2de République* (1914); G. Renard, *La République de 1848* (1900–8); R. W. Postgate, *Revolution from 1789 to 1906* (1920, full bibliog.).

His son, JACQUES MARIE EUGÈNE GODEFROI CAVAIGNAC (1853–1905), French politician, was born in Paris on May 21, 1853. He served as a civil engineer in Angoulême until 1881, when he became master of requests in the Council of State. In 1882 he was elected deputy for Saint-Calais (Sarthe) in the republican interest. In 1885–86 he was under-secretary for war in the Henri Brisson Ministry, and he served in the cabinet of Émile Loubet (1892) as minister of marine and of the colonies. He had exchanged his moderate republicanism for radical views before he became war minister in the cabinet of Léon Bourgeois (1895–96). He was again minister of war in the Brisson cabinet in July 1898, when he read in the chamber a document which definitely incriminated Capt. Alfred Dreyfus. On Aug. 30, however, he stated that this had been discovered to be a forgery by Col. Henry, but he refused to concur with his colleagues in a revision of the Dreyfus prosecution, which was the logical outcome of his own exposure of the forgery. Resigning his portfolio, he joined the Nationalist group in the chamber, and became an energetic supporter of the Ligue de la Patrie Française. In 1899 Cavaignac was an unsuccessful candidate for the presidency of the republic. He died at his country-seat near Flée (Sarthe) on Sept. 25, 1905. He wrote an important book on the *Formation de la Prusse contemporaine* (1891–98), dealing with the events of 1806–13.

See J. M. Cavaignac, *Les deux généraux Cavaignac* (1897); A. Deschamps, *Les deux généraux Cavaignac* (1898); W. Arnoulim, *L'Action clericale en France, Les Cavaignacs devant l'histoire* (1905).

CAVAILLON, a town of south-eastern France in the department of Vaucluse, 20 mi. S.E. of Avignon. Pop. (1936), 8,452. It lies at the southern foot of Mount St. Jacques on the right bank of the Durance above its confluence with the Coulon. To the south of the present town lay the Roman *Cabellio,* a place of some note in territory of the Cavares. Since mediaeval times the town has for the most part followed the fortunes of the Comtat Venaissin, in which it was included. Till the Revolution it was the see of a bishop, and had a large number of monastic establishments. The church of St. Véran is a fine example of 12th century Provençal architecture, with a cloister adjoining. The town is the centre of a rich and well-irrigated plain, which produces fruits and early vegetables. Silk-worms are reared, and silk is an important article of trade. The preparation of preserved vegetables and fruits, distilling and the manufacture of straw hats and leather are carried on.

CAVALCANTI, GUIDO (*c.* 1250–1300), Italian poet and philosopher, was the son of a philosopher whom Dante, in the *Inferno,* condemns to torment among the epicureans and atheists; but he himself was a friend of the poet. By marriage with Beatrice, daughter of Farinata Uberti, he became head of the Ghibellines. He was banished to Sarzana, where he caught a fever, of which he died. Cavalcanti has left a number of love sonnets and canzoni, in honor of a French lady, whom he calls Mandetta. His complete poetical works are contained in Giunti's collection (Florence, 1527; Venice, 1531–32).

The most famous of his sonnets and canzoni are translated by D. G. Rossetti in his *Dante and his Circle* (1874).

CAVALCASELLE, GIOVANNI BATTISTA (1820–1897), Italian writer on art, was born at Legnago on Jan. 22, 1820. He became a student at the Academia delle Belle Arti in Venice, and from early youth studied the art treasures of Italy. His relations sent him to Padua, hoping that he might become an engineer, but in 1844 he returned to his artistic studies. He visited the cities of Tuscany, and then set out to see the masterpieces of Italian art in foreign countries. During a stay in Germany in 1846 and 1847 he made the acquaintance of Joseph Archer Crowe in a post carriage between Hamm and Minden. The two young men felt drawn to each other and met again in Berlin, where they studied together some pictures in the museum. On his return to Venice Cavalcaselle took an active part in the revolution of 1848 against the Austrian rule. He was arrested by Austrian gendarmes and narrowly escaped being shot. He then joined the forces of Garibaldi and was taken prisoner by the French in 1849. He arrived in a miserable plight in Paris, where by good fortune he again met Crowe, and with his help came to

London. The two friends occupied rooms together and worked on a history of early Flemish painters, published in 1857. In the same year Cavalcaselle returned to Italy. In 1864 Crowe and Cavalcaselle published their great work, *New History of Italian Painting,* which was followed by the *History of Painting in North Italy.* Other joint works were *Titian* (1876) and *Raphael* (1883). Cavalcaselle's independent writings are of less importance: *Sul più autentico ritratto di Dante* (1865); *Sulla conservazione dei Monumenti ed oggetti di belle arti; Sulle riforme dell' insegnamento academico* (1875).

Cavalcaselle was for some time secretary to the great art critic and collector, Giovanni Morelli, and his travelling companion when Morelli compiled the inventory of the works of art in the Marca d'Ancona for the Italian Government. Towards the end of his life Cavalcaselle held office as ispettore di belle arti in the Ministry of Education in Rome. He died on Oct. 31, 1897.

Crowe and Cavalcaselle's histories of Italian art are standard works, and have recently been re-edited by Langton Douglas and Tancred Borenius.

CAVALIER, JEAN (1681–1740), the famous chief of the Camisards (*q.v.*), was born at Mas Roux, near Anduze (Gard), on Nov. 28, 1681. His father, an illiterate peasant, had been compelled by persecution to become a Roman Catholic along with his family, but his mother brought him up secretly in the Protestant faith. Threatened with prosecution for his religious opinions he went to Geneva, where he passed the year 1701; he returned to the Cévennes on the eve of the rebellion of the Camisards, who by the murder of the Abbé du Chayla at Pont-de-Monvert on the night of July 24, 1702, raised the standard of revolt. Some months later he became their leader. He showed an extraordinary genius for war. Within a period of two years he was to hold in check Count Maurice de Broglie and Marshal Montrevel, and to carry on one of the most terrible partisan wars in French history.

He maintained the most severe discipline. Each battle increased the terror of his name. On Christmas day, 1702, he dared to hold a religious assembly at the very gates of Alais, and put to flight the local militia which came forth to attack him. At Vagnas, on Feb. 10, 1703, he routed the royal troops, but, defeated in his turn, he was compelled to find safety in flight. But he reappeared, was again defeated at Tour de Bellot (April 30), and again recovered himself, recruits flocking to him to fill up the places of the slain. Cavalier boldly carried the war into the plain, made terrible reprisals, and threatened even Nîmes itself. On April 16, 1704, he encountered Marshal Montrevel himself at the bridge of Nages, with 1,000 men against 5,000, and, though defeated after a desperate conflict, he made a successful retreat. Cavalier was induced to attend a conference at Pont d'Avène near Alais on May 11, 1704, and on May 16, he made submission at Nîmes. Louis XIV. gave him a commission as colonel, which Villars presented to him personally, and a pension of 1,200 livres. At the same time the king authorized the formation of a Camisard regiment for service in Spain under his command.

Before leaving the Cévennes for the last time he went to Alais and to Ribaute, followed by an immense concourse of people. But Cavalier had not been able to obtain liberty of conscience, and his Camisards almost to a man broke forth in wrath against him, reproaching him for what they described as his treacherous desertion. On June 21, 1704, with a hundred Camisards who were still faithful to him, he departed from Nîmes and came to Neu-Brisach (Alsace), where he was to be quartered. From Dijon he went on to Paris, where Louis XIV. gave him audience and heard his explanation of the revolt of the Cévennes. Returning to Dijon, fearing to be imprisoned in the fortress of Neu-Brisach, he escaped with his troop near Montbéliard and took refuge at Lausanne. But he was too much of a soldier to abandon the career of arms. He offered his services to the duke of Savoy, and with his Camisards made war in the Val d'Aosta. After the peace he crossed to England, where he formed a regiment of refugees which took part in the Spanish expedition under the earl of Peterborough and Sir Cloudesley Shovel in May, 1705. At the battle of Almansa the Camisards found themselves opposed to a French regiment, and without firing the two bodies rushed one upon the other. "I fought," Cavalier wrote on July 10, "as long as a man stood beside me and until numbers overpowered me, losing also an immense quantity of blood from a dozen wounds which I received." Marshal Berwick never spoke of this tragic event without visible emotion.

On his return to England a small pension was given him. He settled at Dublin, where he published *Memoirs of the Wars of the Cévennes under Col. Cavalier,* written in French and translated into English with a dedication to Lord Carteret (1726). He was made general on Oct. 27, 1735, and on May 25, 1738, was appointed lieutenant-governor of Jersey. He was promoted major-general in July, 1739, and died in the following year.

See N. A. F. Puaux, *Vie de Jean Cavalier* (1868); David C. A. Agnew, *Protestant Exiles from France,* ii. 54–66 (1871); Charvey, *Jean Cavalier: nouveaux documents inédits* (1884). Eugène Sue popularized the name of the Camisard chief in *Jean Cavalier ou les fanatiques des Cévennes* (1840). A new edition of Cavalier's *Mémoires sur la guerre des Cévennes* was published by F. Puaux in 1918.

CAVALIER, a horseman, particularly a horse-soldier or one of gentle birth, trained in knightly exercises. The word is taken through the French from the Late Lat. *caballarius,* a horseman. *Chevalier,* the French word of parallel descent, means "knight," and is chiefly used in English for a member of certain foreign military or other orders, particularly of the Legion of Honour. Cavalier in English was early applied in a contemptuous sense to an overbearing swashbuckler. Originally used as a term of reproach, it was soon adopted as a title of honour by the supporters of Charles I. in the Great Rebellion, who applied Roundhead to their opponents, and at the Restoration the court party preserved the name, which survived till the rise of the term Tory (*see* WHIG AND TORY). The term "cavalier," in fortification, means a work of great command constructed in the interior of a fort, bastion or other defence, so as to fire over the main parapet without interfering with its firing. A greater volume of fire can thus be obtained, but the great height of the cavalier makes it an easy target for a besieger's guns.

CAVALIERI, BONAVENTURA (1598–1647), Italian mathematician, was born at Milan; his name also occurs in the forms Cavallieri, Cavaglieri, Cavalerius, and de Cavalerüs. He became a Jesuit at an early age and later was inspired to study mathematics by reading a copy of Euclid. On the recommendation of his Order he was made a professor at Bologna in 1629; the post, which he held until he died, was renewed periodically. In 1635 Cavalieri wrote *Geometria indivisibilium continuorum nova quadàm ratione promota,* in which he first stated his principle of indivisibles. The form of the principle was unsatisfactory and was attacked by Guldin. In reply to this attack Cavalieri wrote *Exercitationes geometricae sex* (1647), stating the principle in the more satisfactory form in which it was used by 17th century mathematicians. This work also contained the first rigorous proof of Guldin's theorem relating to the volume of a solid of revolution. The theorem had occurred in the writings of Pappus and had been used in an unsatisfactory fashion by Kepler. Using the principle of indivisibles as a sort of integral calculus, Cavalieri solved a number of problems proposed by Kepler. Other books by Cavalieri are: *Lo specchio ustorio ovvero trattato delle settioni coniche* (1632), *Directorium generale uranometricum, in quo trigonometriae logarithmicae fundamenta ac regula demonstrantur* (1632) and *Trigonometria plana et sphaerica* (1643). Cavalieri died at Bologna on Dec. 3, 1647.

The life of Cavalieri has been written by P. Frisi (Milan, 1776), and by F. Predari (Milan, 1843).

CAVALIERI, EMILIO DEL (1550?–1599?), Italian composer, was born in Rome about 1550 of a noble family and became one of the famous Florentine group of musical reformers —Peri, Rinuccini, Caccini and the rest—who had such an important influence on the subsequent developments of the art.

Cavalieri's style is more facile than that of Peri and Caccini, but he is inferior to them in depth of musical expression. He is, however, important as having been the first to apply the new monodic style to sacred music, and as the founder of the Roman

school of the 17th century which included Mazzocchi, Carissimi and Alessandro Scarlatti.

CAVALLI, FRANCESCO (1602–1676), an early Italian operatic composer of note, was born at Crema in 1602. His real name was Pietro Francesco Caletti-Bruni, but he is better known by that of Cavalli, the name of his patron, a Venetian nobleman. He became a singer at St. Mark's in Venice in 1617, second organist in 1639, first organist in 1665, and in 1668 *maestro di cappella.* He is, however, chiefly important for his operas, twenty-seven of which are still extant, most of them being preserved in the library of St. Mark's at Venice. Monteverde had found opera a musico-literary experiment, and left it a magnificent dramatic spectacle. Cavalli succeeded in making it a popular entertainment. He reduced Monteverde's extravagant orchestra to more practical limits, introduced melodious arias into his music and popular types into his *libretti.* His operas have all the characteristic exaggerations and absurdities of the 17th century, but they have also a remarkably strong sense of dramatic effect as well as a great musical facility, and a grotesque humour which was characteristic of Italian grand opera down to the death of Alessandro Scarlatti.

CAVALLINI, PIETRO (*c.* 1259–1344), Italian painter, born in Rome, was taught painting and mosaic by Giotto while employed at Rome; it is believed that he assisted his master in the mosaic of the Navicella or ship of St. Peter, in the porch of the church of that saint. He also studied under the Cosmati. Lanzi describes him as an adept in both arts, and mentions with approbation his grand fresco of a Crucifixion at Assisi, still in tolerable preservation; he was, moreover, versed in architecture and in sculpture. According to George Vertue, it is highly probable that Cavallini executed, in 1279, the mosaics and other ornaments of the tomb of Edward the Confessor in Westminster Abbey. He would thus be the "Petrus Civis Romanus" whose name is inscribed on the shrine; but a comparison of dates invalidates this surmise. He died in 1344 at the age of 85. Some important works by Cavallini in the church of Santa Cecilia in Trastevere, Rome, were discovered early in this century.

CAVALLOTTI, FELICE (1842–1898), Italian politician, poet and dramatic author, was born in Milan. In 1860 and 1866 he fought with the Garibaldian Corps, but he first attained notoriety by his anti-monarchical lampoons in the *Gazzetta di Milano* and the *Gazzetta Roas* between 1866 and 1872. Elected to parliament in 1872, his turbulent eloquence secured for him the leadership of the extreme Left in 1886 on Bertani's death. His advocacy of democratic reform made him the most popular man of his day next to Crispi, against whom he waged an unceasing and bitter campaign. He was killed in a duel with Count Macola.

See A. de Mohr, *Felice Cavallotti: La Vita e le opere* (Milan, 1899).

CAVALRY. Cavalry constitutes one of the three great ground arms of a military force and is the element whose main duties are: To furnish full terrestrial information of the enemy while screening the movements of its own army; to pursue and demoralize a defeated enemy; at all times to threaten and intercept his communications (lines of supply and command); in battle to strike suddenly and swiftly at weakened points or turn exposed flanks. While it could fight dismounted, cavalry, originally, was considered as an arm which fought on horseback, using the horse's mobility in manoeuvre and his impetus in charging. By the middle of the 16th century the term *cavalry* applied to *mounted men of all kinds* employed for combatant purposes. Cavalry missions have always required a high degree of mobility, and during the early part of the 20th century, in order to accomplish assigned tasks, the arm adopted fast-moving armoured vehicles. Cavalry operating entirely in armoured fighting vehicles became known as "mechanized cavalry."

Cavalry Tactical Doctrine.—The two most primitive types of soldier are the foot-soldier and the horse-soldier, the first being characteristic of early European warfare, and the second of early Asiatic, since in southern Europe, that is, in the countries south and west of the Danube and the Rhine, few suitable breeds of war horses existed. Hence the poverty of Roman cavalry and of early Grecian cavalry. When infantry met infantry battles were decided by numbers, or armament, or discipline; and when cavalry met cavalry, as in Scythia, battles were seldom decided at all, degenerating as they normally did into skirmishes, forays and scattered pursuits. In hilly country, such as most of Greece, cavalry were normally impotent to attack infantry, as is exemplified in the Graeco-Persian Wars (490–479 B.C.); while in open plain land, so frequently found in Asia Minor, they could destroy infantry by besieging them in the field, as happened to Crassus, at Carrhae in 53 B.C. The truth of the matter is that the two arms are complementary, each providing the other with powers not inherent in either separately. Infantry in an advance are useless unless their rear services are protected, and so also are cavalry in the advance, unless the positions won by them can be held so that their forward movement may not be interrupted. The art of an advance through a hostile country has always pivoted on the power of pushing forward a secure and movable base in order to develop from it offensive power. Once infantry and cavalry are combined, the first form the movable base, and the second provide the offensive power. The function of cavalry in any armed force is to fill that requirement of a balanced army which demands a fighting ground element superior to the main element—infantry—in mobility near and on the battlefield, and possessing in common with that arm the ability to engage in offensive and defensive fighting, whether independently or in conjunction with other arms.

When the advance merges into the attack, three targets present themselves, namely, the enemy's infantry, his cavalry and his baggage train. If the third can be seized and held, the severest possible blow is dealt the enemy's organization, consequently the supply services are well protected by the battle front. Infantry can oppose infantry frontally, but if attacked in flank, or rear, by infantry or cavalry, they are taken at a tremendous disadvantage. Throughout history flank protection has been furnished by cavalry. The infantry front may then be pictured as a slowly moving wall behind which are assembled the supply services, and on the flanks of which are hinged two cavalry wings, which, like doors, can swing forwards and backwards, "flapping" away any hostile force which may attempt to raid the baggage train, or attack the infantry in rear. In battle, the first problem is, therefore, the destruction of one or both of the hostile cavalry wings, for when once the opposing infantry wall is bereft of its swinging doors, not only do its flanks become attackable, but also its rear. If, meanwhile, its front can be so firmly held that it is unable to change front, a cavalry attack on its flanks, or rear, is likely to prove decisive. In brief, the object of infantry is to provide a base of operations for cavalry, and the power of cavalry is to be sought, first in ability to overcome their like, and secondly in being able to develop a sufficiency of speed so as to circumvent an infantry front, and attack it in rear before it can face about, which, in the case of an organized army, is an extremely difficult and dangerous operation; impossible if the front is firmly held. The student of military history will consequently find that only when organization, tactics and leadership were such as to allow of the mobility of cavalry being rapidly developed from the stability of infantry has war flourished as an art, and that when this has not been possible it has degenerated into a dog-fight. Likewise, without a mobile arm tactics as an art must cease to be. In the World War of 1914–18 the limitations which the bullet placed on cavalry movement begot the trench; for had cavalry been able to move, the construction of entrenched fronts would have been all but impossible. This fact presents the student of war with a tactical clue to the importance of cavalry in the future, and to follow up this clue it is necessary to understand the past history of the mounted arm.

Early Cavalry.—During the early classical age tactical organization was based on the nature of the country rather than on any idea of weapon co-operation, or combination between the arms. Thus, in Sparta there was practically no cavalry, while in Scythia mounted bowmen alone existed. Nevertheless, immediately the Asiatic horsemen came into contact with European foot-soldiers, as took place in the 5th century B.C., the problem of tactical co-operation, namely, how to equip, arm and manoeuvre a body of men so that offensive power may be developed from a protec-

tive base, was thrust to the fore. This problem was solved by Philip of Macedon, and proved out by his son Alexander the Great.

The backbone of Philip's army was the phalanx, or infantry mass. Armed with the Sarissa, a pike from 18 to 21ft. long, it formed an impenetrable hedge of spears to cavalry attack, though it offered a somewhat vulnerable target to archers both mounted and on foot. To protect it from these, numbers of lightly armed infantry were attached to it, their duty being very similar to that of the British light infantry during the Peninsular War in Spain at the beginning of the 19th century. Recognizing the strong protective and resisting power which the phalanx possessed, Philip was one of the first among the ancients to grasp the fact that stability of organization alone is insufficient to guarantee the act of disruption being followed up by the act of annihilation. The phalanx could not pursue without breaking its formation, it was not armed for the pursuit, and in the pursuit, the pursued almost invariably moves faster than the pursuer, whether both be on foot or mounted. To render the act of annihilation possible, Philip added to the phalanx a superb force of cavalry in the proportion of one trooper to every six heavy foot soldiers. This cavalry he organized in three bodies: Heavy armoured cavalry for the charge, his Companion cavalry being the most notable corps; light cavalry, or Hussars, for reconnaissance and outpost work, and Dragoons who could fight on foot or on horseback. His heavy cavalry doctrine was profoundly simple—horse and rider combined were used as a "projectile" against the enemy once he was held by the phalanx, when the object of his cavalry became the annihilation of all resistance. The tactics which his son developed from this organization were equally simple, and astonishingly effective. Advancing in parallel order to his enemy, he obliqued his right, bringing it forward, and while his centre, protected on its left by the left cavalry wing, held the enemy to his ground, he delivered a series of terrific punches at his opponent's centre, or left, with a view to penetrate or envelop. At the battles of the Granicus (334 B.C.), Issus (333 B.C.), and Gaugamela (331 B.C.) his Companion cavalry decided the day, and at the battle of the Hydaspes (326 B.C.) his cavalry so completely dislocated the Indian Army that his phalanx was able to disrupt it.

Cavalry as the Decisive Arm: 327 B.C.-Adrianople, A.D. 378.—From the days of Alexander onwards, cavalry, on account of their mobility, became the decisive arm. Hannibal's use of cavalry was superb, as the battles of the Trebbia (218 B.C.) and of Cannae (216 B.C.) testify. In both of these the Carthaginian cavalry completely dislocated the Roman legions by a rear attack. In the Roman armies the lack of good cavalry proved their ruin, and it was not until such a force was raised and trained by Scipio Africanus that the Carthaginians were eventually defeated at the battle of Ilipa (205 B.C.), and annihilated at that of Zama (202 B.C.). At Ilipa Scipio beat Hasdrubal by a double envelopment carried out by infantry and cavalry, and at Zama he smashed Hannibal by holding him in front with infantry and striking him in rear with cavalry.

During the days of Julius Caesar, the most serious defeat sustained by the Romans was that of Crassus at the hands of Surena, the Parthian general, whose entire force was composed of mounted archers and heavy cavalry. The Parthians, adopting an improved form of Scythian tactics, won a decisive victory; of the 40,000 Romans who crossed the Euphrates 20,000 were killed and 10,000 made prisoners. The Parthian success was due to the inability of the Romans to develop offensive power from a moving base. Their organization did not enable them to ward off shock and envelopment, while that of their enemy did permit of them enveloping and charging; for in this battle their heavy cavalry provided the necessary stability for the attack of their mounted bowmen and the distraction effected by this attack enabled the heavy cavalry of the Parthians to dislocate and disrupt the Roman legions.

From the battle of Pharsalus (48 B.C.) the legion learned for a space how to hold its own against cavalry, mainly by employing cavalry. Under Diocletian (A.D. 245–313) cavalry rose from one-tenth to one-third of the infantry, and numbered some 160,000; but this great mass of horse was withdrawn from the infantry, and by being formed into a frontier guard lost its offensive spirit. Meanwhile a steady decline took place in the infantry, mercenaries were enlisted, discipline was relaxed, pay increased and armour discarded because of its weight. Of the latter Vegetius wrote: ". . . to avoid fatigue, they allow themselves to be butchered shamefully like cattle." This separation of infantry and cavalry was the main tactical cause of the decline of Rome's military power. The unsupported Roman cavalry, trained as frontier police and for protective duties, were no match for the fierce barbarian horsemen who were now distracting the empire. From the first irruption of the Goths, in the year 248, the Roman cavalry were steadily increased until by the reign of Constantine (288–337) cavalry composed the principal part of the Roman armies; but all in vain. At Adrianople in 378, three Roman legions sent against the Visigoths were overwhelmed and practically annihilated. The Gothic horsemen, *having perfected a new-fangled stirrup,* rode and fought with a vigour and deadliness new to the mounted warrior. Caught massed under a blazing sun, the Roman flank was struck relentlessly by the Gothic horse, and again the dislocation of the Romans, which heralded their disruption, was effected by a cavalry rear attack. The Emperor Valens lost his life, and 40,000 legionnaires perished. From that day cavalry was to become the predominant arm for a thousand years, while the infantry deteriorated into a mere auxiliary.

Cavalry the Predominant Arm: Chalons, 451-Agincourt, 1415.—Fifty-two years after Adrianople, Roman arms at Tricameron won a decisive victory over the Vandals in Africa purely by cavalry. Belisarius had found so little use for his infantry that he mounted them to serve as dragoons. In Europe, however, the hardy and warlike barbarian tribes, fighting chiefly on horseback, soon flooded the Roman provinces. By 410 A.D., the Goths under Alaric captured Rome, and the "mistress of the world" was handed over to the licentious fury of the Huns. The barbarian advance culminated in the battle of Chalons (451) where Attila, after uniting Germany and Scythia, was met and defeated by Aetius and Theodoric. This was the last victory won by Imperial Rome in the West; the dark ages descended upon western Europe, and in the conduct of war that area entered the epoch of the iron-clad lancer.

From the days of Justinian (483–565) to those of the fourth Crusade, which resulted in the sack of Constantinople (1204), highly organized armies comprising well-equipped heavy and light cavalry were maintained by the Eastern empire. In the West, however, military art virtually disappeared, and as principalities took form and feudalism was established the common folk were virtually prohibited from taking part in the "noble" trade of war, which was carried on by raiding and pillaging barons. As the military caste of this period was based on wealth, and as western Europe was largely roadless, cavalry remained the predominant arm, and sought perfection not through improved tactics, or organization, but through armour. By the opening of the 9th century the old military organization of Rome had been replaced by comparatively small bands of mailed knights followed by a mob of retainers who pillaged the countryside and so acted as "administrative units." In England, in the Low Countries and in Switzerland, infantry were still maintained, but were so ill-equipped that when confronted by cavalry in open, or even semi-open, country they were forced to seek protection behind palisades, as was the case with the Saxons at Hastings (1066). Under Charlemagne the mail-clad knight was reaching his zenith, and, as is always the case when the peak of supremacy is topped, decline follows. To the knight of the middle ages the protective base of his offensive power was no longer afforded by the infantry mass, but by the armour he wore, his mobility being provided by his horse. As long as he was not met by equally well mounted and armoured antagonists this combination of mobility and protection proved tactically irresistible, yet seldom did it lead to profitable strategical results. But as soon as he was, it became neutralized, and with neutralization, tactics as an art utterly deteriorated and were replaced by mob fighting.

This self-contained protective power of cavalry is most noticeable during the Crusades, for in spite of the low discipline of the

Christian knights and their very rudimentary knowledge of tactics, normally their casualties were remarkably small. At the battle of Hazarth (1125), Baldwin lost only 24 men, while the Turkish losses amounted to 2,000; at Jaffa (1191) two Crusaders were killed on one side and 700 Turks on the other. The Crusaders, however, lost large numbers of horses, and as the rabble of beggars and vagrants who accompanied them were useless as infantry (further, the code of chivalry did not sanction their use), at times it became necessary for knights to fight on foot, or to abstain from fighting altogether. This involuntary change in tactics led to the Crusaders rediscovering the value of the protective infantry base as a mobile fortress from which the mounted knights could sally forth. In 1248, St. Louis of France adopted this change intentionally. Near Damietta he landed his knights and drew them up on foot in order of battle to cover his disembarkation. The interesting point to note in these operations is that the action of these knights foreshadowed the approaching revival of infantry: "They formed up in serried ranks, placed their bucklers upright in the sand before them, and resting their long lances on the top of their shields, presented an impenetrable array of steel points, before which the Muslim horse fell back in confusion." One of the military influences of the Crusades was the weakening of feudalism through the rise of a commercial class made rich by buying up the knights' lands. This class was concentrated in the cities, and as early as 1057 Pavia and Milan raised armies of their own, largely composed of infantry.

Another result of increasing prosperity was the reintroduction of plate armour, which though it rendered the knight on foot practically invulnerable to infantry attack, when mounted, more and more did it sacrifice his mobility to protection. This seriously influenced the value of the dismounted base, for armour had become so heavy that the dismounted knight was unable to move far on foot. At the battle of Tagliacozzo (1268), Conradin's Ghibelline knights were so heavily armoured that Charles of Anjou's cavalry, after having exhausted them by repeated charges, rolled them out of their saddles by seizing them by their shoulders.

With signs of cavalry power diminishing in the West, there appeared in the East the very essence of power by the mounted warrior. In the latter part of the 12th century there arose on the plains of Mongolia the most formidable cavalry warrior of human annals—Genghis Khan. Utilizing the horsemanship and spirit of conflict which permeated the character of his people, he created vast organized mounted hordes which swept the entire northern and eastern areas of Asia. It is alleged that a mounted force of 700,000 men, held together by a discipline of unyielding iron, rode to his will. Death was the penalty for turning back during action without an order or for neglecting to pick up equipment dropped by a front-file man. From a penetrating native perception, the Khan conceived the powers of co-ordinated and disciplined cavalry. Vigilant and ceaseless training perfected a standard for tactical measures. "A man of my bodyguard," Genghis Khan had announced, "is superior to a regimental commander of another division." The tactical skill of the Mongols had been developed in the stress of war. They had learned to keep track of an enemy's movements while concealing their own. In manoeuvre for battle they had learned not to depend on commands given by a voice which often cannot be heard in the uproar of moving mounted men. Regiments signalled their movements by raising black or white flags during the day and by a similar use of coloured lanterns at night. Other signals were given by the use of whistling arrows, which emitted sound through a hollow pierced head. They hid their formations at times behind a drifting smoke screen. The Mongol horde, unlike the Crusade, formed a movement of deadly intensity by virtue of its disciplined co-ordination and cohesion towards a common end. Followed by immense trains of wagons and great herds of cattle, they could exist for years off the country invaded. They crossed rivers on ice or in leathern boats. They fought mainly with arrows, avoiding close struggle, and strove to destroy their enemies from afar with projectile weapons. There was a fluidity and flexibility in their movements found wanting in the fixed, cumbersome ranks of European forces.

After the death of the great Khan, 150,000 Mongols under the able Sabutai, in 1235, marched towards the setting sun and threatened to flood the whole of Europe. In the next six years this enormous horde had marched one-fourth the distance around the globe. Sabutai swept through present day Russia and on to the plains of Hungary and Poland. Eastern Europe, from the Carpathians to the Baltic, fell under his domain. Although victorious in their fierce battle with the Poles at Wahlstall in April 1241, the strength of the invading Mongols had been so taxed that they turned back to the East. The leaders of western Europe learned little concerning the capacity of highly mobile cavalry in great numbers presented to them by the Mongolian mounted men.

Meanwhile, in western Europe progress in the construction of the bow and the crossbow was another reason for increasing the thickness of armour. At the siege of Abergavenny, in 1182, it is recorded that the Welsh arrows could penetrate an oak door four inches thick. No chain mail could withstand such a blow, consequently plate armour was worn over the mail shirt. As armour increased in weight natural obstacles began to play a decisive part on the battlefield. When ground could not be crossed on horseback it had to be crossed on foot, and the knight deprived of his horse lost much of his tactical value, consequently an able enemy sought every means in his power to compel him to dismount. One of these means was choice of ground, another, archery; for horse armour never proved satisfactory.

At the battle of Dupplin Muir (1332), Baliol and Beaumont did not beat the earl of Mar by reckless charges, but by skillful weapon co-operation. The majority of their knights were dismounted and formed into a phalanx, the flanks of which were protected by archers, while 40 mounted knights were kept in reserve. The earl of Mar charged the phalanx which remained unshaken; his knights, immobilized by the archers on the flanks, were routed by Baliol's mounted squadron. This battle is the birth of a new era in tactics—the tactics of bow, pike and lance combined. It formed the mould in which all the English operations of the Hundred Years' War were cast, a war which proved disastrous to the gallant but insubordinate French chivalry, as the battles of Crécy (1346), Poitiers (1356), and Agincourt (1415) testify. The cavalry difficulty throughout was the armouring of the horse. At Crécy (where gunpowder was first introduced) the horse proved the weak link in the French organization, for of the next great battle, namely Poitiers, John le Bel wrote of the French knights: "All fought on foot, through fear that, as at the battle of Crécy, the archers would kill their horses." Meanwhile in Switzerland infantry armed with pike and halberd, and fighting in phalangeal order, were taking toll of German and Austrian cavalry; and in Bohemia, Ziska by employing wagons in laager created movable fortresses known as the Wagenburg (wagon fort) against which his enemy's cavalry shattered themselves in vain. As wealth increased, mercenaries once again came to the fore, and being professional soldiers whose pay as well as whose lives depended on their art, tactics once again began to assume a coherent form, especially under the English commander-in-chief of Pope Urban V, Sir John Hawkwood, who may be considered the first great general of modern times. From the battle of Poitiers onwards cavalry fell into a rapid decline; the French knights learned nothing, and as the bow and pike destroyed them a new weapon arose in the crude bombards of the 14th century, which was destined to revolutionize the whole art of war, to reduce cavalry to the position they held in the days of the Scythians, and to advance infantry to the heyday of the Spartan phalanx. At the battle of Formigny (1450), three small culverins threw the English archers into disorder, and at Morat (1476) Charles the Bold of Burgundy was defeated by the Swiss who made good use of 6,000 hand guns.

Cavalry in the Age of Gunpowder.—For 1,000 years cavalry had sought to solve the problem of mobility through protection by armour. This being no longer possible, because armour could be penetrated by the bullet, after much trial and error a solution was sought through fire-power (the very cause of its obsolescence), that is to say, by combining cavalry with the other arms. In 1494, Charles VIII of France entered Rome, and in the words of Machiavelli: "He conquered Italy with a piece of chalk."

Arming a tenth of his infantry with the escopette, a species of arquebus, and accompanied by 140 heavy cannon and a number of small pieces, nothing could resist him, and so all he had to do was to chalk off areas on the map to which he wished to go, and there he went.

As armour grew lighter the knight exchanged his lance for the petronel, a type of hand cannon, in order to fire on infantry in place of charging them. This form of attack was first used by the French at the battle of Cerisoles, in 1544, and proved effective because the attack could be prolonged indefinitely, and against such organized Scythian tactics the infantry were powerless until the arquebus was improved, when cavalry became more immobile than ever. Soon the petronel was replaced by the arquebus-à-rouet, and a little later on by the wheel-lock pistol, which was first used by the German cavalry at the battle of St. Quentin, in 1557.

The lance now vanished, and attempts were made to develop cavalry mobility by mixing squadrons with infantry units. As early as the battle of Pavia (1525), the Marquis of Pescara had adopted this organization, and though in a clumsy way it linked fire-power and shock, the mobility of cavalry was so limited by the pace of the infantry that the cavalry attack was reduced to a walk. Twenty-five years after this battle, Marshal de Brissac mounted a number of his infantrymen on horseback, and the era of the modern Dragoon, or mounted infantryman, was initiated.

During the Thirty Years' War (1618–48) the employment of cavalry increased, cavalry mobility being sought not through their own fire power but through that of infantry, and especially artillery. Supported by artillery, Gustavus Adolphus' cavalry rode forward, fired their pistols and charged home with the sword. At Breitenfeld (1631) and at Lutzen (1632) his cavalry played the decisive part. In England he was emulated by Cromwell—the battle of Grantham (1643) was decided by the sword, so was Marston Moor (1644), and so was Naseby (1645). In France the reversion to shock tactics was no whit behind-hand: Turenne favoured the *arme blanche*, and issued instructions to his cavalry to use the sword alone. The impetuous Condé did likewise, and so also Marshal Luxembourg at Leuze, in 1691. In Germany, however, Montecuculi still favoured fire-arms for cavalry; he considered the lance useless, and looked upon the horses of his Dragoons solely as a means of conveyance.

This change is significant and cannot alone be attributed to the genius of such cavalry leaders as Pappenheim and Gustavus. The underlying reason for it is probably to be found in the universal adoption of the matchlock, and the consequent reduction of the pikemen. The matchlock was a slow-loading and unreliable weapon, especially in rainy weather when infantry are apt to be surprised in mist or fog. It was on such occasions as these that cavalry frequently proved themselves the decisive arm, up to the adoption of the percussion cap in 1839. A notable instance of this was the battle of Eylau (1807). During the 18th century the idea of the shock continued to grow. Marlborough used cavalry in mass. Blenheim (1704) was decided by cavalry, and so was Malplaquet (1708). In these battles are to be discovered the germ of the superb cavalry actions of Ziethen and Seydlitz, which characterized the Seven Years' War (1756–63). Charles XII of Sweden carried the shock to its extreme. He prohibited the use of armour, raced over Europe, rode to death two horses while reviewing a regiment, and met an impetuous end at Pultowa (1709). Marshal Saxe, in a reasoned degree, emulated him.

Under Frederick the Great, cavalry once again reached its zenith, and out of 22 of his battles at least 15 were won by the cavalry arm working in close co-operation with gun and musket. In his regulations for cavalry Frederick wrote: "They will move off at a fast trot and charge at the gallop, being careful to be well closed together. His Majesty will guarantee that the enemy will be beaten every time they are charged in this way." The exploits of Seydlitz and Ziethen proved that Frederick was not wrong. Rosbach (1757) was a great cavalry victory, and so, in a lesser degree, was Zorndorf (1758). The secret of Frederick's success lay not only in the artillery preparation which heralded the charge, nor in his system of attack, but in the training of his troopers.

The war of the American Revolution (1775–81) provides no example of outstanding cavalry work, nor do the French Revolutionary Wars, except for the brilliant charge of the English 15th Hussars at Villers-en-Couché (1794), where some 300 British and Austrian cavalry charged and routed 10,000 French infantry and cavalry, driving them into Cambrai with a loss of 1,200 men. The slowing down of the shock first became perceptible in Bonaparte's campaign in Egypt, when the world-famed Mameluke cavalry failed to make any real impression on his infantry squares. At Mount Tabor (1799) 6,000 French infantry under Kléber gained a decisive victory over 30,000 Turks and Mamelukes. From this battle onwards to the World War of 1914–18 the declining power of cavalry remains constant.

Napoleon relied on all arms, but particularly on fire power, and in spite of the many cavalry charges executed during his wars, his cavalry were pre-eminently a strategic force for observation and protection, and a tactical force for pursuit. With his strategic employment of cavalry, no commander was ever more completely informed at all times of the movements and composition of the hostile army than was Napoleon. His earlier manoeuvres, conceived after a careful synchronization of time and space factors, were made practical by skillfully led cavalry. Far-flung columns, well in advance of his main armies, not only kept him posted of hostile movements but were influential in manoeuvring an enemy into an area of Napoleon's own selection. Once contact was gained by main bodies, cavalry invariably were withdrawn to flanks or to the rear in reserve. While mounted charges were executed, they were made at that period in battle when the enemy was shattered by fire and the keen discernment of Napoleon foresaw conclusive results. From the flanks and rear his cavalry were able to deliver the decisive thrust or spring in pursuit of a routed enemy, which meant destruction rather than an orderly retirement and the ability to fight again after reconcentration and reorganization. At Eylau (1807) Napoleonic cavalry, encountering the Russian Cossacks, were confronted for the first time by a mobile element of their own quality; pursuit proved impossible, and strategic reconnaissance ineffective. In the Emperor's subsequent campaigns of 1812–13–14, superior enemy cavalry nullified any real fruits of victory, and in the retreat from Moscow were responsible mainly for the gradual disintegration of the Grand Army. The freedom of manoeuvre, the basis of Napoleon's success, had been reversed.

The Napoleonic wars were followed by 40 years of profound military coma. In 1823, Capt. John Norton, of the 34th English Regiment, invented the cylindro-conoidal bullet. He received no encouragement, for the duke of Wellington considered that the Brown Bess could not be bettered, yet Norton's bullet was the greatest military invention since the flint-lock. In 1853, Capt. Minié, of the French army, invented a similar projectile. In England, Sir William Napier opposed its adoption as he considered that it would destroy the infantry spirit by turning infantry into "long range assassins." It was, however, adopted; it had a range of 1,000yd., and it sealed the doom of the cavalry charge. The war in Crimea (1854–55) taught soldiers nothing new regarding cavalry except to emphasize its misuse by ill-informed commanders of combined arms and to demonstrate the gallantry and spirit of the arm. The battle of Balaklava gave to the world only the famed epic of "The Charge of the Light Brigade" and evidence of the magnificent courage, discipline, and combative will to close with an enemy characteristic of the British mounted warrior. (J. F. C. F.; J. K. H.)

The Mounted Rifleman.—In the next war, the American Civil War (1861–65), a pronounced transition in cavalry tactics took form. The evolution of its tactics switched radically from the accepted European tenets of that day. The Confederate States, largely rural and agricultural, were able to create promptly a considerable cavalry to be used in strictly cavalry rôles. The Union, largely of urban population, organized cavalry at a slower pace, and employed it, initially, on the futile assignments of outpost, convoy, messenger and other associated activities. Employing cavalry in large units, Lee, in Virginia, was able to reap the benefit of decisive victories during the first two

years of the war; his own intentions were always screened from the enemy, while their movements and dispositions habitually were known to him. By May 1862, the Union, finally awake, assembled 10,000 horse into a cavalry corps. At Chancellorsville this formidable cavalry force was dispatched southward on a useless raid. Lee's cavalry, under Stuart, discovering an open flank on the Union right, skillfully screened the movement of Jackson's corps which launched a powerful surprise attack resulting in one of the most complete victories of Confederate arms. By 1863 cavalry tactics on both sides had become concerned principally with dismounted action and proved so effective that the mounted charge was a rarity thereafter. The eventual defeat of Lee was made possible in part through the able employment of a highly mobile cavalry and infantry force under Sheridan. Repeated attacks against the Confederate lines of supply effected their dislocation by depriving them of a protected base. Increased powers of weapon fire had forced a new development of the cavalry dragoon or mounted rifleman—not to be confused with mounted infantry, which utilizes horses only as transportation and habitually fights dismounted; the mounted rifleman is trained and equipped to fight either dismounted or mounted. The revolver, introduced in this war, had proven a formidable cavalry weapon.

The wars which followed in Europe in 1866 and 1870 were marked by a complete disregard of the cavalry lessons learned from the American Civil War. The Austro-Prussian War (1866) saw 56,000 cavalrymen still armed with the lance and sabre charging in the face of the breech loading needle gun and the Minié rifle. The Franco-German War (1870–71) saw 96,000 cavalry take the field similarly equipped. Their tactics called only for mounted action. French cavalry had learned nothing since Waterloo. The Germans were bold and pushful, using their cavalry strategically with considerable effect in order to cover their own movements while discovering those of the enemy. The massed charge was attempted. Margueritte failed; Bredow succeeded, but at terrific cost. His was the last successful massed boot-to-boot cavalry charge in military history.

In South Africa (1899–1902) the Boers, accepting the lessons of the American Civil War, fought with large numbers of mounted riflemen who moved hither and yon, came and went, attacked and retired almost at will. The British faced this type of action initially with a force in which infantry predominated and included a few cavalry regiments armed with swords or lances and depending mainly on these weapons for combat. Not until British mounted elements were reorganized on a dragoon basis were the British able to conquer a people immeasurably their inferior in numbers and resources.

In the Russo-Japanese War (1904–05) cavalry action of little consequence occurred. The outstanding note was the absence of the lance and sword, which were nowhere seen. In combat, the rifle was supreme; any thought of reliance on the sword was banished. The few achievements of Russian cavalry in this war came through the effect of fire action. Little use was made of the cavalry masses of Kuropatkin organized and equipped on the European model of massed action. Japanese cavalry, with few exceptions, carried out their performances with the carbine and usually in close touch with their own infantry. The cavalry dragoon had come into his own.

In the World War of 1914–18 large numbers of cavalry were available for the field. On the Western Front, ten German cavalry divisions (approximately 70,000) faced ten French and one British cavalry divisions. The tool was there for a master of the art of war to appear capable of visualizing the power and capabilities of a numerous cavalry on missions of inspired and skillful design. There was need for mounted riflemen; not the European cavalry of that day relying principally on the sword and lance in mounted action. The French cavalry were split into useless detachments, and the only sizeable force, under Sordet, was marched futilely over the whole of southern Belgium and northern France; his operations availed nothing. The single British cavalry division, operating collectively as a unit, rendered invaluable assistance to the main forces by employing ground fire to delay the German advance south of Mons until reorganization behind them was effected. While their grand plan conceived a powerful enveloping thrust southward through northwestern France, the Germans made little use of the potential power of their cavalry to aid that operation. The bulk of their mounted forces was scattered over the fronts of several field armies rather than assembled for a decisive effort. It is conceivable that 70,000 mounted horse, possessed of ample fire means and operating ruthlessly in the manner understood by Genghis Khan, might have affected materially the outcome of the premeditated action. By preventing the cohesion of the French and British armies, and by seeking out and dislocating the bases and rear areas of the main French forces, there might have been avoided the first battle of the Marne. The same strategical conception, utilizing mechanized cavalry supported by combat aviation, succeeded in 1940.

On the Eastern Front, Russia produced initially twenty-four cavalry divisions (approximately 200,000 horsemen), but like the leaders of ancient Rome, the Russian commanders expended the potential power of this force by scattering it along an entire frontier. The armies of Samsanov and Rennenkampf invaded East Prussia with forces totalling 400,000 combined arms to meet the most crushing defeat of the war at Tannenberg. The decisive victory of the Germans was made possible largely by the success of a single German cavalry division in delaying the army of Rennenkampf. Later, Russia increased her cavalry to 54 divisions, but with military leaders unable to cope with the requirements of massed co-ordination, this vast force accomplished little. It was, indeed, the indirect cause of breaking down the transportation system of the country by the requirements of forage; and the consequent impossibility of feeding the other arms had much to do with the culmination of Russia's struggle in revolution.

Cavalry achievements in this war reached their highest plane in Palestine under Allenby, an outstanding commander of mobile troops. At Armageddon, Sept. 1918, Allenby faced a strong Turkish army with a superior force of combined arms including three cavalry divisions and bombardment aviation. Crushing the enemy right, he dispatched his cavalry, not against the hostile flank, but against the rear. Fleeing Turkish elements crowded into the ravines and defiles which characterized the terrain of that area. Halted and confused by combat aviation, they were annihilated when struck by the charging cavalry columns. The lesson of Armageddon lay not so much in the prowess of ground mobility as in the example of the formidable power of such forces when supported by fire from the air—a dreadful warning of the devastating type of future war. The transcendent cavalry lesson from this war was an exemplification of the need of essential supporting fires for all cavalry action—again, fire power and movement.

Cavalry in the Machine Age: 1919–40.—Four years of stabilized warfare on the continent of Europe had contributed little to the concept of offensive manoeuvre predicated on fire power and movement. Industrial civilization had furnished new potentialities to the power of weapon fires by development of automatic arms and the co-ordinated concentrative effect of massed artillery. Advancement in automotive vehicles afforded new concepts in factors of time and space. Combat aviation gave new reaches to radii of action and means of fire support. Notwithstanding all of these presents which offered new limits to the art of offensive manoeuvre, the military mind became steeped in an exalted respect for the powers of defensive warfare. Thought in some nations focused on the construction of subterranean fortresses of intricate defensive design rather than on wider opportunities for manoeuvre. The significant lessons of Armageddon remained unseen.

The machine age presented to cavalry mandatory adaptations in various fields. The effectiveness and destructive volume of available fire weapons forced new tactical formations. Extended intervals (lateral) and depth of greater distances replaced the closed and more compact patterns of the old order. The horseman took unto himself as an organic part of his arm the newer weapons in order that movement could be made possible by the neutralization of hostile fire. Machine guns, highly mobile artillery, smoke and high explosive mortars, antitank guns, antiaircraft weapons, and truck transport became

absorbed within the armament of cavalry. For the increased need of protective armour, as in the case of knights of former times, the cavalry adopted further an iron horse in the way of the tank and armoured car. As in earlier cavalry, the newer mechanized cavalry became organized and equipped as to type; heavy cavalry with highly armoured tanks—medium cavalry, with lighter and faster tanks—light cavalry, with armoured cars of little armour but great speed. The tactical principles and doctrine of the old applied equally to the new; the tasks assigned remained the same. As throughout history, cavalry continued to be identified by their capacity to fulfill rôles by virtue of their powers of mobility rather than by the means which offered that mobility. The need of employing cavalry in large numbers in a co-ordinated manner was still unchanged. The employment of mobility, fire power and shock continued. Like the cavalry of the 15th century, the newer cavalry was primarily an auxiliary arm and required for its successful use the supporting fires and reenforcement from a co-ordinated effort of the combined arms.

Employed in relatively small numbers in the Spanish Civil War (1936–39), the iron horse achieved little success. Mounted cavalry, thoroughly at home in the rough, mountainous terrain of that country, rendered important assistance in the attainment of a Franco victory. Comprising only five weak squadrons at the commencement of hostilities, Nationalist cavalry, by the end of the war, consisted of 60 mounted squadrons, for it was found that the horse could accomplish tasks impossible to other elements. In the envelopment and pursuit the horsemen were supreme; infantry were found too slow, and machines unable to negotiate rugged terrain.

In 1939, war between major powers again struck Europe. From the early stages of that conflict emerged military leaders who had developed as an art of war the co-ordinated employment of massed machines—on the ground and in the air. The Germans had conceived and perfected a new and effective means of creating fire power from a moving base for the support of highly mobile combat elements. They reached into a new medium, the air, to produce a fire effect so devastating as to dislocate all hostile defenses and permit a freedom of movement for a mobile mass. The *dive bomber* (an aeroplane which gives direction to a projectile by diving at its target rather than dropping it from horizontal flight), employed in massed numbers previously inconceivable, became the instrument for disrupting defensive measures by the destruction of the enemy bases and connecting lines of communication. Under this rain of fire from the air, the newer heavy cavalry breached hostile positions by the power of shock; the lighter cavalry with amazing powers of mobility rushed forward through the breaches to spread fan-like in devastating attacks on the nerve and supply centres in the rear. Once in the open, the sustained drive of this new cavalry continued under the protective power of their own self-contained fire. Mobility reached inspired heights. Poland, as a first class power, was crushed in the space of days—the most decisive military campaign of history up to that day.

In May-June, 1940, the streamlined power of German offence struck through Holland and Belgium and thence south against France. The strategic and tactical doctrine of French and British military leadership continued to be based on the power of defence and other measures equally ill-conceived. Terrestrial observation (high ground) had been forsaken for physical and geographical barriers to thwart the mobility of highly mobile but powerful engines of war. Observation, affording adjustment of weapon fire, led to early destruction of physical barriers, and highly trained German military engineers overcame the geographical obstacles. Massed aerial bombardment dislocated all co-ordination of supporting fires as well as command and supply services in rear areas. The roads to central France lay open. The superiority of offensive power had been restored. Another battle had been won by skillful co-ordination of fire power and manoeuvre.

BIBLIOGRAPHY.—G. T. Denison, *History of Cavalry* (1877); Machiavelli, *The Arte of Warre* (1595); Wallhausen, *Art militaire à Cheval* (1621); Daniel, *Histoire de la Milice Françoise* (1721); Melfort, *Traité sur la Cavalerie* (1776); Brack, *Avant-Postes de Cavalerie Legère* (1831); Roemer, *Cavalry: its History, Management and Uses in War* (1863); Sir Evelyn Wood, *Cavalry in the Waterloo Campaign* (1895); F. N. Maude, *Cavalry: its Past and Future* (1903); Prince Kraft zu Hohenlohe-Ingelfingen, *Letters on Cavalry* and *Conversations on Cavalry* (1880 and 1892); E. Nolan, *Cavalry, its History and Tactics* (1855); C. v. Schmidt, *Instruction for the Training, Employment and Leading of Cavalry* (1881); V. Verdy du Vernois, *The Cavalry Division* (1873); Sir Evelyn Wood, *Achievements of Cavalry* (1893); v. Canitz, *Histoire des exploits et des vicissitudes de la cavalerie prussienne dans les campagnes de Frederic II* (1849); Foucart, *La Cavalerie pendant la campagne de Prusse* (1880); v. Bernhardi, *Cavalry in Future Wars* (1906); v. Pelet Narbonne, *Cavalry on Service* (1906); Official, *A Brief Record of the Advance of the Egyptian Expeditionary Force, under the Command of Gen. Sir Edmund H. H. Allenby, G.C.B., G.C.M.G.* (1919); R. M. P. Preston, *The Desert Mounted Corps* (1921); Gen. M. v. Poseck, *The German Cavalry, 1914* (1923); Wm. A. Mitchell, *World's Military History* (1931); J. F. C. Fuller, *Decisive Battles* (1940); T. R. Phillips, *Roots of Strategy* (1940); R. Shaw, *One Hundred and Seventy-Five Battles* (1937); Jomini, *Art of War* (1862); U. S. Cavalry School, *Cavalry Combat* (1937); Steele, *American Campaigns* (revised 1935); Lamb, *March of the Barbarians* (1940). (J. K. H.)

CAVAN, FREDERIC RUDOLPH LAMBART, 10TH EARL OF (1865–), British general, was born Oct. 16, 1865, and succeeded to the title in 1900. Commissioned in the Grenadier Guards 1885, he was A.D.C. to the governor-general of Canada 1891–93; served in the South African War 1901. Retiring from the army in 1913, he was recalled in Aug. 1914 and in Sept. went out to France to take command of the 4th (Guards) Brigade. In June 1915 he was promoted to command of the 50th Division, and in Aug. to the Guards Division. Winning a reputation as a trusted and admired fighting commander, his next step was the command of the IV. Army Corps at Ypres, which he held from Jan. 1916 to March 1918, when he was appointed to succeed General Plumer as commander-in-chief of the British Forces on the Italian front. A notable mark of trust was that the Italian command put him in charge of the X. Italian Army for the final offensive. It was through the initial forcing of the passages of the Piave by the mixed British and Italian troops under his command that the way was paved for the decisive successes which followed. Remaining on the active list after the War, Lord Cavan was appointed to the Aldershot command in 1920 and in 1922 was advanced to be chief of the Imperial General Staff, a unique distinction in that a retired officer was not only brought back to the active list but became the chief of the army. Cautious, perhaps, in his attitude to military progress and new weapons of warfare, he was a tranquilizing influence rather than a driving force. But in view of the political war weariness and military soreness which prevailed during the first stages of rebuilding the regular army, the former quality was an unquestionable aid in paving the way for subsequent reforms. He retired in 1926.

CAVAN, a county in the province of Ulster, Eire, bounded north by Fermanagh and Monaghan, east by Monaghan and Meath, south by Meath, Westmeath and Longford, and west by Longford and Leitrim. Area 730 sq.mi.; pop. (1936) 76,670.

In the north-west is a mountainous district of millstone grit rising in Cuilcagh to a height of 2,188 ft. The source of the Shannon is thought to be near here. The central portion of the county is a low-lying area of carboniferous limestone, covered by numerous lakes, the most important of which is Lough Oughter, and drained chiefly by the river Erne. The land to the south-east is hilly and irregular and here are encountered the underlying Silurian strata that run from Longford to Donaghadee in Co. Down.

For some centuries after the English settlement this district was known as the Brenny, being divided between the families of O'Rourke and O'Reilly; and its inhabitants, protected by the nature of the country, long maintained their independence. In 1579 Cavan was made shire ground as part of Connaught, and in 1584 it was formed into a county of Ulster. The county subsequently came within the scheme for the plantation of Ulster under James I. Some few remains of antiquity exist in the shape of cairns, raths and the ruins of small castles, such as Cloughoughter castle on an island (an ancient crannog) of Lough Oughter. Three miles from the town of Cavan is Kilmore, with its cathedral, a plain erection containing a Romanesque doorway brought from the abbey of Trinity island, Lough Oughter. The bishopric dates from about 1450.

The climate suffers from dampness arising from the numerous lakes. The soil is generally a stiff clay, cold and watery, but capable of much improvement by drainage, for which its undulating surface affords facilities. Only about $\frac{1}{16}$ of the total area is quite barren. The farms are generally small; oats and potatoes are the principal crops. Flax, once of some importance, is almost neglected. In the higher lands are larger grazing farms which are fairly prosperous.

Cavan is not a manufacturing county. The bleaching of linen and the distillation of whisky are both carried on to a small extent, but the people are chiefly employed in agricultural pursuits and in the sale of home produce. The soil in those districts not well adapted for tillage is peculiarly favourable for trees. The woods were formerly very considerable, and the timber found in the bogs is of large dimensions; but plantations are now chiefly found in extensive demesnes.

The absence of large urban centres is reflected in the limited railway development. The Great Northern railway from Clones to Cavan and the Great Southern railway from Mullingar in Westmeath to Cavan form a through line from north to south. The Great Northern has branches to Belturbet from Ballyhaise, and to Cootehill from Ballybay; the former is continued westwards by the Great Southern railway which has branches also to Killashandra, and from Navan in Meath to Kingscourt. Cavan returns four members to the Dáil Eireann.

CAVAN, urban district and county town of Co. Cavan, Eire, 85½ mi. N.W. of Dublin by the Great Southern railway and the terminus of a branch of the Great Northern of Ireland from Clones. Pop. (1936) 3,393. A Dominican monastery founded by O'Reilly, chieftain of the Brenny, formerly existed here and is the burial place of Owen O'Neill. There was also a castle of the O'Reillys now completely destroyed. The town was burnt in 1690 by the Enniskilleners under Wolseley when they defeated James II.'s troops under the duke of Berwick. There is a grammar school founded by Charles I. and rebuilt on another site in 1819. The town has some linen trade.

CAVANILLES, ANTONIO JOSÉ (1745–1804), Spanish botanist, was born in Valencia on Jan. 16, 1745. In 1801 he became director of the botanic gardens at Madrid, where he died on May 4, 1804. In 1785–86 he published *Monadelphiae Classis Dissertationes X.*, and in 1791 he began to issue *Icones et descriptiones plantarum Hispaniae.*

CAVATINA, originally a short song of simple character, without a second strain or any repetition of the air. It is now frequently applied to a simple melodious air, as distinguished from a brilliant aria, recitative, etc.

CAVAZZOLA or **CAVAZZUOLA, PAOLO MORANDO** (1486–1522), Italian painter of the Veronese school, a pupil of Domenico Morone. He worked at Verona, where he decorated many churches with frescoes (San Nazzaro e Celso, S. Anastasia, S. Chiara, S. Eufemia, S.M. in Organo). His earliest dated work extant was painted in 1508 (Villa Gazzada near Varese). The master is seen at his best in the series of pictures, five in number, which treat of the "Passion," formerly in the church of S. Bernardino and now in the Verona gallery. The series was completed in 1517. Nowhere outside Verona is he so well represented as in the National Gallery, London (which contains two signed pictures, the "St. Roch with the Angel" (1918) and the "Madonna, St. John the Baptist and an Angel." There are also some fine portraits extant (Dresden gallery; Uffizi; Bergamo). The great altarpiece of the Madonna with six saints and with the portrait of the donor, Caterina de Sacchi, is his last work. He died on Aug. 13, 1522, and was buried in St. Polo at Verona. Vasari gives as reason for his premature death that he had set his heart on becoming great, and, working hard, undermined his health. Cavazzola's contemporaries hailed him as the Raphael of the school of Verona.

CAVE, EDWARD (1691–1754), English printer, was born at Newton, Warwickshire, on Feb. 27, 1691, and died on Jan. 10, 1754. He entered the grammar school at Rugby, where his father was a cobbler, but was expelled for robbing the master's henroost. After many vicissitudes he became apprentice to a London printer and was sent to Norwich to conduct a printing house and publish a weekly paper. While still a printer he obtained a place in the post office, and was promoted to be clerk of the franks. He was at this time engaged in supplying London news-letters to various country papers; and his enemies, who had twice summoned him before the House of Commons for breach of privilege, now accused him of opening letters to obtain his news, and he was dismissed from the service. He then set up a small printing office at St. John's Gate, Clerkenwell, which he carried on under the name of R. Newton. He had long formed a scheme of a magazine "to contain the essays and intelligence which appeared in the two hundred half-sheets which the London press then threw off monthly." In 1731 he put it into execution, and began the *Gentleman's Magazine* (*see* PERIODICAL), of which he was the editor, under the pseudonym "Sylvanus Urban, Gent." In 1732 he began to issue reports of the debates in both Houses of Parliament, and in 1738 he was censured for printing the king's answer to an address before it had been announced by the speaker. From that time he called his reports the debates of a "parliament in the empire of Lilliput." To piece together and write out the speeches for this publication was Samuel Johnson's first literary employment. In 1747 Cave was reprimanded for publishing an account of the trial of Lord Lovat, and the reports were discontinued till 1752. Cave published Dr. Johnson's *Rambler,* and his *Irene, London* and *Life of Savage,* and was the subject of a short biography by him.

CAVE, GEORGE CAVE, 1ST VISCOUNT (1856–1928), English lord chancellor, was born in London Feb. 23, 1856, and educated at Merchant Taylors' school, London, and St. John's college, Oxford. Called to the bar in 1880, he became K.C. in 1904. In 1906 he entered parliament as Conservative member for Kingston. In 1915 he became solicitor-general and was knighted. On the formation of the first Coalition Government, in 1916, he was appointed home secretary. In 1918 he was appointed a lord of appeal in ordinary, and received a viscountcy. He sat more frequently at the privy council than in the House of Lords, often presiding over the judicial committee of the council, where he showed a great mastery of the intricate points of law, especially of those arising out of Indian appeals. Cave was lord chancellor in Baldwin's first and second Administrations of 1922 and 1924. As lord chancellor he displayed the reasonableness, the dignity and learning which had characterized him throughout his long career. But in his second term of office his health suffered and on March 27, 1928, he resigned. Next day his advance to an earldom was announced, but he died on the following day before the patent had been made out. His widow was created a countess in the May following.

CAVE, WILLIAM (1637–1713), English divine, was born at Pickwell, Leicestershire. He was educated at St. John's college, Cambridge, and successively held the livings of Islington (1662), of All-Hallows the Great, Thames street, London (1679), and of Isleworth in Middlesex (1690). Dr. Cave was chaplain to Charles II. and in 1684 became a canon of Windsor. His principal works are the *Apostolici,* or History of Apostles and Fathers in the first three centuries of the Church (1677), and *Scriptorum Ecclesiasticorum Historia Literaria* (1688). The best edition of the latter is the Clarendon Press, 1740–43. He died at Windsor on July 4, 1713.

CAVE, a hollow extending beneath the surface of the earth (Lat. *cavea,* from *cavus,* hollow). The word "cavern" (Lat. *caverna*) is a synonym. Caves have been the centres round which have clustered many legends and superstitions, the abode of the sibyls and the nymphs in Roman mythology, in Greek temples, as well as the places where the oracles were delivered.

Caves have been used in all ages by mankind for habitation, refuge and burial. Sanctity attaches to caves in many parts of the world as the abode of powerful spirits, while their use as burial places confers a special importance upon them, since intercourse with the dead, especially those who in life were powerful and eminent in social life, necessarily takes place in proximity to the burial place. Legends like those of Arthur cluster round the caves wherein the hero sleeps his long sleep, whence he shall emerge in due course to a greater glory and a wider empire. We therefore find in them most important testimony as to the ancient history of mankind because they contain evidence of his industry, his mode of life, his ideas and his artistic capacity as well as of the plant and animal world in which he lived (*see* ARCHAEOLOGY: *Palaeolithic Age*), and animals by which they were formerly inhabited. Caves are frequently considered, among primitive peoples, as the passages to the underworld and as the homes of dead heroes. The names given to caves betray the beliefs of the peoples who name them in the mysterious other-worldliness of these caverns.

Physical History.—The most obvious agent in hollowing out caves is the sea. The set of the currents, the force of the breakers, the grinding of the shingle inevitably discover the weak places in the cliff, and leave caves as one of the results of their work, modified in each case by the local conditions of the rock. Those

formed in this manner are easily recognized from their floors being rarely much out of the horizontal; their entrances are all in the same plane, or in a succession of horizontal and parallel planes, if the land has been elevated at successive times. From their inaccessible position they have been rarely occupied by man.

An important class of caves is that composed of those which have been cut out of calcareous rocks by the action of carbonic acid in the rain-water, combined with the mechanical friction of the sand and stones set in motion by the streams which have, at one time or another, flowed through them. They occur at various levels, and are to be met with wherever the strata are sufficiently compact to support a roof.

Caves formed by the action of carbonic acid and the action of water open on the abrupt sides of valleys and ravines at various levels, and are arranged round the main axes of erosion, just as the branches are arranged round the trunk of a tree. The caves themselves ramify in the same irregular fashion as the valleys. Sometimes they are still the passages of subterranean streams; but very frequently the drainage has found an outlet at a lower level, and the ancient watercourses have been deserted. These in every case present unmistakable proof that they have been traversed by water in the sand, gravel and clay which they contain, as well as in the worn surfaces of the sides and bottom. In all districts where there are caves there are funnel-shaped depressions of various sizes called pot-holes or swallow-holes, or bêtoires, "chaldrons du diable," "marmites des géants," or "katavothra," in which the rain is collected before it disappears into the subterranean passages. They are to be seen in all stages, some being mere hollows which only contain water after excessive rain, while others are profound vertical shafts into which the water is continually falling.

America has many caves, some of them picturesquely named by the Indians. For an account of the chief American caves *see* LURAY CAVERN, MAMMOTH CAVE, WYANDOTTE CAVE, COLOSSAL CAVERN, JACOB'S CAVERN.

CAVEA, a term applied both to the ranges of spectators' seats considered as a whole in a Roman amphitheatre (*q.v.*) and also, less commonly, to the cells for wild beasts underneath the arena.

CAVEAT, in law, a notice given by the party interested (caveator) to the proper officer of a court of justice to prevent the taking of a certain step without warning. It is entered in connection with dealings in land registered in the land registry, with the grant of marriage licences, to prevent the issuing of a lunacy commission, to stay the probate of a will, letters of administration, etc. Caveat is also a term used in United States patent law (*see* PATENTS).

CAVEAT EMPTOR, a Latin phrase meaning literally "Let the buyer beware." It represents a legal rule in the purchase and sale of personal property that the buyer purchases at his own risk in the absence of an express warranty, or unless the law implies a seller's warranty, or there is found to have been fraud in the transaction.

CAVEDONE, JACOPO (1577–1660), Italian painter, born at Sassuolo in the Modenese, was educated in the school of the Caracci, and under them painted in the churches of Bologna. His principal works are the "Adoration of the Magi," the "Four Doctors," and the "Last Supper"; and more especially the "Virgin and Child in Glory," with San Petronio and other saints, painted in 1614, and now in the Bolognese academy. Cavedone became an assistant to Guido Reni in Rome. He died at Bologna.

CAVELL, EDITH LOUISA (1865–1915), British nurse, was born Dec. 4, 1865, at Swardeston, Norfolk. She entered the London Hospital as a probationer in 1895. In 1907 she was appointed the first matron of the Berkendael Medical Institute, Brussels, which became a Red Cross hospital on the outbreak of the World War. From Nov. 1914 to July 1915 wounded and derelict English and French soldiers were hidden from the Germans by Prince Reginald de Croy at his château near Mons, thence conveyed to the houses of Edith Cavell and others in Brussels, and furnished by them with money to reach the Dutch frontier, with the aid of guides obtained through Philippe Baucq. On Aug. 5 Edith Cavell was arrested and imprisoned. She admitted having sheltered and helped to convey to the frontier some 200 English, French and Belgians. A court-martial was held (Oct. 7 and 8) and a Belgian lawyer, M. Sadi Kirschen, defended Edith Cavell. On Oct. 9 Edith Cavell and Philippe Baucq were sentenced to death with three others who were afterwards reprieved. Despite efforts to obtain a reprieve in which Mr. Brand Whitlock, the U.S. Minister at Brussels, was active, Edith Cavell and Philippe Baucq were shot on Oct. 12. Miss Cavell, who had tended many wounded German soldiers with devoted care, faced the firing squad with a dignity which moved the world. To the British chaplain who administered a final sacrament, she made the remark, "patriotism is not enough," which at once became as historic as Nelson's utterance at Trafalgar. On May 15, 1919 her body was removed to Norwich Cathedral, after a memorial service in Westminster Abbey. A memorial statue stands opposite the National Portrait Gallery, London.

See *The Case of Miss Cavell from the Unpublished Documents of the Trial,* interpreted by Ambroise Got (1920); Sadi Kirschen, *Devant les Conseils de Guerre allemands* (1919); *Correspondence with the United States Ambassador respecting the Execution of Miss Cavell at Brussels,* Cd. 8013, Stationery Office (1915).

CAVENDISH, GEORGE (1500–1562?), the biographer of Cardinal Wolsey, was the elder son of Thomas Cavendish, clerk of the pipe in the Exchequer. About 1527 he entered the service of Cardinal Wolsey as gentleman-usher, and for the next three years he was in the closest personal attendance on the great man. It is plain that he enjoyed Wolsey's closest confidence to the end, for after the cardinal's death George Cavendish was called before the privy council and closely examined as to Wolsey's latest acts and words. Many years passed before his biography was composed. At length, in 1557, he wrote it out in its final form. It was impossible to publish it in the author's lifetime, but it was widely circulated in ms. The book was first printed in 1641, in a garbled text, and under the title of *The Negotiations of Thomas Wolsey.* The genuine text, from contemporary mss., was first published in 1810. Until that time it was believed that the book was the composition of George Cavendish's younger brother William, the founder of Chatsworth, who also was attached to Wolsey; but Joseph Hunter, in a tract called *Who wrote Cavendish's Life of Wolsey?* (1814), proved the claim of George. The book is the sole authentic record of a multitude of events highly important in a particularly interesting section of the history of England. Its biographical excellence was first emphasized by Bishop Creighton, who insisted that Cavendish was the earliest of the great English biographers and an individual writer of particular charm and originality.

See the edition of the *Life* published by S. W. Singer in 1815, which was reprinted, with a biographical introduction, by Henry Morley in the Universal Library Series (1885). *See* also Francis Bickley, *The Cavendish Family* (1911).

CAVENDISH, HENRY (1731–1810), English chemist and physicist, elder son of Lord Charles Cavendish, brother of the 3rd duke of Devonshire, and Lady Anne Grey, daughter of the duke of Kent, was born at Nice on Oct. 10, 1731. He was sent to school at Hackney in 1742, and in 1749 entered Peterhouse, Cambridge, which he left in 1753, without taking a degree. He appears to have spent some time in Paris with his brother Frederick during the following years, and apparently occupied himself in the study of mathematics and physics. Until he was about 40 he seems to have enjoyed a very moderate allowance from his father, but in the latter part of his life he was left a fortune which made him one of the richest men of his time. He lived principally at Clapham Common, but he had also a town house in Bloomsbury, while his library was in a house in Dean street, Soho; and there he used to attend on appointed days to lend the books to men who were properly vouched for. He was a regular attendant at the meetings of the Royal Society, of which he became a fellow in 1760, and he dined every Thursday with the club composed of its members. Otherwise he had little intercourse with society; indeed, his chief object in life seems to have been to avoid the attention of his fellows. With his relatives he had little intercourse, and even Lord George Cavendish, whom he made his principal heir, he saw



BY COURTESY OF (3) ATCHISON, TOPEKA AND SANTA FE RAILWAY, (4, 6) LURAY CAVERNS CORPORATION, (5) THE WESTINGHOUSE LAMP COMPANY; PHOTOGRAPHS, (1) KEYSTONE VIEW CO., (7, 8) PUBLISHERS PHOTO SERVICE, (2, 9) EWING GALLOWAY

FAMOUS CAVES THROUGHOUT THE WORLD

1. The Giants' hall. Carlsbad Caverns, national park, New Mexico. Series of connected caverns, probably largest in world
2. Great Onyx cave, near Mammoth cave, Kentucky
3. Carlsbad cave, national monument, New Mexico. The king's throne room
4. Caverns of Luray, Virginia, Leidy column, in the blanket room
5. Shenandoah caverns, Virginia. "The Castle of Cardross"
6. Caverns of Luray, Virginia. Helen's Shawl
7. Black Hills, South Dakota. Wind cave
8. Syracuse, Sicily. The Ear of Dionysius
9. Indian Chamber cave, Jenolan, N.S.W., Australia. The Orient cave

only for a few minutes once a year. His dinner was ordered daily by a note placed on the hall table, and his women servants were instructed to keep out of his sight on pain of dismissal. In person he was tall and rather thin; his dress was old-fashioned and singularly uniform, and was inclined to be shabby about the times when the precisely arranged visits of his tailor were due. He had a slight hesitation in his speech, and his air of timidity and reserve was almost ludicrous. He was never married. He died at Clapham on Feb. 24, 1810, leaving funded property worth £700,000, and a landed estate of £8,000 a year, together with canal and other property, and £50,000 at his bankers'. He was buried in the family vault at All Saints' church, Derby; in 1927 this church became the cathedral church of the new diocese of Derby and it was decided to erect a monument there to Henry Cavendish.

Cavendish's scientific work was wide in its range. The papers he himself published form an incomplete record of his researches, for many of the results he obtained only became generally known years after his death; yet the Institute of France in 1803 chose him as one of its eight foreign associates. His first communication to the Royal Society, a chemical paper on "Factitious Airs" (*Phil. Trans.*, 1766), consisted of three parts, a fourth part remaining unpublished until 1839, when it was communicated to the British Association by Canon W. Vernon Harcourt. This paper dealt mostly with "inflammable air" (hydrogen), which he was the first to recognize as a distinct substance, and "fixed air" (carbon dioxide). He determined the specific gravity of these gases with reference to common air, investigated the extent to which they are absorbed by various liquids, and noted that the air produced by fermentation and putrefaction has properties identical with those of fixed air obtained from marble. He introduced new refinements into his experiments, such as the use of drying agents and the correction of the volume of a gas for temperature and pressure. In the following year he published a paper on the analysis of one of the London pump-waters (from Rathbone place, Oxford street), which is closely connected with the memoirs just mentioned, since it shows that the calcareous matter in that water is held in solution by the "fixed air" present and can be precipitated by lime. In 1783 he described observations he had made to determine whether or not the atmosphere is constant in composition; after testing the air on nearly 60 different days in 1781 he could find in the proportion of oxygen no difference of which he could be sure, nor could he detect any sensible variation at different places. Two papers on "Experiments on Air," printed in the *Phil. Trans.* for 1784 and 1785, contain his great discoveries of the compound nature of water and the composition of nitric acid. Starting from an experiment, narrated by Priestley, in which John Warltire fired a mixture of common air and hydrogen by electricity, with the result that there was a diminution of volume and a deposition of moisture, Cavendish burnt about two parts of hydrogen with five of common air and noticed that the only liquefiable product was water. In another experiment he fired, by the electric spark, a mixture of hydrogen and oxygen in a glass globe, similar to the apparatus now called "Cavendish's Eudiometer," and again obtained water. Proceeding with these experiments he found that the resulting water contained nitric acid. In the second of the two papers he gives an account of the methods by which the composition of nitric acid was discovered; he observed also that a very small fraction, about one one-hundred and twentieth, of the "phlogisticated air" of the atmosphere differed from the rest, and in this residue he doubtless had a sample of the inert gas argon which was only recognized as a distinct entity more than 100 years later. It may be noted here that, while Cavendish adhered to the phlogistic doctrine, he did not hold it with anything like the tenacity that characterized Priestley; thus, in his 1784 paper on "Experiments on Air," he remarks that not only the experiments he is describing, but also "most other phenomena of nature seem explicable as well, or nearly as well," upon the Lavoisierian view, but he did not accept it and continued to use the language of the phlogistic theory. Experiments on arsenic, published for the first time in 1921, showed that Cavendish had investigated the properties of arsenic acid about ten years before Scheele.

Cavendish's work on electricity, with the exception of two papers containing relatively unimportant matter, remained in the possession of the Devonshire family until 1879, when the papers were edited by James Clerk Maxwell as the *Electrical Researches of the Hon. Henry Cavendish.* This work shows that Cavendish had anticipated the researches of Coulomb, Faraday and others. He investigated the capacity of condensers and constructed a series of condensers with which he measured the capacity of various pieces of apparatus using the "inch of electricity" as the unit of capacity. He discovered specific inductive capacity and measured this quantity; he showed that electric charges are confined to the surface of a conductor and that the inverse square law of force between charges holds to within 2%. Cavendish introduced the idea of potential under the name of "degree of electrification," in a paper published in 1771, under the title "Attempt to explain some of the principal phenomena of electricity by means of an elastic fluid." He investigated the power of different substances to conduct electrostatic discharges (*Phil. Trans.*, 1775) and completed an enquiry which amounted to an anticipation of Ohm's law.

Cavendish took up the study of heat, and had he published his results promptly he might have anticipated Joseph Black as the discoverer of latent heat and of specific heat. He published a paper on the freezing point of mercury in 1783 and in this paper he expresses doubt of the fluid theory of heat.

Cavendish's last great achievement was his series of experiments to determine the density of the earth (*Phil. Trans.*, 1798). The apparatus he employed was devised by the Rev. John Michell, though he had the most important parts reconstructed to his own designs. (*See* GRAVITATION.) The figure he gives for the specific gravity of the earth is 5·48, but in fact the mean of the 29 results he records works out at 5·448. Other publications of his later years dealt with the height of an aurora seen in 1784 (*Phil. Trans.*, 1790), the civil year of the Hindus (*Id.* 1792), and an improved method of graduating astronomical instruments (*Id.* 1809). Cavendish also had a taste for geology, and made several tours in England for the purpose of gratifying it.

A life by George Wilson (1818–59), printed for the Cavendish Society in 1851, contains an account of his writings, both published and unpublished, together with a critical enquiry into the claims of all the alleged discoverers of the composition of water. Some of his instruments are preserved in the Royal Institution, London, and his name is commemorated in the Cavendish Physical Laboratory at Cambridge, which was built by the 7th duke of Devonshire.

The remainder of Cavendish's papers were placed at the disposition of the Royal Society by the Duke of Devonshire. In 1921 the previously published work, together with a number of unpublished experiments, appeared under the title: *The Scientific Papers of the Honourable Henry Cavendish, F.R.S.; Vol. I., The Electrical Researches,* revised with preface and notes by Sir J. Larmor. *Vol. II., Chemical and Dynamical,* edited by Sir Edward Thorpe, with additions by Dr. Charles Chree and others.

CAVENDISH or **CANDISH, THOMAS** (1555?–1592), the third circumnavigator of the globe, was born in Trimley St. Martin, Suffolk, and educated at Corpus Christi college, Cambridge. In 1585 he accompanied Sir Richard Grenville to America. Soon returning to England, he undertook an elaborate imitation of Drake's great voyage. On July 21, 1586, he sailed from Plymouth with 123 men in three vessels, only one of which (the "Desire," of 140 tons) came home. By way of Sierra Leone, the Cape Verde islands and C. Frio in Brazil, he coasted down to Patagonia (where he discovered "Port Desire," his only important contribution to knowledge), and passing through Magellan's straits fell upon the Spanish settlements and shipping on the west coast of South and Central America and of Mexico. Among his captures was the treasure-galleon, the "Great St. Anne," which he captured off Cape St. Lucas, the southern extremity of California (Nov. 14, 1587). After this success he struck across the Pacific for home; touched at the Ladrones, Philippines, Moluccas and Java; rounded the Cape of Good Hope; and arrived again at Plymouth (Sept. 9–10, 1588), having circumnavigated the globe in two years and 50 days. It is said that his sailors were clothed

in silk, his sails were damask, and his top-mast covered with cloth of gold. Yet by 1591 he was again in difficulties, and planned a fresh American and Pacific venture. John Davis (*q.v.*) accompanied him, but the voyage (undertaken with five vessels) was an utter failure. He died and was buried at sea, on the way home, May 20, 1592.

See Hakluyt's *Principal Navigations*, (*a*) edition of 1589, p. 809 (N.H.'s narrative of the voyage of 1586–1588); (*b*) edition of 1599–1600, vol. iii. pp. 803–825 (Francis Pretty's narrative of the same); (*c*) edition of 1599–1600, vol. iii. pp. 251–253 (on the venture of 1585); (*d*) edition of 1599–1600, vol. iii. pp. 845–852 (John Lane's narrative of the last voyage, of 1591–1592); also *Stationers' Registers* (Arber), vol. ii. pp. 505–509; the Molyneux Globe of 1592, in the library of the Middle Temple, London, and the Ballads in *Biog. Brit.*, vol. i. p. 1196; E. S. Payne, *Voyages of the Elizabethan Seamen to America* (2 vols., 1893–1900).

CAVENDISH, SIR WILLIAM (*c.* 1505–1557), founder of the English noble house of Cavendish, was the younger brother of George Cavendish (*q.v.*). His father, Thomas, was a descendant of Sir John Cavendish, the judge, who in 1381 was murdered by Jack Straw's insurgent peasants at Bury St. Edmunds. Of William's education nothing seems known, but in 1530 he was appointed one of the commissioners for visiting monasteries; he worked directly under Thomas Cromwell, whom he calls "master," and to whom many of his extant letters are addressed. In 1541 he was auditor of the court of augmentations, in 1546 treasurer of the king's chamber, and was knighted and sworn of the Privy Council. Under Edward VI. and Mary he continued in favour at court; during the latter's reign he partially conformed, but on the occasion of the war with France he with other Derbyshire gentlemen refused the loan of £100 demanded by the queen. He died in 1557. Cavendish acquired large properties from the spoils of the monasteries, but in accordance with the wish of his third wife, Elizabeth, he sold them to purchase land in Derbyshire. This wife was the celebrated "building Bess of Hardwick," daughter of John Hardwicke, of Hardwicke, Derbyshire; she completed the original building of Chatsworth House,—begun in 1553 by her husband,—of which nothing now remains. Her fourth husband was George Talbot, 6th earl of Shrewsbury. By her Cavendish had six children; an elder son who died without issue; William, who in 1618 was created earl of Devonshire; Charles, whose son William became 1st duke of Newcastle; Frances, who married Sir Henry Pierpont, and was the ancestress of the dukes of Kingston; Elizabeth, who married Charles Stuart, earl of Lennox, and was the mother of Arabella Stuart; and Mary, who married Gilbert Talbot, 7th earl of Shrewsbury.

CAVETTO, in architecture, any projecting moulding (*q.v.*) with a concave profile of single curvature.

CAVIARE or **CAVIAR,** the roe of various species of *Acipenser* or sturgeon prepared, in several qualities, as an article of food. The word is common to most European languages and supposed to be of Turk or Tatar origin, but the Turk word *khavyah* is probably derived from the Ital. *caviala;* the word does not appear in Russian. The best caviare, which can only be made in winter and is difficult to preserve, is the loosely granulated, almost liquid, kind, known in Russia as *ikra.* It is prepared by beating the ovaries and straining through a sieve to clear the eggs of the membranes, fibres and fatty matter; it is then salted with from 4–6% of salt. The difficulty of preparation and of transport has made it a table delicacy in western Europe, where it has been known since the 16th century, as is evidenced by Hamlet's "His play . . . pleased not the million, 'twas caviare to the general."

Caviare is eaten either as an hors d'oeuvre, particularly in Russia and northern Europe, with kümmel or other liqueurs, or as a savoury, or as a flavouring to other dishes. The coarser quality, in Russia known as *pajusnaya* (from *pajus,* the adherent skin of the ovaries), is more strongly salted in brine and is pressed into a more solid form than the *ikra;* it is then packed in small barrels or hermetically sealed tins. This forms a staple article of food in Russia and eastern Europe. Though the best forms of caviare are still made in Russia, and the greater quantity of the coarser kinds are exported from Astrakhan, the centre of the trade, larger amounts are made each year for export in America and also in Germany, Norway and Sweden. The roe of tunny and mullet, pickled in brine and vinegar, is used, under the name of "botargo," along the Mediterranean littoral and in the Levant.

CAVIGLIA, ENRICO (1862–1945), Italian soldier, was born at Finale Marina (Genoa) on May 4, 1862. After Italy's entry into World War I, he was promoted to major-general and commanded the Bari Brigade. In June 1916 he took over the 29th Division and later was promoted lieutenant-general. In July 1917 he was given command of the XXIV. Corps, which broke through the Austrian lines on the Bainsizza plateau. In June 1918 he was chosen to command the VIII. Army which played an important part in the final victory of Vittorio Veneto. From January to June, 1919, Caviglia was minister of war, and as such became a senator, and in November of the same year he was promoted army general. In Jan. 1920 he took over the command in Venezia Giulia. His task was difficult, since the discipline of the troops had been severely shaken by the example of d'Annunzio's Fiume raid. He restored discipline, and ultimately (Dec. 1920) did not hesitate to use force in driving d'Annunzio from Fiume. In 1926 he was made a marshal. Caviglia died March 22, 1945.

CAVITE, a municipality and capital of the province of Cavite, Luzon, Philippine Islands, on a forked tongue of land in Manila bay, 8 mi. S. of Manila. Pop. (1939) 38,254, of whom 19,695 were males and 204 whites. A native town was already in existence there when the Spaniards came and took possession after their occupation of Manila. The Dutch bombarded Cavite in 1647 and it was long a revolutionary centre. In 1872 a military insurrection broke out and in 1896 there was an execution of 13 of the insurgents to whom a monument was erected by their Filipino sympathizers in 1906. The home of Emilio Aguinaldo, the insurrection leader against both Spain and the United States, was the adjoining municipality of Cavite Viejo. On May 1, 1898 Commodore George Dewey of the United States navy commanded a naval force which overcame the Spanish fleet and captured the town. The same reasons which had made it a naval base for the Spaniards led to its continuance as such by the Americans, viz., a good harbour and proximity to Manila. From 1898 until 1941 it was the chief naval base and coaling station of the U.S. fleet in Asiatic waters, the coaling docks being at Sangley point in the north end of the municipality. But on Dec. 7 it was attacked by Japanese forces and was captured and held by them. The surrounding region, of volcanic origin, is fertile and produces Manila hemp, chiefly exported to Japan, rice, sugar, copra, cacao, coffee and corn. There is convenient rail and trolley connection with Manila, as well as a good automobile road. The U.S. navy had established a radio station and arsenal and remains of old fortifications are still visible. Cavite is one of the Tagalog provinces, and one of the four Spanish penitentiaries in the archipelago was there.

CAVOUR, CAMILLO BENSO, COUNT OF (1810–1861), Italian statesman, was born at Turin on Aug. 1, 1810. Being a younger son (his brother Gustavo was the eldest) Cavour was destined for the army, and became an engineer officer. He soon developed strongly marked Liberal tendencies and an uncompromising dislike for absolutism and clericalism, which made him a suspect in the eyes of the police and of the reactionaries. After the accession to the throne of Charles Albert, whom he always distrusted, he resigned his commission (1831). During the next few years he devoted himself to the study of political and social problems, to foreign travel, and to acquiring a thorough knowledge of practical agriculture. Cavour's political ideas were greatly influenced by the July revolution of 1830 in France, which proved that an historic monarchy was not incompatible with Liberal principles, and he became more than ever convinced of the benefits of a constitutional monarchy as opposed both to despotism and to republicanism. He applied his knowledge of agriculture to the management of his father's estate at Leri, which he greatly improved, he founded the Piedmontese Agricultural Society, and took the lead in promoting the introduction of steam navigation, railways and factories into the country. Thus his mind gradually evolved, and he began to dream dreams of a united Italy free of

foreign influence. In 1847 the psychological moment seemed to have arrived, for the new pope, Pius IX., showed Liberal tendencies and seemed ready to lead all the forces of Italian patriotism against the Austrian domination. Cavour, although he realized that a really Liberal pope was an impossibility, saw the importance of the movement and the necessity of profiting by it. He founded a newspaper at Turin called *Il Risorgimento*, which advocated the ideas of constitutional reform. In Jan. 1848 the revolution first broke out in Sicily, and Cavour, in a speech before a delegation of journalists, declared that the king must take a decided line and grant his people a constitution. Charles Albert, after much hesitation, was induced to grant a charter of liberties (Feb. 8, 1848). Cavour continued his journalistic activity, and his articles in the *Risorgimento* came to exercise great influence both on the king and on public opinion. When the news of the revolt of the Milanese against the Austrians reached Turin on March 19, Cavour advocated war against Austria. His article in the *Risorgimento* made such an impression that it put an end to the king's vacillations, and a few days after its appearance war was declared (March 25).

During the war elections were held in Piedmont. Cavour was returned in June, and he took his seat in parliament on the right as a Conservative. He was not a good speaker, but he gradually developed a strong argumentative power, and he rose at times to the highest level of an eloquence which was never rhetorical. After the dissolution in Jan. 1849, Cavour was not re-elected. The new parliament had to discuss, in the first instance, the all-important question of whether the campaign should be continued now that the armistice was about to expire. The king decided on a last desperate throw, and recommenced hostilities. On March 23 the Piedmontese were totally defeated at Novara, a disaster which was followed immediately by the abdication of Charles Albert in favour of his son Victor Emmanuel II. The new king was obliged to conclude peace with Austria and the Italian revolution was crushed, but Cavour did not despair. There were fresh elections in July, and this time Cavour was returned. His speech on March 7, 1850, in which he said that, "Piedmont, gathering to itself all the living forces of Italy, would be soon in a position to lead our mother-country to the high destinies to which she is called," struck the first note of encouragement after the dark days of the preceding year. He supported the ministry of which Massimo d'Azeglio was president in its work of reform and restoration, and in October of the same year, on the death of Santa Rosa, he himself was appointed minister of agriculture, industry and commerce. In 1851 he also assumed the portfolio of finance, and devoted himself to the task of reorganizing the Piedmontese finances. By far the ablest man in the cabinet, he soon came to dominate it, but as a result of a quarrel with d'Azeglio he resigned; he made use of his freedom to visit England and France again, in order to sound public opinion on the Italian question. In London he found the leaders of both parties friendly. At this time Sir James Hudson was appointed British minister at Turin, where he became the intimate friend of Cavour and gave him valuable assistance. In Paris, Cavour had a long interview with Prince Louis Napoleon, then president of the republic, and also met several Italian exiles in France.

On Cavour's return he found a new cabinet crisis, and was invited to form a ministry. By Nov. 4, he was prime minister. He devoted the first years of his premiership to developing the economic resources of the country; but in preparing it for greater destinies, he had to meet the heavy expenditure by increased taxation. Cavour's first international difficulty was with Austria; after the abortive rising at Milan in Feb. 1853, the Austrian Government, in addition to other measures of repression, confiscated the estates of those Lombards who had become naturalized Piedmontese, although they had nothing to do with the outbreak. Cavour took a strong line on this question, and on Austria's refusal to withdraw the obnoxious decree, he recalled the Piedmontese minister from Vienna. Then followed the Crimean War, in which Cavour first showed his extraordinary political insight and diplomatic genius. In spite of many difficulties and opposition from both extreme Conservatives and Radicals, he negotiated Piedmontese participation in the campaign as a means of bringing the Italian question before the Great Powers. General Dabormida, the minister of foreign affairs, disapproved of this policy and resigned. The vacant portfolio was offered to d'Azeglio, who refused it; whereupon Cavour assumed it himself. On the same day (Jan. 10, 1855) the treaty with France and England was signed, and shortly afterwards 15,000 Piedmontese troops under General La Marmora were despatched to the Crimea.

Events at first seemed to justify the fears of Cavour's opponents. Cholera attacked the Piedmontese soldiers, who for a long time had no occasion to distinguish themselves in action; public opinion became despondent and began to blame Cavour, and even he himself lost heart. Then came the news of the battle of the Tchernaya, fought and won by the Italians, which turned sadness and doubt into jubilation. Joy was felt throughout Italy, especially at Milan, where the victory was the first sign of daylight amid the gloom caused by the return of the Austrians. On the summoning of the Congress of Paris at the conclusion of the war, Cavour represented Piedmont. After much discussion, and in spite of the opposition of Austria, who as mediator occupied a predominant position, Cavour obtained that Piedmont should be treated as one of the Great Powers. By his marvellous diplomatic skill, far superior to that of his colleagues, he first succeeded in isolating Austria, secondly in indirectly compromising Napoleon in the Italian question, and thirdly in getting the wretched conditions of Italy discussed by the representatives of the Great Powers. It was now manifest that the liberation of Italy was personified in him. Cavour's chief measure of internal reform during this period was a bill for suppressing all monastic orders unconnected with education, preaching or charity; this aroused strong opposition and led to the minister's resignation. But he was soon recalled, for the country could not do without him, and the bill was passed (May 29, 1855).

Cavour now saw that war with Austria was merely a question of time, and he began to establish connections with the revolutionaries of all parts of Italy. He continued to strengthen Piedmont's military resources, but he well knew that Piedmont could not defeat Austria single-handed. He would have preferred an alliance with Great Britain, who would never demand territorial compensation; but although British sympathies were with Italy, the British Government was keenly anxious to avoid war. From Napoleon more was to be hoped, for the emperor still preserved some of his revolutionary instincts, while the insecurity of his situation at home made him eager to gain popularity by winning military glory abroad; but he still hesitated, and Cavour devoted the whole of his ability to overcoming his doubts. In spite of the Orsini outrage, an "accidental" meeting between Napoleon and Cavour was arranged and took place at Plombières in July, and although no definite treaty was signed the basis of an agreement was laid, whereby France and Piedmont were to declare war against Austria with the object of expelling her from Italy, and a north Italian State was to be formed; in exchange for this help France was to receive Savoy and possibly Nice. A marriage was to be arranged between Prince Jerome Bonaparte and Princess Clothilde, Victor Emmanuel's daughter. But the emperor still hesitated, and Cavour saw that the only way to overcome the many obstacles in his path was to force Austria's hand. Then there was the danger lest an Italy freed by French arms should be overwhelmed under French predominance; for this reason Cavour was determined to secure the co-operation of volunteers from other parts of Italy, and that the war should be accompanied by a series of risings against Austria and the local despots.

The moment war was seen to be imminent, parties of Italians of all classes, especially Lombards, poured into Piedmont to enlist in the army. Cavour also had a secret interview with Garibaldi, with whom he arranged to organize volunteer corps so that the army should be not merely that of Piedmont, but of all Italy. Every day the situation grew more critical, and on Jan. 10, 1859 the king in his speech from the throne pronounced the memorable words "that he could not remain deaf to the cry of pain (*il grido di dolore*) that reached him from all parts of Italy" —words which, although actually suggested by Napoleon, rang

like a trumpet-call throughout the land. In the meanwhile the marriage negotiations were concluded, and during the emperor's visit to Turin a military convention was signed between the two States, and Savoy and Nice were promised to France as a reward for the expulsion of the Austrians from Italy. But Napoleon, ever hesitating, jumped at the Russian proposal to settle the Italian question by means of his own favourite expedient, a congress. To this Austria agreed on condition that Piedmont should disarm and should be excluded from the congress; England supported the scheme, but desired that all the Italian States should be represented. Cavour was in despair at the turn events were taking but decided at last reluctantly to accept the proposal, lest Piedmont should be abandoned by all, while he clung to the hope that Austria would reject it. On April 19, the Austrian emperor, on the advice of the military party, did reject it; and on the 23rd, to Cavour's inexpressible joy, Austria sent an ultimatum demanding the disarmament of Piedmont. Cavour replied that his Government had agreed to the congress proposed by the Powers and that it had nothing more to say. On quitting the chamber that day he said to a friend: "I am leaving the last sitting of the last Piedmontese parliament"—the next would represent united Italy. France now allied herself definitely with Piedmont, and England, delighted at Cavour's acquiescence became wholly friendly to the Italian cause. A few days later Austria declared war.

As La Marmora now took the chief command of the army Cavour added the ministry of war to the others he already held. His activity at this time was astounding, for he was virtually dictator and controlled single-handed nearly all the chief offices of the State. The French and Piedmontese forces defeated the Austrians in several battles, and the people rose in arms at Parma, Modena, Florence and Bologna; the local princes were expelled and provisional governments set up. Cavour sent special commissioners to take charge of the various provinces in Victor Emmanuel's name. But these events, together with Prussia's menacing attitude, began to alarm Napoleon, who, after Solferino, concluded an armistice with Austria at Villafranca on July 8, without previously informing Cavour. When Cavour heard of it he was thunderstruck; he immediately interviewed the king at Monzambano, and in violent, almost disrespectful language implored him not to make peace until Venice was free. But Victor Emmanuel saw that nothing was to be gained by a refusal, and much against his own inclination, signed the peace preliminaries at Villafranca, adding the phrase, "pour ce qui me concerne," which meant that he was not responsible for what the people of other parts of Italy might do (July 12). Lombardy was to be ceded to Piedmont, Venetia to remain Austrian, the deposed princes to be reinstated, and the pope made president of an Italian confederation.

The cabinet resigned the next day, and Cavour privately advised the revolutionists of central Italy to resist the return of the princes, by force if necessary. Palmerston, who had meanwhile succeeded Malmesbury as foreign minister, informed France and Austria that Great Britain would never tolerate their armed intervention in favour of the central Italian despots. On Nov. 10, peace was signed at Zürich, and on the fall of the Rattazzi-La Marmora cabinet the king, in spite of the quarrel at Monzambano, asked Cavour to take office again. Napoleon still refused to consent to the union of Tuscany with Piedmont, but Cavour saw that Napoleon might be ready to deal; although the bargain of the preceding year had not been exactly fulfilled, as the Austrians were still in Venice, he again brought forward the question of Nice and Savoy. On March 24, the treaty was signed, and the emperor's opposition to the annexation of central Italy withdrawn. On April 2, the parliament representing Piedmont, the duchies of Parma and Modena, Tuscany and Romagna, met, and Cavour had the difficult and ungrateful task of explaining the cession of Nice and Savoy. In spite of some opposition, the agreement was ratified by a large majority.

The situation in the kingdom of Naples was now becoming critical, and Cavour had to follow a somewhat double-faced policy, on the one hand negotiating with the Bourbon king (Francis II.), suggesting a division of Italy between him and Victor Emmanuel, and on the other secretly backing up the revolutionary agitation. Having now learnt that Garibaldi was planning an expedition to Sicily with his volunteers, he decided not to oppose its departure; on May 5, it sailed from Quarto near Genoa. Garibaldi with his immortal Thousand landed at Marsala, and the whole rotten fabric of the Bourbon Government collapsed. He crossed over to the mainland, and entered Naples in triumph. But Cavour feared, that, although Garibaldi himself had always loyally acted in the king of Italy's name, the republicans around him might lead him to commit some imprudence and plunge the country into anarchy, and that Garibaldi might invade the papal States, which would have led to further international complications. But the pope had made considerable armaments; his forces, consisting largely of brigands and foreigners under the French general Lamoricière, maintained a menacing attitude on the frontier; Cavour decided on the momentous step of annexing the papal States with the exception of the Roman province. The Italian forces crossed the frontier from Romagna on Sept. 11, and were everywhere received with open arms by the people; Ancona was taken, Lamoricière was defeated and captured at the battle of Castelfidardo, and on the 20th King Victor marched into the Neapolitan kingdom. On Oct. 1, Garibaldi defeated the Neapolitan troops on the Volturno, and Gaeta alone, where King Francis of Naples had retired, still held out.

Cavour had to use all his tact to restrain Garibaldi from marching on Rome and at the same time not to appear ungrateful. He refused to act despotically, and summoned parliament to vote on the annexation, which it did on the 11th. Two days later Garibaldi magnanimously gave in to the nation's will and handed his conquests over to King Victor as a free gift. Gaeta surrendered on Feb. 13, and King Francis retired to Rome. Parliament was dissolved once more; the new chamber showed an overwhelming majority in favour of Cavour, and Victor Emmanuel was proclaimed king of Italy.

The last question with which Cavour had to deal was that of Rome. In October he declared in parliament that Rome must be the capital of Italy, for no other city was recognized as such by the whole country, and in Jan. 1861 a resolution to that effect was passed. But owing to Napoleon's attitude he had to proceed warily, and made no attempt for the present to carry out the nation's wishes. At the same time he was anxious that the Church should preserve the fullest liberty, and he believed in the principle of "a free Church in a free State." The long strain of these last years had been almost unbearable, and at last began to tell; the negotiations with Garibaldi were particularly trying, for while the great statesman wished to treat the hero and his volunteers generously, he could not permit all the Garibaldian officers to be received into the regular army with the same ranks they held in the volunteer forces. This question, together with that of Nice, led to a painful scene in the chamber between the two men, although they were formally reconciled a few days later. For some time past Cavour had been unwell and irritable, and the scene with Garibaldi undoubtedly hastened his end. A fever set in, and after a short illness he passed away on June 6, 1861. He was buried on his ancestral estate of Santena.

The death of Cavour was a terrible loss to Italy; there remained many problems to be solved in which his genius and personality were urgently needed. But the great work had been carried to such a point that lesser men might now complete the structure. He is undoubtedly the greatest figure of the *Risorgimento*, and although other men and other forces co-operated in the movement, it was Cavour who organized it and skilfully conducted the negotiations necessary to overcome all, apparently insuperable, obstacles. (L. V.)

BIBLIOGRAPHY.—C. Benso di Cavour, *Opere politico-economiche* (Cuneo, 1855) and *Discorsi parlamentari* (Turin, 1863–72); W. de la Rive, *Le Comte de Cavour* (1862), the work of a contemporary and intimate friend; H. von Treitschke, "Cavour" in his *Historische und politische Aufsätze* (Leipzig, 1871); G. Massari, *Il Conte di Cavour* (Turin, 1873); L. Chiala, *Lettere edite ed inedite del Conte di Cavour* (Turin, 1883–87); D. Zanichelli, *Gli Scritti del Conte di Cavour* (Bologna, 1892), and *Cavour* (Florence, 1905); G. Buzzaconi, *Bibliografia Cavouriana* (Turin, 1898); Countess E. Martinengo Cesaresco, *Cavour* (London, 1898), an excellent little monograph; F. X. Krauss, *Cavour* (Mainz, 1902); E. Artom, *L'Opere politica del Sena-*

tore Isacco Artom nel Risorgimento Italiano (Bologna, 1905), a biography of Cavour's devoted private secretary, containing new material; W. R. Thayer, *Life and Times of Cavour* (1911); F. Ruffeni, *La Giovinezza del Conte di Cavour* (1912); P. Orsi, *Cavour and the Making of Modern Italy* (new ed. 1926); G. M. Paléologue, *Cavour* (1926); *Il Carteggio Cavour-Nigra, 1858–61* (Bologna, 1926).

CAVOUR (anc. *Caburrum* or *Forum Vibii*), a village of Piedmont, Italy, in the province of Turin, 32 mi. S.W. by rail and steam tram (via Pinerolo) from the town of Turin. Pop. 1,547 (town); 6,244 (commune). It lies on the north side of a huge isolated mass of granite (the Rocca di Cavour) which rises from the plain. On the summit was the Roman village. The town gave its name to the Benso family of Chieri, who were raised to the marquisate in 1771, and of which the statesman Cavour was a member.

CAVY, the name of several South American rodents of the family Caviidae (*see* RODENTIA); originally it was confined to the domesticated guinea pig and its allies of the genus *Cavia*. (The word "guinea" here may be a corruption of "Guiana" but more probably it means "foreign.") The true cavies are small, self-coloured animals, with short, rounded ears and no tail. They are partly diurnal and live in burrows. The diet is vegetarian and their cries are faint squeaks and grunts. Unlike the prolific guinea pig, which begins to breed at two months old and may be the parent of several hundred individuals in a year, the wild cavies breed only once a year, producing one or two young at a time. These are born in a very advanced stage of development and begin to feed themselves the following day.

Cavies are widely distributed in South America. The original of the domestic race is *C. cutleri* of Peru. *C. niata* is found at great elevations in the Andes. The restless cavy of Brazil is *C. pamparum*. The Patagonian cavy or mara (*Dolichotis australis*) resembles a hare in shape and habits, but lives in a burrow. Fossil species of this genus, of which there is a second smaller type in Argentina, have been found in Brazil and the Argentine.

CAWDOR, village and civil parish, Nairnshire, Scotland. Pop. (1931) 767. The village is situated 5 mi. S.S.W. of Nairn and 3 mi. from Gollanfield Junction on the L.M.S.R. In the vicinity is a large distillery. The castle was the scene, according to the tradition which Shakespeare has perpetuated, of the murder of King Duncan by Macbeth, thane of Cawdor (or Calder), in 1040. Since the oldest part of the structure dates from 1454, however, and seemingly had no predecessor, the tradition has no foundation in fact. The building stands on the rocky bank of Cawdor burn, a right-bank tributary of the Nairn. The massive keep with small turrets is the original portion of the castle, and to it were added, in the 17th century, the modern buildings forming two sides of a square. It is the seat of Earl Cawdor. Kilravock (pronounced *Kilrawk*) castle, 1½ mi. W. of Cawdor, commands the left bank of the Nairn. Its keep dates from 1460, and the later buildings belong to the 17th century. It has been continuously tenanted by the Roses, who settled at Kilravock in 1293, after which date son succeeded father in direct descent. Queen Mary was received at the castle in 1562, and Prince Charles Edward was entertained four days before the battle of Culloden. The gardens are beautiful.

CAWNPORE, a city and district of British India in the Allahabad division of the United Provinces. The city is situated on the south bank of the Ganges, 40 m. south-west of Lucknow, and formed from early times a frontier outpost of the people of Oudh and Bengal against their northern neighbours. Clive selected it, on account of its commanding position, as the cantonment for the brigade of troops lent him by the nawab of Oudh. In 1801, when the Ceded Provinces were acquired by the East India Company, it became the chief British frontier station, but by the time of the Mutiny the frontier had left it behind, and it was denuded of troops. It is now again a military station of some importance, and a very large railway centre. But its industrial development has been unique in northern India. Starting with a government harness factory, the manufacture of leather goods in every form has attained the position of a first-class industry. There are also large cotton-mills, a woollen manufactory with a world-wide reputation and a number of engineering and other minor industries. Extensive city improvements have been launched in order to keep pace with the sanitary requirements of the growing labour force. On the outskirts of the city is a fine agricultural college and demonstration farm. The population of the city and cantonment in 1941 was 487,324.

The name of Cawnpore is indelibly connected with the blackest episode in the history of the Indian Mutiny—the massacre here in July 1857 of hundreds of women and children by the Nana Sahib. The entrenchment, where General Sir H. M. Wheeler with his small band of soldiers and the European and Eurasian residents were exposed for 21 days to the fire of the mutineers, is merely a bare field. About three-quarters of a mile away, on the banks of the river Ganges, is the Massacre Ghat. A grassy road between banks 10 to 12 ft. high leads down to the river, and it was among the trees on these banks that the murderers concealed themselves and shot down the little garrison as soon as they were embarked in the boats which were to take them to safety. On the Ghat itself, or temple steps down to the water, some 600 helpless people were slain, in spite of a promise of safe conduct from the Nana. The remaining 200 victims, who had escaped the bullets of the siege and survived the butchery of the river bank, were massacred afterwards and cast down the famous well of Cawnpore, which is now marked by a memorial and surrounded by gardens. The memorial is crowned by the figure of an angel in white marble, and on the wall of the well itself is the following inscription:

Sacred to the perpetual Memory of a great company of Christian people, chiefly Women and Children, who near this spot were cruelly murdered by the followers of the rebel Nana Dhundu Pant, of Bithur, and cast, the dying with the dead, into the well below, on the xvth day of July, MDCCCLVII.

The DISTRICT OF CAWNPORE is situated between the Ganges and Jumna rivers, and is a portion of the well-watered and fertile tract known as the Doab, the total area being 2,372 sq.mi. The general inclination of the country is from north to south. Besides the two great rivers, the principal streams are the Arand or Rhind, the Kavan or Singar, the Isan and the Pandu. The district is watered by four branches of the Ganges canal. The population in 1941 was 1,556,247.

CAXTON, WILLIAM (*c.* 1422–1491), the first English printer, was born somewhere in the Weald of Kent. The name, which was apparently pronounced Cauxton, is identical with Causton, the name of a manor in the parish of Hadlow. The date of Caxton's birth was arbitrarily fixed in 1748 by Oldys as 1412. Blades, however, inferred that in 1438, when he was apprenticed to Robert Large, he would not have been more than 16 years of age. Robert Large was a rich silk mercer who became lord mayor of London in 1439, and the fact of Caxton's apprenticeship to him argues that Caxton's own parents were in a good position. When Large died in 1441, Caxton was probably sent direct to Bruges, then the central foreign market of the Anglo-Flemish trade, for he presently entered business there on his own account. In 1450 his name appears in the Bruges records as standing joint surety for the sum of £100; and in 1463 he was acting governor of the company of Merchant Adventurers in the Low Countries. This association, sometimes known as the "English Nation," was dominated by the Mercers' Company, to the livery of which Caxton had been formally admitted in London in 1453. In 1464 he was appointed to negotiate with Philip, duke of Burgundy, the renewal of a treaty concerning the wool trade, which was about to expire. These attempts failed, but he was again employed in a similar but successful mission in Oct. 1468 to the new duke, Charles the Bold, who had just married Princess Margaret of York, sister of Edward IV. The last mention of Caxton in the capacity of governor of the "English Nation" is on Aug. 13, 1469, and it was probably about that time that he entered the household of the duchess Margaret, possibly in the position of commercial adviser.

He had already begun his translation of the popular mediaeval romance of Troy, *The Recuyell of the Historyes of Troye*, from the French of Raoul le Fèvre; and, after laying it aside for some time, he resumed it at the wish of the duchess Margaret, to whom the ms. was presented. From July 1471 until after Midsummer 1472 Caxton was in Cologne, and it was there, as his disciple

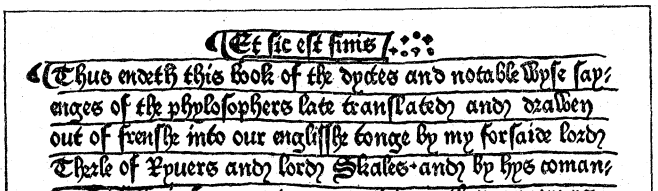
Wynkyn de Worde tells us, that he learned the art of printing. On his return to Bruges, he set up a press, in partnership with Colard Mansion, and there his *Recuyell* was printed in 1474 or 1475. His second book, *The Game and Playe of Chesse,* from the *Liber de ludo scacchorum* of Jacobus de Cessolis through the French of Jehan de Vignay, was finished in 1474, and printed in 1476; the last book printed by Mansion and Caxton at Bruges was the *Quatre derrenieres choses,* an anonymous treatise usually known as *De quattuor novissimis.*



BY COURTESY OF THE JOHN RYLANDS LIBRARY

CAXTON'S DEVICE, CONSISTING OF HIS INITIALS AND TRADE MARK, FOUND IN 11 OF HIS 102 BOOKS AND BROADSIDES. IT IS 5½"X4½"

Then Caxton returned to England and established himself, at Michaelmas, 1476, in the almonry at Westminster at the sign of the Red Pale. The first known piece of printing issued from the Caxton press in England is an *Indulgence* printed by Caxton and issued by Abbot Sant on Dec. 13, 1476, which was discovered in the Record Office in 1928 by Mr. S. C. Ratcliffe. The first dated book printed in England was Lord Rivers' translation (revised by Caxton) of *The Dictes and sayenges of the phylosophers* (1477) (*see* BLACK LETTER). The date, Nov. 18, 1477, is given in the colophon to the copy in the John Rylands Library, Manchester, the only one which possesses the colophon. From this time until his death Caxton was busy writing and printing. His services to English literature, apart from his work as a printer (*see* TYPOGRAPHY), are very considerable. His most important original work is an eighth book added to the *Polychronicon* (vol. viii. in the Rolls Series edition) of Ralph Higden. Caxton revised and printed John of Trevisa's work, and brought down the narrative himself from 1358 to 1460, using as his authorities *Fasciculus temporum,* a popular work in the 15th century, and an unknown *Aureus de universo.* He printed Chaucer's *Canterbury Tales* (1478? and 1483), *Troilus and Creseide* (1483?), the *House of Fame* (1483?), and the translation of Boethius (1478?); Gower's *Confessio Amantis* (1483), and many poems of Lydgate. His press



Et sic est finis

Thus endeth this book of the dytes and notable wyse sayenges of the philosophers late translated and drawen out of frenshe into our englisshe tonge by my forsaide lord Therle of Ryuers and lord Skales and by hys commandement sette in forme and emprynted in this maneve as ye maye here in this booke see Whiche was fynysshed the xviij. day of the moneth of Nouembre. e the seuenteth yere of the regne of kyng Edward the fourth.

BY COURTESY OF THE JOHN RYLANDS LIBRARY, MANCHESTER

COLOPHON TO CAXTON'S "DICTES AND SAYENGES OF THE PHILOSOPHERS" (1477), THE FIRST BOOK PRINTED IN ENGLAND TO BEAR A DATE

The colophon, an inscription placed at the end of a book in early times, contained information now usually found on the title page

was, however, not worked for purely literary ends, but was a commercial speculation. For the many service-books which he printed there was no doubt a sure sale, and he met the taste of the upper classes by the tales of chivalry which issued regularly from his press. He printed Malory's *Morte d'Arthur,* and himself translated from the French the *Boke of Histories of Jason* (1477?), *The Historye of Reynart the Foxe* (from the Dutch, 1481 and 1489?), *Godfrey of Boloyne* or *The Siege and Conqueste of Jherusalem* (1481), *The Lyf of Charles the Grete* (1485), *The Knyght Parys and the Fayr Vyenne* (1485), *Blanchardyn and Eglantine* (1489?), *The Foure Sonnes of Aymon* (1489?); also the *Morale Proverbs* (1478), and the *Fayttes of Armes and of Chyualrye* (1489) of Christine de Pisan. The most ambitious production of his press was perhaps his version of the *Golden Legend,* the translation of which he finished in Nov. 1483. It is based on the lives of the saints as given in the 13th century *Legenda aurea* of Jacobus de Voragine, but Caxton chiefly used existing French and English versions for his compilation. The book is illustrated by 70 woodcuts, and Caxton says he was only encouraged to persevere in his laborious and expensive task by the liberality of William, earl of Arundel. The idleness which he so often deprecates in his prefaces was no vice of his, for in addition to his voluminous translations his output as a printer was over 18,000 pages, and he published 96 separate works or editions of works, with apparently little skilled assistance.

The different founts of type used by Caxton are illustrated by Blades and Duff, and there is an excellent selection of Caxtons in the British Museum and in the University library at Cambridge. His books have no title-pages, and from 1487 onwards are usually adorned with a curious device, consisting of the letters W.C. separated by a trade mark, with an elaborate border above and below. The flourishes on the trade mark have been fancifully interpreted as S.C. for Sancta Colonia, implying that Caxton learnt his art at Cologne, and the whole mark has been read as 74, for 1474, the date of his first printed book. This device was subsequently adopted with small alterations by his successor at the Westminster press, Wynkyn de Worde. The first of his books containing woodcut illustrations was his *Myrrour of the World* (1481), translated from Vincent de Beauvais, but he had used a woodcut initial letter in his broadside *Indulgence* printed in 1476.

No record of Caxton's marriage or of the birth of his children has been found, but Gerard Croppe was separated from his wife Elizabeth, daughter of William Caxton, before 1496, when Croppe made certain claims in connection with his father-in-law's will.

BIBLIOGRAPHY.—Earlier biographies of Caxton were superseded by the work of William Blades, whose *Life and Typography of William Caxton* (1861–63) remains the standard authority. It contains a bibliography of each of the works issued from Caxton's press. For later discoveries *see* E. Gordon Duff, *William Caxton* (1905) and H. R. Plomer, *William Caxton* (1925). Many of Caxton's translations are available in modern reprints.

CAYAPAS, a tribe of South American Indians, belonging to the Barbacoan (*q.v.*) linguistic stock or sub-stock. Their habitat is the lower Cayapa river and adjacent coasts in northern Ecuador. Traditionally they formerly lived in the upland region about Quito, moving to the coast a short time before the first appearance of Europeans. They have now become much mixed with negroes, and relatively little of their original culture survives.

See S. A. Barrett, "The Cayapa Indians of Ecuador" (Museum of the American Indian, *Indian Notes and Monographs,* No. 40. New York, 1925).

CAYENNE, a seaport and the capital of French Guiana, on the north-west extremity of the island of Cayenne, and near the mouth of the river of that name. **Pop.** 11,704. The town forms an almost perfect square, and has clean and well-macadamized streets. In the old town, the streets are not so regularly and well built as in the new. The Place d'Armes, a fine quadrangular space, lies between them. To the right of the governor's house is Mt. Cépéron, on which stand Ft. St. Michel, the marine barracks, the signal station and the lighthouse. Here, too, are the capacious reservoirs for the water-supply of the town, the source of which is a lake to the south of the island. The harbour is shallow at its entrance, and craft drawing more than 14 ft. are obliged to anchor 6 m. from the town. There is no dock for the repair of vessels; but there are two quays at the town. The principal exports of Cayenne are gold, cocoa, phosphates, hides, woods and spices. The imports are French wines, spirits and liqueurs; silk and cotton stuffs, tobacco, hardware, glass, earthenware, clothing, preserved meat, fish, and vegetables, maize, flour, hay, bran, oils and cattle. There is a regular mail service between Cayenne and Martinique once a month. Cayenne is the seat of the government of French Guiana, and was formerly a penal settlement for political offenders. The temperature of Cayenne is between 76° and 88° F throughout the

year; but the heat is tempered by easterly winds. Between December and March a north wind blows. Fevers often attack the inhabitants; but the climate, though moist, is on the whole healthy. (*See* GUIANA.)

CAYENNE PEPPER (*Guinea Pepper, Spanish Pepper, Chilly*), a preparation from the dried fruit of various species of *Capsicum,* a genus of the family Solanaceae. The true peppers are members of a totally distinct family, Piperaceae. The fruits of *Capsicum* have a strong, pungent flavour. The capsicums bear a greenish-white flower, with a star-shaped corolla and five anthers standing up in the centre of the flower like a tube, through which projects the slender style. The podlike fruit consists of an envelope at first fleshy and afterwards leathery, within which are the spongy pulp and several seeds. The plants are herbaceous or shrubby; the leaves are entire, and alternate, or in pairs near one another; the flowers are solitary and do not arise in the leaf-axils. There are about 30 species, natives of Central and South America. In the United States chief production is in Louisiana and South Carolina. The output is about 1,000,000 lb. dried. The principal source of cayenne pepper is *C. annuum,* the spur or goat pepper, a dwarf shrub, a native of South America, but commonly cultivated in the East Indies. It produces a small, narrow, bright red pod, having very pungent properties.

Chillies, the dried fruit of capsicums, are used to make chilly-vinegar, as well as for pickles. Cayenne pepper is manufactured from the ripe fruits, which are dried, ground, mixed with wheat flour and made into cakes with yeast; the cakes are baked till hard, like biscuit, and then ground and sifted. Chillies have been in use from time immemorial; they are eaten in great quantity by the people of Guiana and other warm countries and in Europe are consumed both as a spice and as medicine.

CAYEY, an interior town of Puerto Rico. Pop. (1940), 5,622. The population of the municipal district in 1940 was 31,391. The altitude is 1,400 ft.; average temperature about 71° F. Cayey, one of the healthiest towns of the island, is on the military highway built by Spain diagonally across the island from San Juan on the Atlantic ocean to Ponce on the Caribbean sea. One of the branches of this highway extends to Guayama and another to Salinas, both on the Caribbean. On account of its healthful climate the Spanish rulers established a military post there; the Americans succeeding them used it as a U.S. army post, and it is a subpost of the 65th regiment of the regular army. The United States naval communication service has a high-power station at Cayey for direct communication with Washington, D.C., and with Balboa in the Canal Zone. It is the centre of a region where tobacco and coffee of superior quality are produced, and has many warehouses and factories.

CAYLEY, ARTHUR (1821–1895), English mathematician, was born at Richmond, Surrey, on Aug. 16, 1821. He entered Trinity college, Cambridge, as a pensioner, became a scholar in May 1840, senior wrangler, first Smith's prizeman and fellow of Trinity in 1842 and a major fellow in 1845. In 1846, he entered at Lincoln's Inn, and became a pupil of the conveyancer Mr. Christie. While practising law he met J. J. Sylvester, and the two spent much time profitably discussing mathematics. He was called to the bar in 1849, and remained at the bar till he was elected to the new Sadlerian chair of pure mathematics at Cambridge in 1863, when he married Susan, daughter of Robert Moline of Greenwich. He held this chair till his death, on Jan. 26, 1895. His 800 mathematical papers, published in 13 large quarto volumes by the Cambridge University press, treat of nearly every subject of pure mathematics, and of theoretical dynamics and spherical and physical astronomy. He was as much a geometrician as an analyst. Of special mention are his ten memoirs on quantics in which he developed the theory of algebraic invariants (1854–78), his creation of the theory of matrices, his researches on the theory of groups, his memoir on abstract geometry, the geometry of *n*-dimensional space, a subject which he created, his introduction to geometry of the "absolute," his researches on the higher singularities of curves and surfaces, the classification of cubic curves, additions to the theories of rational transformation and correspondence, the theory of the twenty-seven lines that lie on a cubic surface, the theory of elliptic functions, the attraction of ellipsoids, and the British association reports, 1857 and 1862, on recent progress in general and special theoretical dynamics, and on the secular acceleration of the moon's mean motion. Competent judges have compared him with Leonhard Euler for his range, analytical power and introduction of new and fertile theories. He received nearly every academic distinction that can be conferred upon a man of science. His nature was noble and generous, and the universal appreciation of this fact gave him great influence in his university. His recreations were the Victorian classics, water-colour sketching and architecture. His portrait, by Lowes Dickinson, was placed in the hall of Trinity college in 1874, and his bust, by Henry Wiles, in the library of the same college in 1888.

CAYLUS, ANNE CLAUDE, COMTE DE, Marquis d'Esternay, baron de Bransac (1692–1765), French archaeologist and man of letters, was born in Paris. His mother, the comtesse de Caylus (1673–1729), was a cousin of Mme. de Maintenon, who brought her up like her own daughter. She wrote valuable memoirs of the court of Louis XIV entitled *Souvenirs;* these were edited by Voltaire (1770) and by many later editors, notably by Ch. Asselineau (1860). Caylus was on active service with the French army from 1709–14. After the Peace of Rastadt he travelled in Italy, Greece, the East, England and Germany. He became an active member of the Academy of Painting and Sculpture and of the Academy of Inscriptions. Among his works are *Recueil d'antiquités égyptiennes, étrusques, grecques, romaines et gauloises* (6 vols. 1752–55), *Numismata Aurea Imperatorum Romanorum,* and a *Mémoire* (1755) on the method of encaustic painting with wax mentioned by Pliny, which he claimed to have rediscovered. Caylus was himself an admirable engraver; he also caused engravings to be made of Bartoli's copies from ancient pictures. He encouraged young artists, but his patronage was somewhat capricious. Diderot expressed this fact in an epigram in his *Salon* of 1765: "La mort nous a délivrés du plus cruel des amateurs." The Comte de Caylus had quite another side to his character.

He had a thorough acquaintance with the gayest and most disreputable sides of Parisian life, and left a number of more or less witty stories dealing with it. These were collected (Amsterdam, 1787) as his *Oeuvres badines complètes.* The best of them is the *Histoire de M. Guillaume, cocher* (*c.* 1730).

CAYMAN (or CAIMAN), the name applied to the broad-snouted crocodilians of South America. The black cayman (*Melanosuchus niger*) of the Amazon is a large species, reaching 16 ft. in length. Other smaller species (*Caiman* spp.) are extremely abundant in tropical America. (*See* CROCODILIA.) (K. P. S.)

CAYMAN ISLANDS, three low-lying islands in the West Indies, Grand Cayman, Little Cayman and Cayman Brac, are between 79° 44′ and 81° 27′ W. and 19° 15′ and 19° 45′ N., a dependency of Jamaica, which lies 110–156 mi. E.S.E. Grand Cayman, a flat rock-bound island protected by coral reefs, is approximately 20 mi. long and 8 mi. broad at a maximum. It has two towns, Georgetown and Boddentown. Little Cayman and Cayman Brac are both about 60 mi. N.E. of Grand Cayman. While the soil is shallow and not infertile, commerce is dependent almost exclusively on the various marine industries. The thatch palm *Thrinax argentea* is used for the manufacture of thatch rope for export to Jamaica, but the main industry is the catching of turtles, sharks and sponges. The export of phosphate, coconuts and sisal has ceased. Local mahogany is used to build yachts and schooners.

The government is administered by a commissioner, and the laws passed by the local legislature are subject to the assent of the governor of Jamaica. Pop. (census 1943) 6,670. Land area 93 sq.mi.

The islands were discovered by Columbus, who named them Tortugas, from the turtles with which the surrounding seas abound. They were never occupied by the Spaniards and were colonized from Jamaica by the British.

CAYUGA AND SENECA CANAL: *see* NEW YORK STATE BARGE CANAL SYSTEM.

CAYUVAVAN, a linguistic stock of South American Indians comprising but a single tribe. The validity of this stock is doubtful. The Cayuvavas formerly lived in northern Bolivia on and west of the Mamore river for some 60m. above its confluence with the Guaporé. The surviving remnants are now mainly settled at the mission of Exaltacion de Santa Cruz. The Indians of this group were sedentary agriculturists, and known as the best canoemen of the region. They appear to have retained little of their old culture and, like many of the tribes of this area, are very little known.

See A. D'Orbigny, *L'Homme Americain* (Paris, 1839).

CAZALÈS, JACQUES ANTOINE MARIE DE (1758–1805), French orator and politician, was born at Grenade in Languedoc, of a family of the lower nobility. Before 1789 he was a cavalry officer, but in that year was returned as deputy to the states general. In the Constituent Assembly he belonged to the section of moderate royalists who sought to set up a constitution on the English model, and his speeches in favour of retaining the right of war and peace in the king's hands and on the organization of the judiciary gained the applause even of his opponents. After the insurrection of Aug. 10, 1792, which led to the downfall of royalty, Cazalès emigrated. He fought in the army of the *émigrés* against revolutionary France, lived in Switzerland and in England, and did not return to France until 1803. He died on Nov. 24, 1805. His son, Edmond de Cazalès, wrote philosophical and religious studies.

See *Discours de Cazalès,* ed. by Chare (1821), with an introduction; F. A. Aulard, *Les Orateurs de la Constituante* (2nd ed., 1905).

CAZALIS, HENRI (1840–1909), French poet and man of letters, was born at Cormeilles-en-Parisis (Seine-et-Oise). He wrote under the pseudonyms of Jean Caselli and Jean Lahor. His oriental habits of thought earned for him the title of the "Hindou du Parnasse contemporain."

His works include: *Chants populaires de l'Italie* (1865); *Vita tristis, Réveries fantastiques, Romances sans musique* (1865); *Le Livre du néant* (1872); *Henry Regnault, sa vie et son oeuvre* (1872); *L'Illusion* (1875–93); *Melancholia* (1878); *Cantique des cantiques* (1885); *Les Quatrains d'Al-Gazali* (1896); *William Morris* (1897). *See* P. Bourget in *Anthologie des poètes fr. du XIX.e siècle* (1887–88); J. Lemaître, *Les Contemporains* (1889); E. Faguet in *Revue bleue* (Oct. 1893).

CAZEMBE, the name of an African kingdom which was situated south of Lake Mweru and north of Lake Bangweulu, between 9° and 11° S. In 1894 it was divided between Northern Rhodesia and Belgian Congo. The Cazembe kingdom was named after Muata Cazembe, the hereditary name of its ruler. It was founded by the Baluba, who formed a powerful state in the Kasai region. Muata Yamvo, the Baluba ruler, desiring to control the salt deposits of the Bangweulu, conquered the area early in the 17th century. Baluba formed the aristocracy of the conquered country, and a Baluba was appointed ruler with the title Muata Cazembe. Although autonomous in its political affairs, Cazembe remained nominally dependent on the Baluba state until 1875. Economically, the country was well developed on account of its ivory trade monopoly with Arabs and Portuguese on the east coast. Also, the copper mines of Katanga, which supplied Central and East Africa, were an important source of wealth for the country. (Under European control the Katanga copper mines developed into large industries which in 1939 supplied 25% of the world's production.) About 1875 the Baluba dynasty was overthrown by Msiri, an east African adventurer of the Nyamwezi tribe, who, equipped with European rifles, conquered Cazembe and the adjacent areas. After Msiri's accidental death while negotiating with a Belgian Capt. Bodson, the kingdom disintegrated rapidly. Cazembe was first visited in 1796 by Manoel Caetano Pereira, a Portuguese merchant; Dr. Francesco José Maria de Lacerda explored the kingdom in 1831 and David Livingstone in 1868. The last vestige of the kingdom is the village of Kazembe (9° 48′ S., 28° 51′ E.) in Northern Rhodesia.

See Brohez, "Ethnographie Katangaise," *Bulletin, Société Belge de Geographie* (1909); R. F. Burton, *The Lands of the Cazembe* (1873).

(H. A. Wf.)

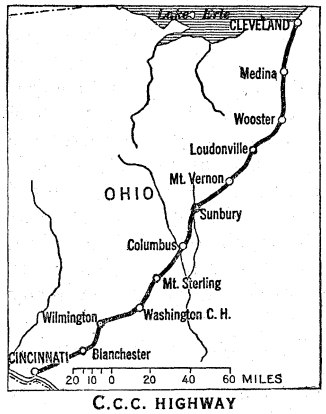
CAZIN, JEAN CHARLES (1840–1901), French landscape-painter, son of a well-known doctor, F. J. Cazin (1788–1864), was born at Samer, Pas-de-Calais. After studying in France, he went to England and was strongly influenced by the pre-Raphaelite movement. His chief earlier pictures have a religious interest; such are "The Flight into Egypt" (1877) and "Hagar and Ishmael" (1880, Luxembourg). Later, his combination of luminous landscape with figure-subjects ("Souvenir de fête," 1881; "Journée faite," 1888) gave him a wide repute and made him the leader of a new school of idealistic subject-painting in France. His wife, Marie Cazin, who was his pupil, was also a well-known artist and sculptor.

CAZOTTE, JACQUES (1719–1792), French author, was born at Dijon. He was educated by the Jesuits, and at 27 obtained a public office at Martinique, returning to Paris in 1760 with the rank of commissioner-general. The most famous of his works is the *Diable amoureux* (1772), a tale with a Spanish setting in which the hero raises the devil. About 1775 Cazotte embraced the views of the Illuminati, declaring himself possessed of the power of prophecy. It was upon this fact that La Harpe based his famous *jeu d'esprit,* in which he represents Cazotte as prophesying the most minute events of the Revolution. On the discovery of some fantastic letters in Aug. 1792, Cazotte was arrested; and though he escaped for a time through the heroism of his daughter he was executed on Sept. 25.

Other works by Cazotte are *Les Mille et une fadaises* (1742; Eng. trans. 1927); and a prose epic *Ollivier* (1762). The only complete edition is the *Oeuvres badines et morales, historiques et philosophiques de Jacques Cazotte* (1816–17), though more than one collection appeared during his lifetime. An édition de luxe of the *Diable amoureux* was edited (1878) by A. J. Pons, and a selection of Cazotte's *Contes,* edited (1880) by Octave Uzanne, is included in the series of *Petits Conteurs du XVIII.e siècle.* The best notice of Cazotte is in the *Illuminés* (1852) of Gérard de Nerval.

CAZUNGO: *see* Angola.

"C" BATTERY is an electric battery, used in radio circuits. It is connected between the cathode or negative electrode and the grid of a vacuum tube and supplies a direct voltage to the grid.



C.C.C. HIGHWAY

C.C.C. HIGHWAY, known as the "Three Cs" highway, extends from Cleveland on the Great Lakes, through Columbus, the capital of Ohio, to Cincinnati on the Ohio river. It is 260 mi. long and passes through the heart of the state. Medina, Wooster, Mt. Vernon and Washington Court House lie in its path.

CEANOTHUS, a showy genus of North American shrubs and woody vines of the buckthorn family (Rhamnaceae), comprising more than 50 species found chiefly in the Pacific coast region, 30 of which are native to California. The small white or blue flowers are borne in handsome dense panicles or umbels. Several are grown as garden plants. Only two species occur east of the Rocky mountains—the New Jersey tea (*C. americanus*), so called because its leaves were used as tea during the American Revolution, and *C. ovatus.* The genus attains its maximum development in the foothills and mountains of California, often constituting a considerable part of the chaparral. Noteworthy representatives are the California lilac and the Oregon tea-tree (*qq.v.*). *See* M. Van Rensselaer and H. E. McMinn, *Ceanothus,* xii, 1–308, illus. (1942).

CEARÁ, a northern maritime State of Brazil, bounded north by the Atlantic, east by the Atlantic and the States of Rio Grande do Norte and Paraíba, south by Pernambuco, and west by Piauí, and having an area of 57,371 sq. miles. It lies partly upon the north-east slope of the great Brazilian plateau, and partly upon the sandy coastal plain. Its surface is a succession of great terraces, facing north and north-east, formed by the denudation of the ancient sandstone plateau which once covered this part of the continent; the terraces are seamed by watercourses, and their valleys broken by hills and ranges of highlands, usually described as mountain ranges, but in fact only the remains

of the ancient plateau, capped with horizontal strata of sandstone, and having a remarkably uniform altitude of 2,000 to 2,400 ft. The flat top of such a range is called a *chapada* or *taboleira,* and its width in places is from 32 to 56 miles.

The boundary line with Piauí follows one of these ranges, the Serra de Ibiapabá, which unites with another range on the southern boundary of the State, known as the Serra do Araripe. Another range, or escarpment, crosses the state from east to west, but is broken into two principal divisions, each having several local names. These ranges are not continuous, the breaking down of the ancient plateau having been irregular and uneven. The higher ranges intercept considerable moisture from the south-east trade winds, and their flanks and valleys are covered with forest, but the plateaus are either thinly wooded or open campo. These upland forests are of a scrubby character and are called *caatingas.*

The sandy, coastal plain, with a width of 12 to 18 mi., is nearly bare of vegetation; behind there is a more elevated region with broken surfaces and sandy soil which is amenable to cultivation and produces fruit, cotton and most tropical products when conditions are favourable. The rivers of the state are small and, with one or two exceptions, become completely dry in the dry season. The largest is the Jaguaribe, which flows entirely across the state in a northeast direction with an estimated length of 210 to 465 miles. The year is divided into a rainy and dry season, the rains generally beginning in October and lasting until December. The soil of the interior is thin and porous and does not retain moisture; consequently the long, dry season turns this part of the country into a barren waste, relieved only by vegetation along the river courses and mountain ranges, and by the hardy, widely distributed carnauba palm (*Copernicia cerifera*), which in places forms groves of considerable extent. Sometimes the rains fail altogether, and then a drought (*sêcca*) ensues, causing famine and pestilence throughout the entire region. The most destructive droughts recorded are those of 1711, 1723, 1777–78, 1790, 1825, 1844–45 and 1877–79, the last-mentioned destroying nearly all the livestock in the state, and causing the death through starvation and pestilence of nearly half a million people—more than half the population—while thousands more were obliged to migrate to other states.

There are two lines of railway running inland from the coast: the Baturité line from Fortaleza to Crato, in the southern part of the state; and the Sobral line from Camocim to Crateús, about 210 miles. A branch line which would connect these two roads was reported (1942) to be under construction. The railways were built by the national government after the drought of 1877–79 to give work to the starving refugees. Great dams are also being constructed and extensive irrigation systems laid out.

Only a very small percentage of the population, which numbered 2,101,325 (1940 census) is of European origin, the very large majority being mestizos. There are few Negroes. The number of landed proprietors, professional men, merchants, etc. is comparatively small (about one-sixth); the remaining five-sixths own no property, pay no taxes, and derive no benefits from the social and political institutions about them beyond the protection of the proprietors upon whose estates they live, the nominal protection of the state, and an occasional day's wage. Education is confined almost exclusively to the upper classes.

The state of Ceará has formed a bishopric of the Roman Catholic Church since 1853, the bishop having his residence at Fortaleza. The state is represented in the national congress by three senators and ten deputies. The capital, Fortaleza, sometimes called Ceará, is the principal commercial centre and shipping port. Its population was 142,453 and that of the *município* was 182,241 in 1940. The principal towns are Aracatí, Baturité, Acaraú, Crato, Maranguape and Sobral.

The territory of Ceará included three of the *capitanias* originally granted by the Portuguese crown in 1534. The first attempts to settle the territory failed, and the earliest Portuguese settlement was made near the mouth of the Rio Camocim in 1604. The French were already established on the coast, with their headquarters at Saint Louis, now Maranhão. Ceará was occupied by the Dutch from 1637–54, and became a dependency of Pernambuco in 1680; this relationship lasted until 1799, when the *capitania* of Ceará was made independent. The *capitania* became a province in 1822 under Dom Pedro I. A revolution followed in 1824, the president of the province was deposed 15 days after his arrival, and a republic was proclaimed. Internal dissensions broke out, the new president was assassinated, and after a brief reign of terror the province resumed its allegiance to the empire. Ceará was one of the first provinces of Brazil to abolish slavery.

BIBLIOGRAPHY.—*See* Rodolpho Theophilo, *Historia da Secca do Ceará, 1877 a 1880* (Fortaleza, 1883); Professor and Mrs. Louis Agassiz, *A Journey in Brazil* (Boston, 1869); George Gardiner, *Travels in the Interior of Brazil* (1846); C. F. Hartt, *Geology and Physical Geography of Brazil* (Boston, 1870); and H. H. Smith, *Brazil: the Amazon and the Coast* (1879). Pierre Denis, *Brazil* (New York and London, 1911); I. W. McConnell, "Irrigation in Brazil," *Bull. Pan-Am. Union,* vol. liii (1924), pp. 688–706; R. C. Mossman, "The Climate of São Paulo and Ceará," *Quart. Jour.,* Roy. Met. Soc., vol. xlv, pp. 53–63, 69–79; F. W. Friese, "The Drought Region of Northeastern Brazil," *Geogr. Rev.,* vol. xxviii (1938), pp. 363–78.

CEAWLIN (d. 593), king of the West Saxons, included, in the *Anglo-Saxon Chronicle,* among the "Bretwaldas" or specially powerful kings, succeeded his father Cynric in 560. He took Silchester, and moving eastwards Ceawlin and his brother Cutha defeated the forces of Aethelberht, king of Kent, at the battle of Wibbandun in 568. In 577 he led the West Saxons from Winchester towards the Severn valley; gained a victory over three British kings, Conmail, Condidan and Farinmail, at Deorham, and added the district round Gloucester, Bath and Cirencester to his kingdom, thus isolating the Britons of Cornwall from those of Wales. A further advance was begun in 583. Uriconium, a town near the Wrekin, and Pengwyrn, the modern Shrewsbury, were destroyed, but Ceawlin was defeated by the Britons at Fethanleag or Faddiley, near Nantwich, and his progress was effectually checked. Internal strife among the West Saxons followed. In 591 Ceawlin lost the western part of his kingdom; in 592 he was defeated by his nephew, Ceolric, at Wanborough, driven from Wessex, and was killed in 593.

See *Two of the Saxon Chronicles,* ed. by C. Plummer (Oxford, 1892); E. Guest, *Origines Celticae* vol. ii (1883).

CEBES, the name of two Greek philosophers. (1) CEBES OF CYZICUS, mentioned in Athenaeus (iv, 156 D), seems to have been a Stoic, who lived during the reign of Marcus Aurelius. Some would attribute to him the *Tabula Cebetis* (*see* below), but as that work was well known in the time of Lucian, it is probably to be placed earlier. (2) CEBES OF THEBES, a disciple of Socrates and Philolaus. He is one of the speakers in the *Phaedo* of Plato, in which he is represented as an earnest seeker after virtue and truth, keen in argument and cautious in decision. Three dialogues, the Ἑβδόμη, the Φρύνιχος and the Πίναξ or *Tabula,* are ascribed to him by Suidas and Diogenes Laërtius. The two former are lost, and most scholars deny the authenticity of the *Tabula* on the ground of material and verbal anachronisms. They attribute it either to Cebes of Cyzicus (above) or to an anonymous author, of the 1st century A.D., who assumed the character of Cebes of Thebes. In the form of an interpretation of an allegorical picture in the temple of Cronus at Athens or Thebes, it develops the Platonic theory of pre-existence, and shows that true education consists in the formation of character.

The *Tabula* has been translated both into European languages and into Arabic (the latter published with the Greek text and Lat. trans. by Salmasius in 1640); Eng. trans. by H. E. Seebohm (Chipping Camden, 1906). It is usually printed together with Epictetus. Separate eds. by S. S. Jerram (with intro. and notes, 1878), C. Prächter (1893), and many others. *See* Zeller's *History of Greek Philosophy;* F. Klopfer, *De Cebetis Tabula* (1818–22); C. Prächter, *Cebetis Tabula quanam aetate conscripta esse videatur* (1885); R. T. Clark, *Characters of Theophrastus, etc.* (1909).

CEBU (Bisayan Sugbu), the second of the 12 chartered Philippine cities in rank of population [146,817 in 1939 (more than double that of 1918—65,502) of whom 72,979 were males and 429 whites] is in the island province of Cebu, of which it is the capital and is on the east coast.

Cebu is one of the most historic points in the Philippines. A native village had long existed on the site of the present city when Magellan, commander of the first world encircling expedition, landed there on April 7, 1521. Opposite the site lies

Mactan Island (whose northwest shore forms the harbour's outer rim) where he met the native chief, Sicatuan, where each sealed a truce compact with his own blood and where, despite the compact, the great navigator lost his life. The image of Santo Niño (the Holy Child), now housed in the Augustinian church, is said to date from that period. The next distinguished foreign visitor was Miguel López de Legazpi, who arrived with some Augustinian friars, including Urdaneta, in 1565; and for the ensuing six years Cebu was the capital of whatever portion of the Philippines the Spaniards ruled. That distinction ceased with Legazpi's removal to what is now Manila; but Cebu has continued to be an important centre for the Bisayas, rivalled by Iloilo alone, which the former has now far outstripped. Toward the end of the 18th century the Roman Catholic cathedral was completed. Cebuanos took a prominent part in the insurrections against both Spain and the United States; but Cebu has profited immensely by the American occupation and its wide streets, motor roads, modern buildings and public school system are but a few of the results.

Cebu was open to foreign trade in 1863. It had long been a port of entry and its harbour is amply protected from the typhoons and baguios to which the region is subject. The city is also the principal one on the railway which skirts the province's eastern coast. An extensive maritime trade is carried on with Manila and Leyte, Bohol and the Negros provinces, Mindanao and elsewhere. The chief exports are abacá (Manila hemp), tobacco, sugar and copra. Manufactures of pottery, fabrics, sugar sacks and salt are carried on.

Cebu is a Roman Catholic Episcopal see and 137,555 of its adherents were reported from there in 1939. The bishop's palace, though small, is noted for its interior decorations. There were also reported from Cebu 2,971 members of the Independent Filipino Church, 2,139 Protestants, 1,262 Buddhists and several thousand of other, or no religious affiliation. Cebuano, the local Bisayan, is the vernacular. There is a provincial high school together with grade and parochial schools, a branch of the Philippine library and a meteorological station.

CECCO D'ASCOLI (1257–1327), the popular name of FRANCESCO DEGLI STABILI, a famous Italian encyclopaedist and poet—Cecco being the diminutive of Francesco, and Ascoli, in the marshes of Ancona, the place of his birth. In 1322 he was made professor of astrology at Bologna university, but, having written a commentary on the sphere of John de Sacrobosco (pub. Venice, 1518), in which he propounded daring theories concerning the agency of demons, he got into difficulties with the clerical party. He betook himself to Florence, where his attack on the *Commedia* of Dante, and the *Canzone d' Amore* of Guido Cavalcanti sealed his fate. He was burned at Florence in 1327.

His *Acerba* (from *acervus*), an encyclopaedic poem (best ed. Venice, 1510), consists of four books in *sesta rima,* treating in order of astronomy and meteorology, of stellar influences, of physiognomy, of the vices and virtues of minerals, of the love of animals, of moral, physical and theological problems.

See G. Castelli, *La Vita e le Opere di C. d'Ascoli* (Bologna, 1892), and C. Lozzi, *C. d'Ascoli* (1904).

CECIL, the name of a famous English family. This house, whose two branches hold each a marquessate, had a great statesman and administrator to establish and enrich it. The first Lord Burghley's many inquiries concerning the origin of his family created for it more than one splendid and improbable genealogy, although his grandfather is the first ascertained ancestor. In the latter half of the 15th century a family of yeomen or small gentry with the surname of Seyceld, whose descendants were accepted by Lord Burghley as his kinsmen, lived on their lands at Allt yr Ynys in Walterstone, a Herefordshire parish on the Welsh marches. Of the will of Richard ap Philip Seyceld of Allt yr Ynys, made in 1508, one David ap Richard Seyceld, apparently his younger son, was overseer. This David seems identical with David Cyssell, Scisseld or Cecill, a yeoman admitted in 1494 to the freedom of Stamford in Lincolnshire. At Stamford he prospered, being three times mayor and three times member of parliament for the borough, and he served as sheriff of Northamptonshire in 1532–33. Remaining in the service of Henry VIII. he was advanced to be yeoman of the chamber and sergeant-at-arms, being rewarded with several profitable leases and offices. By his first marriage David Cecil left at his death in 1536 a son and heir, Richard Cecil, who enjoyed a place at court as yeoman of the king's wardrobe under Henry VIII. and Edward VI. A gentleman of the privy chamber and sometime sheriff of Rutland, Richard Cecil had his share at the distribution of abbey lands, St. Michael's priory in Stamford being among the grants made to him. William Cecil, only son of Richard, was born, by his own account, in 1520, at Bourne in Lincolnshire. He advanced himself first in the service of the protector Somerset, after whose fall, his great abilities being necessary to the council, he was made a secretary of state and sworn of the privy council. In 1571 he was created Lord Burghley, and from 1572, when he was given the Garter, he was lord high treasurer and principal minister to Queen Elizabeth. By his first wife, Mary Cheke, sister of the scholar Sir John Cheke, tutor to Edward VI., he was father to Thomas, first earl of Exeter. By a second wife, Mildred Cooke, the most learned lady of her time, he had an only surviving son, Robert Cecil, ancestor of the house of Salisbury.

Created earl of Exeter by James I., the second Lord Burghley was more soldier than statesman, and from his death to the present day the elder line of the Cecils has taken small part in public affairs. William Cecil, 2nd earl of Exeter, took as his first wife the Lady Roos, daughter and heir of the 3rd earl of Rutland of the Manners family. The son of this marriage inherited the barony of Roos as heir general, and died as a Roman Catholic at Naples in 1618 leaving no issue. A third son of the 1st earl was Edward Cecil, a somewhat incompetent military commander, created in 1625 Lord Cecil of Putney and Viscount Wimbledon, titles that died with him in 1638, although he was thrice married. In 1801 a marquessate was given to the 10th earl of Exeter, the story of whose marriage with Sarah Hoggins, daughter of a Shropshire husbandman, has been refined by Tennyson into the romance of "The Lord of Burleigh." This elder line is still seated at Burghley, the great mansion built by their ancestor, the first lord.

The younger or Hatfield line was founded by Robert Cecil, the only surviving son of the great Burghley's second marriage. As a secretary of State he followed in his father's steps, and on the death of Elizabeth he may be said to have secured the accession of King James, who created him Lord Cecil of Essendine (1603), Viscount Cranborne (1604), and earl of Salisbury (1605). Forced by the king to exchange his house of Theobalds for Hatfield, he died in 1612, worn out with incessant labour, before he could inhabit the house which he built upon his new Hertfordshire estate. Of Burghley and his son Salisbury, "great ministers of state in the eyes of Christendom," Clarendon writes that "their wisdom and virtues died with them." The 2nd earl of Salisbury, "a man of no words, except in hunting and hawking," was at first remarked for his obsequiousness to the court party, but taking no part in the Civil War came at last to sit in the Protector's parliament. After the Restoration, Pepys saw him, old and discredited, at Hatfield, and notes him as "my simple Lord Salisbury." The 7th earl was created marquess of Salisbury in 1789.

Hatfield House, a great Jacobean mansion which has suffered much from restoration and rebuilding, contains in its library the famous series of state papers which passed through the hands of Burghley and his son Salisbury, invaluable sources for the history of their period. (O. B.)

(*See* also, EXETER, EARL, MARQUESS AND DUKE OF; members of the Cecil family separately mentioned are: BURGHLEY, WILLIAM CECIL; SALISBURY, ROBERT, 3RD MARQUESS OF; SALISBURY, ROBERT CECIL, 1ST EARL OF; CECIL, LORD HUGH; CECIL OF CHELWOOD, 1ST VISCOUNT).

CECIL, LORD HUGH RICHARD HEATHCOTE (1869–), English politician, youngest son of the 3rd Marquess of Salisbury, the prime minister, was born on Oct. 14, 1869, and was educated at Eton and University college, Oxford, where he obtained a first class in modern history in 1891, and was elected a fellow of Hertford college. He became one of his father's secretaries. He sat in the House of Commons as a Unionist for Greenwich (1895–1906), and for Oxford university from 1910 onward. He took a keen interest in church matters and was remarkable in debate for his oratorical powers and the loftiness of his ideals. In the stormy debates on the Balfour Education bill of 1902 he maintained that the only possible basis of general agreement was that every child should be brought up in the belief of its parents. He and Winston Churchill gathered round them, in the early years of the 20th century, a small group of young and able Con-

servative members, whose independent proceedings attracted some attention. He took a decided part in resisting tariff reform, and had no seat in the House between 1906 and 1910. He threw himself immediately and with passion into the struggle over the proposed curtailment of the powers of the House of Lords, and was active in resistance to the Parliament bill.

During the World War he joined the Flying Corps; he also served as a member of the commission that enquired into the Mesopotamia expedition. After the war he took a less active part in politics, but generally found himself in agreement with his brother, Lord Robert (later Lord Cecil of Chelwood), in adopting a more independent attitude toward the Coalition Government. With him, too, he supported the Enabling bill, and he became a prominent member of the Church Assembly set up in accordance with its provisions. In the conflict which arose over the Prayer Book Measure in 1928 he gave energetic support to the new proposals, both inside and out of the House of Commons. In 1936 he was appointed Provost of Eton, and his resignation of his parliamentary seat followed in consequence.

CECIL OF CHELWOOD, EDGAR ALGERNON ROBERT CECIL, 1ST VISCOUNT (1864–), British statesman, known before his elevation to the peerage as Lord Robert Cecil, third son of the third Marquess of Salisbury, was born on Sept. 14, 1864. He was educated at Eton and University college, Oxford, and was a prominent speaker at the Oxford Union. Lord Robert acted as one of his father's private secretaries from 1886 to 1888. He was called to the bar at the Inner Temple in 1887, and appeared in many important cases. He took silk in 1900.

In 1906 he entered parliament as Conservative member for East Marylebone, and he was one of the principal critics of Birrell's abortive education bill of that year. On many questions he took a heterodox position from the party point of view. In particular he dissociated himself from the tariff reform policy of Chamberlain, and thereby with Parliament from 1910 to 1911, when he was returned at a by-election for the Hitchin division of Herts, retaining this seat until his elevation to the peerage in 1923. He immediately resumed his old place as a powerful, though independent critic of Liberal policy, especially of the disestablishment of the church in Wales. He was one of the best friends of the women suffragists, and expressed the strongest disapprobation of the violent measures taken against them, though he did not palliate the offences against law and order of the extreme militants. Ultimately, after women had been granted the suffrage, he had the satisfaction of carrying a resolution "to amend the law with respect to the capacity of women to sit in Parliament" (Oct. 21, 1918).

Lord Robert was in office throughout the World War from the time that the Unionists associated themselves with the Government in May 1915 till the Armistice. As under-secretary for foreign affairs, then as minister of blockade and lastly as assistant secretary of State for foreign affairs, he was mainly concerned with the vital question of blockade. Lord Robert resigned at the general election of 1918 on the ground that he could not support the decision of the coalition Ministry to treat Welsh disestablishment as a *fait accompli.* Though no longer a minister of the crown, he nevertheless went over to Paris in 1919, where he served as chairman of the Supreme Economic Council, and played one of the principal parts, together with President Wilson and Gen. Smuts, in drafting the Covenant. After the peace he advocated increasingly full co-operation in the work of the League of Nations. In 1920 he attended the first Assembly of the League in Geneva as a representative of South Africa. In Parliament he steadily drifted into opposition to the coalition Ministry, and, though he did not form part of Bonar Law's Unionist Ministry in 1922, he joined Baldwin's first cabinet in May 1923 as Lord Privy Seal. He was raised to the peerage in Dec. 1923. He returned to office in Baldwin's second cabinet, in Nov. 1924, as chancellor of the duchy of Lancaster, and on several occasions acted as deputy for the foreign secretary, Sir Austen Chamberlain, on the Council of the League of Nations. As the principal British representative on the Disarmament Commission at Geneva in 1926–27 he found that his instructions necessitated a policy not in complete accordance with his convictions, and in 1927 he resigned his place in the Baldwin administration. President (since 1919) of the League of Nations Union, Lord Cecil remained, in face of the effects upon European and world affairs of German and Italian policy, uncompromisingly loyal to the League covenant. In 1937 he was awarded the Nobel peace prize.

CECILIA, SAINT (d. *c.* 176), patron saint of music and of the blind, is commemorated on Nov. 22. She was supposed to have been a noble Roman who with her husband and converts suffered martyrdom (*c.* 230), under the emperor Alexander Severus, but the researches of de Rossi (*Roma Sotteranea* ii. 147) confirm the statement of Fortunatus, bishop of Poitiers (d. 600), that she perished in Sicily under Marcus Aurelius (*c.* 176). The 4th century church at Rome in her honour was rebuilt by Pope Paschal I. (*c.* 820) and again in 1599. Cecilia, whose musical fame rests on a passing notice in her legend that she praised God by instrumental and vocal music, has inspired many a masterpiece in art, including the Raphael at Bologna, the Rubens in Berlin, the Domenichino in Paris, and in literature she is commemorated by Chaucer's "Seconde Nonnes Tale" and by Dryden's famous ode, set to music by Handel in 1736 and later by Sir Hubert Parry (1889).

Another St. Cecilia, who suffered in Africa in the persecution of Diocletian (303–304), is commemorated on Feb. 11.

U. Chevalier, *Répertoire des sources historiques* (1905), i. 826 f.

CECROPIA, in botany, a genus of trees (family Moraceae), native of tropical America. They are of rapid growth, affording a light wood used for making floats. *C. peltata* is the trumpet tree, so-called from the use of its hollow stems by the Uaupé Indians as a musical instrument. It is a tree reaching about 50ft. in height with a large spreading head, and deeply lobed leaves 12in. or more in diameter. The hollows of the stems and branches are inhabited by ants, which it has been claimed in return for the shelter thus afforded, and food in the form of succulent growths on the base of the leaf-stalks, repel the attacks of leaf-cutting ants which would otherwise strip the tree of its leaves. This is an instance of "myrmecophily," *i.e.,* a living together for mutual benefit of the ants and the plant.

CECROPS, traditionally the first king of Attica (Pausanias ix. 33). He was said to have divided the inhabitants into 12 communities, to have instituted the laws of marriage and property and a new form of worship. The introduction of bloodless sacrifice, the burial of the dead and the invention of writing were also attributed to him. He is said to have acted as umpire during the dispute of Poseidon and Athena for the possession of Attica. As one of the *autochthones* (*q.v.*) of Attica, Cecrops is represented as human in the upper part of his body, while the lower part is shaped like a dragon. Miss J. E. Harrison (in *Classical Review,* Jan. 1895) endeavours to show that Cecrops is the husband of Athena, identical with the snake-like Zeus Soter or Sosipolis, and the father of Erechtheus-Erichthonius.

CEDAR, a name applied to several coniferous trees (*see* Gymnosperms), and a few broad-leaved species.

Cedrus libani, the far-famed Cedar of Lebanon, is a tree which because of its beauty and stateliness has always been a favourite with poets and painters. It is frequently mentioned in the Scriptures as a symbol of power, prosperity and longevity. It grows to a height of from 50 to 80 ft. and at an elevation of about 6,000 ft. above sea-level. The bole of young trees is straight and upright and one or two leading branches usually rise above the rest. As the tree increases in size, however, the upper branches become mingled together to form a clump-headed crown. Numerous lateral ramifying branches spread, tier upon tier, in a horizontal direction from the main trunk and cover a compass of ground the diameter of which is often greater than the height of the tree. The branchlets of the cedar assume the same orientation as the branches, and the foliage is very dense. The tree is evergreen; new leaves are developed every spring, but their fall is gradual. In shape the leaves are straight, tapering, cylindrical and pointed, about 1 in. long, dark green and borne in spirally arranged tufts of about 30. The male and female flowers grow on

the same tree but on separate branches. The cones, borne on the upper side of the branches, are flattened at the ends and are 4 to 5 in. in length and 2 in. wide; they require two years to mature and while growing exude much resin. The scales are closely pressed to one another, reddish in colour, and at maturity fall away from the central axis. The seeds are provided with a long membranous wing. The root system is large and ramifying. This cedar, which flourishes best on sandy, loamy soils, appears in great numbers on Mt. Lebanon, chiefly on the western slopes, where it usually occurs in groves, some of which contain several thousand trees. There are also large forests on the higher slopes of the Taurus and Anti-Taurus mountains. The wood is fragrant, though not so strongly scented as that of the juniper or red cedar of America. It is generally reddish-brown, light and of a coarse grain and spongy texture, easy to work, but liable to shrink and warp.

Mountain-grown wood is harder, stronger, more durable and exhibits greater dimensional stability.

The Cedar of Lebanon is cultivated in Europe for ornament only. It thrives well in parks and gardens, but the young plants are unable to withstand great variations of temperature. The term *Eres* (cedar) of Scripture does not apply strictly to one kind of plant: the "cedars" for masts, mentioned in Ezek. xxvii. 5, must have been pine trees. Drawers of cedar or chips of the wood are now employed to protect furs and woollen stuffs from injury by moths. Cedar wood, however, is said to be injurious to natural history objects and to instruments placed in cabinets made of it, because the resinous matter in the wood acts as a corrosive.

The genus *Cedrus* contains two other closely allied species, namely, *C. deodara,* the deodar, or "god tree" of the Himalayas, and *C. atlantica,* the Atlas cedar of the Atlas range in north Africa.

The deodar forms forests on the mountains of Afghanistan, north Baluchistan and the northwest Himalayas at elevations of from 5,500 to 12,000 ft.; it may develop a clear bole of from 60 to 70 ft. under the crown. The wood is close-grained, long-fibred, scented and highly resinous and resists the action of water. The foliage is of a paler green, the leaves are slenderer and longer and the twigs are thinner than those of *C. libani.* The tree is employed for a variety of useful purposes, especially in building. It is cultivated in England and in California as an ornamental plant.

C. atlantica has shorter and denser leaves than *C. libani;* the leaves are glaucous, sometimes of a silvery whiteness, and the cones smaller than in the other two forms. Growth is somewhat more rapid than that of the ordinary cedar, but the tree produces a similar timber. It is found at altitudes of from 4,000 to 6,000 ft.

The name cedar is applied to species of several other genera of conifers, including *Juniperus, Thuja, Libocedrus, Chamaecyparis* and *Cupressus. Libocedrus decurrens,* of western North America, is known in the United States as incense cedar. *Chamaecyparis lawsoniana* is the Port Orford white cedar, a native of Oregon and California. The Bermuda cedar (*Juniperus bermudiana*) and the eastern red cedar (*J. virginiana*) are used in joinery and in the manufacture of pencils. Another species, the Atlantic white cedar (*Chamaecyparis thyoides*), is found in swamps along the southern coastal plains. The Spanish cedar is *Juniperus thurifera,* a native of the western Mediterranean region. Another species, *J. oxycedrus,* common in the Mediterranean region, forms a shrub or low tree with spreading branches and short, stiff, prickly leaves. A species of cypress, *Cupressus lusitanica,* naturalized in the neighbourhood of Cintra, is known as the Cedar of Goa. The genus *Widdringtonia* of tropical and South Africa is also known locally as cedar. The Japanese cedar (*Cryptomeria japonica*) is more closely related to the bald cypress. The family Meliaceae (which is entirely distinct from the conifers) includes, along with the mahoganies and other valuable timber trees, the Jamaica and the Australian red cedars, *Cedrela odorata* and *C. toona,* respectively. (E. S. Hr.)

CEDAR-BIRD or **CEDAR WAXWING:** *see* Waxwing.

CEDAR CITY, a city of Iron county, Utah, in the southwestern part of the state, at an elevation of 5,800 ft.; on federal highway 91, and the terminus of a branch line of the Union Pacific railway, constructed in 1923. The population was 4,695 in 1940 by the federal census. It is the largest city within a radius of 200 mi.; is surrounded by vast expanses of grazing country and potential agricultural land, with some 50,000ac. in irrigated farms, and by great deposits of iron, coal and gypsum; and is the gateway to the Zion National park, Bryce canyon, the north rim of the Grand canyon, Kaibab forest and Cedar Breaks. A Branch of the State agricultural college is situated here. In 1849 an exploring party sent out by Brigham Young discovered the beds of iron ore which gave the county its name. A volunteer company established a colony at Parowan, the county seat, in 1851. Cedar City was settled in 1851, and became the centre of the iron industry of that period, sending 12,500 lb. of pig-iron to Salt Lake City in the next eight years, besides manufacturing many articles of iron. With the development of rail transportation from the east the industry languished. In 1923 mining was begun on a large scale around Iron Springs, 10m. W. of Cedar City, and the present production (by stripping methods) is about 250,000 tons a year, averaging 53% in iron content.

CEDAR CREEK, a small branch of the North Fork of the Shenandoah river, Virginia (U.S.A.). It is known in American history as the scene of a memorable battle, which took place on Oct. 19, 1864, between the Union army under Gen. Sheridan and the Confederates under Gen. Early. (*See* Shenandoah Valley: *Campaigns.*)

CEDAR FALLS, a city of Black Hawk county, Iowa, U.S.A., on the Cedar river, 100 mi. W. of Dubuque. It is on federal highways 20 and 218, and is served by the Rock Island, the Illinois Central, the Chicago Great Western and the Waterloo, Cedar Falls and Northern railways. The population in 1940 (federal census) was 9,349. More than 50 creameries are within a radius of 30 mi. The city is adjacent to the Cedar Falls-Waterloo state parkway. It utilizes its water power for sundry manufactures. It is the seat of the State Teachers college (established in 1876 as a normal school), which has a resident enrolment of over 2,000.

Settlement began there in 1847. The town was laid out in 1851, and chartered as a city in 1865.

CEDAR RAPIDS, a city of Linn county, Iowa, U.S.A., on the Cedar river, in the east-central part of the State. It is on Federal highways 30, 218 and 151; and is served by the Chicago, Milwaukee, St. Paul and Pacific, the Chicago and North Western, the Rock Island, the Illinois Central, the Cedar Rapids and Iowa City and the Waterloo, Cedar Falls and Northern railways. The population was 25,656 in 1900; 45,566 in 1920 (5,863 foreign-born white, of whom 2,833 were from Czechoslovakia); 56,097 in 1930 (4,974 foreign-born white of whom 2,458 were from Czechoslovakia); and 62,120, federal census in 1940. The rapids in the river supply abundant water power, and the city ranks second in the state as a manufacturing centre, with an aggregate factory output valued at $92,000,000. The leading products are cereals, corn products, meat packing, road building and mining machinery, farm hardware, ice cream machinery, radio transmitters, poultry and stock food and milling. There is "Quaker Oats," the largest single unit cereal mill in the world. The city has an extensive jobbing business in all staple lines, and is the distributing centre for a rich agricultural district. Bank deposits in 1940 amounted to $49,877,112.50.

The city has an air of substantial prosperity. Its principal streets are 80–100 ft. wide, well paved and shaded. The assessed valuation of property in 1940 was $57,000,000. There are six fine parks, in one of which (Hawkeye Downs), an annual rodeo show is held. One Bohemian periodical and one Swedish, with a substantial circulation, are published there. Coe college, a co-educational Presbyterian institution, which grew out of the Cedar Rapids Collegiate Institute (1851), was chartered under its present name and opened in 1881. It has an enrolment of 800.

Cedar Rapids was settled in 1838; incorporated in 1856; and adopted a commission form of government in 1908.

CEDARTOWN, a city of Georgia, U.S.A., 62 mi. west-north-west of Atlanta, served by the Central of Georgia and the Seaboard Air Line railways; the county seat of Polk county. The population in 1920 was 4,053 (22% Negroes), and had increased to 9,025 in 1940 by the federal census. There are important mineral deposits in the vicinity, especially of iron, manganese, marble and slate. Hydro-electric power is available and the town has railroad shops, cotton mills, a tire and rubber factory and various other manufacturing industries. It was incorporated as a city in 1898.

CÉDULA, the Spanish form of the English word schedule, of which "cédule" is an obsolete variant; in modern financial usage it refers more specifically to certain securities issued by the South American Governments.

CEFALÙ (anc. *Cephaloedium*), a seaport and episcopal see of the province of Palermo, Sicily, 42 mi. E. of Palermo by rail. Pop. (1936) 9,654 (town), 10,730 (commune). The ancient town is named from the headland (Gr. Κεφαλή, head) upon which it stood (1,233 ft.); its fortifications extended to the shore, on the side where the modern town now is, in the form of two long walls protecting the port. There are remains of a wall of massive rectangular blocks of stone at the modern Porta Garibaldi on the south. It does not appear in history before 396 B.C., and seems to have owed its importance mainly to its naturally strong position. A small ancient building in good polygonal work (a style of construction very rare in Sicily), consists of a passage on each side of which a chamber opens. The doorways are of finely-cut stone, and of Greek type. On the summit of the promontory are extensive remains of a Saracenic castle. The new town was founded at the foot of the mountain, by the shore, by Roger II. in 1131, and the cathedral was begun in the same year. The exterior is well preserved, and is largely decorated with interlacing pointed arches; the windows also are pointed. On each side of the façade is a massive tower of four storeys. The round-headed Norman portal is worthy of note. The interior was restored in 1559, though the pointed arches of the nave, borne by ancient granite columns, are still visible: and the only mosaics preserved are those of the apse and the last bay of the choir: they are remarkably fine specimens of the art of the period (1148) and were carefully restored in 1859–62. Fine cloisters, coeval with the cathedral, adjoin it.

CEHEGÍN, a town of south-eastern Spain, in the province of Murcia, on the right bank of the river Arcos, a small tributary of the Segura. Pop. (1940) 7,724 (mun. 17,316). Cehegín is the market for local wine, olive oil and hemp, and for marble and a little iron from the neighbouring hills. Some of the older houses, the parish church and the convent of San Francisco, which contains still legible Roman inscriptions, are built of stone from the ruins of Begastri, a Roman colony which stood on an adjacent hill. The name Cehegín is sometimes associated with that of the Zenaga, Senhaja or Senajeh, a North African tribe which invaded Spain in the 11th century.

CEILING, the overhead surface or surfaces covering a room; the under side of a floor or a roof; often used as a surface built to hide the floor and roof construction; the term is also employed, technically, for any finished boarding or sheathing, and especially for a type of narrow, thin board, tongued and grooved, with a moulding on the edge. Ceilings, in the larger sense of the word, have been favourite places for decoration from the earliest times, by painting the flat surface, as in the case of Egyptian tombs; by emphasizing the structural members of roof or floor, as in the beamed ceilings of the period of Francis I. in France, or the ceilings of Italian mediaeval churches; *e.g.,* S. Miniato at Florence; by treating it as a field for an over-all pattern of relief; *e.g.,* the earlier rooms of Hampton Court palace near London.

Of Greek ceilings little is known, except for some of marble, over temple porticos, decorated with small, sunk panels or coffers, with moulded edges, and the field further decorated in polychrome. Roman ceilings were rich with relief and painting as is evidenced by the vault soffits of Pompeian baths. Italian Renaissance architects found in similar examples inspiration for much of their most charming painted and relief decoration in stucco, and Robert Adam's 18th century designs for ceilings ornamented with ovals, fans, hanging garlands, delicate scrolls and little painted panels, have the same origin. The general Gothic tendency to use structural elements decoratively led to the rich development of the beamed ceiling, in which large cross girders support smaller floor beams at right angles to them, beams and girders being richly chamfered and moulded, and often painted in bright colours (the palazzo Davanzati in Florence contains numerous late 14th century examples).

In the Renaissance, ceiling design was developed to its highest pitch of originality and variety. Three types were elaborated. The first is the coffered ceiling, in the complex design of which the Italian Renaissance architects far outdid their Roman prototypes. Circular, square, octagonal and L-shaped coffers, with their edges richly carved and the field of each coffer decorated with a rosette, abound. Occasionally pendants are found at the intersections (the Hall of the Two Hundred, in the Palazzo Vecchio at Florence and various rooms of the ducal palace at Mantua are good examples). The second type consists of ceilings wholly or partly vaulted, often with arched intersections, with painted bands bringing out the architectural design and with pictures filling the remainder of the space, as in the loggia of the Farnesina villa in Rome, decorated by Raphael and Giulio Romano. In the baroque period, fantastic figures in heavy relief, scrolls, cartouches and garlands were also used to decorate ceilings of this type; *e.g.,* the Pitti palace, Florence; many French ceilings of the Louis XIV. style are similar. In the third type, particularly characteristic of Venice (*e.g.,* the Doge's palace), the ceiling became one large framed picture.

The early Renaissance saw in England another interesting development, that of plaster ceilings covered with an intricate pattern of intersecting curved lines, ornamented with foliage, grotesque animals and heraldic devices, and frequently accented by repeated large pendants; *e.g.,* Bramall Hall; Hatfield House, London; Knowle; Sizergh. Later, the skilful English plaster workers were trained into a more classic vein, largely through the influence of Inigo Jones, who developed a type with large and deeply recessed panels, bold mouldings and bands of high relief foliage and fruit, which remained fashionable for about a century after 1650. In modern work the general tendency is toward simplified ceilings. Rich colour decoration is, however, sometimes found, especially in public buildings; *e.g.,* Nebraska State capitol, U.S.A., designed by B. G. Goodhue, with ceilings by Hildreth Méière.

(T. F. H.)

CEILLIER, REMY (1688–1761), Benedictine monk of the Lorraine congregation of St. Vannes, was born at Bar-le-Duc on May 14, 1688. He was the compiler of a scholarly Patrology, *Histoire générale des auteurs sacrés et ecclésiastiques* (23 vols. Paris, 1729–63, improved edition, 14 vols. Paris, 1858). His *Apologie de la morale des pères de l'église* (Paris, 1718), also won some celebrity.

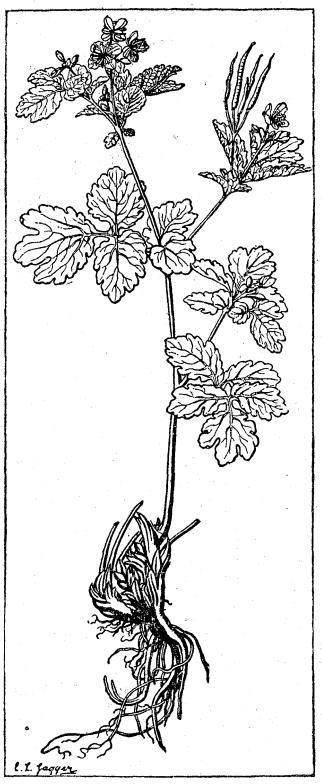
CELAENAE, an ancient city of Phrygia, situated on the great trade route to the East. It was the starting point of the march of Cyrus (401 B.C.) with the 10,000 against Artaxerxes. Its acropolis long held out against Alexander in 333 and surrendered to him at last by arrangement. Antigonus made it the capital of his kingdom; Antiochus of Syria, the son of Seleucus refounded it on a more open site as Apameia (*q.v.*). West of the acropolis were the palace of Xerxes and the Agora, in or near which is the cavern whence the Marsyas, one of the sources of the Maeander, issues.

See G. Weber, *Dineir-Celènes* (1892).

CELANDINE (*Chelidonium majus*), a common British plant, a member of the poppy family (Papaveraceae), an erect branched herb from 1 to 2 ft. high with a yellow juice, much-divided leaves and yellow flowers nearly an inch across, succeeded by a narrow, thin pod opening by a pair of fine valves, separating upwards. The plant grows in waste places and hedgerows, and is probably an escape from cultivation. It has become widely naturalized in eastern North America, in open grounds, roadsides and in woods from Maine to Ontario and Illinois south-

ward to North Carolina. The lesser celandine is a species of *Ranunculus* (*R. Ficaria*), a small low-growing herb with smooth heart-shaped leaves and bright yellow flowers about an inch across, borne each on a stout stalk springing from a leaf-axil. It flowers in early spring, in pastures and waste-places. It is sparingly introduced into the United States from Massachusetts to Maryland.

CELANO, a town of the Abruzzi, Italy, province of Aquila, 73m. E. of Rome by rail. Pop. (1936) 9,784 (town); 11,653 (commune). It is on a hill above the Lago Fucino, and is dominated by a square castle, with round towers at the angles, erected in its present form in 1451. It contains three churches with 13th century façades in the style of those of Aquila. The origin of the town goes back to Lombard times, but it was destroyed in 1223, and rebuilt on a different site in 1227. It was damaged by the earthquake of 1915. It was the birthplace of Thomas of Celano, author of the *Dies Irae,* and biographer of S. Francis and S. Clara.



GREATER CELANDINE, A YELLOW FLOWERED PLANT OF TEMPERATE REGIONS, SOMETIMES USED IN MEDICINE

CELEBES, one of the four great Sunda islands in the Netherlands Indies. It extends from 1° 45′ N. to 5° 37′ S. and from 118° 49′ E. to 125° 5′ E. From the backbone of the island, which runs north and south, three long peninsulas project north-east, east and south-east, respectively, the first being much the longest. These peninsulas form great gulfs—on the eastern side, from north to south they are: the Gulfs of Tomini, or Gorontalo, Tolo and Boni, the first being the largest. Thus the island is of very curious shape, and its length, 800m., and coast-line, 2,000m., are quite disproportionate to its breadth, which averages between 36 and 120m., and at one point narrows to eighteen. As a result, no place in Celebes is as far as 70 miles from the sea. Celebes is situated in a very deep sea, between Borneo, west, which is in a shallow sea, on a shelf off the continent of Asia, and New Guinea, east, also in a shallow sea, and on a shelf projecting from Australia. The coast is dangerously fringed by drying coral reefs with many shoals and banks. The whole island is mountainous. Two parallel ranges run from north to south in the main central mass, and a northern extension of this traverses the entire northern arm of Celebes to Menado. From these ranges a single range projects north-eastwards to the extreme end of the eastern arm of the island, and two parallel ranges run, in a south-easterly direction, throughout the greater part of the south-eastern arm. The great central ranges (with Mt. Koruwe, centre, and Mt. Bonthain, south, over 10,000ft.), throw out large spurs, which dominate the central and western parts of Celebes. In the extreme north-east (Mt. Klabat, 6,620ft.), and south, the mountains are volcanic, some in the former region being active, whilst solfataras and hot springs are found in Minahasa. Wide rift valleys between the mountain ranges contain several lakes—in the north (Minahasa), Tondano, 2,000ft. above sea level, 9m. long and 3½m. wide, (Gorontalo), Limboto, Batudaka, and Bolano Sawu, in the central nucleus, Lake Lindu, further south, in the same rift, Tempe and Sidenreng (monsoon lakes), and east of these, extending into the south-eastern arm, the principal lakes of the island—Poso, Matana and Towuti. They are very deep, Matana having been sounded to 1,500 and Poso to 1,000 feet.

The rivers of Celebes are short and unimportant, for waterfalls and rapids are frequent; their mouths are obstructed by bars, and there is very little coastal plain, save at the head of the Gulf of Boni and near Macassar and among mangrove-swamps of the north coast of the Gulf of Tomini. The Jenemeja, which flows into the Gulf of Boni, is wide and navigable for some distance from its mouth, the Poso, which enters the Gulf of Tomini, is also wide and navigable, for very small craft, to Paluasi, the Sadang, entering the Gulf of Mandar, on the south-west coast, has many affluents, and is navigable by *sampans,* the Lasolo, south-east, admits steamers for 16 miles from its mouth; the rivers of Gorontalo are very small. The best natural harbours are Menado bay, Amurang bay, Kwandang bay, and Dondo bay, on the north coast; Tambu bay, Pare Pare bay, and Palu bay (Donggala), on the west coast; Gorontalo and Poso, in the Gulf of Tomini, with the Gulf of Poh, which penetrates eastward for 22 miles; the bays of Tomori, Kendari, and Staring, in the Gulf of Tolo, and the bays of Mengkoka, Palopo, Usu (Luwu), and Sopang, in the Gulf of Boni. Off the west coast is the Spermunde archipelago, a number of low islands surrounded by coral reefs; off the south coast, Saleyer (*q.v.*); at the end of the south-eastern peninsula are several islands, of which the most important are Kabaena, Muna, Wowoni, and Buton (*q.v.*). They are separated from the peninsula by the straits of Tioro and Wowoni, both dangerous. The Banggai or Peling islands lie off the eastern extremity of Celebes, and though they belong politically to Ternate, geographically they resemble Celebes. In the Gulf of Tomini are the Schildpad islands, extending for nearly 80 miles east and west, the chief of them Talata Koh, Togian and Batu Daka, the Sangihe (Sangir) islands (*q.v.*), form the north-east extension of Celebes towards Mindanao, in the Philippines, which is continued by the Talaua group, north-east of these. With the adjacent islands, the area of Celebes is estimated at 77,855 sq.mi. and without them—69,255 sq.mi. The population of Celebes and the islands under its government, included in the residency of Menado, was, in 1930, 4,231,906.

Its situation between the two shelves of the Asian and Australian continents makes the geology of Celebes specially interesting. The broad central block is a complex of igneous rocks, with granite, gneiss, diorite and amphibolite characters, pierced in places by later eruptives, mostly Tertiary. This block is enclosed around its base by Cretaceous rocks, overlaid by Tertiaries and recent alluvial deposits towards the coasts. In the south-east corner of the block there is a broad band of pre-Tertiary tuffs, fringed occasionally by coral limestone. The northern part of the Gulf of Boni is widely bordered by Pleistocene and alluvial deposits, resting in the north-east upon late Tertiaries: a band of old plutonic rocks stretches from near Paloppo across the Gulf of Boni and the south-east peninsula to the Gulf of Tolo.

The meridional ridge of Celebes has an axis of crystalline schist, tourmaline quartzite, and glaucophane schist, penetrated and overlaid by andesite and basalt, flanked by tuffs, overlaid by late Tertiary *Orbitoides* limestone. The southern extension from the central block shows late Tertiary limestone, raised in parts, to a height of more than 3,000ft. and portions of the Archaean foundation are revealed. East of the central block is a faulted and depressed area of crystalline schists and metamorphosed shales, with gneiss and metamorphic limestones. The south-eastern and eastern peninsulas are, in the main, a broken crustal block with plutonic rocks. Metamorphics run southwards along the Gulf of Boni inland, a series of Pleistocene to recent rocks passes near to north of Muna island, with no Tertiaries except a small patch on Buton island. Around Mengkoka bay is a fringe of coral limestone, which borders Kabaena, covers more than two-thirds of Muna, all except the centre of Buton, and all of Wowoni, and the small islands north of it. There are indications of Jurassic rocks south of Lake Matana and metamorphics re-appear in Peling island. The north-eastern peninsula has northern and southern belts. The northern belt consists mostly of sedimentary rocks, Cretaceous or Tertiary, some altered by metamorphism. This belt runs parallel with the coast, and is separated by a parallel fault line from the southern belt, which consists of granites, gneisses, schists and intrusives, with Archaean schists and altered rocks, caught in faults: the valleys are filled with recent deposits.

Older rocks, Cretaceous and Tertiary, are preserved in occasional east and west bands, and in places near the south coast there are fringes of coral limestone. Minahasa is volcanic, and differs structurally from any other portion of Celebes.

The climate of Celebes is hot, but is tempered by sea winds, which reach every part. Mean temperature ranges between 86° and 72°, with absolute extremes of 94° and 66°: it falls to below 50° at high altitudes on the mountains. At Palu, on the west coast, rainfall averages only 20·92in., as compared with 116·11 at Macassar, whilst Menado and Gorontalo, both in the north-eastern peninsula, average, the former 106·48in., and the latter 47·45 only. Macassar averages 132 rainy days annually; Palu only 77.

In the matter of fauna Celebes is the poorest island in the archipelago in the number of its species, yet amongst these it has animal forms which have no close allies in any other part of the world, except in three of the neighbouring islands—Bachian, Buru and Sulu. Most interesting of these are the *babi-rusa,* or pig-deer, so named by the Malays from its long and slender legs, and curved tusks, resembling horns, the black, crested baboon (*Cynopithecus nigrescens*), akin to the African baboon, and the *anoa,* or dwarf-buffalo, hunted extensively by the natives for its flesh. There are peculiar varieties of other indigenous animals, including five squirrels, a pig, a deer, two wood-rats and two marsupials. Celebes has a number of peculiar species of parrots, woodpeckers, hawks, cuckoos, hornbills, starlings, flycatchers and pigeons; the Brush turkey is found there. Crocodiles are common, there are snakes of various kinds, and many peculiar species of beetles and butterflies, whilst there is a distinct cleavage between the freshwater fishes of Borneo and Celebes. Although it has species which belong neither to the one nor to the other, the fauna of Celebes is more Asiatic than Australian, and the island is established as a transitional region between the Oriental and Australian zoological regions: it is one of the oldest parts of the Archipelago.

Much of Celebes is still covered with forest, especially around the Gulf of Tolo, where it is almost primeval, and practically without tracks or clearings. The vegetation grows on the sides of precipitous and almost vertical mountain slopes, and the scenery is exceedingly varied and picturesque. "Nowhere in the archipelago," wrote A. R. Wallace, "have I seen such gorges, chasms and precipices as abound in the district of Maros; in many parts there are vertical or even over-hanging precipices five or six hundred feet high, yet completely clothed with a tapestry of vegetation." The rift valleys are extremely fertile, and there are extensive plateaux, at varying heights, where there is rich pasture land. The flora shows many resemblances to that of the Philippines, is more Indian in character in the west of the island, and more Australian in the east, and whilst the trees of the lower slopes of the mountains differ strongly from those of Java, and are smaller, the alpine flora is very similar. There are many kinds of palms—fan-leaf, rattan, sago, *Arenga saccharifera,* which gives fibre for ropes, juice for sugar, and a beverage known as "sagueir;" bamboo, bread-fruit, tamarind and coco-nut trees flourish. Staple food crops grown are rice (mostly *sawah*) and maize; sugar-cane, tobacco and vegetables are also raised. The chief commodity for export is copra, followed by corn, coffee, nutmegs, rubber and kapok; copal, damar and rattan are collected, also cattle horns and hides, for export. Fishing for turtles and mother-of-pearl is carried on extensively, and there is a trade in ebony, sandalwood and timber of other kinds. *Kayulara* and *Kolaka,* two kinds of timber almost impervious to attacks of the pileworm, are found in Celebes, and there is teak on the island of Muna. Gold occurs in Menado, and there are three mines being worked there; nickel has been found and exploitation started in 1937; also iron, copper and lead, and in south Celebes, a little coal.

In Minahasa there are 105 people to the square mile, in other parts of Menado only 30, and in the rest of the island and dependencies, 37. The coasts are generally well populated: there are large stretches of mountainous territory entirely uninhabited. There are at least six quite different native peoples of Celebes—the Toala, Toraja, Buginese, Macassars, Minahasese and Gorontalese. The first-named are found scattered all over the island, sometimes living in communities amongst other races, the result of having been enslaved by them originally. It is thought that they represent the true aborigines of Celebes. They are short and dark and have wavy or curly hair, a broad, flat nose, prominent mouth, and receding chin. They are quite undeveloped and uncivilized, shy, jungle-dwellers, partly nomadic, but quiet good-tempered people, and with a distinct language of their own. The Toraja are a collection of tribes, living in central, south-east and east Celebes. Living in isolated groups, in a very thinly-populated country, they differ very much in development. Of Malayo-Polynesian stock, and divided into highland and lowland people, in some parts they have intermingled with the Toala; in others they have come under a Buginese and Macassarese civilizing influence. They are pagan (with an increasing Mohammedan element), are gradually giving up their fortified villages, in very inaccessible positions, for neat little settlements of houses standing each in its own garden, and they are becoming reconciled to the Dutch prohibition of head-hunting and of divination by spear-throwing, but they are unclean, short-lived, and weakly. The mountain peoples are more strongly built than those of the plains, with more prominent cheek-bones, thinner lips, and smaller eyes. Both have large mouths, thick lips, and, usually, a broad nose, skin varying from light to dark brown, and smooth, black hair, worn long. They are lazy, the women working harder than the men, but courteous and good-tempered, when their confidence has been gained. They are agriculturists, with only a few industries, such as plaiting, pottery, wood-carving and iron-working. Bark clothing is worn in remote districts, and Malayan style cotton garments where there is contact with superior races: many ornaments are worn, and teeth are filed. Society is organized on the family basis, and the tribe is an extension of the family, a man choosing a wife from another branch of his own family. There are no social distinctions, or tribal chiefs, and woman has, comparatively, a high position amongst the Toraja, being able to choose her own husband. They collect forest produce, and grow rice, possess their own language, with many dialects, and Christian schools are well received by them. The Buginese and Macassars are probably of Toraja descent, came into touch with Hindu culture in Southern Celebes, their home, and later were converted to Islam. They are now all Mohammedans, but with traces of Hinduism and paganism. Well built, fairly light-skinned, and energetic, they are very keen traders, of very moderate morality, proud, passionate and vindictive, devoted to feasting, gambling and cock-fighting. As ship-builders and sea-farers, they are unsurpassed in the Archipelago; their excellent prahus are to be found everywhere in Malayan seas. Society is both endogamic and exogamic, with survivals of a matriarchate, but Mohammedan law and customs are displacing all others. Both peoples are abstemious, feed chiefly on rice, maize and fish, eating buffalo flesh on festive occasions only: clothing is Malayan in style. They are extremely industrious, but their industries are not in a high state of development. Weaving is one of the chief; cotton *sarongs,* of fine material, being exported in large numbers from Mandar. Plaited goods of superior quality are made in Boni, gold and silver-smiths are mostly in Macassar, Gowa, Mandar and Boni, ironworkers in Luwu, Laiwui and Mandar, whilst shipbuilders flourish in Pambauwang, the Bira regency, and elsewhere. Forest produce is collected, buffaloes, cattle and horses are kept, hunting and fishing are indulged in, for pleasure and as a means of livelihood, and their sea-carrying trade thrives in spite of steamship competition. A peculiar written alphabet, shared by Buginese and Macassars, is used also by some of the tribes of northern Celebes, and by people of Sumbawa. The Macassar language and Buginese, to which it is very nearly allied, belong to the Malayo-Javanese group. Arabic letters are now being used for religious literature, and books in Arabic are read. There is a slight native literature, historical, legal, epistolary, and poetical. The Buginese and Macassars, like other races in Celebes and throughout the Archipelago, are adopting Malay as a *lingua franca,* and are encouraged therein by Dutch authority. The Minahasese are quite distinct in type from the other inhabitants of Celebes, they are closely related to the people of the islands of Siau and Sangi, and are probably part of an immigrant race from the north which settled here, and in the Philippines, of partly Cau-

casian type. They have a very light skin (some of the women have red cheeks and lips), lighter than any other race in the Archipelago, high nose, prominent lips, eyes widely separated, stiff, short, black hair and pleasant features, and they are tall and strong. Like the Maoris, a few generations back they were a savage, warlike race, constantly engaged in raids and head-hunting. European influence has completely eliminated this, and today the Minahasese are Christian, live in European style (each village has its church and school), are cleanly, sober and industrious, make good soldiers, being used extensively in the Dutch Colonial army and police, and compete successfully with Amboinese and Eurasians as clerks, schoolmasters, etc. They have a native tongue, but Malay and Dutch are superseding it. Their territory proper is in the extreme north and northeast, cultivation (coffee, coco-nuts and spices are grown largely), is in the European style, and their numbers do not exceed 300,000. The Gorontalese, who live in the west and south of the northeastern peninsula, are of the Toraja family, not related to the Minahasese, and largely Mohammedan, a short, smooth-haired, and rather light-skinned people, with a marked difference between the people of the coast and inland. They are agriculturists (rice, maize, coco-nuts and tobacco are grown), forest products collected, and weaving and plaiting are carried on, some of the finest materials in Celebes being produced.

They are neither strong nor very industrious; preponderance of women has encouraged extensive polygamy. In numbers they are estimated at about 223,000. Pagan (inland) and Mohammedan coastal tribes live on Banggai and Peleng.

For administrative purposes Celebes is divided into two separate divisions—the residency of Celebes, with dependencies (southeastern, southern peninsulas and islands, and the west coast), and the residency of Menado (the northeastern peninsula and the coast of the Gulf of Tomini—including the Banggai Islands).

The population of Celebes and dependencies is 3,093,251, composed of 4,537 Europeans and Eurasians, 25,497 foreign Asiatics, including Chinese and Arabs, and 3,063,217 natives. The population is much larger on the coasts than inland. The chief port and trade centre and the seat of the resident is Macassar (*q.v.*), with a population of 84,855 (3,447 Europeans included). All the other towns of any importance of Celebes, quite small in comparison with Macassar, are on the coast; for communications hardly exist inland, although the whole country is under direct Dutch rule, with some modification in a few districts of Menado and in the two small states of Luwu and Wajo, where the "short declaration" applies. Authority is enforced by officials on tour and just suffices to pave the way for civilization. Bonthain, on the south coast, is a small port and trade centre (population 6,711); such, also, are Pare Pare, Mamudyu and Madyene on the west coast. On the Gulf of Boni are Kajang, Palima, Desu Bay, Palopo and Kolaka, and on the east coast and Gulf of Tolo—Kendari, Salabanka, Bunku, Koloneday and Luwuk, and on the southern shore of the Gulf of Tomini—Pagimana, Bunta, Posso and Parigi. Some of these places are very small, but all are ordinarily ports of call for ships of the Royal Packet Navigation company and trade centres, zones of collection for great tracts of the hinterland. The residency of Menado has a population of 1,138,655, including 3,146 Europeans and Eurasians, and 25,123 foreign Asiatics. The chief port and centre of administration is Menado, in the extreme northeast, on Menado bay, with a population of 27,544. Unlike the rest of Celebes, Menado has centres of population inland, on plateaus among the mountains, and of these Tondano (2,000 ft.), near the lake and river of the same name, is the chief, with a population of 15,007. It has a cool, refreshing climate, and, situated amid beautiful mountain scenery, is quite a health resort. A pretty little town near by is Tomohon, a few hundred feet higher, which has a training school for native girls and a training college for native preachers, and a wireless station. Gorontalo, on the south coast of the peninsula, is a very important port and trade centre. It has an excellent harbour, with a magnificent approach, mountain ridges, thickly clad with vegetation running down to the shore, on either side of the narrow Gorontalo bay. (Lake Limboto is not far distant.) It has a population of 15,603, does a busy trade in copra, coffee and other products, and, like Menado, is in direct touch with ports in Java, Singapore and other large ports. Small ports on the north coast are Amurang, on the bay of that name, and with a safe anchorage in all weathers, Kwandang, on Kwandang bay, having ruins of an old fort, and Palehleh, a centre for the gold-mining district, near by; on the southeast coast are Kema, Buna and Jikol; on the west coast lies the port of Donggala (pop. 3,821), the seat of an assistant resident. Service was suspended some years ago on a short tramway (28.7 mi. long), from Macassar to Takalar. Sea transport provides the principal, and in most parts, the only means of communication, though motor roads exist in Menado and southern Celebes. Macassar has cable communication with Java, Menado with Borneo, and Gorontalo with Ternate (Moluccas); there is a telegraph line between Amurang and Menado; and Macassar, Menado and Gorontalo have telephone systems. Imports and exports were respectively, in 1939, for Menado 3,280,000 and 5,176,000 guilders, and for Celebes and dependencies 16,028,000 and 17,057,000 guilders.

The Portuguese appear to have discovered and established some influence in Celebes in 1512 when they were monopolizing the spice trade of the Moluccas. The sultan of Macassar, as head of the state of Gowa (southwestern Celebes) favoured the Portuguese and the English, who later attempted to get a footing in Celebes. This annoyed the Dutch, who defeated the sultan early in the 17th century, though the Portuguese helped him. In 1607 a Dutch settlement at Macassar began to establish a firm trade footing in southern Celebes. The Dutch then used the sultan to check the power of Ternate in the Moluccas, and with their friendship he was able to subdue Boni, a rival state in southeast Celebes, and to hold Luwu, but he grew too powerful, and the Dutch (1654) conquered the island of Tidore in spite of a Macassarese fleet. War with Gowa, interrupted only by indecisive treaties, lasted till 1667, when the Dutch Admiral Speelman crushed Gowa and the Macassarese, with help from Boni, and imposed the Bongay treaty. Gowa abandoned all claims to supremacy, surrendered lands to the Dutch East India company, left to it trade monopoly, and fell into decay. Boni's growth in power led the Dutch later to protect the independence of Gowa but the Dutch used their Buginese allies of Boni in the early wars in Java, and during the British occupation of Java, Raffles had to send an expedition to Celebes against the unruly Buginese in Boni. When Dutch power in Java was restored, a Dutch expedition had to be sent to Boni; but it was not until 1848 that Boni submitted to the Bongay treaty in a revised form. The treaty was not kept and a second expedition, in 1859, made Boni a fief of the Netherlands government, while part of its territory was ceded to the Dutch. The last prince, La Pawowoni Kraeng Segeri, refused in 1905 to pay certain dues and interfered with other states, and he was banished, and Boni then lost its independence completely. About the same time Gowa interfered in another part of Celebes. The Dutch sent troops and in 1911, Gowa, too, was incorporated in Dutch territory. The state of Luwu signed the Bongay treaty in 1667, but it was not until after the Boni War, in 1861, that the Dutch succeeded in establishing any real influence there and there was some trouble in 1886 over the refusal of Luwu to pay a fine for the murder of some shipwrecked sailors on its coast; but in 1905 it agreed to abide by the "short declaration," which then was also applied to the state of Wajo, likewise a signatory of the Bongay treaty, but which had at times been in open revolt, often in trouble with Boni, and had experienced serious internal disorder as recently as 1902. Menado was first colonized by the Spaniards, on the northern coast, and settlers were attracted from neighbouring islands. The sultan of Ternate also claimed suzerainty over it, and fairly early in the 17th century the Dutch entered into relations with the natives of the country to protect them from both Spaniards and Ternate. In 1657 the present capital and fort were built, at Menado, and a trade agreement was signed for the delivery of a certain amount of ironwood annually. In 1677 the Sangi and Talaua islands, and later, certain small kingdoms on the north coast, were placed under the rule of the Dutch governor of Ter-

nate, and from that time onwards Dutch influence expanded, until the conquest of the East Indies by the Japanese during World War II. Japan landed troops at the northern tip of the Celebes Jan. 11, 1942, and within a month controlled most of the island except the remote interior areas.

BIBLIOGRAPHY.—A. R. Wallace, *The Malay Archipelago* (1890); P. and F. Sarasin, *Reisen in Celebes* (Wiesbaden, 1905); F. Sarasin, *Versuch einer Anthropologie der Insel Celebes* (Wiesbaden, 1906); Handbook of the Netherlands East Indies Department of Agriculture, Industry and Commerce, Buitenzorg. (E. E. L.; X.)

CELERY (*Apium graveolens*), a biennial plant (fam. Umbelliferae) which, in its wild state, occurs in England by the sides of ditches and in marshy places, especially near the sea, producing a furrowed stalk and compound leaves with wedge-shaped leaflets, the whole plant having a coarse, rank taste and a peculiar smell. It is also widely distributed in the north temperate region of the old world. By improvement through breeding and selection and blanching, the stalks lose their acrid qualities and assume the mild sweetish aromatic taste peculiar to celery as a salad plant. A large number of varieties are cultivated by gardeners, which are ranged under three classes, green, white and red—the improved green varieties being generally the best flavoured and most crisp and tender. Red varieties are little known in the United States. Both blanched and green it is stewed and used in soups. In the south of Europe celery is much used in its natural condition. In the United States approximately 590,000 tons annually were grown commercially in 1940 and 1941. It was grown most extensively in California, Florida, Michigan and New York, in the order named, at that time.

Celeriac, or turnip-rooted celery (*Apium graveolens,* var. rapaceum), is a variety cultivated more for its roots than for the stalks, although both are edible. It is chiefly grown in northern Europe. (V. R. B.)

CÉLESTE, MADAME (1815–1882), French dancer and actress, was born in Paris on Aug. 16, 1815. As a little girl she was a pupil in the ballet class at the Opéra, and made her début at the Bowery theatre, New York city, at 15. In England in 1837 she gave up dancing, and appeared as an actress. In 1844 she joined Benjamin Webster in the management of the Adelphi, and afterwards took the sole management of the Lyceum till 1861. She retired in 1870. She died in Paris on Feb. 12, 1882.

CELESTIAL MECHANICS is the branch of astronomy that deals with the mathematical theory of the motions of celestial bodies. The foundation was laid by Sir Isaac Newton by the publication in 1687 of his *Philosophiae Naturalis Principia Mathematica,* usually referred to as the *Principia.* Here he published the three laws of motion which express the principles of mechanics, consolidating progress begun with the pioneer work of Galileo Galilei earlier in the 17th century. Newton also formulated the universal law of gravitation which states that any two particles of mass in the universe attract each other with a force that varies directly as the product of the masses and inversely as the square of the distance between them. These foundations permit the statement of a problem in celestial mechanics in the form of a set of equations of motion, ordinary differential equations of the second order. A proper understanding of the subject requires knowledge of this branch of mathematics.

An important triumph of Newton's was that Kepler's three laws of planetary motion, which had been derived empirically by Johann Kepler, were obtained as a consequence of the law of gravitation in conjunction with the laws of motion, applied to the problem of two bodies (*see* ORBIT, in which basic technical terms used in this article are defined). The next in order of difficulty is the case in which three bodies are considered, the famous problem of three bodies. The solar system, consisting of the sun and nine known principal planets, all but three surrounded by one or more satellites, constitutes a problem of many bodies. The significant circumstance that the mass of the sun is about 1,000 times that of the most massive planet, Jupiter, makes the sun's gravitational attraction far outweigh the mutual attractions of the planets. This suggests a process of successive approximations that has become the standard procedure in the mathematical theory of planetary motion, the deviations from elliptic motion being called the perturbations. In the case of the moon's motion the earth produces the principal attraction. Notwithstanding the very great mass of the sun, the effect of the sun's attraction is a small fraction of that of the earth owing to the close proximity of the latter. However, in the case of some satellites the perturbations produced by the sun's attraction may reach very sizable amounts. The mutual attractions of the component stars in triple and quadruple systems of stars suggest other interesting problems in celestial mechanics. In all known cases the configuration is always similar to that of the sun-earth-moon system, and methods similar to those employed in the study of satellite motion may be used. In part because of observational difficulties this field is not as far advanced as the study of motions in the solar system.

During the 18th century powerful analytical methods, made possible by the development of differential and integral calculus, were applied to the problems of celestial mechanics. These methods were generally successful in accounting for the observed motions of bodies in the solar system, and for more than 200 years this success built up a high degree of confidence in Newtonian mechanics and Newton's law of gravitation. This attitude was well expressed by J. H. Poincaré who wrote, in 1892, that ". . . the ultimate aim of celestial mechanics is to solve the great problem of knowing whether Newton's law alone explains all astronomical phenomena." On account of the necessary introduction of the theory of relativity the statement would require modification.

Relativity Effects.—It is now recognized that the Newtonian laws of motion and law of gravitation are approximations to the true laws governing the motions of celestial bodies (*see* RELATIVITY). It has been found, however, that the relativity effects, *i.e.,* the deviations from the motions derived on the basis of the classical Newtonian theory, are exceedingly small in all astronomical problems. In the motion of the perihelion of the innermost planet, Mercury, and in a very few other cases, they are large enough to be revealed by the most precise observations. A comparison between observations and theory, in which the perturbations are properly taken into account, confirms the excess of the motion of the perihelion in the amount of 43 seconds of arc per century, as required by the theory of relativity. This is one of the most convincing observational proofs of the theory of relativity. The effect diminishes rapidly for planets at a greater distance from the sun. In the case of the earth the relativity advance of the perihelion is about 4 seconds of arc per century, just large enough to be confirmed by the observations. On account of the smallness of the relativity effects in problems in celestial mechanics the justified procedure is to continue the use of the equations of motion following from the classical theory, and to apply the small relativity corrections, if at all necessary, in a minor adjustment of the results.

Gravitational Attraction of Finite Bodies.—The Newtonian law of gravitation is stated for particles, not for bodies of finite extent. It was shown by Newton that bodies the masses of which are arranged with perfect spherical symmetry attract each other in accordance with the law of gravitation as if the masses were concentrated in the centres of the respective spheres. It is found that the effect of nonsphericity diminishes rapidly with the distance between the bodies. Hence in the solar system in which the principal bodies are all nearly spherical and the distances, as a rule, large compared with the dimensions of the bodies, it is in many cases permissible to treat the planets and satellites as point-masses. Some interesting exceptions exist: the innermost satellite of Jupiter's system revolves in an orbit the radius of which is only $2\frac{1}{2}$ times the radius of the planet. Owing to its rapid rotation the planet is flattened, and its gravitational attraction differs appreciably from that of a spherical body of the same mass. The principal effect upon the motion of the satellite is an advance of the perijove and a backward motion of the node, both at the rate of $2\frac{1}{2}$ revolutions a year. The innermost satellite of Saturn shows a similar effect with a rate of one revolution a year. These are extraordinary cases; in most satellite orbits the resulting effect is small.

Other Branches of the Subject.—A related branch of celes-

tial mechanics is the gravitational theory of rotating liquid or gaseous masses with applications to the earth and the other larger planets. Astrophysical applications to close double stars have become increasingly important (*see* GEODESY and PRECESSION OF THE EQUINOXES). Newton explained the ocean tides as caused by the gravitational attraction of the moon and the sun. Sir George Howard Darwin, in addition to developing modern methods of tidal analysis and tidal prediction, also treated the cosmogonic aspect of tidal theory in his work on the development of the earth-moon system (*see* TIDES).

The various subjects described are recognized branches of celestial mechanics, which may be understood to embrace all of gravitational astronomy. The central problem, however, remains that of the mutual attractions among three or more bodies, each treated as a point-mass. There are two distinct approaches to the subject. The astronomer is forced to use methods that lead to a practical solution, even if they have the defect that the representation of the motion is valid for a limited interval of time only. The mathematician insists on using only processes of unquestionable validity, and is not primarily concerned with the astronomical requirements. Both points of view are meritorious, and each has had effects upon the development of the other.

Planetary Theory.—An important method for the treatment of planetary perturbations was introduced by Joseph Louis Lagrange (1736–1813). In an elliptic orbit the six orbital elements have constant values, completely determined by the three co-ordinates and the three components of the velocity at any time. Since the attractions by other planets cause a planet to follow a path differing from a fixed ellipse, the elements of its orbit so determined will necessarily vary with the time. Hence one may describe the "perturbed" orbit of a planet by giving the elements as functions of the time. Lagrange's method provides a process for deriving analytical expressions for the derivatives of the varying elements. These expressions are rigorous, but their integration requires the introduction of a process of successive approximations. The ordinary procedure gives rise to the presence of terms proportional to the time, in addition to periodic terms, in the final expressions for the elements. The terms proportional to the time, t, are called secular terms. Their presence raises such questions as whether the eccentricity of a planetary orbit may increase indefinitely, endangering the stability of the planetary system. Such a conclusion would be very superficial. The terms obtained in further approximations, having higher powers of t as factor, will modify the terms obtained in the earlier approximations in a manner that cannot be foreseen without appropriate mathematical analysis.

The integration of the periodic terms introduces divisors of the form $kn+k'n'$, in which n, n' are the mean motions of the two planets, and k, k' integers, both positive and negative. In the mean longitude the squares of these divisors occur. Whatever the mean motions, there will always be linear combinations $kn+k'n'$, small compared with either of the mean motions, n or n'. Such small divisors cause large coefficients in long-period terms, with the principal effect in the mean longitude. The motions of the planets Jupiter and Saturn furnish one of the most interesting illustrations of the effects of small divisors. The annual motions of the two planets are very nearly in ratio 5 to 2, which produces a long-period term with period of about 900 years. The amplitude of the perturbation in the mean longitude is 1,196 seconds of arc in Jupiter and 2,908 seconds of arc in Saturn. These are "the great inequalities" in the motions of these planets the cause of which was discovered by Laplace in 1786. The small divisors in celestial mechanics are related to the more general problem of resonance in mechanical systems.

A more direct approach to the solution of the perturbation problem is that in which the perturbations in the co-ordinates are obtained directly. Among the methods of this type that were employed with success may be mentioned those of Pierre Simon de Laplace and of Simon Newcomb. The apparent advantages are largely cancelled, however, in cases of planetary motion in which large perturbations due to small divisors are an important feature. In such cases a method in which the mean longitude is obtained has decided advantages. By an ingenious procedure, P. A. Hansen succeeded in deriving a method that combines the advantages of the two solutions of the perturbation problem. This method has been tested in numerous applications, and was chosen by G. W. Hill for his theory of Jupiter and Saturn, the most difficult problem among the principal planets.

An accomplishment that demonstrated strikingly the power of the theory of planetary motions was the discovery of the planet Neptune in 1846. Its presence and location in the sky had been predicted with astonishing accuracy by J. C. Adams and by U. J. J. Leverrier from deviations in the motion of the planet Uranus (*see* NEPTUNE). Attempts were made to discover planets beyond Neptune by a similar procedure, but the discovery of Pluto at the Lowell observatory in 1930 must be ascribed to perseverance in systematic search rather than accuracy of prediction by mathematical theory.

Secular Variations.—Planetary theories of the types described are entirely satisfactory for the immediate purposes of astronomy; the construction of tables that represent the motion of a planet for a limited time, say, a few thousand years. For questions concerning the stability of the solar system or, generally, its configuration in the very distant past and future such representations of planetary motion are insufficient. The question arose whether the secular terms occurring in planetary theories could be avoided. Lagrange obtained a solution in which he ignored the periodic terms. Retaining only the terms of the lowest power in the elements he obtained for the variation of the elements two sets of linear differential equations with constant coefficients, the eccentricity and perihelion appearing in one set, the inclination and node in the other. For the principal planets of the solar system, excluding Pluto, these equations have been solved in closed trigonometric form. In a solution of this type one obtains for the eccentricity and perihelion of each planet expressions containing eight trigonometric terms, the separate terms constituting oscillations with periods ranging from 57,000 years to 2,100,000 years. Similar expressions are obtained for the elements defining the positions of the orbital planes in space. These results give at least some indication of the long-period fluctuations in the elements of the planetary orbits. They should, however, be applied with caution. Further approximations present the same difficulty of small divisors as is met in the case of the periodic perturbations of the ordinary planetary theory. A still outstanding problem is the inclusion of Pluto in the solution of the secular variations. This will require a novel approach since the ordinary procedure leads to divergent developments.

The asteroids or minor planets furnish a rich field of application of the processes of celestial mechanics. The existence of the gaps in the ring of asteroids leads to the difficult theory of resonance in planetary motion. The application of the theory of secular variations led K. Hirayama to the discovery of five families of minor planets. He concluded that the members of each family must be fragments of a larger parent body. F. L. Whipple established a similar relationship between the orbit of Encke's comet and the orbits of certain meteors determined from trails on photographic plates obtained at the Harvard observatory (*see* MINOR PLANETS).

Satellite Motion.—A common feature of all satellite problems is that the motion proceeds at a much more rapid rate than among planetary orbits. In the moon's motion the line of apsides goes through a revolution in about nine years, the node in 19 years. These periods should be compared with the periods of tens or hundreds of thousands of years that affect the motions of the perihelia and nodes of planetary orbits. Consequently, in a satellite theory one cannot permit the appearance of the time in the coefficients of perturbation terms in the manner in which they are tolerated in planetary theories. One must aim at expressions free from this defect. The most complete solution of a satellite problem is the lunar theory (*see* MOON). Elaborate investigations have also been devoted to the satellite systems of Jupiter and Saturn. These systems present cases of resonance that are among the more interesting problems of celestial mechanics.

Modern Methods.—From the time of Lagrange until the present mathematical astronomers have made attempts to introduce the more perfect methods used in the lunar theory into the problem of planetary motion. A method similar to that used by Charles Eugène Delaunay in the lunar theory has been applied to planetary problems, but its application to the entire system of principal planets would be exceedingly laborious.

G. W. Hill opened up a new approach to problems in celestial mechanics by his use of a periodic orbit as a first approximation to the lunar theory. This subject was very fully investigated by J. H. Poincaré, whose work has led to a clearer understanding of the mathematical questions involved. Principally because of his work it is now recognized that, from a mathematical point of view, even such perfect developments as the lunar theories by Delaunay and by Brown leave something to be desired.

On account of the analytical difficulty of many problems in celestial mechanics investigators have resorted to the method of numerical integration. The method is used extensively for calculating the motions of asteroids and comets, and also in mathematical researches in the problem of three bodies.

The General Problem of Three Bodies.—This problem possesses ten known integrals, all of an algebraic character. Such an integral is a function of the co-ordinates and momenta of the three bodies that remains constant throughout the motion. The original equations of the problem form a system of the 18th order, nine differential equations of the second order. With the aid of the ten integrals, the "elimination of the nodes" and the elimination of the time the system may be reduced to one of the sixth order. This reduction was actually made by Lagrange and improved by later authors by the use of the canonical form of the equations. The reduction of the problem of three bodies with the aid of known integrals suggested that, if additional integrals were discovered, the problem might be further reduced and even completely solved. All such attempts failed; finally H. Bruns, in 1887, proved that no further algebraic integrals of the three-body problem exist. Soon afterward Poincaré proved that no further integrals uniform with respect to the elliptic elements exist. This result is of the greatest importance since it proves that the developments in trigonometric series used in the astronomical methods cannot converge for all values of the constants within a finite range. It does not exclude such a representation in the case of particular orbits; obvious examples are furnished by the periodic solutions and by the particular solutions which were first studied by Lagrange (*see* TROJAN PLANETS).

The simplified problem in which one of the three bodies has negligible mass and moves in the orbital plane of the two massive bodies, which are supposed to move in circular orbits, is the so-called restricted problem. The system of equations is one of the fourth order with one known integral, the Jacobian integral. Let $1-m$ and m be the masses of the finite bodies; r, r_1, r_2, the distances of the infinitesimal mass from the centre of the mass and the two bodies respectively, and V the velocity of the infinitesimal mass in a co-ordinate system the origin of which is at the centre of mass, and which rotates uniformly with the period of revolution of the finite masses. The Jacobian integral, if the units of time and distance are conveniently chosen, is then

$$r^2 + \frac{2(1-m)}{r_1} + \frac{2m}{r_2} = V^2 + C,$$

C being an arbitrary constant. By putting $V^2=0$ one obtains a single family of curves with C as parameter. These "curves of zero velocity" may be looked upon as barriers in the sense that an orbit for which the constant of the Jacobian integral equals C' can never cross any of these curves of zero velocity for which C' exceeds C. The curves of zero velocity were first introduced by Hill with application to the moon's motion and have figured prominently in more recent studies of the restricted problem.

A totally different approach to the solution of the problem of three bodies was made by using developments in powers of a variable related to the time. If applied to the original equations the method fails owing to the singularities of the differential equations that correspond to collisions. These singularities may be removed by suitable changes of variables, a procedure known as regularization. The first significant step in this direction was made by P. Painlevé. In 1912 K. F. Sundmann obtained a solution for the general problem of three bodies that can be expanded as power series which are convergent, but not uniformly so, for all values of the time. This result is of great theoretical interest, although its actual application to astronomical problems is excluded by practical difficulties. Moreover, the form of the solution does not reveal the character of the orbits.

In the restricted problem, the use of the Jacobian integral permits the elimination of one of the velocity components. Hence the motion can be represented completely by a trajectory in a three-dimensional phase space comparable with a streamline in a noncompressible fluid. This approach permits an attack upon problems that were not accessible by other methods. The earlier developments are due to Poincaré; important advances were made by G. D. Birkhoff, especially on questions concerning the probability that a trajectory returns to the same small region in space.

BIBLIOGRAPHY.—An elementary exposition of the principles of celestial mechanics is found in Russell, Dugan and Stewart, *Astronomy*, vol. i, chap. x (1926). Introductory treatises are: F. R. Moulton, *Introduction to Celestial Mechanics*, 2nd. ed. (1914); H. C. Plummer, *An Introductory Treatise on Dynamical Astronomy* (1918). The standard treatise covering developments through the 19th century is F. Tisserand, *Traité de Mécanique Céleste*, 4 vols. (1889–96). Excellent chapters on the mathematical aspects of the problem of three bodies are contained in E. T. Whittaker, *A Treatise on the Analytical Dynamics of Particles and Rigid Bodies*, 4th. ed. (1937). Other important works for specialists are: J. H. Poincaré, *Les Méthodes Nouvelles de la Mécanique Céleste*, 3 vols. (1892–99); E. W. Brown, *An Introductory Treatise on the Lunar Theory* (1896); J. H. Poincaré, *Leçons de Mécanique Céleste*, 3 vols. (1905–10); *Enc. der Math. Wiss.*, vol. vi, 2A, 2B, (1905–34); G. W. Hill, *Collected Math. Works*, 4 vols. (1905–07); G. D. Birkhoff, *Dynamical Systems* (Amer. Math. Soc. Colloquium Publ., vol. ix, 1927); A. Wintner, *The Analytical Foundations of Celestial Mechanics* (1941). (D. BR.)

CELESTIAL SPHERE, the imaginary sphere of indefinite radius on which the positions of the fixed stars are defined by their directions relative to an observer at its centre. The earth's axis meets the celestial sphere in two points, the *celestial poles*. (*See* ASTRONOMY: *Spherical.*)

CELESTINA, LA, the popular alternative title attached from 1519 (or earlier) to the anonymous *Comedia de Calisto y Melibea,* a Spanish novel in dialogue which was celebrated throughout Europe during the 16th century. The authorship of the *Celestina* and the date of its composition are doubtful. An anonymous prefatory letter in the editions subsequent to 1501 attributes the book to Juan de Mena or Rodrigo Cota, but this ascription is universally rejected. The prevailing opinion is that the author of the 21 acts was Fernando de Rojas, apparently a Spanish Jew resident at the Puebla de Montalban in the province of Toledo; R. Foulché-Delbosc, however, maintains that the original 16 acts are by an unknown writer who had no part in the five supplementary acts. Some scholars give 1483 as the date of composition; others hold that the book was written in 1497. These questions are still unsettled. The *Celestina* excels all earlier Spanish works in tragic force, in impressive conception, and in the realistic rendering of characters drawn from all classes of society. It passed through innumerable editions in Spain, and was the first Spanish book to find acceptance throughout western Europe. A Latin version by Caspar Barth was issued under the title of *Pornoboscodidascalus latinus* (1624) with all the critical apparatus of a recognized classic. James Mabbe's English rendering (1631) is one of the best translations ever published. The original edition of 1499 has been reprinted by R. Foulché-Delbosc in the *Bibliotheca Hispanica,* vol. xii (1902).

BIBLIOGRAPHY.—M. Menéndez y Pelayo's introduction to the *Celestina* (Vigo, 1899–1900); R. Foulché-Delbosc, "Observations sur la Célestine" in the *Revue hispanique,* vol. vii, pp. 28–80 (1900) and vol. ix, pp. 171–199 (1902); and K. Haebler, "Bemerkungen zur Celestina," in the *Revue hispanique,* vol. ix, pp. 139–170 (1902).

CELESTINE (CAELESTINUS), the name of five popes.

CELESTINE I, pope from 422 to 432. After his triumph over the dissensions caused by the faction of Eulalius (*see* BONIFACE I) his episcopate was peaceful. He instructed Cyril, bishop of Alexandria, to inquire into the doctrines of Nestorius. To extir-

pate Pelagianism, he sent to Britain a deacon, Palladius, at whose instigation St. Germanus of Auxerre came to inculcate orthodoxy among the clergy of Britain. Celestine also commissioned Palladius to preach the gospel in Ireland which was beginning to rally to Christianity. Celestine was the first pope who is known to have taken a direct interest in Britain and Ireland.

See Duchesne, *Lib. Pontificalis,* t. 1.

CELESTINE II., pope in 1143–1144. Guido del Castello, born of noble Tuscan family, able and learned, studied under Abelard and became a cardinal priest. He was pope from Sept. 26, 1143 to March 8, 1144. He removed the interdict which Innocent II. had employed against Louis VII. of France.

See A. Certini, *Vita* (Foligno, 1716); Migne, *Patrol. Lat.* 179, 765–820; Jaffé, *Regesta Pontificum Romanorum* (1888), vol. ii., 1 ff.

CELESTINE III. (Giacinto Bobo), pope from 1191 to 1198, once cardinal deacon of Santa Maria in Cosmedin, became pope on March 30, 1191. Henry VI. of Germany forced the pontiff to crown him emperor, and three years later took possession of the Norman kingdom of Sicily; he refused tribute and the oath of allegiance, and even appointed bishops subject to his own jurisdiction; moreover, he gave his brother in fief the estates which had belonged to the countess Matilda of Tuscany. Celestine dared not excommunicate him. In England, Prince John and the barons refused to recognize the papal legate, the bishop of Ely. Richard I. had been set free before the dilatory pope put Leopold of Austria under the ban. He died on Jan. 8, 1198.

See "Epistolae Coelestini III. Papae," in M. Bouquet, *Receuil des historiens des Gaules,* t. 19 (1738 ff.); Migne, *Patrol. Lat.* 206, 867 ff.; further sources in *Neues Archiv für die ältere deutsche Geschichtskunde,* 2. 218; ii., 398 f.; 12. 411–414; Jaffé, *Regesta Pontificum Romanorum* (1888), vol. ii. 577 ff.

CELESTINE IV. (Godfrey Castiglione), pope in 1241, nephew of Urban III. (1185–87), was archpriest and chancellor at Milan, before he joined the Cistercians. In 1227 Gregory IX. created him cardinal priest, and in 1233 cardinal bishop of Sabina. Elected to succeed Gregory on Oct. 25, 1241, he died on Nov. 10 before consecration.

See A. Potthast, *Regesta Pontificum Romanorum,* vol. i. (1874), 940 f.

CELESTINE V. (St. Peter Celestine), pope in 1294, was born of poor parents at Isernia about 1215, and became a Benedictine. Living as a hermit he attracted other ascetics whom he organized into a congregation of the Benedictines which was later called the Celestines (*q.v.*). His *Opuscula* (Naples, 1640) are probably not genuine. A fight between the Colonna and the Orsini, as well as dissensions among the cardinals, prevented a papal election for over two years after the death of Nicholas IV. Finally, Celestine was elected on July 5, 1294. Apocalyptic notions then current doubtless aided his election, for Joachim of Floris and his school looked to monasticism to deliver the church and the world. Multitudes came to Celestine's coronation and he began his reign the idol of visionaries, of extremists and of the populace. But the pope was in the power of Charles II. of Naples, and became his tool against Aragon. When he wished to abdicate, Benedetto Gaetano, destined to succeed him as Boniface VIII., removed all scruples against this unheard of procedure by finding a precedent in the case of Clement I. Celestine abdicated on Dec. 13, 1294, and died in a monastic cell in the castle of Fumone on May 19, 1296. He was canonized by Clement V. in 1313.

See Herzog-Hauck, *Realencyklopädie;* Jean Aurélien, *La Vie admirable de . . . Saint Pierre Celestin* (Bar-le-Duc, 1873); H. Finke, *Aus den Tagen Bonifaz VIII.* (Münster, 1902).

CELESTINE or **CELESTITE,** a name applied to native strontium sulphate ($SrSO_4$), having been suggested by the celestial blue colour which it occasionally presents. It is usually colourless, or has only a delicate shade of blue. It crystallizes in the orthorhombic system, being isomorphous with barytes (*q.v.*). The cleavage is a perfect parallel to the basal pinacoid, and a less marked parallel to the prism. Although celestine much resembles barytes in its physical properties, having for example the same hardness (3), it is less dense, its specific gravity being 3·9. It is less abundant than barytes, but is, however, much more soluble.

Celestine occurs in the Triassic rocks of Britain, especially in veins and geodes in the Keuper marl in the neighbourhood of Bristol. At Wickwar and Yate in Gloucestershire it is worked for industrial purposes. Colourless crystals of great beauty occur in association with calcite and native sulphur in the sulphur deposits of Sicily, as at Girgenti. Very large tabular crystals are found in limestone on Strontian island in Lake Erie; and a blue fibrous variety from near Frankstown, Blair county, Pa., is notable as having been the original celestine on which the species was founded by A. G. Werner in 1798.

Celestine is much used for the preparation of strontium hydrate, which is employed in refining beetroot sugar. (F. W. R.)

CELESTINES, a religious order founded about 1260 by Peter of Morrone, afterwards Pope Celestine V. (1294). It was an attempt to unite the eremitical and cenobitical modes of life. Peter's first disciples lived as hermits on Mount Majella in the Abruzzi. The Benedictine rule was taken as the basis of the life, but was supplemented by regulations notably increasing the austerities practised. The form of government was borrowed largely from those prevailing in the mendicant orders. Indeed, though the Celestines are reckoned as a branch of the Benedictines, there is little in common between them. During the founder's lifetime the order spread rapidly, and eventually there were about 150 monasteries in Italy, and others in France, Bohemia and the Netherlands. The French houses formed a separate congregation, the head-house being in Paris. The French Revolution and those of the 19th century destroyed their houses, and the Celestine order seems no longer to exist.

See Helyot, *Histoire des ordres religieux* (1792), vi. c. 23; Max Heimbucher, *Orden und Kongregationen* (1896), i. § 22, p. 134; the art. "Cölestiner" in Wetzer und Welte, *Kirchenlexicon* (ed. 2), Herzog-Hauck, *Realencyklopädie* (ed. 3) and *Catholic Encyclopaedia,* vol. xvi. pp. 19, 20.

CELIBACY, the state of being unmarried. In the original Latin (*caelibatus,* from *caelebs,* unmarried) it meant merely the fact of being unmarried, but was later restricted almost entirely to the perpetual renunciation of marriage, especially for religious motives. Celibacy was a practice of various religions even in pre-Christian times, as exemplified in the Roman vestal virgins and in Buddhist monasticism. Judaism frowned on celibacy, and considered childlessness a reproach, for it banished the hope of begetting the Messiah. But marriage was rejected by the majority of the Jewish sect of Essenes, which arose about two centuries before Christ, probably from Persian-Babylonian influences during the captivity and from contact with Hellenism through the Greek language.

Christ commended celibacy for the sake of the kingdom of heaven (Matt. xix, 12), but did not prescribe it; and St. Paul praised virginity as better than marriage (I Cor. vii; 7, 32–40). Celibacy was a common practice among the early Christians, who were inspired by the example of Christ, the virtues of self-control and self-denial, and the freedom from family cares which would leave greater liberty for prayer, contemplation and apostolic activity, and would win the confidence and respect of the people. The practice was not confined to the clergy, but it became by church law an obligation for those who wished to embrace the clerical state.

Origins of Clerical Celibacy.—The majority of scholars agree that the law of clerical celibacy was not of apostolic origin. St. Paul recommended celibacy, but he also wrote that a bishop should be a man of one wife (I Tim. iii, 2; Titus i, 6). This was generally understood to exclude from bishoprics, not unmarried men, but rather men who had married more than once, at least after their baptism. A few contemporaries of St. John Chrysostom found in these texts a command that a bishop should have a wife, and this interpretation was revived in the 16th century by the Protestant reformers.

While no strict law of celibacy existed during the first three centuries of Christianity, its practice was in honour among the clergy from the time of the apostles. Tertullian admired the number of celibate clergy and Origen contrasted the spiritual fatherhood of the priests of the New Testament with the carnal paternity of the Levites of the Old Law. At the same time, ac-

cording to Clement of Alexandria, the church approved of clergymen who had married; if they used their marriage rights without sin, they would be saved by having children. When a law of celibacy was proposed in the ecumenical council of Nicaea in 325, Paphnutius, a celibate Egyptian bishop, objected that nothing should be added to the ancient tradition which opposed marriage after ordination, but did not prohibit wedded life for those who married before ordination. The council accepted this advice and contented itself with the provision that the clergy should not have in their houses unmarried women other than near relatives.[1]

Celibacy in the Oriental Church.—The law of clerical celibacy developed during and after the 4th century, more stringently in the west than in the east. The practice of celibacy was esteemed in the eastern church, but was not universal. The council of Ancyra in 314 allowed a candidate for the diaconate to state his choice of celibacy or marriage, and bound him accordingly. A few years later the council of Gangra condemned any disdain for the ministry of married priests. The bishops, however, practised continence even when married, and this custom gradually passed into church law, for which Justinian established civil sanctions. The discipline of the oriental church was finally fixed in the council of Trullo in 692. Absolute continence was prescribed for bishops; if they had been married they could not be consecrated unless their wives would enter monasteries. Ordained priests, deacons, and subdeacons could not marry, but they were free to retain wives they had taken before ordination.[2] This law has remained substantially the same in the eastern churches, but the practice has been to select bishops only from the unmarried priests.

Many of the eastern churches that have reunited with the Roman see have also accepted the stricter Roman discipline, but the retention of the old oriental practice has been tolerated in some of them.

The Early Latin Church.—After the beginning of the 4th century the custom of clerical celibacy gradually evolved into a legal obligation in the western church. The council of Elvira (Grenada) about the year 300 prescribed continence for bishops, priests and deacons.[3] This was merely a provincial council local to a part of Spain, but it has been prominent in the history of celibacy since it established the earliest recorded legislation on this subject. The same discipline was decreed in 386 by the church in Rome, and Pope Siricius set about making it universal in the Latin church. By letters to Spain and Africa he notified the bishops of the ruling, and prescribed penalties for violations.[4] A few years later Pope Innocent I wrote to the bishops of Rouen (404) and Toulouse (405) in the same vein. Councils in Carthage in 390 and 401 prohibited matrimonial intercourse of priests and deacons. At about the same time councils in Toledo and Turin barred advancement in orders if deacons or priests failed to observe continence with their wives. French councils demanded a promise of perpetual chastity from candidates for the diaconate. The church in England and Ireland also followed the continental law. Pope St. Leo I (440–461) restated the law of celibacy and included subdeacons among its subjects.[5]

The law met with opposition and St. Jerome knew of more than 300 married bishops. Other writers and many epitaphs of the clergy recorded clerical marriages as late as the 6th century. Time was required for the law to be universally accepted, but it was clear and definite after the 6th century except for subdeacons, for whom it became general in the 9th century.

Since married men received orders and undertook the obligation of celibacy, their wives were to be treated as sisters thereafter, and were called deaconess, priestess and episcopess. The wife of a priest or deacon remained mistress of his house, but a bishop's wife was to live in a separate home, and measures of vigilance were prescribed for them. But the proximity of the married couple was a source of danger, and violations of the law were not rare, although it was generally well observed during the Merovingian period, and many of the clergy were unmarried.

In the 8th century violations of the law became more frequent especially when Charles Martel began to distribute benefices to men who were more interested in the income than in the duties of a cleric. There was chaos in the Frankish church, as St. Boniface reported to Pope Zachary, but the saint succeeded in effecting a great reform there. In Spain King Witiza went so far as to abrogate the law of celibacy. With the advent of the Carlovingians better discipline was restored. Various councils renewed the old canons and Charlemagne sanctioned the traditional church law. But after the break-up of his empire the laws of both church and state were largely disregarded. During the 10th and most of the 11th centuries the laxity of the clergy made clerical marriages quite numerous. In many places the abuse was so rampant that marriage tended to become the normal state of the clergy with no stigma attached to it. The term "concubinage" was applied to these unions, but not in its strict sense, for the church had not yet made holy orders an impediment to valid wedlock. Some clerics did keep mistresses, but others contracted true marriages, either secretly, or even openly, as Pope Leo VII deplored in a letter to the Gauls and Germans.

In the middle of the 10th century the bishop of Augsburg was St. Ulric to whom an extant letter in favour of sacerdotal marriage has been attributed. Dr. Henry C. Lea in his *History of Sacerdotal Celibacy* vouched for its authenticity, but no careful scholar after the middle of the 19th century would disagree with August Potthast's evaluation in his bibliography of mediaeval history. He catalogues the letter under the heading, "Pseudo-Udalricus" as a fabrication of about 1075, a century after Ulric's death in 973, and a period of sharp controversy between the papacy and the empire.[6]

Reforms of Gregory VII.—In the 11th century the church began to re-establish the old canons, but the long-standing abuse was not repressed without a struggle. It took the exhortation of the most virtuous among the clergy and the drastic legislation of the greatest of the popes to bring about a reform. Severe laws and penalties were enforced, not only against the incontinent clergy, but also against their illegal partners. Some of the clergy who were liberated serfs took free women to wife in order to have children who would be free and inherit their property according to the civil law. Hence Benedict VIII, in the synod of Pavia about 1022, decreed the children of the clergy to be serfs of the church, and Henry II incorporated this into the law of the empire.

Leo IX in the Lateran synod of 1049 enslaved the concubines of the Roman clergy to the Lateran palace. Various synods in England and France allowed the rural clergy to keep the wives they had taken, but forbade future clerical marriage.

St. Peter Damien and Hildebrand were strong supporters and advisers of the popes of this period, and when Hildebrand became Pope Gregory VII in 1073, he made strenuous efforts to restore the ancient discipline. Many clerics believed that contrary custom had abrogated the law and made their marriages blameless, so when Gregory's legates instructed the German hierarchy to enforce celibacy, some of the clergy threatened to give up their ministry rather than their wives, saying that the pope might get angels to take their places. Similar disturbances occurred in France, but Gregory was not to be turned from his purpose. He took the unprecedented and dangerous step of subjecting the clergy to the judgment of the laity. He wrote several letters exhorting princes and people to refuse, and even to hinder by force, the ministrations of priests who were tainted with incontinence.[7] The temporary harm of such a measure was justified by the permanent gain effected, for the efforts of Gregory and his immediate successors brought about the desired reform. One of the principal causes of clerical incontinence was removed by the eventual settlement of the conflict over lay investitures. Finally the first and second ecumenical councils of the Lateran

[1]Socrates, *Hist. eccl.*, I I, c. XI; *Concilium Nicaenum*, can. 3; Mansi, *Concilia*, vol. 2, col. 670.

[2]*Concilium Trullanum*, can. 6, 12, 13, 48; Mansi, *Concilia*, vol. 11, col. 944–948, 965.

[3]*Concilium Eliberitanum*, can. 33; *ibid.*, vol. 2, col. 11.

[4]*Epist. ad Himerium; Epist. ad Afros.*

[5]St. Leo I, *Epistle XIV*, c. IV.

[6]Lea, *History of Sacerdotal Celibacy*, vol. I, p. 171; *see* Thurston, "A Saint Averse to Celibacy," *The Month*, vol. III (1908) pp. 311–315.

[7]*Cf.* Gregorius VII ad Germanos, Mansi, *Concilia*, vol. 20, col. 625.

(1123 and 1139) removed the possibility of clerical marriage after ordination to the subdiaconate by making this and higher orders an impediment to valid marriage.[1] After these decrees the unlawful unions of clerics were mere concubinage. These steps led to a general observance of the law so that in the 13th century concubinage was the rare exception among the clergy.

A new decline set in during the 14th and 15th centuries and various princes and churchmen proposed the adoption of the practice of the oriental church. The question was raised, without result, in the councils of Vienne (1311–12), Constance (1414–18) and Basel (1431–49). Some priests claimed special dispensations from the law of celibacy and even used forged papal documents to prove their claim.

In the 16th century Martin Luther and other Protestant leaders attacked clerical celibacy, and as Protestantism progressed, some Roman Catholics thought a relaxation of the law might help to restore unity in the church.

Modern Roman Discipline.—The great reforming council of Trent, after long discussion, retained the earlier laws, including the Lateran decree that holy orders nullify an attempt to marry, and defined as an article of faith the church's power so to legislate.[2] The observance of the law was greatly forwarded by founding seminaries in which the candidates were trained in virtue while being instructed in preparation for ordination.

After Trent, at the request of Ferdinand I and Maximillian II, Pope Pius IV for a time considered permitting clerical marriage in Germany, but the question was shelved and the law of Trent remained the settled legislation of the church. It was incorporated into the 1918 *Codex Juris Canonici* in canons 132, 987 and 1072.

Dispensations have sometimes been granted to subdeacons and deacons who returned to lay status, but to priests very rarely and only in view of the common welfare. General dispensations were given in England to the clergy who had embraced Anglicanism and married, but who wished to return to Rome under Mary Tudor; and to the small section of the French clergy who had unfrocked themselves and married in fear of the Terror.

The church never absolutely prohibited the ordination of married men, but to protect the rights of their wives the practice arose of refusing ordination unless the wife freely vowed perpetual chastity. This was the law in the 14th century.[3] The 1918 code of canon law prohibited ordination of a married man without the very rarely granted dispensation of the Holy See.

There has been occasional laxity since the council of Trent, and in the early 19th century there was German agitation for a mitigation of the law, but in general the celibacy of the Roman Catholic clergy has won respect and influence in and outside their church.

The practice of celibacy was revived in the Church of England during the latter part of the 19th century by some monastic institutions which also made foundations in America.

BIBLIOGRAPHY.—Among the best treatments of celibacy are F. X. Funk, "Cölibat und Priesterehe," in his *Kirchengeschichtliche Abhandlungen und Untersuchungen,* 1897, vol. I, pp. 69-120; and E. Vacandard, "Célibat," in *Dictionnaire de Théologie Catholique,* 1923, vol. II, part 2, col. 2068–2088. A good historical and archaeological treatment of the first eight centuries is found in H. Leclercq, "Célibat," in *Dictionnaire d'Archéologie Chrétienne et de Liturgie,* 1925, vol. II, part 2, col. 2802–2831, where a complete bibliography also is found. A good English treatment with detailed discussion of celibacy in England is Herbert Thurston's "Celibacy of the Clergy," in *The Catholic Encyclopedia,* vol. III, pp. 481–488. The best known opponent of clerical celibacy is Henry C. Lea, *History of Sacerdotal Celibacy in the Christian Church,* 1907, but he has been charged with superficial and biased scholarship by Roman Catholic scholars and some others. Disaffection was expressed by Johann and Augustin Theiner in *Einführung der erzwungenen Ehelosigkeit,* 1828, which was prohibited by the Holy See and afterward repudiated by Augustin Theiner.

(H. R. W.)

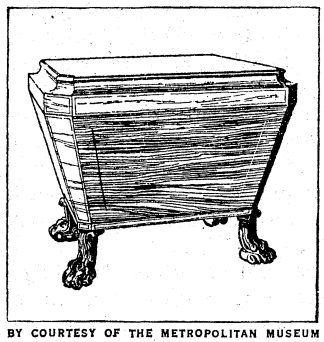
CELINA, an incorporated village in western Ohio, U.S.A., on Grand lake (or Lake St. Marys); the county seat of Mercer county. It is served by the Cincinnati Northern and the Nickel Plate railways. Pop. in 1940, 4,841 by the federal census. Celina is a summer resort, the commercial centre of a farming region and an important furniture-manufacturing town. Stearic acid and metal products are also manufactured. The village was settled in 1834 and incorporated in 1885. Grand lake is an artificial lake, 9 mi. long by 3 mi. wide, built to feed the old Miami and Erie canal.

CELL, originally a small detached room in a building (Lat. *cella,* a small room), particularly a small monastic house (*see* ABBEY). Also used for the small sleeping apartments of the monks, or the small dwelling of a hermit. This use still survives in the small separate chambers in a prison (*q.v.*). The word also denotes various small compartments which build up a compound structure, such as honeycomb, etc.

In electricity a cell may be defined as a system which produces electromotive force by chemical action; for voltaic, dry and concentration cells *see* BATTERY, and ELECTROLYSIS: *Voltaic Cells;* for secondary cell *see* ACCUMULATOR (STORAGE CELL); for gas cell *see* HYDROGEN-ION CONCENTRATION; for standard cell *see* INSTRUMENTS, ELECTRICAL.

In biology the term cell denotes microscopic structural elements which form the bulk of the tissues of animals and plants of visible dimensions. The precise meaning of the term cell in biological literature is set forth in the article CYTOLOGY (*q.v.*). When the term came into usage in biology, it referred to the smallest units of structure that the microscope could reveal in the animal or plant body. First used by Robert Hooke (1665) for the minute cavities of cork, a tissue which he described as made up of "little boxes or cells," it is a survival from the microscopic descriptions of plant structure made by 17th century botanists, and as such is really a misnomer, for tissues of animals rarely display the honeycomb-like appearance of pith, cork, etc., when examined microscopically. To-day the cell is recognized to be a complex, consisting of a number of well-defined structures (*nucleus, mitochondria,* etc.) so that it is no longer possible to define the cell as the ultimate structural unit of living matter. On the other hand, it is a physiological unit. It is the delimitation of this characteristic complex of microscopically visible units by a boundary which possesses the physical property of differential permeability to different kinds of molecules that characterizes the individual cell, which has thus come to be regarded as a unit of physiological activity of a certain order. The fact that the respective contributions of the maternal and paternal parents to the physical constitution of the offspring are derived in each case from a single cell of the parent-body has revolutionized the study of heredity; and has stimulated a considerable body of research which makes it possible to-day to envisage the structural basis of hereditary transmission and the determination of sex.

Thus the Cell Doctrine, *i.e.,* the recognition of the cell originally as the structural unit of the body and later as a unit of physiological activity, has exerted its influence on every department of biological thought since it was formulated by M. J. Schleiden and Theodor Schwann in 1839. (L. T. H.)



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A DUNCAN PHYFE CELLARET OF THE 19TH CENTURY, MOUNTED WITH CLAW FEET

CELLA, in architecture, the Latin name for the enclosed portion of a Roman temple, corresponding with the naos of the Greek temple, or any similar structure, whether of a temple or other building.

CELLARET (*i.e.,* little cellar), strictly that portion of a sideboard which is used for holding bottles and decanters. Sometimes it is a drawer, divided into compartments lined with zinc, and sometimes a cupboard, but still an integral part of the sideboard. In the latter part of the 18th century, when the sideboard was in process of evolution from a side-table with drawers into the large and important piece of furniture which it eventually be-

[1] *Conc. Lateranense* I, can. 21; *ibid.,* II, can. 7; *see Decretum Gratiani,* dist. XXVII, c. 8; *ibid., causa* XXVII, q. 1, c. 40.

[2] *Concilium Tridentinum,* sess. XXIV, can. 4 and 9; Mansi, *Concilia,* vol. 33, col. 150–151.

[3] See *Corpus iuris canonici, cap. unic., tit. 6, de voto et voti redemptione, in Extravag. Ioannis XXII.*

came, the cellaret was a detached receptacle. It was most commonly of mahogany or rosewood, many-sided or even octagonal, and occasionally oval, bound with broad bands of brass and lined with zinc partitions to hold the ice for cooling wine. Sometimes a tap was fixed in the lower part for drawing off the water from the melted ice. Cellarets were usually placed under the sideboard, and were, as a rule, handsome and well-proportioned; but as the artistic impulse which created the great 18th-century English school of furniture died away, their form grew debased, and under the influence of the British Empire fashion, which drew its inspiration from a bastard classicism, they assumed the shape of sarcophagi incongruously mounted with lions' heads and claw-feet. Hepplewhite called them *gardes du vin;* they are now nearly always known as "wine-coolers."

CELLE, a town of Germany, in the Prussian province of Hanover, on the left bank of the navigable Aller, near its junction with the Fuse and the Lachte, 23 m. N.E. of Hanover. Pop. (1933) 27,715. Founded in 1292, the town was the residence of the dukes of Lüneburg-Celle, a cadet branch of the ducal house of Brunswick, from the 14th century until 1705. The most interesting building is the former ducal palace, begun in 1485 in Late Gothic style, but with extensive Renaissance additions of the late 17th century. There are manufactures of biscuits, umbrellas, leather, sugar, dyes and paper, and trade is carried on in wax and timber. Celle is the seat of the court of appeal from the superior courts of Aurich, Detmold, Göttingen, Hanover, Hildesheim, Lüneburg, Osnabrück, Stade and Verden.

CELLIER, ALFRED (1844–1891), English composer of light operas of which one, "Dorothy," enjoyed prodigious popularity, running from Sept. 25, 1886, till April 1889. "The Mountebanks," to a libretto by W. S. Gilbert, was also very successful.

CELLINI, BENVENUTO (1500–1571), Italian artist, metal worker and sculptor, born in Florence on Nov. 1, 1500. His father was a musician and artificer of musical instruments, who married Maria Lisabetta Granacci, and 18 years elapsed before they had any children. Benvenuto (meaning "welcome") was the third child. The father destined him for his own profession and tried to thwart his inclination for design and metal work. At 15, however, he was apprenticed to a goldsmith, Antonio di Sandro, named Marcone. He had already attracted some notice in Florence when, being implicated in a brawl, he was banished to Siena where he worked for Francesco Castoro, a goldsmith. He visited Bologna and Pisa, and returned to Florence before he went to Rome in 1519. To this period belong a silver casket, some silver candlesticks, a vase for the bishop of Salamanca, and the gold medallion of "Leda and the Swan"—the head and torso of Leda cut in hard stone—executed for Gonfaloniere Gabbrello Cesarino, which is now in the Vienna museum. In the attack upon Rome (1527) by the constable de Bourbon, the bravery of Cellini proved of signal service to Pope Clement VII.; if we may believe his own accounts, his was the hand which shot the Bourbon dead, and he afterwards killed Philibert, prince of Orange. His exploits paved the way for a reconciliation with the Florentine magistrates and his return to Florence. Here he worked on medals, the most famous of which are "Hercules and the Nemean Lion," in gold repoussé work, and "Atlas supporting the Sphere," in chased gold. From Florence he went to the court of the duke of Mantua, and thence again to Rome, where he was employed in the working of jewellery and the execution of dies for private medals and for the papal mint. Here, in 1529, he avenged a brother's death by slaying the slayer; soon afterwards he had to flee to Naples to shelter himself from the consequences of an affray with a notary, Ser Benedetto, whom he wounded, but on the accession of Paul III. he was reinstated. The plots of Pierluigi Farnese, a natural son of Paul III., led to his retreat from Rome to Florence and Venice, and once more he was restored with greater honour than before.

On returning from a visit to the court of Francis I., being now aged 37, he was imprisoned for some time on a charge (apparently false) of having embezzled during the war the gems of the pontifical tiara. At last, however, he was released at the intercession of Pierluigi's wife, and more especially of the Cardinal d'Este of Ferrara. For a while after this he worked at the court of Francis I. at Fontainebleau and in Paris. But the enmity of the duchesse d'Etampes and the intrigues of the king's favourites led him, after about five years of laborious and sumptuous work, to retire in 1545 in disgust to Florence. During the war with Siena, Cellini was appointed to strengthen the defences of his native city. He died in Florence on Feb. 14, 1571, unmarried, and was buried in the church of the Annunziata.

Besides the works in gold and silver which have been mentioned, Cellini executed several pieces of sculpture. The most distinguished is the bronze group of "Perseus holding the head of Medusa," now in the Loggia dei Lanzi at Florence, one of the most typical monuments of the Italian Renaissance.

Not less characteristic of its splendidly gifted and barbarically untameable author are his autobiographical memoirs begun in Florence in 1558—a production of the utmost energy, directness, and racy animation, setting forth one of the most singular careers in all the annals of fine art. His amours and hatreds, his passions and delights, his love of the sumptuous and the exquisite in art, his self-applause and self-assertion, make this one of the most singular and fascinating books in existence. The original manuscript is at the Laurenziana in Florence. Cellini also wrote treatises on the goldsmith's art, on sculpture, and on design (translated by C. R. Ashbee, 1899).

Among his works of art, many of which have perished, were a colossal Mars for a fountain at Fontainebleau and the bronzes of the doorway, coins for the papal and Florentine states, a Jupiter in silver of life size, and a bronze bust of Bindo Altoviti. His other works in existence to-day are the celebrated salt-cellar made for Francis I. at Vienna; a medallion of Clement VII. in commemoration of the peace between the Christian princes, 1530, signed with the artist's name; a medal of Francis I. with his portrait, also signed; and a medal of Cardinal Pietro Bembo. Cellini, while employed at the papal mint at Rome during the papacy of Clement VII. and later of Paul III., executed the dies of several coins and medals, some of which still survive. He also executed in 1535 for Alessandro de' Medici, first duke of Florence, a 40-soldi piece, with a bust of the duke on one side and standing figures of the saints Cosmo and Damian on the other.

The important works which have perished include the uncompleted chalice intended for Clement VII.; a gold cover for a prayer-book as a gift from Pope Paul III. to Charles V.; large silver statues of Jupiter, Vulcan, and Mars, wrought for Francis I. during his sojourn in Paris; a bust of Julius Caesar; and a silver cup for the cardinal of Ferrara. The magnificent gold "button," or morse, made by Cellini for the cope of Clement VII., appears to have been sacrificed by Pius VI., in furnishing the indemnity of 30,000,000 francs demanded by Napoleon in 1797. Fortunately there are in the print room of the British Museum three water-colour drawings of this splendid morse done by F. Bertoli in the first half of the 18th century.

BIBLIOGRAPHY.—Cellini's autobiography was published by O. Bacci (1900). English translations by J. A. Symonds, Thomas Roscoe, A. Macdonnell and R. H. Cust. Bolzenthal, *Skizzen zur Kunstgeschichte der modernen Medaillen-Arbeit 1429–1840* (1840); J. Friedländer, *Die italienischen Schaumunzen des 15en Jahrhunderts* (1880–82); A. Armand, *Les médailleurs italiens des 15e et 16e siècles* (1883–87); Eugène Plon, *Cellini, orfèvre, médailleur, etc.* (1883); A. Heiss, *Les médailleurs florentins* (1887); E. Babelon, *La gravure en pierres fines* (1894); N. Rondot, *Les médailleurs lyonnais* (Mâcon, 1897); L. Dimier, *Cellini à la cour de France* (1898); Dr. Julius Cahn, *Medaillen und Plaketten der Sammlung W. P. Metzler* (Frankfort-on-Main, 1898); Molinier, *Les Plaquettes;* I. B. Supino, *Il Medagliere Mediceo nel R. Museo Nazionale di Firenze* (Florence, 1899); T. Longueville, *Cellini, His Times and Contemporaries* (1899); *L'Arte di Benvenuto Cellini* (Florence, 1901); C. von Fabriczy, *Medaillen der italienischen Renaissance* (Leipzig); L. Forrer, *Biographical Dictionary of Medallists, etc.* (1904).

CELLULOID. This artificial substance, known also as artificial ivory and xylonite, is a compressed, solid solution of nitrated cellulose in camphor or a camphor substitute. It is colourless or slightly yellow, transparent in thin sheets, and capable of being stained with the most delicate colours, which permeate its entire mass. Celluloid is of uniform composition and its specific gravity is about 1·35; it is insoluble in water or dilute acid, usually emits a faint smell of camphor and is inflammable.

Celluloid becomes plastic when immersed in water at or near

boiling-point and can then be moulded into any desired form. At ordinary temperatures it can be cut, turned, sawn, drilled and otherwise worked to form numerous useful and ornamental articles. Having a tensile strength of 10,000–12,000 lb. per sq. in., it is one of the strongest of artificial materials. Celluloid is elastic, and can be produced in very thin sheets and films; celluloid films 0·0000039($\frac{1}{256,000}$) in. thick were made in 1924 by the U.S. Bureau of Standards, for use in X-ray researches.

The solubility of nitrated cellulose in camphor is the important property on which the success of making ordinary celluloid depends. Tissue paper, cotton, wood or other cellulose material is nitrated by means of a mixture of strong nitric and sulphuric acids. The product, which is of the nature of, but less highly nitrated than, gun-cotton, is bleached, washed and dried; it is then incorporated in a mixing-machine, with natural or synthetic camphor and volatile solvents. At this stage softeners, *e.g.*, oils, colouring matter and filling material, selected according to the kind of celluloid required, may be added. The gelatinous mass obtained is transferred to heated adjustable rollers by which it is kneaded and rolled into sheets of any desired thickness. After removal from the rollers, the sheets are pressed and dried or seasoned to eliminate the volatile solvents.

Numerous modifications of the process thus briefly described have been proposed, some having for their objects the production of so-called "non-inflammable celluloid" and the use of a substitute for camphor, the price of which is usually high.

Making Celluloid Safe.—The attempts to make a celluloid which is less inflammable than ordinary celluloid have been to some extent successful. To achieve this result, a chloride has been added to the celluloid-making materials, or a bromate or other substance capable of liberating flame-extinguishing gases, or the celluloid mass has been very highly compressed. Acetyl cellulose or cellulose ethers have also been used instead of the nitrated cellulose; this use, however, leads to a consideration of processes, outside the scope of this article, in which acetyl cellulose, cellulose ethers, and synthetic resins and not nitrated cellulose are used.

There have been very many attempts, mostly unsuccessful, to obtain a suitable camphor substitute. The most commonly used substitutes for camphor are the cresyl phosphates dibutylphthalate; these also render the celluloid less inflammable. Recently celluloid manufacture has been very much modified. Celluloid is precipitated, in the form of powder, by gradually adding water to its solutions. After separation, the powder is dried, filled into moulds and heated until plastic under pressure. Such processes have the advantage of considerably shortening the seasoning step and facilitating addition of colouring matter.

The term celluloid was first applied by Messrs. J. W. and I. S. Hyatt, who began the manufacture of the material in the United States in 1869. Their work was based on that of A. Parkes and D. Spill, who, in 1855 and 1868 respectively, succeeded in England in making similar plastic materials. The advance of J. W. and I. S. Hyatt was due to their investigations into the action of camphor upon cellulose and to their improved mechanical methods. The industry has become established in the United States, Great Britain, France, Germany, Austria, Switzerland and Japan.

Not only ivory but also horn, tortoise-shell, amber, agate, ebony and many other natural substances may be imitated by means of celluloid, and it is used in making numerous useful and ornamental articles. These include cutlery handles, billiard balls, collars, automobile windows, piano keys, buttons, combs, brush and mirror backs, fancy boxes, dolls, hollow balls and other toys, dental plates, accumulator cases, telephone mouthpieces, transparent screens and parts of drawing and optical instruments. During the War the demand for celluloid articles such as accumulator cases and transparent screens, was great.

In obtaining irregular colour effects in celluloid, *e.g.*, for producing imitation tortoise-shell, colouring matters are dropped very carefully and in small quantities upon a sheet of celluloid before seasoning, as the sheet passes between rollers; the colouring matter sinks into the sheet.

See F. Boeckmann, *Celluloid* (1921); H. H. Hodgson, *Celluloid* (1925). (T. E. L.)

CELLULOSE. The main ingredient of the membranous cell walls of plants, which in the more advanced stages of development assume elongated shapes and become tubular and fibrous. In the plant structure cellulose is always accompanied by other substances in intimate association, as incrustants, from which it can be freed by various methods. Cellulose of high purity is easily prepared from cotton, the seed hair of *gossypium*, by prolonged boiling of the raw material with 1% solution of sodium hydroxide, subsequent treatment with dilute acetic acid and repeated washing with distilled water: its analysis will then be about 99·8% of cellulose and 0·05% of ash. Cellulose obtained in this sort of way is regarded as standard cellulose. Chemical filter paper is practically pure cellulose, especially when it has received an exhaustive treatment with hydrochloric and hydrofluoric acids for removal of ash, which is partly siliceous. Standard cotton cellulose is white, fibrous and of characteristic form and appearance: other pure fibrous celluloses, *e.g.*, bleached flax, hemp, ramie, wood-cellulose, are equally characterized in form and appearance. Commonly it absorbs 6–8% of moisture in contact with the air, which is given off again by drying at 100–105°C.: it appears that it gives up water more slowly than it absorbs it. When dry, cellulose is a good electrical insulator with specific inductive capacity about 7. The specific gravity of cellulose is about 1·58 and depends on its source and on its state or condition (woods, containing 40–80% of air, have an apparent specific gravity about 0·3–1·3). W. N. Hartley (1893) and S. Judd Lewis (1918–24) have shown that cellulose is strongly fluorescent to much of the ultra-violet spectrum; it appears that constituent groups within the cellulose molecule affect the fluorescent properties, as indicated by distortion of the characteristic frequency curve, so that it may be possible, eventually, to use this method in the determination of questions of constitution.

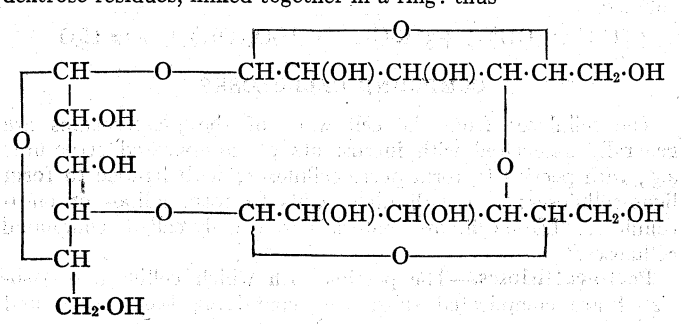
The properties of cellulose depend to a considerable extent on its state or condition. Thus, whereas cotton cellulose will absorb about 7% of moisture from the air, regenerated cellulose, such as artificial silk, will absorb similarly about 10% and so on; the general experience being that almost any sort of pre-treatment tends to make some portion at least of the cellulose more reactive, and this effect is not reversible.

Comparison of Celluloses.—From cellulosic raw materials, celluloses can be separated by a variety of methods, some of which are of great industrial importance. The celluloses thus separated have properties that are not identical with those of standard cotton cellulose. The cotton cellulose is, for example, relatively more resistant to the action of acids (hydrolysis) and alkalis than are other celluloses. The less resistant portions of the celluloses are termed hemicelluloses. Whether or not the more resistant, less soluble residual portions of these celluloses are identical with the resistant cellulose of cotton is a difficult question, not yet finally answered, on which recent methods of investigation by X-ray analysis have given valuable information. Something of the nature of the difficulties underlying this kind of enquiry will be appreciated from the following considerations. Classical chemistry has achieved its successes largely by analytic and synthetic methods of re-arranging atoms and molecules in fluid media (gases, liquids, solutions). The systematic principles guiding these methods have had to be derived, until comparatively recently, almost entirely from the study of fluid systems; and thus it happened that very little was known about the fundamental internal arrangements and groupings of atoms and molecules, inside solids. But the study of the colloidal state has shown that the properties of substances and the qualities of materials are related not merely to fundamental arrangements and groupings of their atoms and molecules but also, in turn, to the higher aggregation of these fundamental units into particles, micelles, crystallites or whatever they may be called. X-ray analysis has shown, further, that a substance like sodium chloride, consisting of separate NaCl molecules in solution, is when *in situ* in the crystal, an aggregate of linked, alternate Na and Cl atoms arranged in lines and planes, in orderly sequence: so that the whole crystal is really a single, ordered aggregate of atoms and its properties and qualities are related to that state or condition of aggregation.

The chemistry of cellulose has been derived, of necessity, very largely from the study of its reactions to reagents which, of course, affect the state or condition of aggregation and it is probable that it has never been possible to reverse chemical treatment to the full extent of restoring the cellulose to the state or condition of aggregation in which the plant formed it originally, and upon which its qualities and properties as cellulose material depend. When, therefore, celluloses derived from different sources by different methods behave differently, *e.g.*, towards acids or alkalis as already recorded, it may be either that they are not one and the same sort of cellulose or that if they are the same then their state of aggregation may be not the same. X-ray analysis has given some information on this problem though much remains to be done before its conclusions can be accepted with finality. The method depends upon the diffraction of X-rays by the planes of the atoms. By ingenious arrangements the diffracted rays are registered photographically on a film as a series of parallel lines of varying intensity and characteristic pattern. The method shows that the cellulose aggregates consist of crystallites: their arrangement in crystalline form is the same for cotton, ramie and wood. The artificial silks, excepting cellulose acetate, which is amorphous—show the same sort of crystallite units. But there are differences, however, which appear to arise in respect of the arrangement of crystallites about the fibre axis: irregular arrangements produce photographic ring diagrams and regular arrangements produce point diagrams. Artificial silks (excepting acetate silk) have an intermediate arrangement: cotton treated with strong solution of sodium hydroxide (mercerized cotton) and washed without tension gives a ring diagram, but if it is washed under tension, a point diagram is obtained. Thus there is some direct evidence that the crystallites are probably identical in all these different materials and that differences of property may be related to differences of crystallite arrangement, more particularly with respect to fibre axis.

Empirical Composition.—The elementary composition of cellulose indicates that it is a carbohydrate containing carbon 44·4%, hydrogen 6·2%, oxygen 49·4% whence the empirical formula $C_6H_{10}O_5$ is derived which is identical with that of starch: it is thus non-nitrogenous, though originating in the cell protoplasm. The cellulose from the cell walls of the lower cryptogams, when purified, does, however, retain 2–4% of nitrogen and, when hydrolysed, it gives glucosamine in addition to monoses and acetic acid. The cellulose of phanerogams is generally associated in the plant with other complicated substances with which it forms the so-called "compound celluloses."

Chemical Constitution.—Cellulose is a complex polysaccharose or polyose of monosaccharoses or monoses: it may, in fact, be regarded as derived from monoses by the elimination of x molecules of water from x molecules of monose to form one molecule of polyose: thus $_xC_6H_{12}O_6 - xH_2O \rightarrow (C_6H_{10}O_5)_x$. This reaction is evidently of fundamental importance in plant physiology. Conversely, cellulose is hydrolysed by acids to give dextrose: G. W. Monier Williams (J. Chem. Soc. 119 [1921], 803–805) obtained 90·67% of the theoretical amount of crystalline dextrose. J. C. Irvine and E. L. Hirst (J. Chem. Soc. 123 [1923], 518–532) showed also that cotton when methylated and hydrolysed gives a quantitative yield of 2:3:6-trimethyl dextrose: they have consolidated these facts, taken together, into a formula which expresses the constitution of cellulose in terms of three dextrose residues, linked together in a ring: thus



Various other formulae have been also suggested from time to time and it is still possible that no single formula will adequately represent the constitution of cellulose; but the evidence thus available appears to indicate that in the equation given above $x=3$.

Cellulose and Water: Hydrated Cellulose.—The interactions of cellulose and water involve questions of great interest and these questions are still open. So-called "hydrated cellulose," in which water is intimately associated with cellulose, may be produced in a number of ways; *e.g.*, (*a*) by mechanical comminution and pressure of cellulose with water, and this is essentially the method used industrially in the papermaker's "beater"; (*b*) by the action of strong solutions of certain salts such as zinc chloride, calcium sulphocyanide, cuprammonium solution (Schweizer's reagent), etc., and this is essentially the method used for making vulcanized fibre, cuprammonium silk and willesden goods; (*c*) by the action of strong solutions of alkalies, and this is essentially the mercerizing process used in the cotton textile industries and also the first step in the making of viscose; (*d*) by strong solutions of acids, and this is essentially the acid process of parchmentizing paper; (*e*) by regenerating cellulose from its esters, and this is essentially the process of making artificial silks—excepting acetate silk. Hydrated cellulose is cellulose associated with more or less water (even up to 90% water to 10% cellulose) to form a more or less swollen or gelatinous mass. The swelling of solids by imbibition of liquids and their dispersion in the liquids is quite a well known and common phenomenon: thus gelatine and starch will swell and, on warming, disperse in water: gelatine swells greatly, starch hardly at all, both disperse readily. On the other hand, cellulose neither swells nor disperses in pure water though it "hydrates" when it is subjected to continuous mechanical comminution and pressure, as it is in the "beater"; but in the various other circumstances detailed above it does show effects very similar to ordinary swelling and dispersion. The questions then arise, What is this "hydration" and is it analogous to swelling (imbibition) and dispersion as known in other substances such as those named? J. R. Katz (Physik. Zeit [1924] 25, 321) has examined the phenomena concerned by X-ray analysis and the diagrams he obtained, being in general the same for hydrated cellulose as for cellulose itself, appear to indicate that the water taken up is inter-crystallite rather than intra-molecular; the process would then be imbibition. It was also found, however, that when strong sodium hydrate solution is the hydrating agent a different X-ray diagram is obtained for the hydrated, alkali-cellulose produced and when the sodium hydrate is removed, by washing, the diagram for cellulose is obtained anew: this appears to indicate that the action in this instance is rather different, and reversible. The balance of evidence favours the interpretation that the hydration of cellulose is, for the present, to be regarded as a physical association of water with the crystallites of cellulose and not as an entry of water into the molecules. In cellulose hydrate, therefore, the water is not to be considered as held like the water in salt hydrates, called water of crystallization, though the nomenclature is the same. A definite salt hydrate such as Barium Chlorate, $BaClO_3$, $1H_2O$, when dehydrated at constant temperature, will give up all its water at a definite and constant pressure equal to its vapour pressure at that temperature. Hydrated cellulose, on the other hand, when dehydrated, gives up its water at pressures falling gradually and continuously and without sign of constancy at any stage: this is characteristic of all systems in which water is held physically, *i.e.*, under inter-molecular rather than intra-molecular forces. At the same time it is also true that a certain relatively small proportion of the water might also be present bound within the molecules without its presence being discoverable in the presence of so large an excess of the physically held water, which would probably mask its presence. It cannot be said with absolute certainty, therefore, that the possibility of a definite hydrate of cellulose is altogether excluded. The hydration of cellulose is a factor of great importance in the economy of the plant, in determining the conditions of equilibrium between the water content of the cell wall and the sap. It is also no doubt a factor of great importance in the seasoning of timber.

Cellulose and Alkalis.—Though cotton cellulose is remarkably resistant to dilute alkalis, with a 15–20% solution of, *e.g.*, sodium hydroxide its ribbon-like fibre, with reticulated walls, swells out into a smooth walled cylinder. This was first noticed in 1844–1850 by John Mercer and in 1889 H. A. Lowe discovered that simultaneous stretching, to resist the contraction consequent on the swelling, imparted characteristic lustre to mercerized cotton. The quantity of sodium hydroxide thus taken up by the cellulose corresponds to some such proportions as $(C_6H_{10}O_5)_2NaOH$; but whether or not it is in chemical combination or in some physical association with the cellulose is not finally decided though more recent investigators appear to think the available evidence is more in accord with chemical combination than with physical association, and the work of J. R. Katz, referred to above, tends toward that conclusion. Oxides such as those of lead, manganese, barium, iron, aluminium and chromium are also taken up by cellulose in some sort of association, the cellulose scarcely changing in appearance (excepting colour), and industrial application is made of the fact in the dyeing and printing of fabrics. These effects are mainly colloidal, adsorption effects.

Cellulose and Acids.—Acids act upon cellulose according to their nature and their concentrations. Dilute acids or acids dried on to the fibre produce chiefly hydrocellulose, which is an indefinite product, perhaps consisting of small quantities of bodies of the nature of dextrines associated with unchanged cellulose. Stronger acids at first hydrate or parchmentize and finally hydrolyse cellulose to form dextrines and simple sugars. Under controlled conditions strong acids will react with cellulose to form esters. Hydrocellulose produced by the action of dilute acids or as recovered by, *e.g.*, the saponification of cellulose acetate, is soluble in alkali solutions, it reduces Fehling's solution, it forms esters more easily than does cellulose to give brittle substances of no industrial value and it has a greater affinity for dyes, such as methylene blue, than cellulose has. The constitution of hydrocellulose has been the subject of much investigation and much speculation with the only result that it has not been possible to distinguish its elementary composition from that of cellulose itself.

Cellulose and Oxidants.—Oxidizing agents such as nitric acid (60%), chloric acid, chromic acid, permanganates, hypochlorites, hydrogen peroxide and even air itself in presence of moisture and certain salts (the rotting of moist cotton cloth or rope in contact with iron is well known) or under the influence of strong sunlight, as in the tropics especially, change cellulose into oxycellulose with ultimate disintegration of the fibre and the formation of such substances, of low molecular weight, as carbonic and oxalic acids. Oxycelluloses contain free aldehydic groups, are easily attacked by hydrolysing agents and are decomposed by boiling with dilute hydrochloric acid to give relatively large yields of furfural. Oxycelluloses reduce Fehling's solution, have affinities for dyes and in general are difficult to distinguish from hydrocelluloses: esters also can be formed. The disintegration of cotton fabrics and of overbleached paper is usually referable to the formation of oxycelluloses.

Cellulose Esters.—Cellulose forms compounds called esters by reactions in which it behaves as a tri-hydric alcohol $C_6H_7O_2(OH)_3x$. With, *e.g.*, nitric acid, the hydrogen of the acid and the hydroxyl of the cellulose are eliminated as water and NO_3 groups replace one, two or three of the OH groups to form the mono-, di- or tri-nitrates. To get the higher nitrates it is not sufficient to use nitric acid alone but strong sulphuric acid must be used with the nitric acid. After the reaction the cotton, which is usually used because of its freedom from hemicelluloses, has hardly changed its appearance, but it will be soluble in alcohol-ether if the di-nitrate and insoluble if the tri-nitrate: commonly, various mixtures of the nitrates will arise with varying conditions of nitration and much research work has been done in adjusting these conditions to specific purposes, particularly for the explosives industries. The di-nitrate, soluble in alcohol-ether, is familiar by the name of collodion and it is the basis of Chardonnet, collodion or nitro artificial silk and also the celluloid, film, lacquer and plastic mass industries. The tri-nitrate is insoluble in ether-alcohol but soluble in nitro-glycerine and in other solvents: it is, of course, of very great importance as an explosive. Cellulose reacts also with acetic anhydride to form mixtures (probably) of the acetate esters and, in presence of sulphuric acid or some other suitable substance acting as catalyst, the tri-acetate may be obtained, which is insoluble in acetone but soluble in chloroform: this acetate on hydrolysis yields 62·5% of acetic acid. If, however, this acetylation is carried out in the cold and, after completion of the acetylation, the product then heated, a change occurs which is probably a change of aggregation accompanied by partial hydrolysis and the tri-acetate, insoluble in acetone, passes into a form soluble in acetone and of good spinning quality. On hydrolysis, it yields about 55–58% of acetic acid.

Viscose.—The sodium xanthogenate ester, or viscose, is the basis of the viscose artificial silk industry which provides about 88% (1927) of the world's output of artificial silk. The reaction was patented by Cross and Bevan in 1892. High grade, bisulphite, wood-pulp is most usually, and cotton linters sometimes, used in making viscose industrially. It is treated with mercerizing (17%) sodium hydroxide solution for two hours, the surplus solution is then squeezed out and the resultant alkali-cellulose is torn into crumbs which are matured for 24 hours or more in a closed vessel: at this stage 60cc. of carbon bisulphide per 100 grams of air-dry cellulose used, are added and the crumbs then gradually swell and become deep-orange coloured and gelatinous. After the further addition of an appropriate quantity of water and sodium hydroxide solutions, and waiting a day or two, the fluidity will have increased so that the viscose may be spun: after some days the viscose begins to become more and more viscous until, finally, cellulose (reverted, hydrated cellulose) separates out as a congealed mass which can be dried to a very hard and dense material called "Viscoid." In the artificial silk industry the spun viscose filaments are immediately reverted to cellulose by immersion in a "setting" solution of sodium sulphate and sulphuric acid or other appropriate substances. The reactions of this remarkable process are not yet well understood. The quantity of sodium hydroxide required in the mercerizing stage is in the proportion of 2-C_6 cellulose units to 1-NaOH: the reactions thereafter, with carbon bisulphide and the reversion to cellulose (hydrated), may be represented as follows:

$$[2(C_6H_{10}O_5)_x]\cdot x\text{NaOH}+xCS_2\longrightarrow[(C_6H_{10}O_5)_2C\cdot S\cdot SNa)_x$$
$$\longrightarrow 2(C_6H_{10}O_5)_x+x\text{NaOH}+xCS_2$$

It is noteworthy that it has been possible to prepare only the mono-sodium xanthogenate ester. Cellulose esters of formic acid and also esters of the higher fatty acids, such as stearic acid, have been prepared: the latter are of interest as being probable constituents of cork and other cuticular "compound celluloses." Benzoyl and other aromatic esters have been also prepared.

Cellulose Ethers.—A true ether results when cellulose, acting as a tri-hydric alcohol, is condensed with the residue of another alcohol (R·OH) in presence of a suitable condensing agent; with elimination of water. One, two or three R·OH residues may react and R may be any of the legion of groups that confer alcoholic properties on the OH group. Thus the number of possible ethers of cellulose that can be prepared is also legion and a very large number have actually been prepared and described. Many of them are known to have valuable intrinsic qualities and only the relatively high cost of preparing them prevents their industrial utilization in competition with the esters (nitrate, acetate and xanthogenate). The reaction of formation may be represented as follows:

$$[C_6H_7O_2(OH)_3]_x+3x\text{R}\cdot\text{OH}\rightarrow[C_6H_7O_2(OR)_3]_x+3x\ H_2O.$$

COMPOUND CELLULOSES

The celluloses from the cell walls of the phanerogams are generally associated with incrustants of complicated structure: *e.g.*, with pectins to form pecto-celluloses; with lignone to form ligno-celluloses; and with fatty acids to form adipo- or cuto-celluloses. These cellulosic materials are usually called "compound celluloses."

Pecto-celluloses.—The pectins with which cellulose is associated are complicated substances containing less carbon and

more oxygen than cellulose itself and their properties resemble those of the oxy-celluloses. The typical pecto-cellulose is flax fibre (*linum usitatissimum*).

Ligno-celluloses.—The typical ligno-cellulose of simplest type is jute fibre (*corchorus*). Ligno-celluloses constitute the main substance of the wood of trees. A great deal of work has been done in investigating the constitution of lignone after its separation from cellulose: its constitution *in situ* must be, of course, different. In the product obtained by the action of sulphurous acid on spruce wood various reactions indicate the presence of such groupings as

$$C_{21}H_{15}O_2(SO_3H)(OH)_2(CH_2OH)(CHOH)(CHO)(OCH_3)_2$$

The $C_{21}H_{15}O_2$-residue is probably a complex of multiple ring nuclei of benzene type. Chlorine reacts with the lignone of jute to form chlorides of constant composition $C_{19}H_{18}Cl_2O_9$ and $C_{19}H_{18}Cl_4O_9$ the latter of which reacts with sodium sulphite solution to form a soluble substance of characteristic magenta-red colour. Cellulose is thus isolated; and this is the standard method commonly employed for the evaluation of cellulose content in raw materials and known as "cellulose by chlorination." Industrially, the removal of lignone is of immense importance in the manufacture of pulp from wood, for the paper industries: the three important processes being the so-called "bisulphite," "soda" and "sodium sulphate" processes.

Adipo- or Cuto-celluloses.—These compound celluloses are resolved by alkali-saponification into cellulose and a mixture of fatty acids of peculiar and little known constitution; among which, however, such acids as stearic acid may be ingredients. They occur chiefly, but by no means solely, in corticular and cuticular tissues, leaves and stems.

Decomposition Products of Celluloses.—The formation of coal and the distillation of wood are special decompositions, dealt with in the articles COAL AND COAL MINING and DISTILLATION. The hydrolysis of cellulose by acids has been mentioned above. Oxalic acid is prepared industrially by fusing sawdust with a mixture of sodium and potassium hydroxides in flat, iron pans and, from the mixed salts of oxalic acid thus obtained, the free acid is prepared by subsequent treatment. The bacterial decomposition of cellulose, known for a long time in connection with the digestive processes of the Herbivora, in the decompositions of sewage and marshland and in the processes of soil humus, have latterly attracted new interest, with the object of bringing them under productive control. Methane producers, hydrogen producers, denitrifiers and thermophilic species of organisms are known among the bacteria that attack cellulose; and in some instances attempts have been made to make industrial applications of their action. It is said that cellulose is not essentially more resistant to bacterial attack than are starches and sugars and the products obtained from its decomposition are closely related to conditions: thus, with limited aeration acetic acid is the main product, whereas, increased aeration favours the production of ethyl alcohol. Deterioration of quality in badly stored cellulose materials, the decay of wood and the formation of coal are no doubt related to these general phenomena. An aerobic organism isolated from Rothamsted soil decomposes cellulose rapidly with formation of a yellow pigment, fatty acids and a mucilage resembling pectin, at an optimum temperature of 30°C.: other carbohydrates do not support growth. These facts have been applied to the preparation of synthetic farmyard manure, and other artificial fertilizers, from garden refuse.

Cellulose in the Arts and Industries.—This is the age of cellulose as much as it is the age of iron and steel: *e.g.*, cotton is now the basis of the largest item of international trade. The cellulose material of British industries is mostly exotic: practically, a small proportion of the wood for structural work is home grown and a considerable proportion of the flax of the linen industry: within the Empire a very large proportion of the world's jute crop is produced, about 12% of the cotton used in British mills and much wood and pulp. The applications of cellulose and cellulose materials to the necessities, amenities, and luxuries of modern life may be classified as follows:

A. CELLULOSE AND COMPOUND CELLULOSE MATERIALS:

(*a*) *Foodstuffs:* The foodstuffs of animals, and therefore of man, are produced ultimately by plants; but the average plant turns most of its sugars not into starch which is digestible but into cellulose which is not; hoofed animals, however, harbour in their digestive tracts bacteria that attack cellulose, on the decomposition products of which the animals live; and hence it is through their flesh that cellulose becomes ultimately a source of food for man.

(*b*) *Textiles:*

Fine:—Cotton, flax (hemp, ramie) for clothing, dress and other decorative materials.

Coarse:—Lower grades of the above and also especially jute for wrappings, balings, mattings and coverings of all kinds.

Manila, sisal, phormium for cordage, ropes and twines.

Miscellaneous:—Cereal straws, wood materials (canes), raffia, for hat-making, basket work. Coir, bast, kapok, for mat-making, stuffing, packing and upholstery.

(*c*) *Paper Making:*—Many of the above materials, usually the wastes of other arts and industries, are used up for the manufacture of paper, straw boards, papier maché.

Pulps from wood and grasses (*e.g.*, esparto).

(*d*) *Constructional:*—Timber structures, carpentry, joinery, cabinet-making (woods).

(*e*) *Linoleum and Cork Industries.*

B. CELLULOSE DERIVATIVES:—Either the esters or reverted cellulose.

(*a*) *Explosives:*—Tri-nitro cellulose.

(*b*) *Artificial silks:*—Chardonnet, collodion or nitro-artificial silk; cuprammonium silk; viscose silk; acetate silk.

(*c*) *Films, tissues:*—Celluloid, inflammable film made from nitro-cellulose; acetate, non-inflammable film made from cellulose acetate; Cellophane, wrapping tissue made from viscose; bottle-caps (hermetic closure) from viscose. Safety glass, a three-ply material made by cementing nitro or acetate film between two sheets of glass.

(*d*) *Lacquers:*—Nitro-cellulose dissolved in special solvents with special softeners, pigmented and applied by brush, or patent sprayer, for motorcar bodies and other high-class work out-of-doors; cellulose acetate, used similarly, especially as "dope" for aeroplane wings, to which it gives a shrunk finish and is also non-inflammable.

(*e*) *Plastic masses for moulded articles:*—Nitro-cellulose often mixed with camphor, pigments and other substances in great variety—celluloid. Also cellulose acetate as lonarite.

(*f*) *Waterproofing and sizing of fabrics:*—Willesden goods by the cuprammonium process, of military, webbing-equipment by the viscose process; artists' canvases and other fabrics, by viscose. Vulcanized fibre, from paper hydrated by zinc chloride or other solution.

C. DECOMPOSITION PRODUCTS OF CELLULOSE AND COMPOUND CELLULOSE.

(*a*) *Coal.*

(*b*) *Wood distillation products:*—Oxalic acid.

(*c*) *Bacterial decompositions:*—Power gas, industrial alcohol, organic acids, synthetic farmyard manure.

See PLANTS AND PLANT SCIENCE: PHYSIOLOGY; ANATOMY; CYTOLOGY.

BIBLIOGRAPHY:—C. F. Cross and E. J. Bevan, *Cellulose and Researches on Cellulose* (1895–1910): pioneer work in the chemistry of cellulose; A. W. Schorger, *Chemistry of Cellulose and Wood* (1926) full account of chemistry of cellulose; A. J. Hall, *Cotton Cellulose* (1927): full account of cotton cellulose; W. Fuchs, *Die Chemie des Lignins* (1926): authoritative monograph on lignone and lignification; A. C. Thaysen and H. J. Bunker, *The Microbiology of Cellulose* (1927): monograph on action of organisms on cellulose.

(C. J. J. F.)

CELSIUS, ANDERS (1701–1744), Swedish astronomer, was born, on Nov. 27, 1701, in Uppsala, where he was professor of astronomy (1730–44). At Nuremberg he published in 1733 a collection of 316 observations of the aurora borealis made by himself and others 1716–32. In Paris he advocated the measurement of an arc of the meridian in Lapland, and took part, in 1736, in the expedition organized for the purpose by the French Academy. Six years later he described the centigrade thermometer in a paper read before the Swedish Academy of Sciences (*see* THERMOMETRY). Celsius died at Uppsala on April 25, 1744. He wrote: *Nova Methodus distantiam solis a terra determinandi* (1730); *De observationibus pro figura telluris determinanda* (1738); besides many less important works. The centigrade thermometer is often called the Celsius thermometer, as other thermometers are named after Fahrenheit and Réaumur.

See W. Ostwald's *Klassiker der exacten Wissenschaften*, No. 57 (Leipzig, 1904), where Celsius's memoir on the thermometric scale is given in German with critical and biographical notes.

CELSIUS SCALE: *see* THERMOMETRY.

CELSUS (*c.* A.D. 178), an eclectic Platonist and opponent of Christianity known mainly through the reputation of his work, *The True Word* (or *Account;* ἀληθής λόγος), brought to light in 248 by Origen who in his *Against Celsus* quotes, paraphrases and reproduces about nine-tenths of it. On internal evidence the work seems to be of Alexandrian origin and to date between 176–180.

Its attack on Christianity is opened by a rehearsal of Jewish taunts levelled at the Christians. Jesus was the natural son of Mary and Joseph. He did not convince even His own countrymen. His companions as well as His poverty were inconsistent with divine dignity. The Incarnation is absurd, for God stands in no special relation to man as against animals. Christ's miracles, like His resurrection, were inventions of His disciples. The Christians lack unity among themselves and their teachers have no power over educated men. Their doctrine comes from Plato and the Stoics, especially their belief in the future life and the spirituality of God. Their resurrection of the body is a corruption of the doctrine of transmigration and ignores the fact that matter is evil. Celsus ends his work by inviting the Christians to join the religion of the majority, to become good citizens, to give thanks to the powers of nature and to abandon the idea of establishing the universal rule of their doctrines. His work, which shows the strength of the Church in his day, is conspicuous for its lack of bitterness against the Christians, its recognition of the abuses of paganism, and its knowledge of the Old Testament and the Synoptic Gospels and also of the gnostic writings. Echoes of it are found in Tertullian and Felix Minucius (*q.v.*), but it lay forgotten until Origen gave it new life.

Celsus was not a professed philosopher but a man of the world whose religion was the empire. His keen mind combined an intimate knowledge and appreciation of the various national religions and mythologies with many genuine moral convictions as well as a sceptical tendency. For him, philosophy alone could impart some notion of the Father of the universe, a notion which the elect soul must develop.

BIBLIOGRAPHY.—*The True Word* is contained in Origen's work *Against Celsus,* published in Migne: *Patrol. Graec. xi.* The text has been reconstructed, and trans. into Ger. by T. Keim *Celsus Wahres Wort* (1873). *See* J. Patrick *The Apology of Origen* (1892); L. Rougier *Celse* (Paris, 1925); F. S. Muth, *Der Kampf des heidnischen Philosophen Celsus gegen das Christentum* (Mainz, 1899); A. Harnack *Gesch. der altchristlichen Lit. I.;* and Herzog, *Realencyclopädie.*

CELT or **KELT,** the generic name of an ancient people, the bulk of whom inhabited the central and western parts of Europe. (For the sense of a primitive stone tool, *see* the separate article, CELT.) Much confusion has arisen from the inaccurate use of the terms "Celt" and "Celtic." It is the practice to speak of rather short and dark-complexioned Celtic-speaking people of France, Great Britain and Ireland as Celts, although the ancient writers seem to have applied the term "Celt" chiefly to folk of great stature and with fair hair and blue or grey eyes.

The ancient writers regarded as homogeneous all the fair-haired peoples dwelling north of the Alps, the Greeks terming them all *Keltoi.* Physically they fall into two loosely-divided groups, which shade off into each other. The first of these is restricted to north-western Europe, having its chief seat in Scandinavia. It is distinguished by a long head, a long face, a narrow aquiline nose, blue eyes, very light hair and great stature. Those are the peoples usually termed Nordic. The other group is marked by a round head, a broad face, a nose often rather broad and heavy, hazel-grey eyes, light chestnut hair; they are thick-set and of medium height. This race is often termed "Celtic" or "Alpine" from the fact of its occurrence all along the great mountain chain from south-west France, in Savoy, in Switzerland, the Po valley and Tirol, as well as in Auvergne, Brittany, Normandy, Burgundy, the Ardennes and the Vosges. It thus stands geographically and in physical features between the "Nordic" type of Scandinavian and the so-called "Mediterranean race" with its long head, long face, its rather broad nose, dark brown or black hair, dark eyes and slender form, and medium height. In the Alps and the Danube valley some of the Celts or their forefathers had dwelt from the Stone Age. But it was during the development of the La Tène culture that the Celts attained their maximum power, and it was the La Tène period (500 B.C.–A.D. 1) that witnessed the tremendous and remarkable expansion of these people from their homeland in Central Europe. Much of their power has been ascribed to great skill in metallurgy, especially as regards the working of the native iron resources.

The beginning of the 3rd century B.C. was the period of the greatest Celtic movement, but the expansion had no doubt begun long before that period. One of the earliest advances was directed against the Mediterranean coast of France, and at much the same time other bands of the Celts spread southwards into Spain, penetrating into that country as far south as Gades (Cadiz), some tribes, *e.g.* Turdentani and Turduli, forming permanent settlements and being still powerful there in Roman times; and in northern central Spain, from the mixture of Celts with the native Iberians, the population henceforward was called Celtiberian. About this time also took place a great invasion of Italy; Segovisus and Bellovisus, the nephews of Ambigatus, led armies through Switzerland, and over the Brenner and by the Maritime Alps, respectively (Livy v. 34). The tribes who sent some of their numbers to invade Italy and settle there were the Bituriges, Arverni, Senones, Aedui, Ambarri, Carnuti and Aulerci.

Certain material remains found in north Italy, *e.g.,* at Sesto Calende, may belong to this invasion. The next great wave of Celts recorded swept down on north Italy shortly before 400 B.C. These invaders broke up in a few years the Etruscan power, and even occupied Rome herself after the disaster on the Allia (390 B.C.). Bought off by gold they withdrew from Rome, but they continued to hold a great part of northern Italy, extending as far south as Sena Gallica (*Sinigaglia*), and henceforward they were a standing source of danger to Rome, especially in the Samnite Wars, until at last they were either subdued or expelled, *e.g.,* the Boii from the plains of the Po. At the same time as the invasion of Italy they had made fresh descents into the Danube valley and the upper Balkan, and perhaps may have pushed into southern Russia, but at this time they never made their way into Greece, though the Athenian ladies copied the style of hair and dress of the Cimbrian women. About 280 B.C. the Celts gathered a great host at the head of the Adriatic, and accompanied by the Illyrian tribe of Autariatae, they overthrew the Macedonians, overran Thessaly, and invaded Phocis in order to sack Delphi, but they were finally repulsed, chiefly by the efforts of the Aetolians (279 B.C.). The remnant of those who returned from Greece joined that part of their army which had remained in Thrace, and marched for the Hellespont. Here some of their number settled near Byzantium, having conquered the native Thracians, and made Tyle their capital. The Byzantines had to pay them a yearly tribute of 80 talents, until on the death of the Gallic king Cavarus (some time after 220 B.C.) they were annihilated by the Thracians. The main body of the Gauls who had marched to the Hellespont crossed it under the leadership of Leonnorius and Lutarius. Straightway they overran the greater part of Asia Minor, and laid under tribute all west of Taurus, even the Seleucid kings. At last Attalus, king of Pergamum, defeated them in a series of battles commemorated on the Pergamene sculptures, and henceforth they were confined to a strip of land in the interior of Asia Minor, the Galatia of history. Their three tribes—Trocmi, Tolistobogians and Tectosages—submitted to Rome (189 B.C.), but they remained autonomous till the death of their king Amyntas, when Augustus erected Galatia into a province. Their descendants were probably St. Paul's "foolish Galatians" (*see* GALATIA.)

Nor was it only towards the south and the Hellespont that the Celtic tide ever set. They passed eastward to the Danube mouth and into southern Russia, as far as the Sea of Azov, mingling with the Scythians, as is proved by the name Celto-scyths. Mithridates VI. of Pontus seems to have negotiated with them to gain their aid against Rome, and Bituitus, a Gallic mercenary, was with him at his death.

The Celts moved westwards likewise and two divisions of them reached the British Isles, namely the Brythons and the Goidels. The Brythons crossed the channel and established themselves in England and Wales but the Goidels, probably in the 4th

century B.C., passed directly from the mouth of the Loire to Ireland where they quickly became a ruling caste. At a much later period there were settlements of Goidels from Ireland on the western fringe of England, Wales and Scotland. The Celtic invasions of the British Isles are in all probability to be correlated with the advent of the La Tène culture (though this is a disputed point), and it is now thought to be unlikely that the invaders came over in large migrating hordes that displaced the older population. It is more probable that the new Celtic strain was quickly merged in the native races and that the principal result of the invasion was that the Celtic over-lords imposed the Celtic language on the indigenous folk.

See Ridgeway, *Early Age of Greece,* vol. i., and *Oldest Irish Epic;* Ripley, *The Races of Europe;* Sergi, *The Mediterranean Race;* Eoin MacNeill, *Phases of Irish History;* T. D. Kendrick, *The Druids.*

CELT (kĕlt, also sĕlt), as once used by British and French archaeologists, described the hatchets, adzes or chisels of chipped or shaped stone used by primitive man. The word is variously derived from the Welsh *cellt,* a flintstone (the material of which the weapons are chiefly made, though celts of basalt felstone and jade are found), from being supposed to be the implement peculiar to the Celtic peoples; or, more probably, from a Low Latin word *celtis,* a chisel. The term is somewhat loosely applied to metal as well as stone axe-heads. In general form, stone celts approach an oval in section, with sides more or less straight and one end broader and sharper than the other. In length they vary from about two to as much as 16 inches. Some were fixed in wooden handles, and in the later stone adzes, holes are sometimes found pierced to receive the handles.

The term "celt" has been largely superseded by "axe," though it is by no means certain that all "celts" were "axes." Some, such as the larger ones of ground stone, may well have been used in agriculture for moving the soil. Many were doubtless mounted as adzes, particularly those of the "shoe-last" type (*Schuhlastenbeil*), which have a very wide European distribution from the Balkans to Scandinavia.

Bronze celts are found in Europe, in Siberia, India (the Shan States) and China. They are flat, flanged, winged and socketed. An intermediate form is called "palstave"; and it has been suggested that the socketed celt was derived from the palstave by a natural transition, the invention being attributed to the people of the Lausitz culture of Germany. It is equally possible that the socketed celt was suggested by the beating over of the wings of the winged celt of Switzerland and Bavaria. Both explanations may be correct. The socket itself had been independently invented in England in the early bronze age, where it was applied to the spearhead.

In the west of England the country folks believe that the weapons fell originally from the sky as "thunderbolts," and that the water in which they are boiled is a specific for rheumatism. In the north and in Scotland they are safeguards against cattle diseases. In Brittany a stone celt is thrown into a well to purify the water. In Sweden they are regarded as a protection against lightning. In Norway the belief is that, if they are genuine thunderbolts, a thread tied round them when placed on hot coals will not burn but will become moist. In Germany, Spain, Italy, the same beliefs prevailed. In Japan the stones are accounted of medicinal value, while in Burma and Assam they are regarded as thunderbolts and as infallible specifies for ophthalmia. In Africa they are the weapons of the Thunder God. In India and among the Greeks the hatchet appears to have had a sacred importance, derived, doubtless from the universal superstitious awe with which these weapons of prehistoric man were regarded.

See Sir J. Evans, *Ancient Stone Implements of Great Britain;* Lord Avebury, *Prehistoric Times* (1865–1900) and *Origin of Civilization* (1870); E. B. Tylor, *Anthropology and Primitive Culture.* For the history of polished stone axes up to the 17th century *see* Dr. Marcel Baudouin and Lionel Bonnemère in the *Bulletin de la Société d'Anthropologie de Paris* (April-May, 1905).

CELTES, KONRAD (1459–1508), German humanist and Latin poet, was born at Wipfeld, near Schweinfurt. After studying at Heidelberg Celtes led the wandering life of a scholar of the Renaissance, teaching in various universities, and everywhere establishing learned societies on the model of the academy of Pomponius Laetus at Rome. Among these was the *Sodalitas litteraria Rhenana* or *Celtica* at Mainz (1491). In 1486 he published his first book, *Ars versificandi et carminum,* which gained him the honour of being crowned as the first poet laureate of Germany, the ceremony being performed by the emperor, Frederick III., at the diet of Nuremberg in 1487. In 1497 he was appointed by the emperor, Maximilian I., professor of poetry and rhetoric at Vienna, and in 1502 was made head of the new Collegium Poetarum et Mathematicorum, with the right of conferring the laureateship. He did much to introduce system into the methods of teaching, to purify the Latin of learned intercourse, and to further the study of the classics, especially the Greek. But he was more than a mere classicist of the Renaissance. He was keenly interested in history and topography, especially in that of his native country. It was he who first unearthed (in the convent of St. Emmeran at Regensburg) the Latin poems of the nun, Hrosvitha of Gandersheim, of which he published an edition (Nuremberg, 1501). He also published an historical poem, *Ligurinus sive de rebus gestis Frederici primi imperatoris libri x.* (Augsburg, 1507), and the map of the Roman empire known as the *Tabula Peutingeriana* (after Konrad Peutinger, to whom he left it). He projected a great work on Germany; but of this only the *Germania generalis* and an historical work in prose, *De origine, situ, moribus et institutis Nurimbergae libellus,* appeared. As a writer of Latin verse Celtes far surpassed any of his predecessors. His epigrams, edited by Hartfelder, were published at Berlin in 1881. His editions of the classics are now, of course, out of date.

For a full list of Celtes's works *see* Engelbert Klüpfel, *De vita et scriptis Conradi Celtis* (Freiburg, 1827); also Johann Aschbach, *Die früheren Wanderjahre des Conrad Celtes* (1869); Hartmann, *Konrad Celtes in Nürnberg* (Nuremberg, 1889).

CELTIBERIA, a term used by Greek and Roman writers to denote sometimes the whole north-east of Spain, and sometimes the north-east part of the central plateau. The latter was the correct use. The Celtiberi were the most war-like people in Spain, and for a long time offered a stubborn resistance to the Romans. They served both Carthaginians and Romans as mercenaries, and Livy (xxiv. 49), states that they were the first mercenaries in the Roman army. In 179 B.C. the whole country was subdued by T. Sempronius Gracchus, who by his generous treatment of the vanquished gained their esteem and affection. In 153 they again revolted, and were not finally overcome until the capture of Numantia by Scipio the younger (133 B.C.). After the fall of Numantia, and still more after the death of Sertorius (72 B.C.), the Celtiberians became gradually romanized, and town life grew up among their valleys; Clunia, for instance, became a Roman municipality, and ruins of its walls, gates and theatre testify to its civilization; Bilbilis (Bambola), another municipality, was the birthplace of Martial.

The Celtiberians may have been descendants of Celtic immigrants from Gaul into Iberia (Spain), or a mixed race of Celts and Spaniards (Iberians); that a strong Celtic element existed in Spain is proved both by numerous traditions and by the more trustworthy evidence of place-names.

Their country was rough and unfruitful as a whole (barley, however, was cultivated), being chiefly used for the pasture of sheep. Its inhabitants either led a nomadic life or occupied small villages; large towns were few. Their infantry and cavalry were both excellent. They carried double-edged swords and short daggers for use hand to hand; their defensive armour was a light Gallic shield, or a round wicker buckler, and greaves of felt round their legs They wore brazen helmets with purple crests, and rough-haired black cloaks, in which they slept on the bare ground. They were said to offer sacrifice to a nameless god at the time of the full moon, when all the household danced together before the doors of the houses.

Although cruel to their enemies, they were hospitable to strangers. They ate meat of all kinds, and drank a kind of mead.

E. Hübner's Article in Pauly-Wissowa's *Realencyklopädie,* iii. (1886–93), collects all the ancient references.

CELTIC LANGUAGES. The Celtic languages form one group of the Indo-European family of languages, intermediate

between the Italic and Teutonic groups, but distinguished from these and other branches of the family by certain well-marked characteristics, the most notable of which are the loss of initial and inter-vocalic *p*, and the change of I.-E. *ē* to *ī*, the I.-E. labialized velar *gv* is represented by *b*, while the medial aspirates *bh, dh, gh* result in simple voiced stops. I.-E. sonant *r* and *l* become *ri, li*. The initial mutations which are so characteristic of the living languages arose after the Romans had left Britain. The Celtic languages and the Italic dialects stand in a close relationship to one another. The features common to both Celtic and Italic are: (1) the gen. sing. ending *-ī* of masc. and neut. stems in *o;* (2) verbal nouns in *-tion;* (3) the *b-* future; (4) the passive formation in *-r*.

The various Celtic dialects are: (1) Gaulish; (2) Goidelic, including Irish, Scottish Gaelic, and Manx; (3) Brythonic, including Welsh, Breton, and Cornish. Gaulish and Brythonic change the I.-E. labialized velar guttural *qu* to *p*, whilst the Goidelic dialects retain the *qu*, which later gives up the labial element and becomes *k*.

See INDO-EUROPEANS; GAELIC LANGUAGE; CORNISH LANGUAGE; MANX LANGUAGE AND LITERATURE; WELSH LANGUAGE AND LITERATURE. *See* also Windisch's article "Keltische Sprachen" in Ersch und Gruber's *Allgemeine Encyklopädie der Wissenschaften und Künste*, and V. Tourneur, *Esquisse d'une histoire des études celtiques*, vol. ii. with full bibliography (Liége, 1905); Zeuss's *Grammatica Celtica* as revised by Ebel; a comparative grammar of the Celtic dialects by H. Pedersen (Göttingen, 1908); H. Zimmer, "Die Kelt. Litteraturen" in *Die Kultur d. Gegenwart*, T. i. Abh. xi. I. (Berlin and Leipzig, 1909). *See* also Whitley Stokes and A. Bezzenberger, *Wortschatz der keltischen sprach-einheit* (Göttingen, 1894); A. Meillet and M. Cohen, *Les Langues du Monde* (1924).

CELTIC LITERATURE: *see* BRETON LITERATURE; IRISH LITERATURE; CORNISH LANGUAGE; WELSH LANGUAGE AND LITERATURE and SCOTTISH LITERATURE.

CELTIUM is the name given by G. Urbain and A. Dauvillier to the element of atomic number 72, for which the former obtained some evidence from *X*-ray spectra in 1911. Their claim to have discovered this element was, however, disputed by D. Coster and G. Hevesy (1923) who named it *Hafnium*, under which heading it is described. Of the resulting polemical papers only a few are suggested for reference.

BIBLIOGRAPHY.—D. Coster and G. Hevesy, *Nature*, 111, pp. 79, 252, 462 (1923). G. Urbain and/or A. Dauvillier, *ibid.*, p. 218, *Comptes rendus, 176*, p. 676 (1923); *Chemistry and Industry, 42*, p. 764 (1923).

CEMBAL D'AMORE or **CEMBAL D'AMOUR,** a keyboard instrument invented by the famous organ and clavièr maker, Gottfried Silbermann, who was later so prominently identified with the earlier pianofortes. It was a kind of clavichord with strings of double the usual length, and its other mechanism modified to correspond, but it was not a success.

CEMBALO or **CIMBALO,** the Italian names for a dulcimer (*cf.* cymbal); whence, in due course, clavicembalo for a pianoforte, otherwise a keyed dulcimer. Hence, too, the frequent use of "cembalo" in earlier days in the case of pianoforte music, the word as used in such cases being merely a contraction of "clavicembalo." (*See* DULCIMER.)

CEMENT. The word "Cement" apparently was first used of a mixture of broken stone, tiles, etc., with some binding material, and later it was used of a material capable of adhering to, and uniting into a cohesive mass, portions of substances not in themselves adhesive. The use of cementing material dates from very early days, and it is probable that adhesive clay was one of the first materials used for uniting stones, etc. Bitumen probably was also used for the same purpose, while the use of burnt gypsum, and also lime, dates back to the time of the Egyptians.

In its widest sense the word "cement" includes an infinite variety of materials and ranges from the clay used to bind stones and other materials together to form the natives' huts in tropical countries, or the clay in the sand used by small boys to make sand models, up to the modern rapid hardening cements which are capable of binding three times their own weight of sand together in such a way that, at the end of 24 hours, they will stand a compression of several thousand pounds per square inch. It also includes those materials which join individual crystals together to form masses of rock, etc., such as the cementitious material which joins the grains of sand together in a sandstone, and ultimately merges into glues, solders and adhesives in general, between which there is no sharply defined line of demarcation.

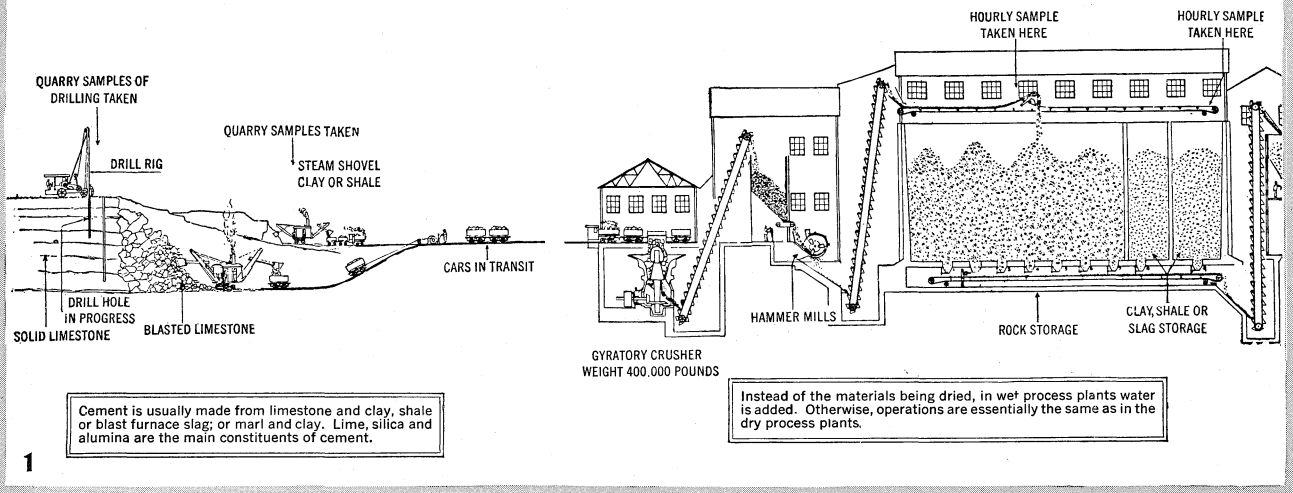
In its more restricted sense, particularly if it is unqualified and used in connection with building and engineering, the word practically always means Portland cement, as this is by far the most important cement used at the present time, the world's output amounting to millions of tons per annum. A fairly full description of this cement is therefore justified, and a brief description of other cements will be given towards the end of this article.

Portland Cement.—Portland cement is made by burning a mixture of calcareous and argillaceous material to clinkering temperature, and grinding the resulting clinker. The mixture may be a natural one, such as the marls, or an artificial one, such as chalk or limestone, for the calcareous material, and clay or shale for the argillaceous material. The binding qualities of modern cements are very considerable, and it is possible to make good concrete from properly graded sand and ballast with the use of 1 part of cement to 12, or more, parts of aggregate; but, as it is not always possible in practice to obtain a thorough distribution of cement throughout the mass, it is customary to use a larger proportion of cement, *e.g.*, 1:3:5 parts of cement, sand and gravel, and, for a better quality concrete, 1 part of cement to 2 or 3 parts of sand, and 3 or 4 parts of gravel. A good cement mortar can be made from 1 part of cement to 4 or 5 parts of clean sharp sand, free from clay. If the mixture is too rich, *e.g.*, equal parts of sand and cement, there is danger of cracks due to shrinkage, and apart from this the extra strength gained by using a greater proportion of cement than 1 to 3 of sand is so small that the additional cost is not justified.

History.—Very little definite information about the preparation and uses of cement can be found before the 18th century. Various districts gained reputations for the special qualities of their lime cements, such as the power of setting hard under water, but the reasons for these special qualities were not known until the last century. John Smeaton was one of the first to make any serious attempt to grapple with the question of the cause of the varying hydraulic properties of different lime cements. In 1756, whilst engaged on the construction of the Eddystone lighthouse, he made a series of experiments to find the best cement capable of hardening under water. The result of these experiments revealed the fact that the best hydraulic limes were made from limestone containing an appreciable quantity of clay. This led to a number of investigators carrying out experiments. In 1796 Parker invented his "Roman cement," which was made by "reducing to powder certain burnt stones or argillaceous productions called 'noddles' of clay." This cement "will set . . . in 10 or 20 minutes either in or out of water." The raw materials for Roman cement were burnt to just short of the vitrifying temperature, whereas for hydraulic lime the raw materials were heated to a much lower temperature, which was just sufficient to decompose the calcium carbonate. This was a distinct advance, as the overburnt or vitrified pieces of lime had formerly been picked out and rejected as being useless for mortar.

Vicat, in 1813, made a series of experiments on the effect of adding different clays in varying proportions to slaked lime, and then burning the mixture. The success of these experiments led other investigators to try artificial mixtures of clay and calcareous materials and in 1822 Frost brought out his "British cement," which was soon followed by Aspdin (1824) with "Portland cement." Both of these, however, were hydraulic limes, in that the mixtures were only calcined and not clinkered. Aspdin was apparently the first to use the word "Portland" to define a particular type of cement, although Smeaton, over half a century earlier, had said that cement made from these materials would "equal the best merchantable Portland stone in solidity and durability." His "Portland cement" was, of course, quite different from modern Portland cement, but nevertheless the colour and properties of concrete made from this cement were somewhat similar to Portland stone.

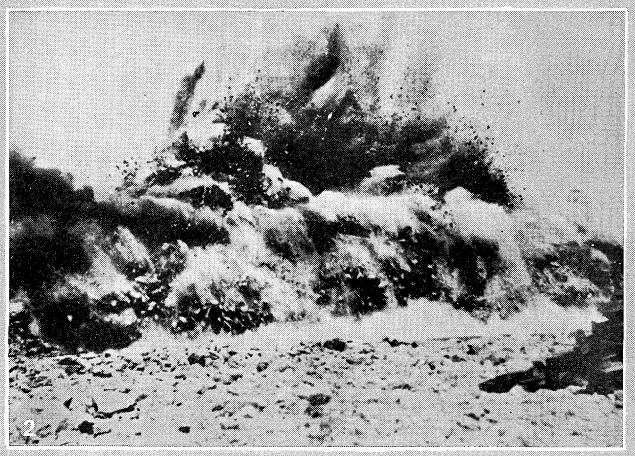
By this time (1820–30) works were springing up in various



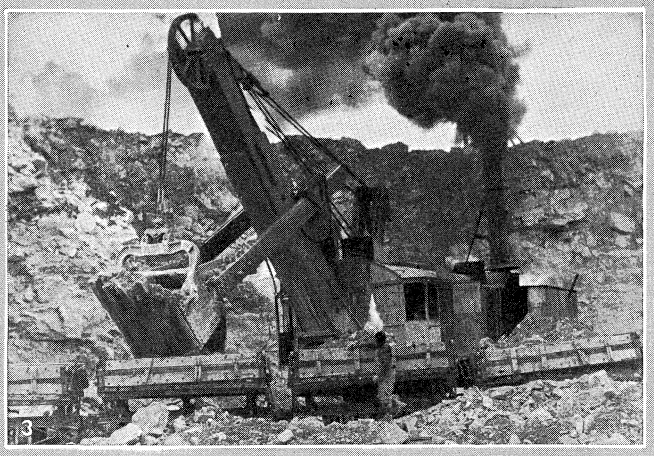
Cement is usually made from limestone and clay, shale or blast furnace slag; or marl and clay. Lime, silica and alumina are the main constituents of cement.

Instead of the materials being dried, in wet process plants water is added. Otherwise, operations are essentially the same as in the dry process plants.

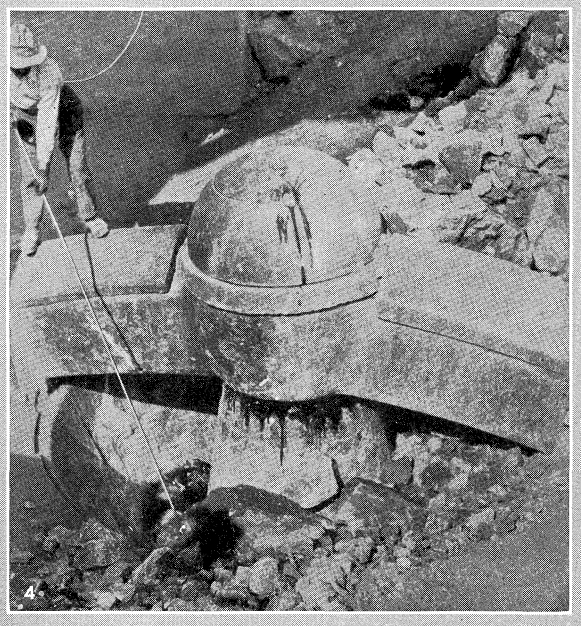
1



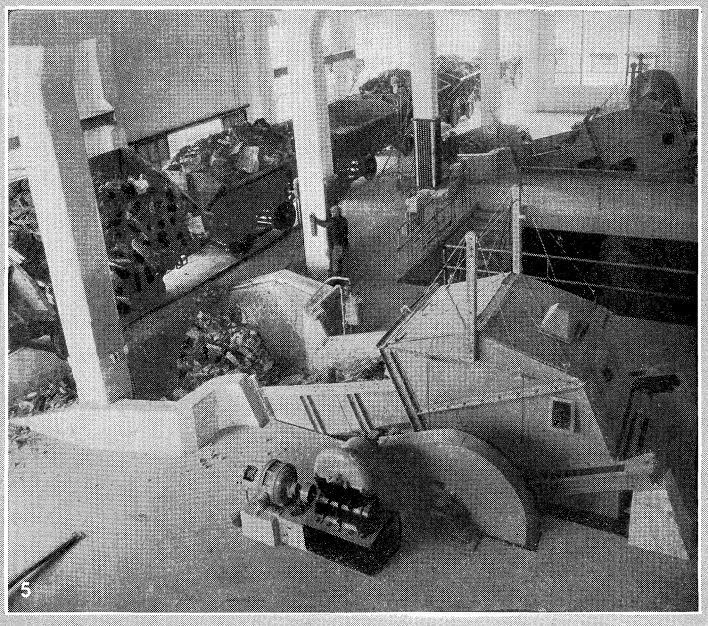
2



3



4



5

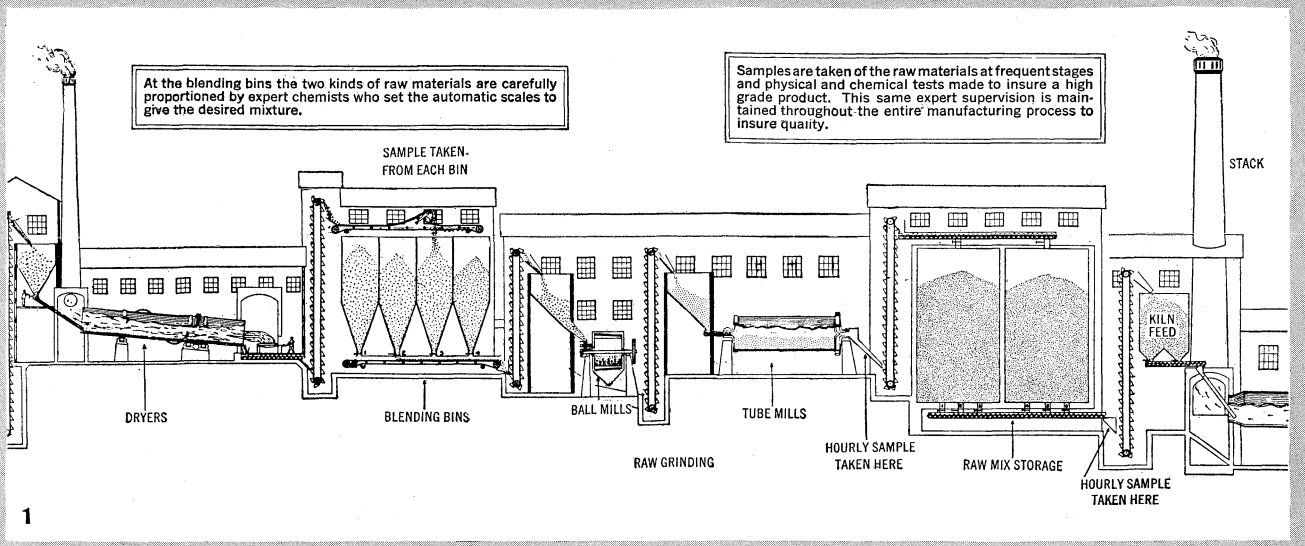
BY COURTESY OF THE PORTLAND CEMENT ASSOCIATION

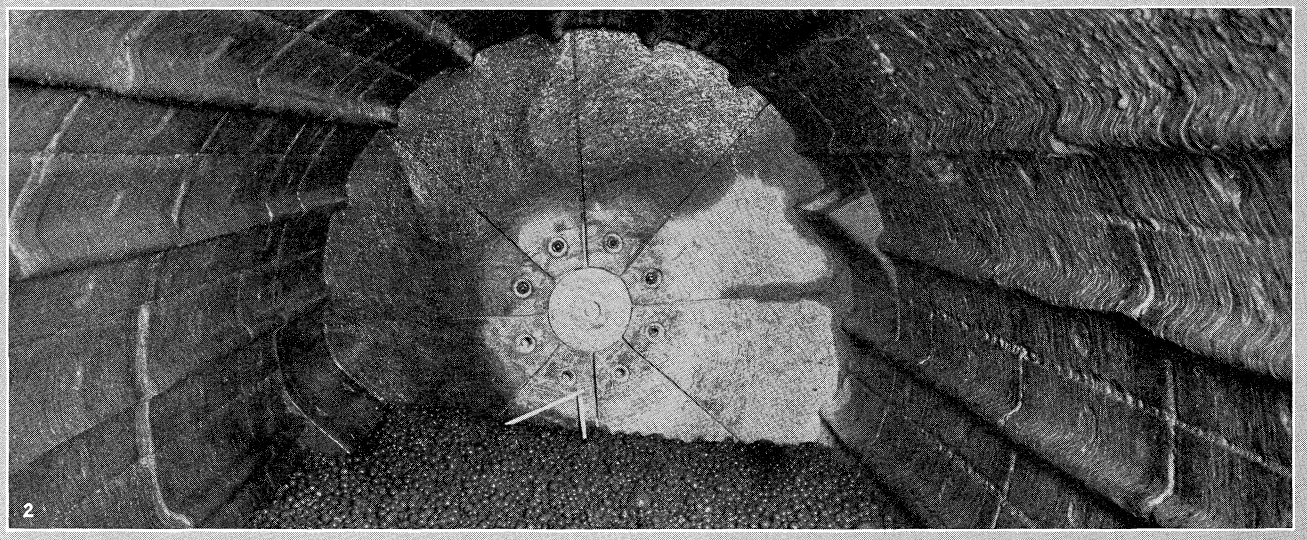
PRELIMINARY STEPS IN CEMENT MANUFACTURE

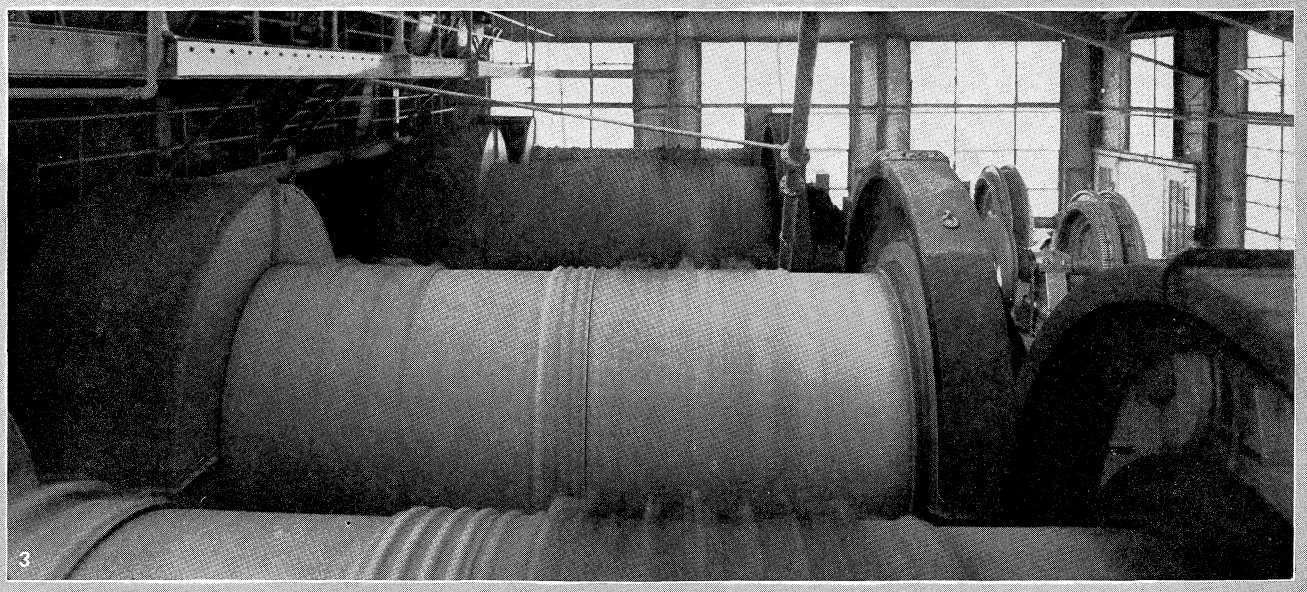
1. Diagram of successive steps in the manufacture of cement (part one)
2. Blasting rock at the quarry. As much as 400,000 tons, enough to fill 8,000 standard gondola cars, is sometimes loosened in a single blast
3. Large power shovel loading rocks into cars at the quarry
4. Gyratory crusher. The rocks are dumped directly from the cars into the crusher (a steel cable and life belt protect the workman)
5. Quarry rock being dumped into the hopper of a jaw-crusher, sometimes used instead of the gyratory crusher shown in fig. 4

NOTE: THE ILLUSTRATIONS SHOW THE DRY PROCESS OF CEMENT MANUFACTURE, WHICH DIFFERS FROM THE WET PROCESS IN METHOD BUT NOT IN PRINCIPLE. THE DIAGRAM ABOVE COULD APPLY IN GENERAL TO THE WET PROCESS BY ELIMINATING THE DRIERS AND SUBSTITUTING LARGE TANKS INSTEAD OF THE RAW MIX STORAGE

CEMENT



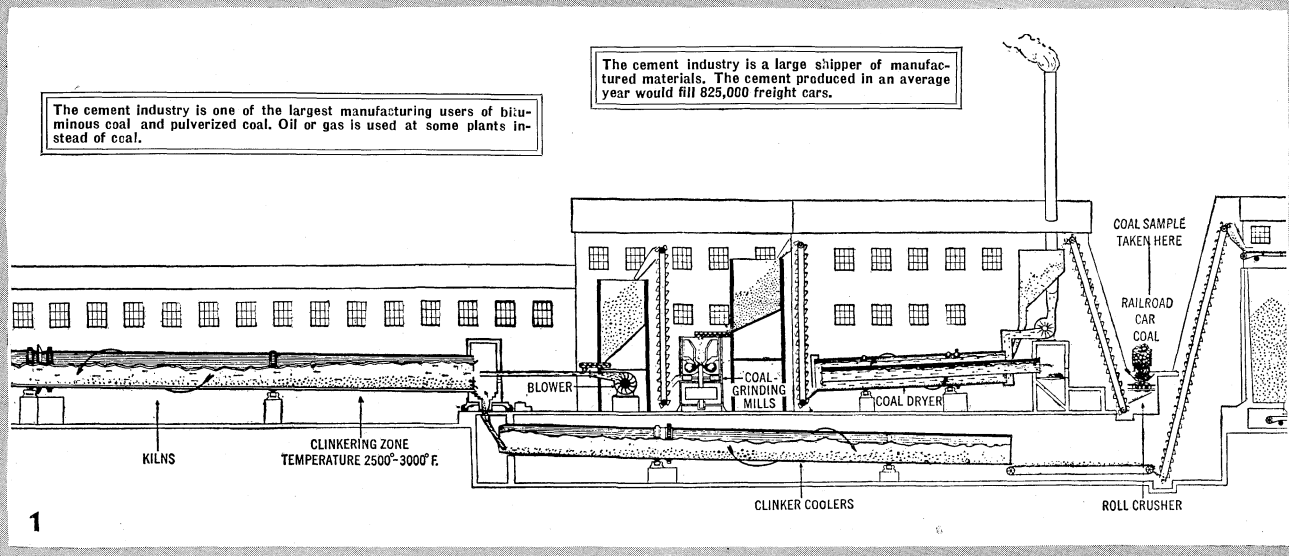


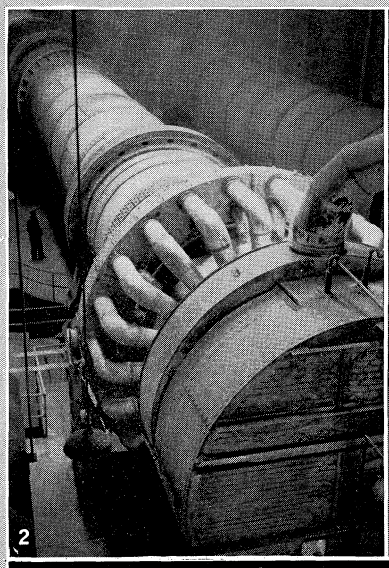


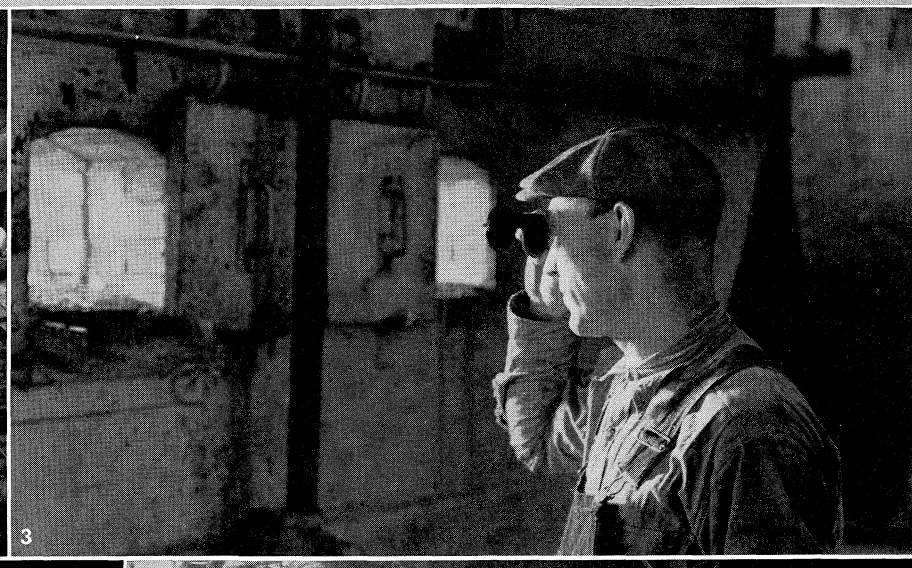
BY COURTESY OF THE PORTLAND CEMENT ASSOCIATION

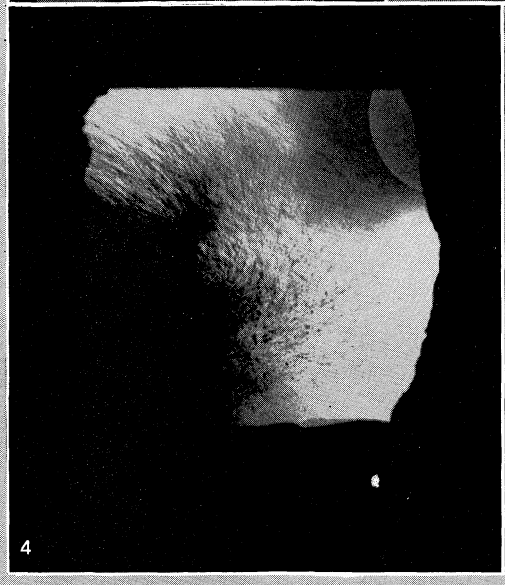
GRINDING THE ROCK

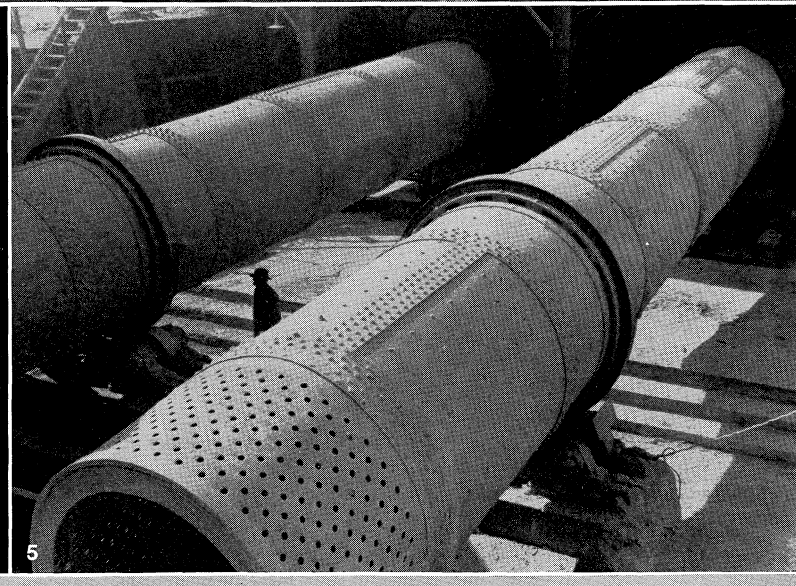
1. Diagram of successive steps in the manufacture of cement (part two)
2. Interior of a tube mill, showing the charge of steel balls that grind the rock after it has been crushed and hammered
3. Battery of tube mills in operation. The pieces of rock are ground into particles finer than flour, as the cylinders revolve at a rate of 23–26 revolutions per minute









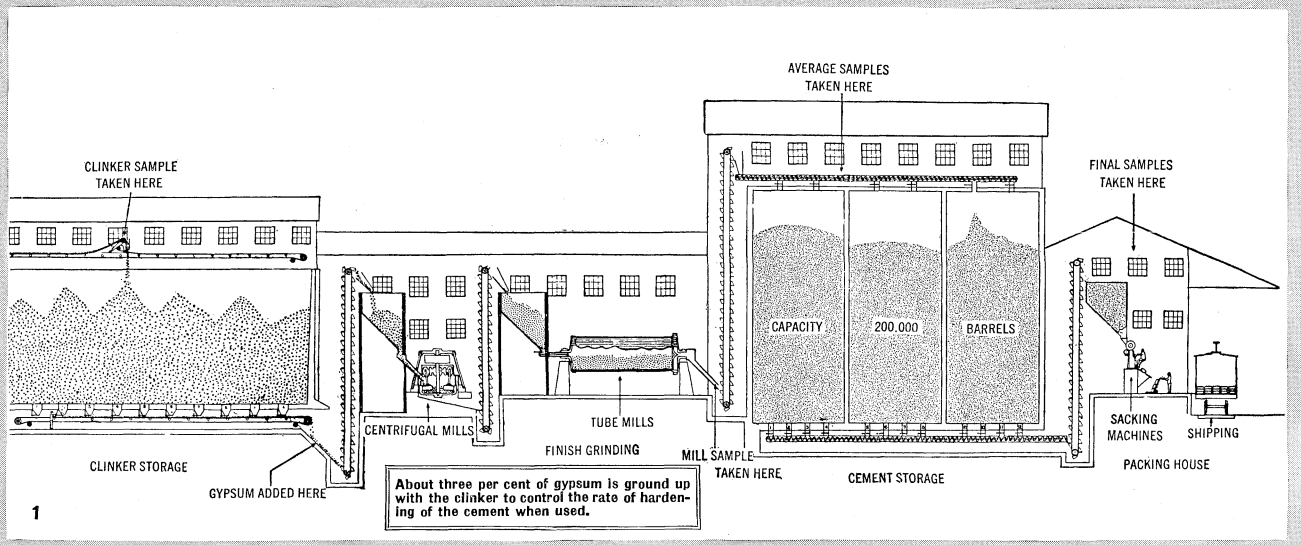


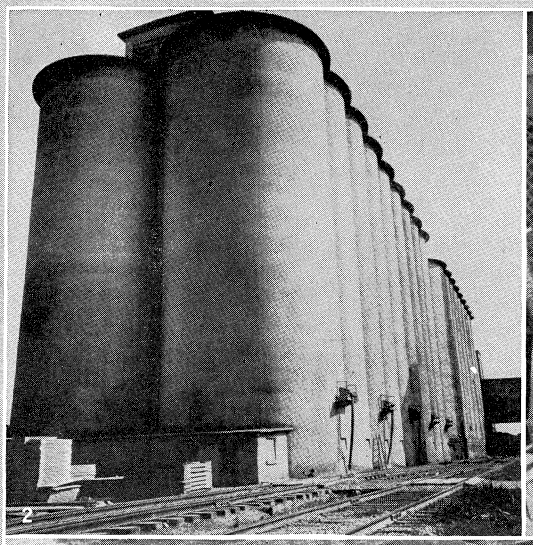
BY COURTESY OF THE PORTLAND CEMENT ASSOCIATION

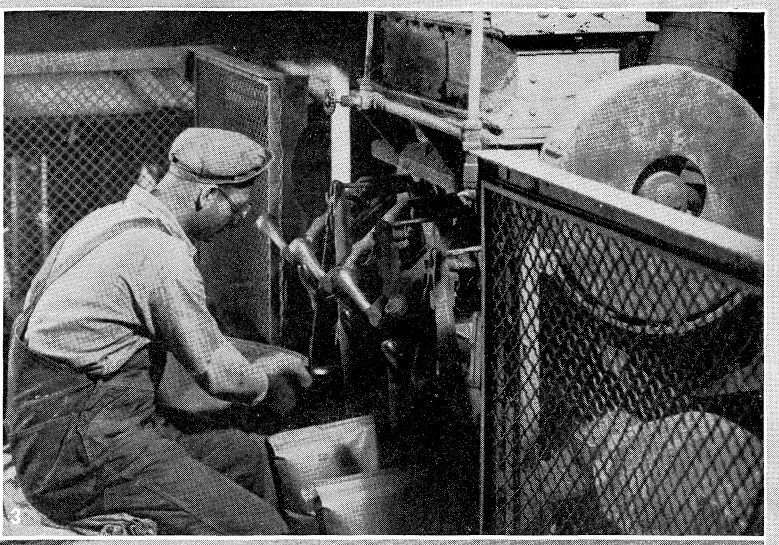
BURNING AND COOLING

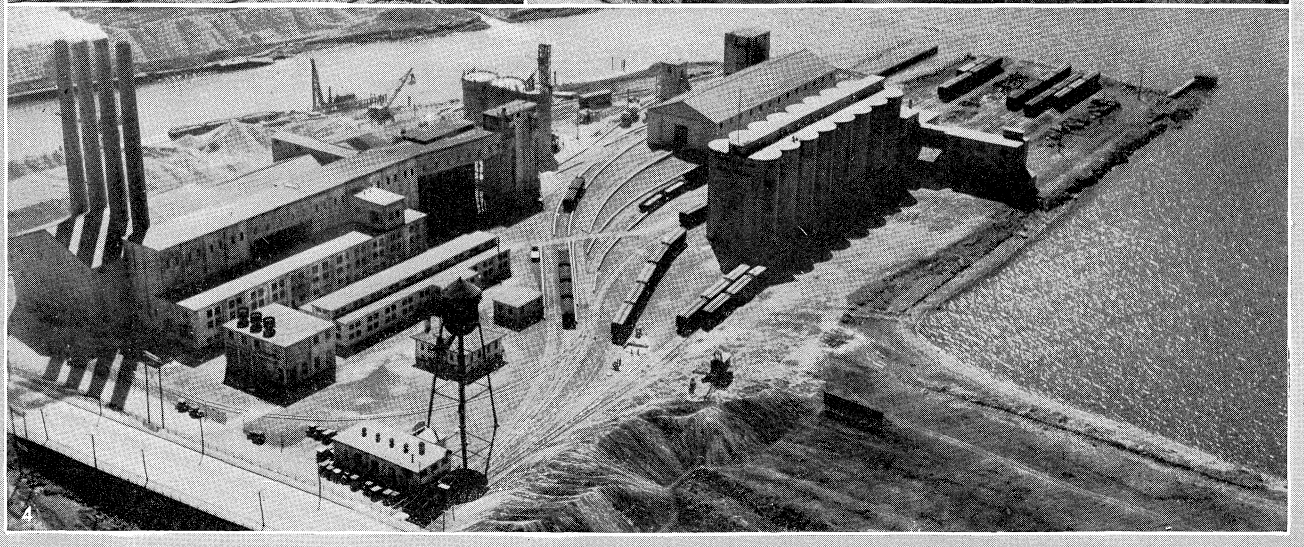
1. Diagram of successive steps in the manufacture of cement (part three)
2. A rotary cement kiln. The pulverized raw material goes into the kiln, where it is burned into small, glass-hard balls called cement clinker. The fuel (oil, natural gas or powdered coal) is blown into the kilns under pressure
3. Burner foreman observing the condition of clinker in a kiln
4. View of the inside of a kiln through an observation port. The temperature ranges between 2,500° and 3,000° F.
5. Rotary cooler through which the hot cement clinker passes before going to storage. Other types of coolers are also used

CEMENT









BY COURTESY OF (1-3) THE PORTLAND CEMENT ASSOCIATION; (4) LEHIGH PORTLAND CEMENT COMPANY

STORING AND PACKING

1. Diagram of successive steps in the manufacture of cement (part four)
2. When the clinker has been ground into cement, after the addition of a small amount of gypsum, the finished product is stored in large concrete silos
3. Filling cement sacks by machines which force the cement through a self-closing valve at the bottom. The machine nozzle shuts off automatically when exactly 94 lb. of cement has entered the sack
4. General view of a cement plant

parts of the country where the raw materials were suitable; Parker's "Roman cement" was manufactured at Northfleet, Kent, "British cement" was made by Frost at Swanscombe, and the Aspdins were making "Portland" cement at Wakefield and Gateshead. This Portland cement, as mentioned above, was more of the nature of hydraulic lime; but about 1845 Mr. I. C. Johnson, who was then manager of Messrs. White & Sons' works at Swanscombe, Kent, produced a cement of the modern Portland cement type, by burning the raw materials "with unusually strong heat until the mass was nearly vitrified," and this clinker, when finely ground, made a cement which was far in advance of the ordinary type produced at that time.

During the next few years many works started making true Portland cement, both in Britain and in other countries. In France, Dupont and Demarle were delivering fairly large quantities of Portland cement in 1850 from their works at Boulogne-sur-Mer and the demand continued to grow. Naturally with such a demand, and with such scanty knowledge as to the special requirements necessary for ensuring the production of good sound cement, a large quantity of inferior material came on to the market, and failures resulting from this gave the cement a doubtful reputation. Investigations for improving the quality of cement continued with moderate results. Grant's tests, in 1865, show an average tensile strength of 353·2lb. for $2\frac{1}{4}$ sq.in. ($1\frac{1}{2}$in.$\times$ $1\frac{1}{2}$in.) cement and sand briquettes (1:1) at seven days (157lb. per sq.in.), while in 1878 a tensile strength of 500lb. ($2\frac{1}{4}$in. briquettes), *i.e.*, 222lb. per sq.in., was specified for briquettes made from 6 parts of cement to 10 parts of sharp sand. This may be compared with modern rapid hardening cement, which, with 1 part of cement to 3 parts of standard sand, has a tensile strength of over 500lb., and sometimes over 600lb. per sq.in. after 24 hours.

Manufacture.—When cement was first made from "stone noddles," as in Parker's method, the stone was placed in a bottle kiln or dome kiln ordinarily used for burning lime. When at a later date artificial mixtures of chalk and argillaceous materials were used, it was found that the best and most intimate mixtures were made by beating clay and chalk into a thin slip or slurry with water. This slurry was then allowed to stand in large settling tanks, or "backs," until the material had settled, and the water was drawn off and the deposit dried and burned. The time taken for the settling and drying of the raw materials was so great that efforts were made to improve the kiln (which, of course, could only be fed with dry material) by utilizing the waste heat for drying the slurry. One of the first of these was the chamber kiln of I. C. Johnson, which consisted of a long horizontal chamber connected with the top of the ordinary kiln, so that the hot gases from the latter had to pass through the chamber on the way to the chimney stack. The liquid slurry, either from the "backs" or direct from the washmill, was placed on the floor of the chamber and was effectively dried by the hot gases passing over it, providing the layer of slurry was not too thick. The chamber had to be of considerable length in order to provide floor space to dry sufficient slurry for a full charge of the kiln, and improvements in the direction of shortening this were made by Batchelor and others, by providing two or three floors one above the other. Coke was used for burning the raw materials and ranged from 8–9cwt. per ton of clinker. In 1870 Goreham patented his method of grinding his slurry with burr stones, thereby producing a better slurry and containing only 40–42% of water, a proportion much less than was usual at that time, which, of course, facilitated drying. The construction of the bottle kiln, even in its improved form, the chamber kiln, necessitated intermittent firing, as each charge of fuel and dried slurry had to be built up by hand. Experiments with the object of doing away with this costly intermittent method led to the development of shaft kilns, with continuous burning of the raw material. The shaft kiln, as its name implies, consists of a vertical shaft, the top of which leads into a chimney. A few feet from the ground level removable bars are fixed across the shaft. On to these bars is placed a layer of coke, then alternate layers of dried slurry and coke until the kiln is filled. The coke at the bottom is fired, and this burns the raw material above it, while the hot gases pass through and heat the layers above. As the coke burns away the cement clinker drops on to the bars and heats the incoming air, while the burning zone rises to about half way up the shaft. The partly cooled clinker on the bars is removed from time to time and fresh layers of dried slurry and coke are put in on top. The process thus becomes continuous, and the loss of time in waiting for the kiln to heat up and cool down, together with the resultant loss of heat, which is unavoidable with the chamber kiln, is entirely overcome in the shaft kiln. Modifications of the shaft kiln were patented by Dietszch (fig. 1), Stein, Schneider and others, and the different types became known by the names of the patentees. The next improvement was the use of forced draught instead of natural induced draught from the chimneys, and tests on a standard Schneider kiln showed an increase in output from the normal 70 tons per week to 150 tons per week when using mechanical draught.

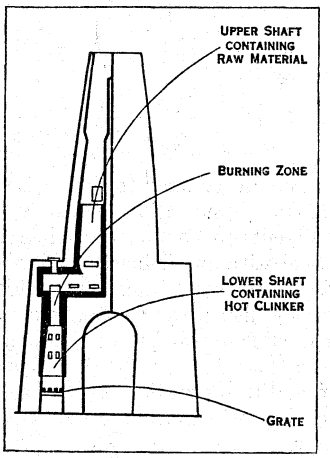


FIG. 1.—DIETSZCH SHAFT KILN
Fresh layers of coke and slurry are added from the top as soon as the coke at the bottom is burned away, thus keeping the burning process continuous

One of the weaknesses of the shaft kiln—or a fixed kiln—is the difficulty of ensuring even burning of the clinker, some of it being under burnt while other portions were heavily clinkered, and various mechanical improvements have been made in the grate with the object of keeping the whole of the material in the kiln on the move by the continuous withdrawal of the clinker. The improvements in the shaft kiln reduced the quantity of fuel required from 70 to 80% of the weight of good clinker produced by the old kiln to 20 to 30% (dried slurry being used in both cases). This economy of fuel and the small amount of handling required, together with low capital cost, render the shaft kiln method suitable for use where the small output does not justify the cost of the rotary kiln.

Other methods of preventing the waste of heat resulting from the heating up and cooling of the old type of kiln were investigated. One of the most successful was the Hoffman Ring kiln, which consisted of a number of kilns arranged in a ring round a central chimney. The flues from the kilns are so arranged that air, which is heated by being drawn through clinker which is cooling, is used for burning the fuel in the next kiln or two, and the hot gases are drawn through the other kilns to heat the raw materials before passing into the main flue. These ring kilns are very economical with regard to fuel but require skilled hands for charging, and the labour costs are high.

Another method, which laid the foundations for the modern rotary kiln process, was devised by Thomas Russell Crampton, who in 1877 patented a method for burning "Portland and other cements in revolving furnaces heated by the gases resulting from the combustion of coal or carbonaceous material" or "by the combustion of air and powdered carbonaceous material."

In 1885 Frederick Ransome patented a method of burning dry powdered materials in a rotating cylinder by means of which he hoped to obtain the finished product from the kiln in a powder form sufficiently fine for use without further grinding, evidently overlooking the fact that clinkering is an essential process in the manufacture of true Portland cement. He also stated that the raw material might be fed in either at the chimney end of the kiln or at the firing end, which suggests that he had not appreciated the full value of feeding the kiln at the end opposite to that used for burning the fuel. Further improvements were effected by F. W. S. Stokes who, in 1888, patented a method of drying the slurry by passing the hot gases from the rotating kiln through a revolving drum on to the outside of which the slurry was fed. He also used another revolving drum for cooling the clinker,

ANALYSES OF TYPICAL MATERIALS

	Chalk	Limestone	Blue Lias limestone	Marl	Gault clay	Clay	Shale
	%	%	%	%	%	%	%
Silica (SiO_2)	5·94	1·16	12·66	13·10	37·68	58·78	60·20
Alumina (Al_2O_3)	1·46	0·33	3·92	3·98	14·92	18·42	19·42
Ferric oxide (Fe_2O_3)	1·20	0·08	1·50	1·72	6·28	7·60	8·24
Lime (CaO)	50·68	54·82	43·26	44·58	17·84	0·52	0·40
Magnesia (MgO)	0·51	0·28	1·30	0·48	1·61	1·90	1·46
Sulphuric anhydride (SO_3)	Trace	Trace	0·39	Trace	0·68	Trace	Trace
Carbonic anhydride (CO_2), combined water (H_2O) and alkalies	40·21	43·33	36·97	36·14	20·99	12·78	10·28
	100·00	100·00	100·00	100·00	100·00	100·00	100·00

utilizing the waste heat for heating the air supplied to the fuel in the kiln. In 1895 and 1896 E. H. Hurry and H. J. Seaman obtained various patents for improvements in cooling the clinker, arrangements for using powdered coal with an air blast for burning, etc., and various other developments have been made with the rotary kiln, until it has very nearly displaced all others where a large output of Portland cement clinker is required. Among the first rotary kilns erected was that at Arlesey (1887). This was 26ft. long and 5ft. in diameter, and forms an interesting comparison with those now in common use, which are 200 to 300ft. long, and 8½ft. to 12½ft. in diameter.

Modern practice is to grind a mixture of suitable calcareous and argillaceous materials, either wet or dry, in such proportions as will give the correct composition to the finished cement. The wet ground material is pumped, in the form of a slurry containing about 40% of water, into a series of large mixing tanks having a capacity of 1,000 to 2,000 tons of slurry, and from these it is pumped into the kiln. The dry ground raw material is carried by a conveyor to the storage bins, and from the bins it is fed into the kiln after having been damped to prevent too much dust being blown up the chimney. The raw material, either in the form of slurry or damp meal, enters the kiln at the top end close to the chimney and meets the oncoming hot gases. As the kiln revolves the raw materials fall down towards the clinkering zone, having been first dried by the hot gases, and then having the carbon dioxide driven off from the calcareous materials. In the clinkering zone, where the heat is maintained by the combustion of powdered coal carried in by a blast of air, the lime of the calcareous materials combines with the silica and alumina of the argillaceous materials, and at this stage they partially fuse or clinker together, an action which is facilitated by the alkalies and iron oxide, etc., in the materials. The partially fused product or "cement clinker" passes from the lower end of the kiln to the cooler, where it parts with some of its heat to the air going to the kiln. The clinker, with the addition of a little gypsum or water to regulate the setting time, is then ground in ball and tube mills to such a fineness that the finished product—Portland cement—leaves a residue of under 10%, usually 1–3%, on a sieve having 32,400 meshes to the square inch.

The raw materials consist of argillaceous or alumina and silica bearing materials and calcareous materials, the former including clay, shale, slate, etc., and some forms of slag, and the latter including chalk, limestone, marine shells, etc., while many materials such as marls, gault clays, cement rock, etc., contain natural mixtures of both the calcareous and argillaceous constituents.

The method of obtaining the raw materials will depend on whether they are hard or soft. With soft materials, such as clay, marl, and soft chalk, a steam digger or scraper is used. After the "overburden" or top refuse material has been removed, a face is opened up in the material. The steam digger is brought up to this face, and the teeth of the digger bite into the material, and, on being lifted upwards, break or cut away lumps which fall into the bucket. The bucket, which holds from ½ to 3 or more cubic yards, is swung round and emptied into a truck which is then taken to the washmill. For very soft materials, such as mud or clay under water, a dredging machine—a form of chain bucket excavator—is used. For hard materials, *e.g.*, limestone, etc., the rock is blasted with an explosive such as gelignite, which will break it into pieces sufficiently small for the crusher to take. If the pieces are too large they are very difficult to handle or break again, and it is in regulating the position and depth of the boreholes, and the size of the charge, that the good quarry foreman shows his skill in obtaining the greatest quantity of loose rock of the right size with the least cost. The broken rock lying at the base of the quarry is picked up by a power shovel or a grab, taking up 3 or more cubic yards at a time, put into trucks and taken to the mills.

Grinding Raw Materials.—The methods used depend on whether the materials are soft or hard. Soft materials are usually washed down with water until they form a slurry of the consistence of cream, containing about 40% of water. The trucks of marl or chalk and clay are tipped into a washmill, which consists of a large circular tank of concrete about 14ft. or more in diameter, with baffles and slotted screens ($\frac{1}{8}$in. to $\frac{3}{16}$in. slots) let into the sides. Water is allowed to run into the mill and a number of harrows suspended on chains from radial arms from the centre of the mill are caused to revolve at a rapid rate. These harrows break up the large pieces of chalk, etc., and by dashing the raw materials, suspended in the water, against the screens and baffles, break up the clay and chalk into such fine particles that about 98% will pass through a sieve having 180 meshes to the linear inch. If, owing to the presence of coarse particles of sand, etc., the slurry is too coarse, it may be necessary to finish it off in a tube mill. In America the 200 mesh sieve is commonly used.

Hard materials are first put through a crusher which may be of the jaw type, in which the stone is fed in between two steel jaws set at an angle, one of which moves backwards and forwards with a rocking motion, or through a gyratory crusher, in which the gyratory motion of a central jaw causes a crushing action against an outer jaw, or through some other form of crusher suitable for large stone. The crushed stone is fed into smaller crushers which may be one of the above types, or a hammer mill in which rods with hinged hammer heads are allowed to swing round rapidly and break the stone against stationary bars on the outer edge of the mill, or if the material is sufficiently soft it may be fed into crushing rolls.

From this fine crushing the small stone is taken by a conveyor to the tube mills, and thence to the kiln. The process differs according as the dry process or the wet process is used. In the dry process the limestone and shale, etc., are fed into the mills from the weighing machines or feed tables (which regulate the quantity) in such proportions as will give a finished product of the correct composition. The mills may be of various types. In the ball and tube mill, separate or combined, steel balls falling over each other in a revolving cylinder have a pounding or hammering action on the particles of stone between the balls. In the centrifugal type of mill a heavy mass of steel is caused to revolve rapidly, and centrifugal force causes it to press against a stationary ring and exerts both a crushing and grinding action on the stone between the revolving weight and the ring. In the Fuller mill the revolving weights are large steel balls, in the Griffin mills they are large pestles, while in mills of the Hercules, Huntingdon, Sturtevant and Kent types they consist of movable or swinging rolls.

The finely ground raw meal from the mills is passed into the storage bin, whence it is fed into the kiln, after being damped if

necessary. From this point the treatment is the same as the wet process. The advantage of the dry process is a saving of fuel, and of water, if the water supply is limited. Also, where waste-heat boilers are installed, more heat is available for power generation. For a long time it was generally believed that dry raw materials could not be mixed sufficiently well to ensure even composition, but since the introduction of compressed air devices for conveying these materials (cement pumps), and the "floating" of the materials in storage bins by use of compressed air, a state of practical fluidity is obtained which results in dry blending as thorough as can be accomplished by the wet process.

In the wet process the limestone and shale from the feed tables, or weighing machines, are fed into the ball mill and then the tube mill, or into a compound mill where the two are combined, and the requisite quantity of water added at the same time. The normal slurry coming from the mills contains about 40% of water, and leaves under 2% residue on a sieve having 180 meshes to the linear inch, but as it occasionally contains coarse particles which have passed through the mills, it is customary to put the slurry through a separator, usually of a centrifugal type, which rejects all the coarse particles. The slurry from the sump of the washmill, in the case of soft materials, the tube mill in the case of hard materials, or the separator, is pumped to the mixers, which are large tanks capable of holding 1,000 to 2,000 tons of slurry. These mixers serve three purposes—(1) they allow of corrections being made in the composition of the slurry, (2) they overcome any temporary variation in the composition by dispersing it and mixing it with the large bulk, and (3) they give efficient storage, allowing the grinding plant to be shut down over the week end (and at night, if required) while the kiln continues to run. To prevent settlement in the tanks the slurry is continuously kept on the move.

This is done either mechanically by rotating arms with paddles, or by the release of compressed air in the bottom of the tank, which bubbles up through the slurry.

Until recently cement manufacturers obtained slurry mixtures entirely by blending natural raw materials. In 1934, a process of flotation, long employed in the concentration of ore, was adapted to the concentration or benefication of limestones. In fine grinding rocks they are largely broken down into their mineralogical constituents such as calcite, quartz, mica, etc. By employing the principles of froth flotation, the calcite can be floated off, so that a slurry containing originally perhaps only 40% calcium carbonate (lime material) can be concentrated to 75%. Similarly, excesses of silica, alumina, iron oxide, magnesium bearing minerals like mica, etc., may be separated and used, or discarded. The flotation process applied to cement raw materials has greatly widened possibilities of cement manufacture from rock deposits previously rejected. It also makes possible manufacture of various kinds of Portland cement—that is cements adapted for special purposes such as low heat of hydration, sulphate resisting, etc., cements.

From the mixers the slurry is pumped to a small tank at the top end of the kiln, whence it is fed into the kiln at such rate as the burner thinks necessary. The usual method of doing this is by a spoon feed, the revolving spoons dipping into the tank and delivering the slurry into the kiln. Occasionally the feed is regulated by a variable orifice leading into a delivery pipe. Whichever of these two methods is used, it is the regular practice to keep the tank at constant level by over pumping and allowing the excess of slurry to run back to the mixer through an overflow pipe. Other methods, such as the spray feed and dewatering the slurry by means of vacuum filters, have been tried with some success.

Burning.—The most essential part of the manufacture of Portland cement is the complete chemical combination of certain constituents, viz., silica, alumina and lime. The other constituents, particularly the iron oxide and alkalies, play their part but are subsidiary to the three main constituents. These readily combine at a high temperature, but at this temperature it is difficult to get the kiln lining to stand up, and therefore every means should be taken which will assist the chemical combination to take place at a somewhat lower temperature, and also prevent any excessive attack on the lining bricks. Fine grinding plays an important part in meeting the first of these two requirements, and the second is met by obtaining a coating of a more fusible slurry to adhere to the lining brick, and thus protect them.

The kiln itself consists of a cylindrical shell made of steel plates, lined with fire bricks for nearly the whole of its length. The length varies from 150ft. to 350ft. or more, and the diameter from 8ft. to 14ft., usually with an enlarged diameter at the firing zone, so that the clinker may be allowed to "soak" at the high temperature. The kiln itself is carried on three to six tires, according to its length, and is driven by a gear ring usually fixed a little below the middle of the kiln. The expansion of the kiln is considerable, and therefore the tires and gear ring are not riveted directly on to the kiln, lest they be fractured, but are fixed to metal bands riveted at one end to the kiln, and are also supported by guide blocks. As the kiln is set at an angle usually of 1 in 25, the tendency of the kiln to slide down, while revolving, is counteracted by having the faces of the tires and the supporting rollers set at an angle. As a further precaution check rollers are fixed so that should the kiln slip down a little these rollers come into action on the side of the tires and stop the kiln from slipping off the supporting rollers. At the upper end, where the slurry, or damp meal, is fed in, the kiln passes into the dust chamber, through a joint which is reasonably tight to prevent loss of draught, and the hot gases, having deposited a large portion of the dust, are led into the chimney.

Before the chimney, flues are sometimes installed leading under boilers where steam is generated for turbine-generator units, which furnish sufficient power to operate the plant. Near cities and towns plants are frequently equipped with dust collectors, either mechanical or of electrical precipitation type. Otherwise dust losses may amount to 5% or more of the kiln output; and neighbours object to dust. The lower end of the kiln is fitted with a large adjustable hood, on rails, which allows access to the interior for relining, etc. The white hot clinker falls through an opening in the bottom of the hood into a clinker cooler. The old method of cooling was to allow the clinker to roll through a refractory-lined cylinder, similar to the kiln, but smaller, open at the lower end. Later installations use "air-quenching" devices, usually an enclosed slowly moving grate, through which a blast of cold air is blown. It is quite generally believed, in the United States at least, that quickly cooled clinker is superior. The kiln is fired through a pipe opening, usually in the centre of the hood, with a mixture of pulverized coal, natural gas or oil, and air. This primary air is heated by being passed over or through the clinker. Secondary air to complete combustion is admitted through openings in or around the hood. Modern installations use heated primary air to dry the coal in the pulverizer as well as inject it into the kiln. Burning formerly depended largely on the judgment of the attendant (the burner) but indicating and recording instruments now permit accurate control, and in the newest installations instrumental control of kiln speed, draft, and feed practically eliminate the personal equation of the burner.

Clinker Grinding.—The clinker as it comes from the kiln is in a fairly stable condition, and may be stored for months in the open if necessary without any appreciable deterioration. This, however, represents so much locked up capital, and it is therefore customary to grind the clinker soon after it is made. Very fresh clinker appears to be a little tougher than clinker which has been allowed to stand a week or two, and this sometimes affects the power required for grinding. The clinker from modern kilns is usually small enough to be fed directly into a ball mill or a high speed mill, but if it is too large it is passed through a crusher first. As it is usually necessary to add a definite proportion of gypsum to the clinker in order to regulate the setting time of the cement, both the clinker and gypsum are passed over feed tables before being mixed and fed into the mills. The feed tables are simple devices for regulating the quantity of any material passing over them in a given time and consist of a revolving table, fixed scrapers and a vertical feed pipe, with an adjustable collar, just above the centre of the feed table. The material falls in a heap

in the centre of the table, and as it revolves a portion of the material is guided by the scrapers away from the heap to the edge of the table, whence it falls on to a conveyor and is taken to the mills. The heap in the centre is at once replenished from the feed pipe, and the size of the heap, and therefore the quantity removed by the scraper, is regulated by the height of the adjustable collar of the feed pipe above the table.

The mills used for grinding the clinker are of the same types as those described for the grinding of the raw materials. The type most frequently used for clinker grinding in modern plant in Britain is the compound mill, which is usually 7 or 8ft. in diameter and 30 to 40ft. long.

The fineness of Portland cement was formerly universally specified as percentages passing very fine mesh testing sieves, but there is a tendency to drop sieve sizes and specify "specific surface area," which is the calculated surface area in square centimetres per gram.

Storing and Packing.—Finished cement from the grinding mills is conveyed to storage bins or silos by belt conveyors, screw conveyors, bucket elevators, or in recent installations by a screw conveyor-compressed air device known as a cement pump, which delivers through piping a steady flow of cement suspended in or made fluid by air. Storage bins are generally cylindrical reinforced-concrete silos, holding 12,000 to 15,000bbl. (2,500 to 3,000 tons) each. Storage was originally considered desirable to "season" the cement. This is no longer essential with a properly made cement, but storage of as much as one-fourth to one-half the annual capacity of the plant is desirable in order to provide continuous and economic operation. Moreover, large purchasers demand that the cement be held and tested before shipment, and some tests require 30 days' time.

The cement is withdrawn from the silos by screw conveyors or cement pumps and conveyed to small bins serving packing machines, or is conveyed directly to spouts or pipes for bulk shipment in specially designed railway cars, barges, and motor trucks. Most of the cement nowadays is packed in cotton or paper valve bags, which in the United States hold 94lb. net, or approximately one cubic foot of cement. The tops of the bags or sacks are tied or sealed before filling and a turned-in corner, or valve, on the bottom provides the opening for slipping the bag over the spout of the bag-packing machine. These machines utilize the principle that cement flows freely when the proper amount of compressed air is injected into the feeding device. A single operator can manipulate three to four loading spouts. The flow of cement into the bags is automatically cut off when the proper weight is reached, the material in the bag closes the corner valve, and the bag drops off to a belt conveyor below. The empty bags must be slipped over the filling spout by the operator. In one type of machine this is the only manual part of the operation. Cotton bags are returned to the cement manufacturer (a discount being allowed on the purchase price for their return), and are reused many times.

Cement for export is often packed in wooden barrels or steel containers, which stand on scales while being filled. Originally all cement was shipped in barrels, the standard American barrel holding 376lb. net. Four bags therefore are equivalent to one barrel. The fact that the trademarks or brands of the older cement companies are circular designs is because they were intended to be used on barrel heads.

Lay-out of Works.—For the purpose of economy and efficiency, considerable care must be exercised in the "lay-out" of the works, so that the raw materials and coal are delivered at the places where they are to be used, and the clinker and cement stores are in the proper position for the minimum handling of these materials.

Analysis and Tests.—Drafting specifications to insure quality of Portland cement is complicated because qualities most desired are physical—workability, strength, durability, impermeability, and density in the mortar and concrete made with cement—and these may be obtained with cements of various chemical compositions. After years of argument, the Cement Committee of the American Society for Testing Materials by 1939 had reduced its specifications to simple form covering only the following factors: (1) chemical limits; (2) soundness; (3) time of setting; (4) tensile strength; (5) packaging and marking; (6) storage; (7) inspection; (8) rejection; (9) methods of testing.

The chemical limits are that the cement shall show on testing amounts not greater than indicated with the respective tolerances in the following table:

	Limits (%)	*Tolerances* (%)
Loss on ignition	4·00	0·25
Insoluble residue	0·85	0·15
Sulphuric anhydride (SiO_3)	2·00	0·10
Magnesia (MgO)	5·00	0·40

The A.S.T.M. soundness test consists of subjecting a pat of neat cement (cement mixed with water) to five hours' steaming. The pat must not distort, crack, check, or disintegrate. A soundness test used by American cement manufacturers in their own laboratories for control purposes, and one included in many specifications, consists of subjecting one-inch square bars of neat cement, usually 10 inches long, to an autoclave test with steam at 350lb. pressure for three hours. The bar should not disintegrate, or expand in length over 1% (although no limit has been fixed). Elsewhere than in the United States, the Le Chatelier test is widely used, wherein the expansion of neat cement moulded in a small brass cylinder, after immersion in boiling water for three hours, is measured. The chief causes of unsoundness of cement are assumed to be free, dead-burned, or uncombined lime and magnesia which remain unhydrated for a long time at ordinary temperatures.

Time of setting as determined by a Vicat needle must not be less than 45 minutes, or by a Gillmore needle 60 minutes. In this test the penetration of a weighted needle during the setting period is the criterion. The final set must be attained within ten hours.

The strengths of mortar specimens made of one part of cement and three parts of standard sand, according to the A.S.T.M. specifications for standard Portland cement, must equal or exceed the following:

Age in days	Storage of specimen	Tensile strength Pounds per sq.in.
7	1 day in moist air 6 days in water	275
28	1 day in moist air 27 days in water	350

For High Early Strength Portland cement the following:

Age in days	Storage of specimen	Option No. 1 Tensile strength P.S.I.	Option No. 2 Compressive strength P.S.I.
1	1 day in moist air	275	1,300
3	1 day in moist air 2 days in water	375	3,000

This was not considered necessary in the A.S.T.M. specifications for several years prior to 1940. In that year new specifications were adopted covering five types of Portland cement, with requirements for fineness varying from minimums 1600 sq.cm. per gram to 1800. While the A.S.T.M. specifications do not designate these five varieties of Portland cement by other names than type I, type II, etc., they conform closely to the five varieties defined by the U.S. Bureau of Reclamation in the table on page 110, except that the order is different: Type I is so-called "standard" cement; type II, "modified"; type III, "high early strength"; type IV, "low heat of hydration"; type V, "sulphate resisting." Modern cements are ground to sizes measured in microns rather than openings of the finest wire sieves, yet specifications requiring from 92 to 98% to pass a 200-mesh sieve (200 meshes to the linear inch, or openings of 74 microns on a side) are common—in some instances to insure that a small percentage be retained on the sieve and the cement be not too finely ground. Many specifications define required fineness in terms of specific surface area per gram, as 1,700 sq.cm. (calculated on the assumption that the particles are spheres). This estimation is made by use of an instrument known as a turbidimeter, which determines the turbidity of a suspension of cement in some non-reactive liquid medium, such as kerosene, by measuring the intensity of light penetrating the suspension. Determination of the approximate percentages of the various sizes of particles is also made by use of an elutriator using either a liquid or air medium.

Composition.—The essential chemical components of Portland cement are the oxides of calcium, silicon, aluminium and iron—CaO, SiO_2, Al_2O_3, Fe_2O_3. As a result of adding gypsum to control the setting time SO_3, sulphuric anhydride, is also present. Other constituents such as magnesium oxide (MgO) and compounds of sodium and potassium are usually present in small amounts. Chemical analyses are made in terms of these oxides, although they do not exist in unhydrated cement as simple oxides but are in complicated com-

binations brought about by partial melting, forming liquid and solid solutions and subsequent cooling to phase equilibrium, depending not only on the proportions of the various oxides but on the temperatures of the melt and of that of the "freezing" or crystallization. It is therefore possible to obtain cements with quite different characteristics from the same proportions of the essential oxides. The chemical analysis of a typical Portland cement is given by Lea and Desch as follows:

Lime, CaO	64.10%
Silica, SiO_2	22.90%
Alumina, Al_2O_3	4.50%
Iron Oxide, Fe_2O_3	3.11%
Magnesia, MgO	0.79%
Rutile, TiO_2	0.24%
Sodium oxide, Na_2O	0.54%
Potassium oxide, K_2O	0.64%
Sulphuric Anhydride, SO_3	2.37%
Loss on ignition by difference	0.81%

From this analysis it is possible, by certain assumptions, to calculate the probable compound composition in the quaternary system $CaO.Al_2O_3.SiO_2.Fe_2O_3$ as

$4CaO.Al_2O_3.Fe_2O_3$	9·5%	$3CaO.SiO_2$	42.0%
$3CaO.Al_2O_3$	6·7%	$2CaO.SiO_2$	34.0%

The two latter, tricalcium silicate and dicalcium silicate, are the most essential and useful. Their actual identification can be made only by microscopic or X-ray analysis.

Uses of Portland Cement.—The demand for Portland cement for use in structural work continues to grow, and, in addition to this, Portland cement is being used for an increasing variety of purposes (*see* CONCRETE), which can only be briefly mentioned. Concrete, sometimes reinforced with iron or steel, is being used for all big structural buildings, engineering works, harbours, docks, ships, piers, bridges, piles, general building, artificial stone, roads (both foundation and surface), water towers, natatoria, lakes, etc., and the facility with which the concrete can be placed in any position and the fact that local stone and sand can frequently be used to the extent of 5 to 10 parts to 1 of cement are very important points with regard to cost of labour and carriage, as compared with that of stone. Concrete is also used for smaller articles such as telegraph poles, railway signal posts, sleepers, fencing posts, monuments, tombstones, coffins, troughs of various kinds, tiles, bricks, pipes (spun and moulded), paving blocks, manhole covers, etc. Very considerable developments have also been made in the use of cement for ornamental work, including not only that required for buildings, but sculptural work of all description, both large and small; and by the introduction of various aggregates, excellent substitutes for different ornamental stones have been made, frequently having improved weathering properties. Portland cement is particularly useful where there is much repetition of ornamental work, *e.g.*, for the capitals of pillars, tracery, etc. In the case of stone each piece must be carved separately, whereas a few moulds will be sufficient for a large number of blocks of cement concrete.

Theory of Setting.—The reason for the setting and hardening of Portland cement continues to afford abundance of scope for fascinating research work. The comparatively simple ternary system of the lime-silica-alumina group becomes very complicated through thermal changes which are very dependent on the temperature from which the clinker is cooled, and also on the rate of cooling. Moreover, the balance of solution of the various constituents is modified by the different impurities included in the clinker. In addition to this there is some evidence that the constituents of the cement itself tend to acquire a more stable condition on storage. The investigation of the setting and hardening of cement is still more difficult. The simple hydration theory of earlier days has, on closer investigation, resolved itself into an extremely complex system which includes an infinite number of partially hydrated compounds, together with the formation of new compounds. A large amount of research work has been carried out on fairly pure preparations of the various silicates and aluminates of lime with good results; but their value is restricted because very different and complex action takes place when they are mixed, which accounts for the widely differing results obtained by the most recent research. Some of the above compounds have helped in the identification of some of the constituents in set cement, *e.g.*, small hexagonal plate crystals of tricalcium aluminate, fine needle crystals of mono-calcium silicate, colloidal masses of mono-calcium silicate, large hexagonal crystals of calcium hydrate, etc., and apparently the colloidal mono-calcium silicate plays a large part in the hardening of the cement. Thus the two schools of theorists—the crystalline and colloidal—are being brought together. Although no final conclusions have been reached, the general results of these investigations have been valuable and have resulted in a very marked improvement in the quality of Portland cement.

OTHER CEMENTS

Rapid-hardening Cements.—The demand for speed in construction during recent years has resulted in the development of the aluminous type cements—those high in alumina. They differ from Portland cements in the proportions of lime, silica, and alumina; the lime varying from 36.5 to 44%, the silica from 4.5 to 9.5%, and the alumina from 36.5 to 44%. Since impure bauxite is the source of the alumina there is usually a considerable percentage of iron present as Fe_2O_3, sometimes as much as 14%. Such cements develop tensile strengths in 1:3 mortar briquettes of over 500 p.s.i. in 1 day, or as much as ordinary Portland cement briquettes in 28 days. Concrete made with these cements is more resistant to the action of sea water and sulphate waters than that made with ordinary Portland cement. It also has refractory properties. It hydrates with the release of much more heat than Portland cement, and for that reason is not suitable for mass concrete under ordinary conditions. It has been used quite successfully for winter concrete construction because its heat of hydration delays freezing and because it hardens so rapidly. Aluminous cements, like Portland cement, are made in rotary kilns and also in electric furnaces. The melting or slagging in the formation of the clinker is carried farther than in the manufacture of Portland cement, and it costs much more to produce.

The success of aluminous cements led to development of Portland cements that also harden rapidly—known in the United States, where most of this development has taken place, as High Early Strength Portland cements. With these it is possible to obtain 1-day strengths comparable to those of aluminous cements. They differ from standard Portland cement in having a higher tricalcium silicate ($3CaO.SiO_2$) content and are usually more finely ground. They also develop more heat of hydration than desirable for mass concrete.

Low-Heat Cements.—To avoid so far as possible cracks in great masses of concrete, which are caused by temperature changes during the hardening and curing period, a "low heat of hydration" Portland cement has been developed. It was first used on a large scale for the construction of the Boulder dam in Colorado river by the U.S. Bureau of Reclamation. These low-heat cements are characterized by high percentages of dicalcium silicate ($2Ca.SiO_2$) and tetracalcium alumino ferrite ($4CaO.Al_2O_3.Fe_2O_3$) and low percentages of tricalcium silicate ($3Ca.SiO_2$) and tricalcium aluminate ($3CaO.Al_2O_3$). While the actual criterion is low heat of hydration, which can be accurately determined by a special type of calorimeter, specifications used by the United States Government aim to secure the desired quality through chemical limitations, which require a high percentage of silica, low lime and both alumina and iron oxide low or present in such prescribed ratios that the calculated $3CaO.Al_2O_3$ shall be low (6 to 8%).

For similar massive concrete structures a "modified Portland cement" has been developed and is extensively used by the United States Government. The compound composition of "modified" cement is characterized by low tricalcium aluminate ($3CaO.Al_2O_3$) and high tetracalcium alumino ferrite ($4CaO.Al_2O_3.Fe_2O_3$) with the percentages of tricalcium silicate ($3Ca.SiO_2$) and dicalcium silicate ($2CaO.SiO_2$) approximately the same as in standard Portland cement. The hydration of tricalcium aluminate is the cause of most of the undesired heat and the object is to combine the alumina in the less active tetracalcium alumino ferrite, although it is known that this component has little value as a cementing material.

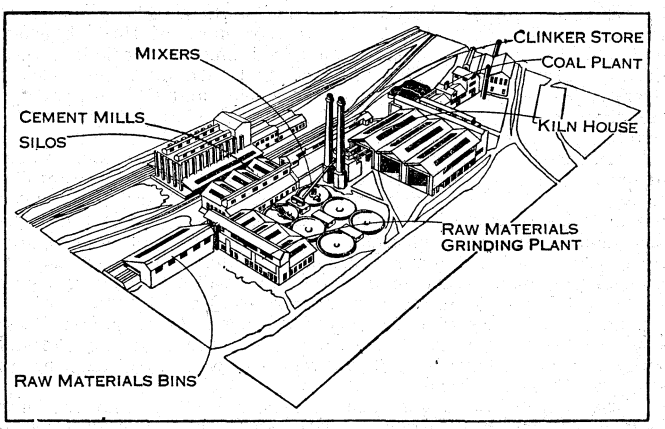


FIG. 2.—DIAGRAM OF LAYOUT OF A WET PROCESS CEMENT PLANT

The raw materials are ground to a slurry which is then pumped into the mixers and from there to the rotating kiln. In passing through the kiln it becomes dried, then decarbonated and finally, in the burning zone, clinkered. The white hot clinker passes through coolers, heating the air for the kilns, and when cool, is ground in tube mills.

Sulphate Resisting Cements.—For concrete structures in regions exposed to alkali soils and waters it has been found that ordinary Portland cements often proved unsatisfactory. Two types of cement have been developed to provide more resistant concrete. A Portland cement designed for this purpose is unusually high in tricalcium silicate ($3CaO.SiO_2$) and dicalcium silicate ($2CaO.SiO_2$) and unusually low in tricalcium aluminate ($3CaO.Al_2O_3$) and tetracalcium alumino ferrite ($4CaO.Al_2O_3.Fe_2O_3$), the sum of these two being less than for any other type of cement. It is difficult to manu-

facture because it is low in fluxing agents (alumina and iron). The second type of cement designed for sulphate resistance is "Portland-pozzolana." In the manufacture of these, Portland cement and a pozzolana, natural or artificial, are intimately mixed or ground together. A pozzolana is defined as a siliceous material which will react with lime in the presence of water at ordinary temperatures. Obviously, there are various degrees of pozzolanic activity. This type of cement has been much more extensively made and used in Europe than in the United States.

A comparison of the compound compositions of these cements (omitting the Portland-pozzolana) is given in the following table (from the *Concrete Manual,* U.S. Bureau of Reclamation), in which tricalcium silicate ($3CaO.SiO_2$) is designated, as is now common in cement literature, as C_3S; dicalcium silicate ($2CaO.SiO_2$) as C_2S; tricalcium aluminate ($3CaO.Al_2O_3$) as C_3A; tetracalcium alumino ferrite ($4CaO.Al_2O_3.Fe_2O_3$) as C_4AF:

Type of Cement		Compound Composition (Percentages)							Ignition loss
		C_3S	C_2S	C_3A	C_4AF	$CaSO_4$	Free CaO	MgO	
High Early Strength Portland	Max.	70	38	17	10	4·6	4·2	4·8	2·7
	Min.	34	0	7	6	2·2	0·1	1·0	1·1
	Average	56	15	12	8	3·9	1·3	2·6	1·9
Standard Portland	Max.	54	43	14	10	3·3	1·5	3·8	2·3
	Min.	29	22	9	6	2·2	0·0	0·7	0·6
	Average	43	31	12	8	2·8	0·8	2·4	1·2
Modified Portland	Max.	50	46	9	18	3·3	1·8	4·4	2·0
	Min.	29	22	3	10	1·9	0·1	1·5	0·5
	Average	43	30	6	13	2·9	0·6	3·0	1·0
Sulphate Resisting Portland	Max.	55	49	6	9	3·1	0·6	2·3	1·2
	Min.	35	27	4	5	2·7	0·1	0·7	0·8
	Average	43	40	5	7	2·9	0·4	1·6	1·0
Low Heat Portland	Max.	33	61	8	18	4·0	0·9	4·1	1·9
	Min.	10	41	3	6	2·5	0·0	1·0	0·0
	Average	21	51	6	14	3·2	0·3	2·7	1·1

White Cements.—White Portland cements are of approximately the same composition as standard Portland cements except that the iron oxide content is very low, and special care must be taken in processing to avoid contamination which would discolour the product. Cryolite and fluorspar are frequently used as fluxing agents. Suitable raw materials are quite scarce.

Portland Blast-Furnace Cement.—A type of cement made largely in Germany (Eisenportland) is a mixture of Portland cement clinker and granulated slag ground to the required fineness. It is a pozzolana cement, as understood in the United States. A similar cement, although not a true Portland, is made of a mixture of hydrated lime and granulated slag.

Masonry Cements.—A great variety of cements for brick and stone masonry have been developed to overcome the harsh-working handicap of ordinary Portland cement mortars. They consist of mixtures of Portland cement with one or more of the following: hydrated lime, granulated slag, pulverized limestone, colloidal clay, diatomaceous earth or other finely divided form of silica, calcium stearate, paraffin, etc. The various ingredients and their proportions are often kept secret or are patented and they are frequently described as "patent mortar cements."

Natural Cements.—In the United States the rapid development of the Portland cement industry was caused in large measure by discovery of large deposits of "natural cement" rock. The Lehigh valley is a notable example. These argillaceous limestones contain the necessary minerals for Portland cement manufacture in approximately the correct proportions. Later refinements in manufacture have made it necessary in some cases to add to the mix small quantities of higher grade limestones or to concentrate the calcium carbonate in the original stone by flotation. For many years cements made from these limestones in vertical shaft kilns, like lime, were used, and are still used to some extent, as natural cements, without attempting to simulate Portland cement.

Lime Cements.—These include various grades, from the pure "fat" white lime through the gray limes to the hydraulic limes which have already been referred to under Portland cement. White lime consists of oxide of calcium, or, in its slaked form, hydrate of calcium. It is prepared by calcining calcium carbonate (chalk or limestone) until all the carbonic anhydride has been driven off and only the oxide is left. This oxide (quicklime) has great affinity for water, with which it combines readily, forming calcium hydrate, or slaked lime. This action is exothermic, *i.e.*, gives out heat, and is very vigorous unless it is properly controlled. The dry slaked lime occupies two or three times the volume of the original quicklime, according to the method by which it is slaked. Gray lime is an impure form of white lime, and, according to the quantity and nature of the impurities, its properties vary between white lime and hydraulic lime. The latter differs from white or gray lime in that, owing to the amount of argillaceous material contained in it, the lime slakes comparatively slowly, and when used for making mortar is capable of hardening under water.

Lime, probably on account of its long history, is frequently made in the simplest form of kiln, the bottle kiln, which is extremely extravagant with both coal and labour, particularly if white lime is being produced, as this must be kept free from the ash of the fuel. Various other kilns, such as those described under Portland cement, are also used, but the rotary kiln is now in very general use for limestone burning, fired either with producer gas or with pulverized coal, and lime is obtained from this kiln with great economy of labour and fuel, provided the raw material is sufficiently pure. Another great advantage of this kiln is that it will take "smalls," *i.e.*, material which is so small that it would choke a stationary kiln, and therefore has to be rejected. On the other hand, a rotary kiln is not suitable for burning large lumps of chalk or limestone, and as there is a certain demand for large lumps of lime (probably because of the uncertain quality of the fine stuff in the earlier days), it is still necessary to use fixed kilns if this demand is to be met.

Lime, before it is used for mortar, must be slaked, and this was formerly done at the place where it was to be used. On account of the irregular way in which this was sometimes carried out, portions of the less pure lime used to slake and expand after the mortar had been used and cause the work to "blow." To overcome this trouble, architects and others frequently specify that the mortar should be made up 2 or 3 months before use. This method of overcoming the difficulty was at the expense of the strength of the finished mortar, for the lime was carbonating and deteriorating during this period. The modern method is to slake the lime mechanically at the lime works and remove the slaked lime from the unslaked by air separation. The slaked lime is then stored in bulk for 10 to 14 days, after which it is ready for use, yielding a lime which is free from any risk of "blowing," and at the same time retaining its hardening properties unimpaired.

Mortar made from white lime and the purer forms of gray lime works very easily under the trowel, and, if necessary, can be floated off to a very smooth surface for facing walls, etc., and on account of this property the white lime is frequently spoken of as "fat" lime because it is supposed to suggest the smoothness of butter. Experiments have been made to improve the lime for mortar purposes, etc., by the addition of various substances to the water used for slaking, or to the slaked lime.

The setting of white lime and gray lime is largely due to "drying out," and to a small extent calcium hydrate recrystallization. The hardening appears to be almost entirely due to the lime combining with the carbon dioxide in the air and forming calcium carbonate, although this is sometimes assisted by a slight pozzolanic effect of the silica in the sand or other material used with the lime. In hydraulic lime the setting and hardening properties are due to a combination of the above with that of those constituents which are similar to Portland cement. For most purposes Portland cement has taken the place of hydraulic lime; but there are still certain conditions where the latter is preferable to the former, particularly for embedding large steel sections, where the hardening effect should not take place until the steel has finally settled into position.

Selenitic Cement.—The addition of 5 to 10% of plaster of Paris to lime increases the hardening properties of the latter by 50 to 100%, and this mixture is sometimes known as Selenitic cement.

Pozzolanic Cement.—Lime, in the presence of water, readily combines with silica in the active state and forms a calcium silicate similar to that in Portland cement. Various natural and artificial materials, such as pozzolana, trass, kieselguhr, pumice, tufa, santorin earth, granulated slag, etc., contain active silica, and where the cost is low they make a useful addition to lime mortar. To obtain the best effect the granulated slag, or other material, should be ground with the lime until both materials are in a fine state of division and intimately mixed. When properly made, pozzolanic cements will attain a strength approaching that of Portland cement; but frequently the material is simply mixed with the lime, and the bulk of the pozzolanic material acts as an aggregate instead of an active constituent of the cement.

Calcium Sulphate Cements.—This class includes all those cements which primarily depend on the hydration of calcium sulphate for their setting and hardening properties, and includes plaster of Paris, Keene's cement, Parian cement, etc. The raw material is gypsum (*q.v.*), which may be almost chemically pure, in which case it is suitable for Keene's cement and other special brands, or may contain a small quantity of foreign matter, when it is suitable for ordinary plaster of Paris. The mode of preparation is to calcine the gypsum at a comparatively low temperature, viz., about 205° C for plaster of Paris, at which temperature the gypsum loses three-fourths of its combined water, and at about 500° C for the Keene's cement class, when the whole of the combined water is driven off. At a higher temperature the gypsum becomes "dead burned" and will then only hydrate very slowly, or in some cases not at all. The gypsum for plaster of Paris is usually calcined either in ovens or in kettles, and for Keene's cement in kilns, where the ash of the fuel can be kept away from the finished product. These methods are inferior in economy to the rotary kiln, and this type of kiln will probably be the method of the future, as, if fired with producer gas, the product is not contaminated with ash. The setting of plaster of Paris depends on the fact that when $2CaSo_4.H_2O$ is treated with water it dissolves,

forming a super-saturated solution of $CaSO_4.2H_2O$. The excess held temporarily in solution is then deposited in crystals of $CaSO_4.2H_2O$. In the light of this knowledge the mode of setting of plaster of Paris becomes clear. The plaster is mixed with a quantity of water sufficient to make it into a smooth paste; this quantity of water is quite insufficient to dissolve the whole of it, but it dissolves a small part and gives a super-saturated solution of $CaSO_4.2H_2O$. In a few minutes the surplus hydrated calcium sulphate is deposited from the solution and the water is capable again of dissolving $2CaSO_4.H_2O$, which in turn is fully hydrated and deposited as $CaSO_4.2H_2O$. The process goes on until a relatively small quantity of water has by instalments dissolved and hydrated the $2CaSO_4.H_2O$, and has deposited $CaSO_4.H_2O$ in felted crystals forming a solid mass well cemented together. The setting is rapid, occupying only a few minutes, and is accompanied by a considerable expansion of the mass. There is reason to suppose that the change described takes place in two stages, the gypsum first forming orthorhombic crystals and then crystallizing in the monosymmetric system. Gypsum thus crystallized in its normal monosymmetric form is more stable under ordinary conditions than the orthorhombic form. Correlatively, in its process of dehydration to form plaster of Paris, monosymmetric gypsum is converted into the orthorhombic form before it begins to be dehydrated. The essential difference between the setting of Keene's cement and that of plaster of Paris is that the former takes place much more slowly, occupying hours instead of minutes, and the considerable heating and expansion which characterize the setting of plaster of Paris are much less marked.

It is the practice in Great Britain to burn pure gypsum at a low temperature so as to convert it into the hydrate $2CaSO_4.H_2O$, to soak the lumps in a solution of alum or of aluminium sulphate, and to recalcine them at about 500° Centigrade. Instead of alum various other salts—borax, cream of tartar, potassium carbonate, etc.—may be used. On grinding the recalcined lumps they give Keene's cement, Parian cement, Keating's cement, etc. The quantity of these materials is so small that analyses of Keene's cement show it to be almost pure anhydrous calcium sulphate, and make it difficult to explain what, if any, influence these minute amounts of alum and the like can exert on the setting of the cement.

These cements form excellent decorative plasters on account of their clean white colour and the sharpness of the castings made from them, this latter quality being due to their expansion when setting. Keene's cement is especially adaptable for surfaces where a hard polished finish is required. All cements having calcium sulphate as their base are suitable only for indoor work because of their solubility in water.

Oxychloride Cements.—In 1853 Sorel discovered that zinc chloride solution, when mixed with zinc oxide, formed a very hard cement, and later he found that magnesium chloride, magnesia and various other metallic oxides and chlorides did the same, an oxychloride being formed in each case. Of these the most important is the magnesia oxychloride, commonly known as Sorel cement, and on account of its great strength and unusual binding properties it is used for such widely different purposes as uniting carborundum for grindstones, where great strength and rigidity are required, and binding wood sawdust together to form monolithic floors which have a certain amount of spring in them. It is also used for making artificial marble and other ornamental stone, and if cast on glass which has been waxed to prevent adhesion the material, on removal of the glass, will have a highly glazed surface.

The magnesia, which should be freshly calcined and ground, is mixed with several times its volume of carborundum, wood sawdust, sand or other material, and is then moistened with a solution of magnesium chloride having a density of 25°–30° Baume, and thoroughly mixed so that each grain of material is covered with the magnesia oxychloride. The plastic mass is then put into moulds, or placed in position and "floated" off. The speed of setting and hardening is dependent on the freshness of the magnesia and the strength of the solution of the magnesium chloride, and when the right strength has been found for any particular batch of materials this should be rigidly adhered to for the work.

Adhesive Cements.—Mixtures of animal, mineral and vegetable substances are employed in great variety in the arts for making joints, mending broken china, etc. A strong cement for alabaster and marble, which sets in a day, may be prepared by mixing 12 parts of Portland cement, 8 of fine sand and 1 of infusorial earth, and making them into a thick paste with silicate of soda; the object to be cemented need not be heated. Casein, with some solvent, usually an alkali, forms the basis of many waterproof cements and cold water glues. For stone, marble and earthenware a strong cement, insoluble in water, can be made as follows:—skimmed-milk cheese is boiled in water till of a gluey consistency, washed, kneaded well in cold water, and incorporated with quicklime; the composition is warmed for use. A similar cement is a mixture of dried fresh curd with one-tenth of its weight of quicklime and a little camphor; it is made into a paste with water when employed. A cement for Derbyshire spar and china, etc., is composed of 7 parts of rosin and 1 of wax, with a little plaster of Paris; a small quantity only should be applied to the surfaces to be united, for, as a general rule, the thinner the stratum of cement the more powerful its action. Quicklime mixed with white of egg, hardened Canada balsam, and thick copal or mastic varnish are also used for cementing broken china, which should be warmed before their application. For small articles, shellac dissolved in spirits of wine is a very convenient cement. Cements such as marine glue are solutions of shellac, india-rubber, or asphaltum in benzine or naphtha. For use with wood which is exposed to moisture, as in the case of wooden cisterns, a mixture may be made of 4 parts of linseed oil, boiled with litharge, and 8 parts of melted glue; other strong cements for the same purpose are prepared by softening gelatine in cold water and dissolving it by heat in linseed oil, or by mixing glue with one-fourth of its weight of turpentine, or with a little bichromate of potash. *Mahogany cement,* for filling up cracks in wood, consists of 4 parts of beeswax, 1 of Indian red, and yellow ochre to give colour. *Cutler's cement,* used for fixing knife blades in their hafts, is made of equal parts of brick-dust and rosin, melted, or of 4 parts of rosin with 1 each of beeswax and brick-dust. For covering bottle corks a mixture of pitch, brick-dust and rosin is employed. A cheap cement, sometimes used to fix iron rails in stonework, is melted brimstone, or brimstone and brick-dust. For pipe-joints a mixture of iron turnings, sulphur and sal ammoniac, moistened with water, is employed. *Japanese cement,* for uniting surfaces of paper, is made by mixing rice-flour with water and boiling it. *Jewellers'* or *Armenian cement* consists of isinglass with mastic and gum ammoniac dissolved in spirit. Gold and silver chasers keep their work firm by means of a cement of pitch and rosin, a little tallow and brick-dust to thicken. *Temporary cement,* for lathe-work, such as the polishing and grinding of jewellery and optical glasses, is compounded thus:—rosin, 4oz., whitening previously made red hot, 4oz., wax, ¼oz.

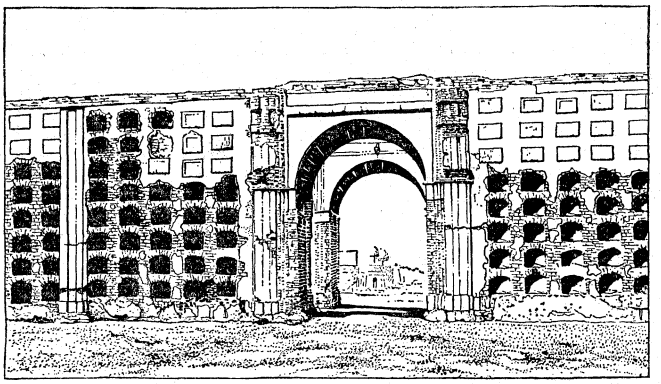
BIBLIOGRAPHY.—F. M. Lea and C. H. Desch, *The Chemistry of Cement and Concrete* (1935); D. B. Butler, *Portland Cement* (3rd ed., 1913); B. Blount, W. H. Woodcock and H. J. Gillett, *Cement* (1920); E. A. Dancaster, *Limes and Cements* (2nd ed., 1920); E. C. Eckel, *Cements, Limes and Plasters* (3rd ed., New York, 1928); A. C. Davis, *Portland Cement* (1934) and *A Hundred Years of Portland Cement* (1924); G. R. Redgrave and C. Spackman, *Calcareous Cements* (3rd ed., 1924); R. W. Lesley, J. B. Loker and G. S. Bartlett, *History of Portland Cement in the United States* (Chicago, 1925); R. W. Meade, *Portland Cement* (1938); H. L. Childe, *Manufacture and Uses of Concrete Products and Cast Stone* (1927); *Everyday Uses of Cement* (Cement Marketing Co., London, 4th ed., 1921, rev. ed., 1928). *See* also *Concrete and Constructional Engineering,* London; *Rock Products, Cement and Engineering News,* Chicago; *Le Ciment,* Paris; and various publications of the Building Research station, London; the Mineral Industry, New York; the National Bureau of Standards, Washington, D.C. (W. H. Wo.; N. C. R.)

CEMENTATION, a metallurgical term which describes processes by which one substance is, by exposure to great heat in a furnace, caused to interpenetrate and change the character of another. Although a high temperature is employed, the process is not one of melting materials together, but of combining them through contact at a temperature which is below their melting-points. Thus, in the manufacture of blister steel by cementation, a rod of iron becomes steel because exposed at a temperature of about 1,000°C. to carbon which penetrates its substance. (*See* BLISTER STEEL; IRON AND STEEL.)

CEMETERY, literally a sleeping-place, the name applied by the early Christians to the places set apart for the burial of their dead. These were generally extra-mural and unconnected with churches, the practice of interment in churches or churchyards being unknown in the first centuries of the Christian era. The term cemetery has, therefore, been appropriately applied in modern times to the burial-grounds, generally extra-mural, which have been substituted for the overcrowded churchyards of populous parishes both urban and rural (*see* BURIAL).

From 1840 to 1855, attention was repeatedly called to the insanitary condition of the London churchyards by the press and by parliamentary committees, the first of which reported in 1843. The vaults under the pavements of the churches, and the open ground surrounding them, were crammed with coffins. Coffins were placed tier above tier in the graves until they were only just below the surface. To make room for fresh interments the sextons had recourse to the surreptitious removal of bones and partially-decayed remains. The neighbourhood of the churchyards was usually unhealthy. In all the large towns the evil prevailed more or less, but in London it forced itself more readily upon public attention, and after more than one partial measure of relief had been passed the churchyards were, with a few exceptions, finally closed by the act of 1855, and the cemeteries which now occupy a large extent of ground to the north,

south, east and west became henceforth the burial-places of the metropolis. Several London cemeteries had been established by private enterprise before the passing of the Burial Act of 1855 (Kensal Green cemetery dates from 1832), but that enactment forms the epoch from which the general development of cemeteries in Great Britain and Ireland began. Burial within the limits of cities and towns is now almost everywhere abolished,



BY COURTESY OF THOMAS F. LEE

COMMUNAL VAULTS, GUATEMALA

In these concrete walls with rows of receptacles for coffins, the remains of the dead are left intact so long as rent is paid. On failure to pay the rent, the bones are removed and buried in a common heap, and the "pigeon hole" is rented again

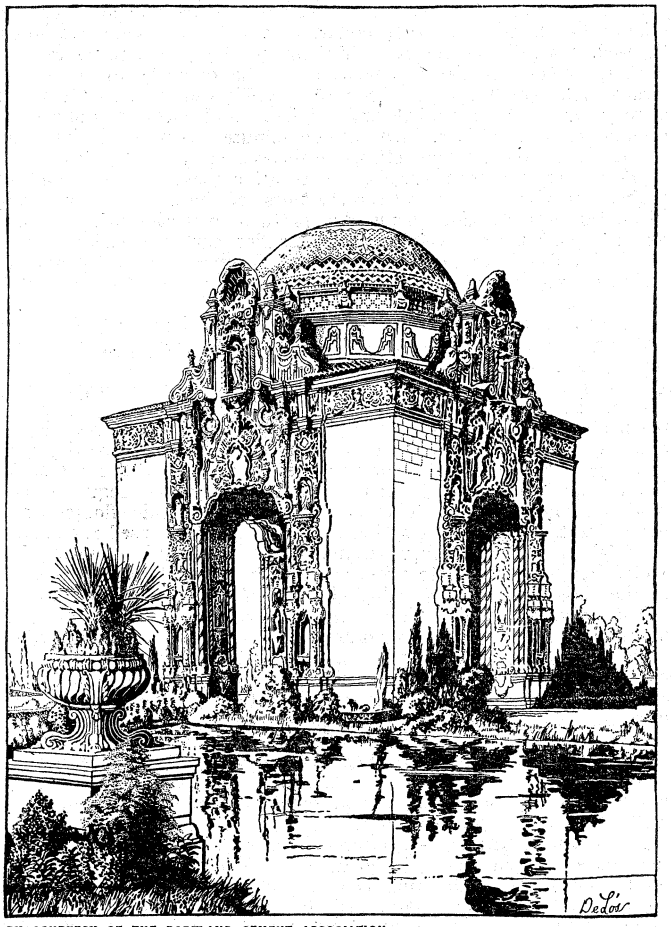
and where it is still in use it is surrounded by such safeguards as make it practically innocuous. The increasing practice of cremation (*q.v.*) has assisted in the movement for disposing of the dead in more sanitary conditions; and the practice of burying the dead in more open coffins, and abandoning the old system of family graves, has had considerable effect.

In England a cemetery is either the property of a private company incorporated by Act of Parliament or of a local authority and is subject to the Cemeteries Clauses Act 1847, the Public Health Act, 1875 and the Public Health (Interments) Act, 1879. By S. 33 of the Burial Act, 1852, a burial board under such conditions as it thinks proper may sell the exclusive right of burial, either in perpetuity, or for a limited period, in grave spaces; the right of constructing any vault or place of burial with the exclusive right of burial therein in perpetuity, or for a limited period; and also the right of erecting and placing any monument, gravestone, tablet or monumental inscription. By S. 38 the general management, regulation and control of a burial ground is vested in the burial board. Regulations are made by the Minister of Health and Rules may be made by the board. By S. 44 of the Cemeteries Clauses Act 1847 the grant of the right of burial, whether in perpetuity or for a limited time, becomes the personal estate of the grantee. Under such a grant there is implied the right to visit the grave, and to plant shrubs and plants and to keep the surface in order, and if there is a monument, head or curb stones to keep them in repair (see *Ashby* v. *Harris* [1868] L.R. 3 C.P. 523). This case was discussed, but not overruled in *McGough* v. *Lancaster Burial Board* (1888) 21 Q.B. D. 323 where, in consequence of a rule of the board, made prior to the grant, prohibiting the placing of glass shades on graves, it was held that the grant of burial in a grave space to the plaintiff did not include a right to place a glass shade on his grave. Although a burial board cannot sell the freehold of a grave space, the property in a vault, tomb, monument, headstone, curb or any other erection remains in the person who erected them. See *Spooner* v. *Brewster* (1825) 3 Bing. 136 and *Sims* v. *The London Necropolis Co.* (1885) 1 T.L.R. 584; but *see* also *Hoskyns Abrahall* v. *Paignton U.D.C.* (1928) 2 Ch. (*See* J. B. Little, *Law of Burial,* 1902.)

UNITED STATES

In the United States cemeteries were the final outgrowth of individual burial places on the farms or near the homes of the earliest settlers. Later the burial place was connected with the church, which custom is not entirely obsolete. Prominent men were buried beneath the church building for a long time during the 17th and 18th centuries, but the crowded conditions together with the fact that the practice was recognized as unsanitary caused it to be abandoned. In villages and small towns the church "graveyards" grew into disrepute many years ago because of the neglect they were subjected to. There was no provision for care of such burial places, except the slight attention a sexton would give, and disorder resulted. Detached cemeteries have been in use in the United States since 1831 when Mt. Auburn was established in Boston. Philadelphia soon after set up some notable large burial places and Greenwood in New York had its beginning in 1840. From 1860 churchyard burials have gradually been discontinued until to-day they are but exceptions to the rule of beautiful community cemeteries. From single burial plots on private property, to church graveyards, to cemeteries and now to "memorial parks" has been a notable transition.

During the days when cemeteries were maintained by and in connection with the church, members and their families were entitled to a burial site. No expense was attached to the burial except the cost of opening the grave. No funds were available for upkeep which accounts for the deterioration of the property, and the ultimate abandoning of that type. In the cemeteries of to-day lots are sold by the city or village, if owned by such a body, or by the association, which has charge. A definite fee is charged for perpetual care and a charge is made for opening the grave and



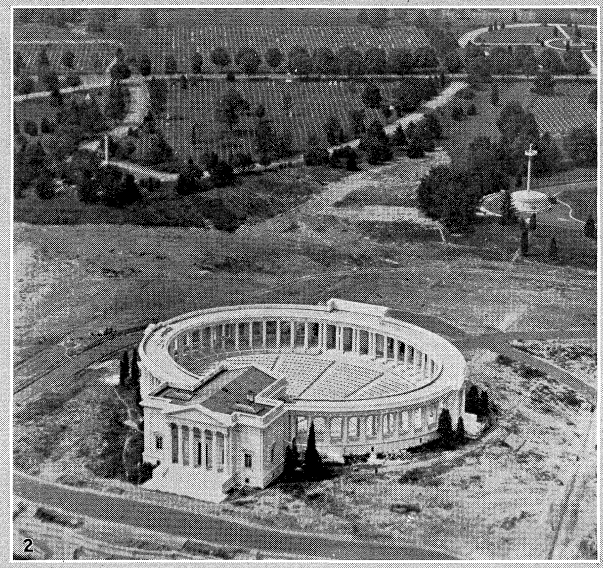
BY COURTESY OF THE PORTLAND CEMENT ASSOCIATION

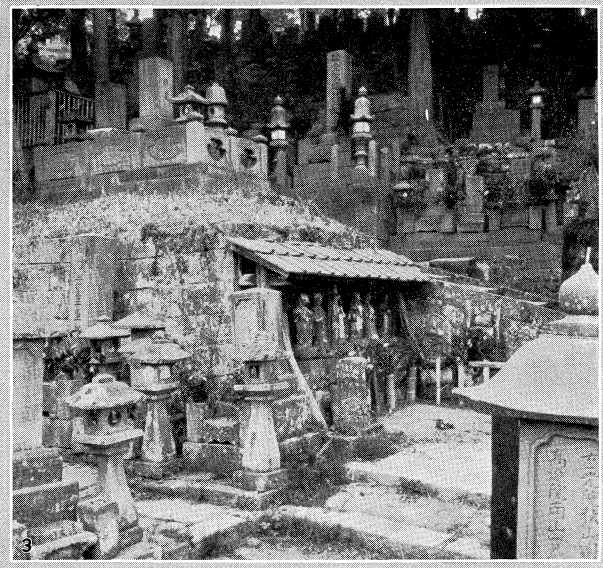
ENTRANCE TO VALHALLA MEMORIAL PARK IN BURBANK, CALIFORNIA

other duties performed by the sexton or superintendent. Generally speaking cemeteries are supposed to be maintained with no idea of profit, and that holds good in a great majority of places.

Some churches have their own cemeteries, though not in connection with the church, notably the Catholic church. The Jews have many beautiful burial sites, and now and then one comes across a cemetery maintained by one or another of the Protestant societies. Throughout the country there are many beautiful cemeteries maintained by the Masonic or other fraternities for their own members and members of their families. There are many

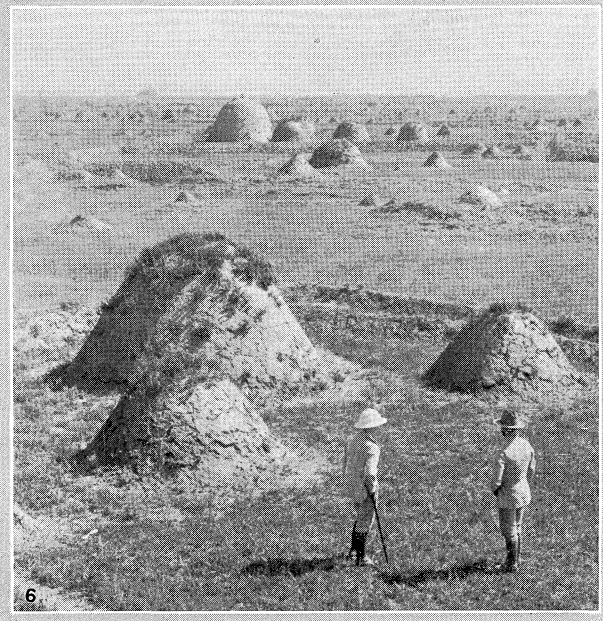












PHOTOGRAPHS, (1, 4) PUBLISHERS PHOTO SERVICE, (2, 6) UNDERWOOD AND UNDERWOOD, (3, 5) BURTON HOLMES FROM EWING GALLOWAY

CEMETERIES IN THE EAST AND WEST

1. Palestine, Jewish cemetery in the Garden of Gethsemane, valley of Jehoshaphat, showing tombs of S. James, Absalom and Zachariah in the foreground
2. Amphitheatre at Arlington National Cemetery, Washington, D.C., showing soldiers' graves in the background
3. Cemetery in Matsue, Japan
4. Indian graves in southern Chile
5. Talma's tomb in the Père Lachaise cemetery, Paris
6. Graveyard of the Ages, in Canton, southern China

State and national cemeteries in the United States provided by statute, given over to the burial of departed army and navy men, and men connected with State institutions, usually attached to soldiers' homes or army posts.

CENACLE, the term applied to the eating-room of a Roman house in which the supper (*cena*) or latest meal was taken. It was sometimes placed in an upper storey. The Last Supper in the New Testament was taken in the cenacle, in the "large upper room" cited in St. Mark (xiv. 15) and St. Luke (xxii. 12).

CENCI, BEATRICE (chĕn'chē) (1577–1599), a Roman woman, famous for her tragic history, was born on Feb. 6, 1577, in the Cenci palace in Rome. She was the daughter, by his first wife, of Francesco Cenci (1549–1598), a vicious man of great wealth. He was tried in 1594 for sodomy, but was released on payment of a fine of 100,000 scudi. Cenci had 12 children by his first wife; his second wife, Lucrezia Petroni, a widow with three daughters, brought him no children. He was embroiled with his sons and after the trial he decided to remove his wife Lucrezia, with Beatrice, to La Petrella, a lonely castle on the road to Naples which he obtained from Marzio Colonna. There in 1595 he shut up his wife and daughter in the upper rooms of the castle, and there he visited them from time to time treating them, especially Beatrice, with great brutality. There is no evidence for the charge of attempted incest with his daughter, but the details of life at La Petrella, as given in the subsequent trial, were revolting, and might well have given colour to the accusation. Beatrice seems to have found refuge in a liaison with the keeper of the castle, Olimpio Calvetti. At intervals the two younger Cenci children, Bernardo and Paolo, visited La Petrella. Olimpio was expelled by Colonna from the castle at the demand of Francesco Cenci, who does not, however, seem to have known of his relations with Beatrice. At length, Beatrice, with her stepmother and with her brother Giacomo and Bernardo, decided to secure the murder of their father. He was killed in his bed (Sept. 9, 1598) by Olimpio and a hired assassin named Marzio.

Information having been communicated to Rome, the whole of the Cenci family were arrested early in 1599. Lucrezia, Giacomo and Bernardo confessed the crime; and Beatrice, who at first denied everything, even under torture, also ended by confessing. Great efforts were made to obtain mercy for the accused, but the pope (Clement VIII.) refused to grant a pardon; on Sept. 11, 1599, Beatrice and Lucrezia were beheaded, and Giacomo, after having been tortured with red-hot pincers, was killed with a mace, drawn and quartered. Bernardo's penalty, on account of his youth, was commuted to perpetual imprisonment, and after a year's confinement he was pardoned. The property of the family was confiscated. There is a study by Guido Reni or Guercino in the Palazzo Barberini said to represent Beatrice, but it is unlikely that Reni saw her.

The history of the Cenci family has been the subject of poems, dramas and novels. Shelley found in it material for his great tragedy. The most famous of the novels is F. D. Guerrazzi's *Beatrice Cenci* (Milan, 1872). The first attempt to deal with the subject on documentary evidence is A. Bertolotti's *Francesco Cenci e la sua famiglia* (2nd ed., Florence, 1879), containing a number of interesting documents which place the events in their true light; *cf.* Labruzzi's article in the *Nuova Antologia,* 1879, vol. xiv., and another in the *Edinburgh Review,* Jan. 1879. *See* also C. Ricci, *Beatrice Cenci,* 2 vols. (1923), where new documents and new information are to be found.

CENOBITES, monks who lived together in a convent or community under a rule and a superior—in contrast to hermits or anchorets who live in isolation (from Gr. *κοινός, common,* and *βίος, life*). *See* MONASTICISM.

CENOMANI (Kĕn-ŏ-mah'nē), a branch of the Aulerci in Gallia Celtica, whose territory corresponded generally to Maine (department of Sarthe). Their chief town was Vindinum, afterwards Civitas Cenomanorum (whence Le Mans). They assisted Vercingetorix in the great rising (52 B.C.) with a force of 5,000 men. Under Augustus they formed a *civitas stipendiaria* (tributary community) of Gallia Lugdunensis. About 400 B.C., under the leadership of Elitovius (Livy v. 35), a large number of the Cenomani crossed into Italy, drove the Etruscans southwards, and occupied their territory. The limits of their territory are not clearly defined, but were probably the Adige on the east, the Addua on the west and the Padus (Po) on the south. Their chief towns were Brixia (Brescia) and Verona. They assisted the Romans in the Gallic war (225 B.C.), when the Boii and Insubres took up arms against Rome, and during the war against Hannibal. They joined in the revolt of the Gauls under Hamilcar (200), but after they had been defeated by the consul Gaius Cornelius (197) they finally submitted. In 49 B.C., with the rest of Gallia Transpadana, they acquired the rights of citizenship.

BIBLIOGRAPHY.—A. Desjardins, *Géographie historique de la Gaule romaine,* ii. (1876–93); Arbois de Jubainville, *Les Premiers Habitants de l'Europe* (1889–94); article and authorities in *La Grande Encyclopédie;* C. Hülsen in Pauly-Wissowa's *Realencyklopädie,* iii. pt. 2 (1899); full ancient authorities in A. Holder, *Alt-celtischer Sprachschatz,* i. (1896).

CENOTAPH, a monument or tablet to the memory of a person whose body is buried elsewhere (Gr. *κενός,* empty, *τάφος* tomb). The custom arose from the erection of monuments to those whose bodies could not be recovered, as in the case of drowning. The term is often used of the monuments raised in many places in memory of those who perished on the field in the World War, especially of the cenotaph in Whitehall, London, the scene of an annual memorial service on the anniversary of Armistice Day (*q.v.*).

CENSOR. I. *In ancient Rome,* the title of the two Roman officials who presided over the census (from Lat. *censere,* assess, estimate), the registration of individual citizens for the purpose of determining the duties which they owed to the community. This idea of "discretionary power" was never entirely lost; although it came to be intimately associated with the appreciation of morals. The censorship was the Roman manifestation of the state control of conduct.

The office was instituted in 443 B.C. to relieve the consuls of the duties of registration. The election always took place in the *Comitia Centuriata* (*see* COMITIA). The censorship, although lacking the imperium, was one of the higher magistracies, and was regarded as the crown of a political career. It was an irresponsible office; and the only limitations on its powers were the restriction of tenure to a year and a half, and the restraint imposed on each censor by the fact that no act of his was valid without the assent of his colleague.

The original functions of the censors were (1) the registration of citizens in the state-divisions, such as tribes and centuries; (2) the taxation of such citizens based on an estimate of their property; (3) the right of exclusion from public functions on moral grounds, known as the *regimen morum;* (4) the solemn act of purification (*lustrum*) which closed the census. Two other functions were subsequently added: (5) the selection of the senate (*lectio senatus, see* SENATE), and (6) certain financial duties such as the leasing of the contracts for tax-collecting and for the repair of public buildings. The census involved a detailed examination of the citizen body as represented by the heads of families. In connection with this review the censors published their edicts stating the moral rules they intended to enforce. Disqualification might be the result of offences in private relations or in public life. Certain kinds of employment (*e.g.,* acting) caused a stigma. *Infamia,* the general name for the penalties inflicted by the censors, varied in degree. A senator might lose his seat, a citizen his place in tribe and century, and so his vote. All disabilities inflicted by one pair of censors might be removed by their successors.

The censorship lasted as long as the republic; and it was only suspended, not abolished, during the principate. Although the *princeps* exercised censorial functions he was seldom censor. Yet the office itself was held by Claudius and Vespasian. Domitian assumed the title of life censor, but he was not followed.

BIBLIOGRAPHY.—Mommsen, *Römisches Staatsrecht* (1887), ii., 331, *et seq.;* A. H. J. Greenidge, *Roman Public Life* (1901); J. E. Sandys, *Companion to Latin Studies* (1921), with useful bibliography; W. E. Heitland, *Roman Republic* (1923).

II. In modern times the word "censor" is used generally for one who exercises supervision over the conduct of other persons. In the Universities of Oxford and Cambridge it is the title of the supervisor of those students who are not attached to a college, hall or hostel. In Oxford the censor is nominated by the vice-chancellor and the proctors, and holds office for five years; in Cambridge he is similarly appointed, and holds office for life. The censors of the Royal College of Physicians are the officials who grant licences.

Council of Censors, in American constitutional history, is the name given to a council provided by the constitution of Pennsylvania from 1776 to 1790, and by the constitution of Vermont from 1777 to 1870. Under both constitutions the council of censors was elected once in seven years, for the purpose of enquiring into the working of the governmental departments, the conduct of the state officers, and the working of the laws, and as to whether the constitution had been violated in any particular. The Vermont council of censors, limited in number to thirteen, had power, if they thought the constitution required amending in any particular, to call a convention for the purpose. A convention summoned by the council in 1870 amended the constitution by abolishing the censors.

For the censorship of the press, *see* PRESS LAWS; for the censorship of plays, THEATRES, LAWS RELATING TO, and LORD CHAMBERLAIN.

CENSORINUS, Roman grammarian and writer, flourished during the 3rd century A.D. He was the author of a lost work *De Accentibus* and of an extant treatise *De Die Natali,* written in 238, dedicated to his patron as a birthday gift and dealing with the natural history of man, the influence of the stars and genii, music, religious rites, astronomy and the doctrines of the Greek philosophers. The second part deals with chronological and mathematical questions and has been useful in determining the principal epochs of ancient history. The chief authorities used were Varro and Suetonius. Some scholars hold that the work is practically an adaptation of the lost *Pratum* of Suetonius. The fragments of a work *De Natali Institutione* are not by Censorinus.

The only good edition with commentary is still that of H. Lindenbrog (1614); the most recent critical editions are by O. Jahn (1845), F. Hultsch (1867), and J. Cholodniak (1889). There is an English translation of the *De Die Natali* (the first 11 chapters being omitted), with notes by W. Maude (New York, 1900).

CENSORSHIP in modern practice may be generally defined as action taken by any governing authority to prevent the dissemination of false statements, inconvenient facts or displeasing opinions among the governed (for derivation and history *see* CENSOR above).

Censorship of Printed Publications.—In Great Britain almost entire freedom of the Press has existed since 1695—except in time of war. Milton's eloquent protest in his *Areopagitica* against the tyrannous censorship of the Long Parliament had no effect at the time; it had its effect after the Revolution. Since 1695 there have been no official restrictions except in so far as all publishers of criminal or injurious matter are answerable to the laws of libel and blasphemy and must comply with certain statutory requirements framed with a view to the identification of offenders (*see* PRESS LAWS). In 1771, however, the house of commons attempted unsuccessfully to prevent the publication of its debates; and in 1819 the tax of fourpence a copy on all periodicals (retained until 1836) amounted to a censorship of readers, if not of the Press.

In other European countries, control by Government of printed publications has in the past been almost universal. Its stringency has varied greatly according to the country and the time, but the right of Governments to attempt to control opinion has seldom been in serious question. Books have been freely suppressed, their authors fined and imprisoned, on such grounds as *lèse majesté,* and newspapers and periodicals have been subjected to a censorship, always political and military, and often religious and "moral" as well. Such a system was seen in full flower in Germany during World War I, and as censorships are generally stronger, because more necessary and more easily tolerated, in time of war, it may be well to describe it in detail. When war was declared the control of the censorship was transferred to the military command and administered from the headquarters of the army corps districts into which Germany was divided. Every two or three days instructions were issued to the Press in every district on (1) what they were definitely forbidden to publish, (2) the attitude they were to take up with regard to certain questions, (3) inspired articles—often taken from other newspapers—which they were requested or given permission to reproduce.

The methods of exercising this Press censorship, which were much the same as those adopted in peace time, are typical of most censorships in highly centralized and bureaucratic countries. Editors were allowed to produce their papers without preliminary examination of proofs. If they transgressed any regulations they could be prosecuted and their paper suspended or placed under "preventive censorship." Except where purely military subjects were involved, it was impossible for an editor to escape responsibility by submitting his copy to the censor by way of precaution. "Preventive censorship" involved the submission of all proofs before they were passed for press. The censor was thus in a position to strike out all matter to which he objected, whether actionable or not. Generally no discussion of doubtful topics was allowed, no criticism of the Government and above all no criticism of the higher command. All information which might be of military value was excluded, though in spite of the efforts of the censors, much military information was obtained by the British War Office from the German Press. An organization was created in London to scrutinize all enemy periodicals, and a similar institution existed in Berlin. Both organizations were able to obtain much information from the indiscretions of the enemy Press.

A peculiar feature of the German censorship was the censors' insistence that the published periodical should bear no obvious traces of censorship. This was not so in the Allied countries, where most papers appeared daily either heavily *caviaré,* as it was called in Russia (*i.e.,* with paragraphs blacked out), or with large numbers of blank spaces. In Germany it was considered bad for *moral* that censorship should be so obvious.

In Great Britain a system was devised which first established a series of offences—communicating military information, spreading false reports or publishing statements likely to cause disaffection or to undermine *moral*—and then supplied a practical line of defence for editors and publishers against such charges by setting up an "Official Press Bureau" to which matter of doubtful legality or expediency could be submitted for "censoring" or for an official *imprimatur.* The Bureau, however, had no power to insist on submission to censorship and its *imprimatur* did not relieve an offender from the liability to prosecution. On the positive side, the Bureau issued from time to time secret instructions for the guidance and information of editors.

Dramatic Censorship.—The censorship of stage plays still surviving in Great Britain is one exception to the now vanished tyrannies which sought to regulate opinion in the mediaeval world. The theatre has in some way been controlled by authority in this country since the time of Henry VII., but the office of Licenser of Plays and the foundations of the present system of dramatic censorship dates from 1737. The Licensing Act of that year was the direct result of Henry Fielding's attacks on Walpole at the Little Theatre in the Haymarket. It prohibited under a penalty of £50 for each performance the acting for gain of any play or theatrical performance not sanctioned by letters-patent from the Crown or licensed by the lord chamberlain. Lord Chesterfield in his speech on the bill pointed out that there were already remedies at hand for the abuses at which it was aimed, and declared that the powers with which it was proposed to invest the lord chamberlain were more absolute than those of the monarch himself. The "Examiner of the Stage" then appointed had in practice little to do for the age was not squeamish and the theatrical world was entirely taken up with the fight for freedom of enterprise against the two "patent" houses, Drury Lane and Covent Garden. In 1832 the chairman of a royal commission appointed to examine the situation was strongly against the continuance of the office of Licenser of Plays, but of the 15 witnesses examined ten were in favour of retaining the censorship and only five against it. Ten years later, the Theatres Act of 1843 at last defined the lord chamberlain's

powers as a licenser of plays, and he was forbidden to withhold his license unless "he shall be of opinion that it is fitting for the preservation of good manners, decorum or of the public peace so to do." Twenty-one dramatic authors of note petitioned for the abolition of the censorship in 1865, but a select committee of both Houses in 1866 recommended no change. In 1907—there had been much intermediate agitation—71 authors joined in a letter of condemnation of the censorship which they sent to the *Times*. They included Meredith, Swinburne and Hardy and their language did not err on the side of mildness. As a result another select committee was appointed and reported in 1909. The central feature of the scheme they proposed was that "it should be optional to submit a play for license and legal to perform an unlicensed play, whether it had been submitted or not."

Since that time the question has found a working solution by the appointment of a representative committee of arbitrators to which the lord chamberlain can refer any play about which any doubt appears to exist in his own mind or in that of his reader. Pragmatically regarded, the censorship may be said to have justified itself; and the lord chamberlain's licence is probably generally preferable to the mercies of ignorant watch committees and an uninstructed police. The examiners during the 19th century were Larpent, George Colman the younger, Charles Kemble, John Mitchell Kemble, William Smyth-Pigott and G. A. Redford. Larpent was easy-going, Colman a little ridiculous because of his exaggerated notions of decency; but the Kembles and Smyth-Pigott were men of letters and men of tact and manners, well acquainted with the world they lived in. Redford was very much out of place and it was largely the *gaucherie* with which he carried out his duties that led to the protest of 1907. His successors have given critics of the office little ground for complaint.

Religious Censorship.—It would be a mistake to suppose that religious censorship has ever been confined to one section of avowed Christians. But the Roman Catholic Church having at many times asserted its authority regarding the temporal as well as the spiritual welfare of Christians, has naturally worked out its own system of censorship through the ages *pari passu* with the secular censorships of national States. The *Index Librorum Expurgandorum* (or *Prohibitorum*) is published by papal authority as a catalogue of printed publications prohibited to professing Christians whether on doctrinal or moral grounds. In the past there have no doubt been other grounds of prohibition. The first Roman Index was undertaken at the Council of Trent, and when it could not be completed was handed over to Pius IV., who published the first complete list of prohibited books in 1564. Books named in the Index may be either absolutely condemned or prohibited until they have been "corrected." In modern times it has been found quite impossible for the Congregation of the Index to keep pace with the output of the printing presses of the world, but on the other hand there already exist general rules regarding the use of books which the positive prohibitions of the Index are only intended to supplement.

WAR CENSORSHIPS

The outbreak of the World War in 1914 necessitated censorships from a purely military point of view in all belligerent countries, to deal with (1) postal communications; (2) telegrams and wireless communications; (3) printed publications. With (3) we have already dealt above.

Postal Censorships.—In peace time censorship of letters and cables is comparatively uncommon, though even in such a country as England the Home Office may empower the postmaster general to seize and open specified correspondence while it is in his hands. In war time, however, postal censorships were almost universal. In most of the armies field censorships were established to deal with the correspondence of the combatant forces. The censoring was performed in the area of military operations by regimental officers, or if necessary at the base by staff officers specially appointed for the purpose. In Great Britain only such letters arriving from the area of military operations as appeared to have escaped the eyes of the field censors were submitted by the post office for scrutiny to the censors in London.

This part of the censorship's activities was really a part of the *contre-espionnage*, a service designed to defeat the enemy's attempts to extract useful information from behind the lines. Such services were general in all belligerent countries, and necessitated a strict examination of any suspicious documents which might convey, by the use of cipher, code, sympathetic ink or any other device, a message to the enemy. In the British, French and German postal censorships special branches were organized to deal with these problems, and as a result many enemy agents were apprehended and enemy channels of communication closed. In Great Britain arrangements were made by which communications intended for enemy persons might be placed in open envelopes and enclosed in covers addressed to a neutral country. All such letters were submitted to examination. Mails for neutral countries contiguous to the enemy were censored from the first, and as the area involved by the War extended, it became necessary to examine practically all outgoing mails. Communications obtained from known enemy agents were in many cases altered so as to convey false information and then allowed to proceed. Printed publications emanating from enemy sources and found in postal packets were often of a highly propagandist nature, and were therefore seized and condemned. Others, less objectionable, were condemned because of the extreme ease with which secret communications can be made (by code and derivation) through printed matter and the difficulty of detecting such messages. Certain neutral publications were placed on a "black list" and destroyed whenever found.

In other belligerent countries the methods adopted were sometimes more radical and based on the principle that no correspondence can be dangerous which the addressee never receives.

Cable Censorship.—The position of Great Britain gave her a valuable control over enemy communications by cable. A cable censorship was established at the beginning of the War under a military chief responsible to the Army Council. The action taken by the censors, however, was based on the International Telegraph Convention of 1875. Great importance was attached to commercial cables. The principle adopted was purely to withhold, as far as British cables were concerned, all facilities for carrying on trade with an enemy country. In spite of much neutral protest the British policy was upheld and shown to be in accordance with the International Convention. Trade cables often contained military, and especially naval, information. (W. E. Bar.)

Irish Free State Film Censorship.—The Censorship of Films Act (1923) established the office of Official Censor of Films, the holder to be appointed by the Minister of Home Affairs. No film can be exhibited in public until it has received a certificate from this official. For certain kinds of films a limited certificate may be issued authorizing the showing of the picture under certain restrictions (which must be expressed on the certificate). The Act also established a Censorship of Films Appeal Board of nine commissioners appointed in the same manner to which the film-renter may appeal a decision of the Censor. In 1929 a Censorship of Publication Act was passed.

THE UNITED STATES

Preventive censorship, or the examination before publication of some form of communication (book or periodical, theatrical presentation, moving-picture or radio broadcast) by an official licensing agency with power to approve, change or suppress the offering has not been a characteristic American method of controlling the public mind or morals. Freedom of communication has generally been limited by the police power, acting after publication, to protect the State, public morals or public peace. Such police interference has been called punitive censorship, for the fear of punishment often acts as a deterrent to publication.

Censorship in the American Colonies.—Preventive censorships have existed from Colonial days to the present. The first printing-press (Cambridge, 1639) was licensed by the Massachusetts theocracy. Religious books were censored until 1695; and after that special manuscripts were submitted to authority. The Crown governors acted as licensers; and from 1686 to 1730 were instructed in their charters that "no book, pamphlet or other matter be printed without your especial leave and consent." The

first newspaper, *Publick Occurrences,* Boston, 1690, was suppressed after one issue. "Published by Authority" appeared on newspapers until about 1725. Since, pre-publication censorship has existed only in war-time. The trial of John Peter Zenger, publisher of the *New York Journal,* in 1735, ended one kind of post-publication control by establishing the right of the jury to determine not only the fact of publication, but whether the words constituted a libel. The judge had hitherto claimed this dangerous prerogative. Since 1776 the State Constitutions have almost universally guaranteed freedom of the press. In 1791 the First Amendment to the Constitution of the United States declared: "Congress shall make no law . . . abridging the freedom of speech or of the press." This ended all censorship. The courts agreed with the narrow dictum of Blackstone: "The liberty of the press consists in laying no previous restraints upon publications, and not in freedom from censure for criminal matter when published." Liberals have maintained that this is a foolish and unhistoric interpretation since the censor had disappeared from the colonies about 1725–30, and that the clause meant a much larger freedom, with protection from post-publication punishments unless the publication could be proven a clear and imminent danger to the State or public morals. The extreme libertarian holds that communications may be punished only when they cause an overt act since no other objective criterion of their psychological tendency can be found. The courts have generally accepted the conservative Blackstone view (*see* Patterson v. Colorado, *205 United States 454*).

Military Censorship.—War has generally re-established some principle of censorship. During the flurry with France in 1798, the Federalist party passed the Sedition Act, which provided punishments for publications, oral or printed, that reflected on the Government, promoted sedition or resistance to law. About ten persons, chiefly Republican editors, were convicted. The issue defeated the Federalists in 1800, and the law lapsed, without interpretation by the Supreme Court. President Jefferson released every person under punishment or prosecution. During the Civil War (1861–65) the postmaster general barred from the mails several Northern periodicals opposed to the war. Certain editors were imprisoned on the mere order of the secretary of State or of War. Newspaper offices in Missouri, Chicago and New York city were actually seized by troops, and issues of papers suppressed. Certain correspondents had to submit articles to the military for approval. Telegraphic dispatches were censored in Washington. In Colorado, 1904, and West Virginia, 1912, State militia under so-called martial law arrested editors, or suppressed and censored labour newspapers during strikes. In the World War the press established a voluntary censorship. Informal control was exercised through a governmental instrument, the Committee on Public Information. The newspapers, press associations and other organizations co-operated to prevent the disclosure of military or naval information, or matter calculated to weaken public morale. Strict military censorship was applied to news from correspondents with the American forces abroad. Foreign language periodicals in the United States were regulated by the Trading with the Enemy Act (United States Compiled Statutes, 1918, 3,115½ j.) and had to file English translations. The Department of Justice declared, however, that the constitutional right of free speech existed in war as in peace.

The Postal Censorship.—The so-called "postal censorship" is based on the power of the postmaster general to deny the second-class mailing-privilege to publications that contain matter forbidden by certain Federal statutes. The idea was born in 1835 when Southern representatives in Congress tried to pass a law forbidding Federal postmasters from distributing "incendiary" matter advocating the abolition of negro slavery in States that had banned such agitation. The law failed of passage, but in fact Southern postmasters never delivered Abolitionist papers. In the Civil War, a Congressional committee upheld the postmaster general's power to bar recalcitrant northern journals from the mails. In 1868 lottery information was forbidden the mails by law; and in 1873 the famous "Comstock Law" against obscene matter and contraceptive information was passed. This has produced many prosecutions and punishments. Later, matter furthering frauds, or the sale of alcoholic liquors, or advocating criminal anarchy was proscribed by statutes. The final extension came during the World War when Title XII. of the Espionage Act of June 15, 1917 made non-mailable any matter violating these specifications in Title I:

> (i.) making false statements or reports with intent to interfere with the operations or success of the armed forces of the United States; (ii.) wilfully causing or trying to cause insubordination, disloyalty, mutiny, or refusal of duty in the armed forces; (iii.) wilfully obstructing the recruiting or enlistment services of the United States.

Heavy penalties (fine or imprisonment) were to be imposed on those attempting to use the mails for these purposes. The Sedition Act, May 16, 1918, added nine other specifications, such as, obstructing the sale of United States bonds; publishing language intended to cause scorn or contempt for the Government, Constitution, flag or uniform; urging curtailment of the production of war needs. The postmaster general could act on "evidence satisfactory to him." Under these acts, the mailing-privilege was denied to one or more issues of two Socialist dailies, to many Socialist and radical magazines and even journals of liberal opinion. Periodicals had their second-class privilege absolutely suspended. Books and pamphlets were barred. More than 100 publications were interfered with to some degree—the widest interference with the press in the nation's history.

The Courts have always held that these statutes do not limit freedom of the press and refuse to review such exclusions as they are held legitimate exercises of an executive function. The post office avoids the position of a censor by refusing to define objectionable matter in advance. The liberal view holds that since the Government enjoys a postal monopoly, the publication denied this preferential rate (granted publications to encourage the dissemination of knowledge) cannot compete with those enjoying the privilege.

Censorship of Motion Pictures.—The Federal Government under the interstate commerce power, has forbidden the importation or transportation of prize-fight films, and lewd or obscene films. (Penal Code, Section 245, Revision of June 5, 1920.) Few cases have arisen under these statutes. Proposals to establish a Board of Censors in the Bureau of Education have been defeated.

Preventive censorships exist in Pennsylvania (1911), Ohio (1913), Kansas (1914), Maryland, Virginia, and New York. Boards of appointed "well-qualified" persons, receiving salaries, preview all films for public exhibition, and may ban an entire film, delete scenes or words, or prescribe revision. The Supreme Court has held such censorships constitutional. Since certain of the large States with censorships are important sources of revenue, the producers edit all films to conform to their codes, and thus six States influence the character of the films offered in all the States. In 1935 the Legion of Decency, the Catholic Church, and the National Federation of Churches united to combat what they deemed low moral standards in motion pictures, by establishing a listing of approved or disapproved productions that the respectable public might support or boycott. The producers have set up a voluntary self-censorship under a strict code. Certain municipalities control motion pictures through police powers, especially through licensing ordinances for exhibitions. Cases have arisen on films dealing with birth-phenomena, and those viewed as inflammatory of race, religious, or international controversy.

Censorship of Radio Broadcasting.—The Federal Communications Commission created by Public Law 416, June 19, 1934, is empowered to license public broadcasting stations to use wave-channels and time periods as "public convenience, interest, or necessity requires." (Section 303). Its censorship powers are explicitly limited to prohibiting profane or obscene language, and to enforcing equal rights for legal candidates for public office. It has intervened in cases of alleged obscenity or profanity, and to correct advertising abuses. Its acts reveal no political motives. Liberals declare the commission exercises an indirect censorship, since station owners, required to secure renewal of licences at short intervals, will conform to the program standards implied by the commission's acts or utterances. They oppose as legally unwar-

ranted the commission's order (May 1939) that short-wave broadcasts "reflect the culture of the United States and international good will." As for the stations, they scrutinize materials before broadcasting them, at times censor offerings, and even bar speakers. Labour and socialist organizations have charged that these precautions, defensible as preventives of libelous or scandalous utterances, have sometimes limited their air freedom. The self-regulatory code adopted by the National Association of Broadcasters (1939) sets high standards for the handling of controversial issues, and religion, with fairness and freedom.

Censorship of Plays and Books.—No formal censorship of the theatre has ever existed in the United States. Interference has been by local prosecutors or the police, who have, on complaint, viewed exhibitions, and sometimes ordered them withdrawn or amended, or instituted proceedings against both producers and actors that have in certain cases resulted in fines or jail sentences. The New York statute (1927) included matter dealing with sex perversions under obscenity. The suspension of the licences of theatres offering alleged immoral burlesque shows revealed the commissioner as a potential censor.

Interferences with the distribution of books and periodicals have been under the postal law, the customs law (it now provides for judicial review), and local morality ordinances. Liberal court decisions have limited the activities of the New York Vice Society against alleged pornographic publications that in the past had suppressed books of admitted literary worth. In Boston, The Watch and Ward Society, by agreement with the prosecutor, listed books for the sale of which booksellers might be prosecuted. Later the police established their own censorship under which in 1927–28 over 50 volumes were proscribed, although many were sold everywhere else in the United States.

In recent years the Supreme Court has extended the free press guarantee by a decision in the Minnesota "Gag Law" case (*283 United States 697*) that the due process clause of the 14th Amendment protected the press against invasions by State action; in *Grosjean v. American Press Company, Inc.*, it nullified a discriminatory Louisiana tax on the advertising revenues of certain newspapers because it denied constitutional press freedom; and in Georgia protected the distribution of leaflets, although the police power control over such distribution is not finally defined.

BIBLIOGRAPHY.—Z. Chafee, Jr., *Freedom of Speech* (1920); Leon Whipple, *The Story of Civil Liberty in the United States* (1927), and *Our Ancient Liberties* (1927); Horace Kallen, editor, *Freedom in the Modern World* (1928); M. Ernst and Wm. Seagle, *To the Pure* (1928); Ruth Brindze, *Not to Be Broadcast* (1937). (L. R. W.)

CENSUS. In modern usage, primarily denotes the periodical survey of the number and condition of the people—more fully described as "census of population" where necessary to distinguish it from the census of production, census of agriculture and similar institutions.

History.—Numberings of the people and national stocktakings are known to have been conducted from very ancient times. The Old Testament records the enumeration at the Exodus of the fighting strength of the Children of Israel and of the non-military Levites, and the famous enumeration of fighting men, conducted by Joab at the command of David, on which the divine wrath was visited. Records survive of a complete cadastral survey and census of Babylonia comprising agriculture, stock and produce, which appears to have been carried out for fiscal purposes in the third millennium B.C., and in the Persian empire, in China and in Egypt similar surveys are known to have taken place for the assessment of fiscal, military or labour liabilities. A most notable example was the Roman census, from which the modern institution derives its name: under this system the members and property of every family were enumerated quinquennially for the purpose of determining their civil status and corresponding liabilities. Dating from pre-republican Rome, the Roman census was extended by Augustus in 5 B.C. to the Roman empire and thus covered the whole of the civilized world of those times. The Roman census perished in the wreck of the Roman empire. Feudalism may have rendered the revival of census-taking, even when practicable, less necessary; and superstition may have contributed to its abeyance. The Christian Church remembered the punishment of Israel; and even in the British House of Commons in 1753 it was possible for the fear to be expressed that a numbering of the people would be followed by "some great public misfortune or epidemical distemper." It is, of course natural that objections to taxation or military service should assume the cloak of religious scruple; but there must have been more than this. It is impossible not to infer that in the Old Testament story and in the purificatory sacrifice concluding the Roman census folk-memory lingered of a primitive *taboo*. And these speculations receive interesting support from the announcement, in connection with the Kenya census of 1926, that the authorities anticipated trouble with certain tribes among whom there was a strict *taboo* against counting either themselves, their wives or their cattle.

Thus, apart from undertakings such as Charlemagne's Breviary and the English Domesday Book (an inquest upon geld assessments) there was a long interval in census history until the mid-17th century, when a periodical census of the modern type was instituted in La Nouvelle France (Quebec) and Acadie (Nova Scotia). Enumerations of population took place in several of the German States from 1742 onwards, in Sweden in 1748, Denmark in 1769 and Spain in 1787. In Great Britain, after proposals had been made and defeated in 1753, the census was definitely established in 1801. From these and similar beginnings in other countries the institution of the census rapidly gained a permanent place in the organization of nearly all modern States, the most recent convert being Turkey in 1927. It will be seen that the precursors of the modern census were almost wholly executive operations discharging essential functions of government such as military recruitment and taxation. But in the long interval which preceded the revival these functions cut for themselves other channels of administration; and when inquests and surveys upon a national scale were again resumed it was with a very different object, viz., to supply knowledge for the guidance of public policy and to "substitute certainty for conjecture" upon the vexed questions of fact which are vital to political action and foresight.

CONCEPTION AND EVOLUTION OF MODERN CENSUS

The census, as now conceived, has two main objects. It provides an instantaneous picture of the community—a cross-section of the body-politic exhibiting its constitution at the point of time when it is made. It thus affords knowledge of numbers and conditions which is valid for the particular point of time and, with approximations, for adjacent periods. But all things are subject to change; and knowledge of the force and direction of changes in the community are even more important than the facts at any given date. A single sounding will disclose what depth of water is below the keel; but not without repeated soundings is it known whether the water is shoaling, and how rapidly. Hence in the modern census each enumeration is conceived not only as a source of static knowledge but as an item in a consecutive series. From the succession of these alone can be ascertained and measured those great drifts and currents in the national life which, whether deemed good or evil, whether resistible or irresistible, must at least be known and reckoned with.

House to House Visitation.—The first among the questions upon which certainty was deemed requisite was the number of the population. Such a numbering entails a house-to-house visitation coupled with enquiries of the inmates. This process (primitive, but not to be bettered) affords opportunities, on the one hand, and imports limitations on the other, which have substantially determined the scope and evolution of census-taking. In the first place, the itinerary may be planned so as to group the dwellings visited according to any designed arrangement of boundaries: thus information obtained respecting the population of each areal group may be separately recorded and becomes available, not only as a component part of the national total, but also by itself, or as a component part of larger areal units, for the purpose of exhibiting the local distribution of that total. Further, the need to ensure that no dwelling is omitted leads to a record being made of all premises on the itinerary. It is but

a step to include particulars of each dwelling, *e.g.*, whether inhabited or vacant, and the number of its rooms, thus affording, in combination with other material, statistics as to housing conditions, overcrowding, etc. The convenience of obtaining particulars from one spokesman on behalf of each family or household leads to a system of household returns which themselves afford a count of such families. But the germ of the fertile elaboration of census enquiries is to be found in the fact that the information is obtained by direct enquiry of the persons concerned, thus permitting of the inclusion of every subject on which the individual can reasonably be expected to state his own position and that of his dependants. Age may be asked and given: the relationship and marital status of persons comprised in the household group can be described. Birthplace and nationality may be stated. A further group of personal particulars has furnished a great body of statistical material relative to occupation and industry. Every occupied person can state his job in terms which permit of precise occupational classification. And in addition to stating that he is, for example, a crane-driver, he can add that he is employed by a firm of brewers, thus enabling himself to be classed to the industry which he serves. Other enquiries are regularly included where the conditions render them suitable, such as religion, language spoken and literacy. Comparatively complicated enquiries may be included such as the "fertility of marriage" enquiry in English, French, Netherlands, Spanish and Norwegian censuses (date of marriage: number of deceased and number and ages of living children of the marriage).

The Personal Aspect.—The common element in all these enquiries is that they are personal. It has been suggested that the whole field of statistics can be viewed as concerned with either *personnel* or with *material:* this is not an entirely watertight division, but it accurately represents an important difference between the main points of view from which statistical information is sought and studied. The census as an instrument for the collection of information is predominantly concerned with aspects of *personnel*, and covers the major portion of that province. It is unable to elucidate any subject except as an attribute of the individual man or woman. The inclusion of agricultural statistics in some countries is an apparent exception: but such enquiries may be in a sense an extension of the record of dwellings. The homestead is visited; it is noted that so many acres of arable, etc., are annexed and that there is stock of a certain kind and number. This is consistent with the census procedure, which must locate as it counts: it cannot deal with wealth which is everywhere and nowhere. Subjects such as exports and imports are clearly out of the picture. But there are some limitations in the field of personal attributes. The enquiry must be capable of being simply put and answered. Intrinsically there is nothing to prevent the use of the census to ascertain the distribution of the national wealth or income; but the preparation of a statement in the form necessary to furnish the answer upon a uniform basis would be beyond the power of most individuals. If all particulars needed for the calculation were asked they would need a census schedule to themselves; and if the final figure alone were to be given there would be no security that it was properly arrived at. An enquiry of all wage-earners as to the rate of pay received (as in the Spanish census) would not be subject to the same objection.

Difficulty of Verification.—But in many countries another general limitation would apply. Census returns cannot be verified, in view of the magnitude of the operations; and it is useless to make any enquiry respecting which individuals may have any conscious motive, real or fancied, for suppressing or distorting the facts. Hence information which in the popular apprehension might be used by the authorities for enforcing individual liabilities, such as taxation, cannot profitably be asked; and truthful information upon subjects, such as illegitimacy, which are felt to be delicate is often unobtainable owing to a fear of it becoming public. These considerations have tended to emphasize the character of the modern census as a source of abstract statistical information only. Whatever expectations may have been formed in the early days of the census revival as to its incidental utility for executive purposes, census administrators have had to choose between making it an effective instrument for the collection of statistics only and making the worst of both worlds. Another minor limitation applies to the doubtful ability of the individual to give reliable answers to enquiries as to infirmities such as blindness, deafness, etc. Even if no bias due to prejudice arises, the terms employed are unavoidably indefinite; and the conditions themselves cannot be properly assessed save by trained medical judgment. It is becoming recognized that the census can afford little assistance of value in this sphere.

Advantages.—Within limitations the census has the peculiar and enormous advantage that all the varied attributes which it records are related to the individual to whom they jointly belong. Hence every type and class of information obtained can be presented in combination with every other type and class. If it be assumed, for the sake of illustration, that the collection of occupational data is omitted from the census and separately organized by means of returns from employers, information might still be forthcoming of the number of metal spinners, while the census would continue to state the number of men aged 49. But between the two sets of figures there would be a gulf; it would be impossible to obtain the number of metal spinners aged 49. Given, however, the inclusion of both enquiries in the census any combination of these and other results is possible; and a census enquiry, as distinct from one separately promoted, not only affords the desired information but adds a fuller and richer significance to all those which it supplements.

Utility of Census.—And as the scope of the census has expanded, so the sphere of its utility has been enlarged. It still discharges its original function as an intelligence service of the government by which it is promoted in both legislation and administration. Estimates cannot be framed, for example, of the money provision requisite in future for the payment of old age pensions, or of the school provision needed for the rising generation, without the help of census material. Social insurance schemes equally rely upon such material for their actuarial foundation. Electoral redistribution must be largely based upon population distribution; in South Africa constituencies are rearranged on the results of each census. Census statistics are the common tools and material of the business of government in ways too numerous to detail; but they are equally indispensable to the direction of State policy. In matters of defence the most pacific nation cannot afford not to know where it stands and whither it is tending. Questions of unemployment cannot begin to be considered without a knowledge of the industrial disposition of the people. Policy respecting migration still depends upon a recognition of the forces of population pressure which have so often changed the face of history. Knowledge of all these facts, even where not directly contributing to the solution of the problems of statecraft or state-policy, nevertheless forms a background against which they must be viewed. And for the public service in its widest significance the census provides material for research and study, helping to define and clarify the issues on the great questions to which there is as yet no agreed answer, and which, so far from having been admitted within the sphere of government responsibility, are but vaguely stirring in the conscience of the community. Not among the least of the services of the census is that which it renders to statistical method whereby, for example, mortality data may be converted into mortality rates, thus eliminating variables and reducing to a comparable basis a wealth of material which for many purposes would otherwise be useless.

CENSUS METHOD AND PRACTICE

Within the essential framework of the census system—house-to-house visitation coupled with enquiries—diversities in national practice are for the most part of little moment. But in one case, at any rate, a question of method is also a question of principle. Populations are represented in some countries *de jure,* in others *de facto.* A *de facto* enumeration, following the principle of the instantaneous picture, allocates individuals to the areas in which they are physically found at the census date, regardless

of their usual residences. A *de jure* distribution, on the other hand, is that which assigns the population to the respective areas of usual residence. Where populations are immobile, one set of figures serves both purposes: but in most industrially developed countries there is much, and increasing, population movement. It is usual in *de facto* enumerations to select a census date which so far as possible avoids population movement and on which *de facto* thus approximates to *de jure*: otherwise a *de facto* distribution is apt to be fortuitous and meaningless. But *de jure* as a norm is not valid for all purposes. What, after all, is the population of Blackpool? The number of its permanent winter residents, or its doubled or tripled complement of the holiday season upon whom so much of its existence and conditions depends? The great daily migrations between home and workplace raise a similar question: what, it may again be asked, is the population of the City of London—the 13,000 night residents, or the 400,000 who spend there a third of the most active portion of their lives? The truth is, of course, that there is no one answer: the purpose to be served determines the choice. But it will be clear, at any rate, that the meaning of the term "population" admits of some refinements.

Typical Systems.—The following outline will afford an indication of the scope and salient features of a few typical census systems. The English census has been hitherto decennial, though quinquennial powers are now available. The return is made by the householder, the enumeration being *de facto*. The schedule (1921) includes name, relationship to householder, age, sex, marital condition, orphanhood, birthplace, nationality, school attendance, occupation, industry, industrial status (whether employer, employee or working on own account), place of work, and number and ages of living children and stepchildren under 16.

France.—In France the census is quinquennial: a skeleton household return is made by the householder, supplemented by a separate return by each member. The former includes absent members and distinguishes temporary residents, thus providing for a *de jure* distribution. The individual schedule (1921) requires name, sex, date and place of birth, nationality, marital condition, date of marriage, number of deceased and number and ages of living children of the marriage, usual residence (if temporarily present), literacy, and principal and secondary occupations, together with particulars of principal industry, industrial status, number of employees, or if employee, whether unemployed.

Italy.—In Italy the regular census is decennial: the return, which is made by the householder, includes particulars as in France for a *de jure* distribution. The schedule (1921) requires name, father's name (and whether alive or dead), relationship to householder, sex, date and place of birth, marital condition, literacy, principal and secondary occupations, whether owning property (distinguishing land and buildings), and nationality.

Germany.—Germany affords an interesting example of a quinquennial census of alternately greater and lesser scope. In 1919 the schedule comprised (apart from special post-war enquiries) name, relationship to householder, sex, date of birth and marital status, with the distinctions requisite to provide a *de jure* distribution. In 1925 these enquiries were supplemented by religion, nationality, mother tongue, last residence before the World War, principal and secondary occupations and industry and industrial status. The return is made by the householder.

Population Registers.—As seen in the foregoing examples, the frequency of the census series is usually decennial or quinquennial: the latter is generally deemed desirable on statistical grounds, but the census is an expensive and laborious undertaking. The attractive prospect has at times been indulged of the creation of population registers, containing in respect of each individual the particulars usually elucidated by the census, and accurately maintained, as a mirror of the people and of the passing phases of their lives, by reports of all changes in the personnel or in the particulars recorded about them. Given such registers, it has been urged, a census of the written records could be taken at any time, however frequent, to ascertain the current position regarding all or any of the recorded particulars without the labour and expense of the census visitation. The prospect, though attractive, is hardly realizable. Were it the case that all the requisite information is already available through one channel or another, nothing would be needed but their complete co-ordination for the maintenance of the registers. But in all countries there are great gaps in the essential information which could not be filled without a revolution in national habits or administrative machinery. Maintenance of the occupational and industrial record, for example, would involve a duty to notify change of occupation or employment in the case of every individual. Maintenance of accurate particulars as to local distribution would involve an obligation to report every change of address.

Population registers with a limited scope exist in some countries, such as The Netherlands, Belgium and Sweden; and many systems of public supervision require the registration of residence, arrival and departure. But such countries do not dispense with a census, and it seems doubtful whether removals are notified with sufficient completeness for statistical purposes. It will be clear that in Great Britain, at any rate, and in other countries similarly situated, the proposition would impose upon every individual a host of new obligations which though trifling in themselves would not be discharged without legal enforcement, and which, for want of sympathy with their purpose, would appear meaningless and oppressive. Such a system even if practicable would not be less laborious and costly than the census: it would be rigid, moreover, and lacking the valuable capacity of the census proper to experiment in new methods and new fields of enquiry on each successive occasion.

But while the census remains indispensable, the essential element of value in such proposals is well recognized, viz., the co-ordination of all continuously available demographic material, such as that of vital registration, with the periodical census results. The census population of a given date may be corrected by allowance for births and deaths over any subsequent period to show the population at a later date as modified by net natural increase or decrease. Allowance for the remaining factor of migration is necessary to complete the adjustment; and, given adequate records of migration, a population figure may thus be constructed which is as correct and authoritative as any census product. The process could be carried into further detail were the migration records fully complementary to the registration data. But if inadequate for the construction of fully authentic intercensal statistics, the supplementary sources are invaluable in the framing of estimates to bridge the intercensal gap. Vital registration is closely related to the census both in subject-matter and through their association for joint or mutual service; and cannot be ignored in any study of the census system.

See the articles POPULATION; BIRTH-RATE; DEATH-RATE and MARRIAGE-RATE; *see* also official census publications of the respective national governments (census of Commonwealth of Australia 1911; vol. i.: Statistician's report contains extensive commentary on census history and practice) and League of Nations series of "Statistical Handbooks" dealing with the official vital statistics of various countries.

(S. P. V.)

UNITED STATES

The Federal census, which began in 1790 and has been taken every ten years since under a mandate contained in the U.S. Constitution, was the outgrowth of a controversy in the convention which prepared the document. Representatives of the smaller States as a rule claimed that the vote, and so the influence, of the States in the proposed Government should be equal. Representatives of the larger States as a rule claimed that their greater population and wealth were entitled to recognition. The controversy ended in the creation of a bicameral legislature in the lower branch of which the claim of the larger States found recognition, while in the upper, the Senate, each State had two votes. In the House of Representatives seats were to be distributed in proportion to the population, and the convention, foreseeing rapid changes of population, ordained an enumeration of the inhabitants and a redistribution or reapportionment of seats in the House of Representatives every ten years.

The provision of the Constitution on the subject is as follows:

Representatives and direct taxes shall be apportioned among the several states which may be included within this Union according to their respective numbers, which shall be determined by adding to the whole number of free persons, including those bound to service for a term of years and excluding Indians not taxed, three-fifths of all other persons. The actual enumeration shall be made within three years after the first meeting of the Congress of the United States, and within every subsequent term of ten years, in such manner as they shall by law direct.

In 1790 the population was reported classed as slaves and free, the free classed as white and others, the free whites as males and females, and the free white males as under or above sixteen years of age. In 1800 and 1810 the same classification was preserved, except that five age-groups instead of two were given for free white males and the same five were applied also to free white females. In connection with the census of 1810 an attempt was made to gather certain industrial statistics showing "the number, nature, extent, situation and value of the arts and manufactures of the United States." In 1820 a sixth age class was introduced for free white males, an age classification of four periods was applied to the free coloured and the slaves of each sex, and the number of aliens and of persons engaged in agriculture, in manufactures and in commerce was called for. The inquiry into industrial statistics begun in 1810 was also repeated and extended.

In 1830 13 age classes were employed for free whites of each sex, and six for the free coloured and the slaves of each sex. The numbers of aliens, of the deaf and dumb, and the blind were also gathered.

The law under which the census of 1840 was taken contained a novel provision for the preparation in connection with the census of statistical tables giving "such information in relation to mines, agriculture, commerce, manufactures and schools as will exhibit a full view of the pursuits, industry, education and resources of the country." This was almost the first indication of a tendency, which grew in strength for half a century, to load the Federal census with inquiries having no essential or necessary connection with its main purpose, which was to secure an accurate enumeration of the population as a basis for a reapportionment of seats in the House of Representatives. This tendency was largely due to a doubt whether the Federal Government, under the Constitution, possessed the power to initiate general statistical inquiries, a doubt well expressed in the 9th edition of the *Encyclopædia Britannica* by Francis A. Walker, himself a prominent member of the party whose contention he states:—

The reservation by the states of all rights not granted to the general government makes it fairly a matter of question whether purely statistical inquiries, other than for the single purpose of apportioning representation, could be initiated by any other authority than that of the states themselves. That large party which advocates a strict and jealous construction of the constitution would certainly oppose any independent legislation by the national Congress for providing a registration of births, marriages and deaths, or for obtaining social and industrial statistics, whether for the satisfaction of the publicist or for the guidance of the legislature. Even though the supreme court should decide such legislation to be within the grant of powers to the general government, the distrust and opposition, on constitutional grounds, of so large a portion of the people, could not but go far to defeat the object sought.

The difficulty stated in the foregoing quotation, although now mainly of historic importance, exerted great influence upon the development of the American census prior to 1900. The pioneer work of the census of 1840 in the fields of educational statistics, statistics of occupations, of defective classes and of causes of death, suffered from numerous errors and defects. Public discussion of them contributed to secure radical modifications of scope and method at the census of 1850. Before the census law was passed, a census board, consisting of three members of the president's cabinet, was appointed to draft plans for the inquiry, and the essential features of its report prepared after consultation with a number of leading statisticians and based largely upon the Boston census of 1845, which had introduced many innovations from the Irish census of 1841, were embodied in the law.

The census of 1850 was taken on six schedules; for free inhabitants, slaves, deaths during the preceding year, agriculture, manufactures and for social statistics. The last asked for returns regarding valuation, taxation, educational and religious statistics, pauperism, crime and the prevailing rates of wages in each municipal division. It was also the first American census to give a line of the schedule to each person, death or establishment enumerated, and thus to make the returns in the individual form indispensable for a detailed classification and compilation. The results of this census were tabulated with care and skill, and a preliminary analysis gave the salient results and in some cases compared them with European figures.

The census of 1860 followed the model of its predecessor with slight changes. When the time for the next census approached it was felt that new legislation was needed, and a committee of the House of Representatives, with James A. Garfield, afterwards president of the United States, at its head, made a careful and thorough study of the situation and reported an excellent bill, which passed the House, but was defeated by untoward influences in the Senate. In consequence the census of 1870 was taken with the outgrown machinery established 20 years earlier, a law characterized by Francis A. Walker, the superintendent of the census, who administered it, as "clumsy, antiquated and barbarous." It suffered also from the fact that large parts of the country had not recovered from the ruin wrought by four years of civil war. In consequence this census marks the lowest ebb of American census work. The accuracy of the results is generally denied by competent experts. The serious errors were of omission, probably confined in the main to the Southern States, and especially frequent among the negroes.

Since 1870 the development of census work in the United States has been steady and rapid. The law which had been prepared by the House committee for the census of 1870 furnished a basis for greatly improved legislation in 1879, under which the census of 1880 was taken. By this law the census office for the first time was allowed to call into existence and to control an adequate local staff of supervisors and enumerators. The scope of the work was so extended as to make the 22 quarto volumes of the tenth census almost an encyclopaedia, not only of the population, but also of the products and resources of the United States. Probably no other census in the world has ever covered so wide a range of subjects, and perhaps none except that of India and the succeeding American census has extended through so many volumes. The topics usually contained in a census suffered from the great addition of other and less pertinent matter, and the reputation of the work was unfavourably affected by the length of time required to prepare and publish the volumes (the last ones not appearing until near the end of the decade), the original underestimate of the cost of the work, which made frequent supplementary appropriations necessary, the resignation of the superintendent, Francis A. Walker, in 1882, and the disability and death of his successor, Charles W. Seaton. The eleventh census was taken under a law almost identical with that of the tenth, and extended through 25 large volumes, presenting a work almost as encyclopaedic, but much more distinctively statistical.

SCOPE OF CENSUS NARROWED

Competent discussion between 1890 and 1900 fastened on this point, and under the law of 1899 the scope of the census of 1900 was greatly narrowed. This was secured not by abandoning any of the numerous inquiries which had overloaded the two preceding censuses, but by dividing them into major and minor groups, the major group embracing those inquiries, population, vital statistics, agriculture and manufactures, for making which enumerators were needed in the field; the minor group embracing those which could be conducted by correspondence supplemented to a slight degree, if necessary, by field agents at strategic points. The law required the completion of the major inquiries in three years (the two preceding censuses had taken more than twice as long to finish) and postponed the minor inquiries until the major group was completed. The new law thus foreshadowed, but did not establish, an office functioning without interruption, and as a natural consequence of it, in 1902 the bureau of the census was made permanent. This important and salutary change has been maintained in all subsequent legislation.

In no field of census work has it been more beneficial than in that of vital statistics. The registration of births and deaths is under the jurisdiction of the states, only 11 of which had registration systems in 1900 adequate to meet the requirements for admission to the death registration area which was set up at that time. Model registration laws were formulated, however, and these were adopted and put into effect year by year in additional states until, in 1933, all the states were included in both death and birth registration areas, giving a complete coverage of the United States. Statistics of deaths and births compiled from state records are published by the bureau of the census in its annual volumes entitled, respectively, *Mortality Statistics* and *Birth, Stillbirth, and Infant Mortality Statistics*. Statistics of marriage and divorce have been collected for the years from 1867 to 1906, for 1916 and for 1922 to 1932—the latter appearing in a series of annual reports. These reports were resumed on an annual basis beginning with 1940.

The census of 1910 was the first decennial census taken under the permanent census bureau. This census covered four subjects, namely, population, agriculture, manufactures and mines and quarries, many of the other subjects included in earlier decennial censuses having been taken care of either by annual reports, as in the case of vital statistics, or by inquiries conducted between the decennial census years, as in the case of the statistics of religious bodies and of benevolent and corrective institutions. The most significant additions to the list of questions asked on the 1910 population schedule, as compared with that of 1900, were mother tongue and ability to speak English, with special reference to the foreign-born; and for the gainful workers, industry as well as occupation, and unemployment. The data on gainful workers were tabulated by occupation in combination with industry, though only a limited publication was made, by reason of insufficiency of funds at the close of the census period. For a similar reason the unemployment data were not published at all. A new basis of distinction between urban and rural population, in which all incorporated places having 2,500 inhabitants or more were counted as urban (substantially the present basis), was set up; and many details were added to the tabulations published for counties and the smaller cities.

The population census of 1920 was patterned very closely after that of 1910, except for the omission of questions on unemployment and the introduction of a new category in the classification, namely, the farm population, that is, the population living on farms. In order to expedite the publication of the new census data, the text in the main reports of this census was limited to such descriptive and explanatory matter as was required for the understanding of the figures. These reports were supplemented by more detailed analysis of important topics in a series of 12 monographs, which appeared at intervals during the decade.

In 1930 one significant question, namely, the value or rent of the home, was added to the population schedule; and there was a separate schedule on unemployment, going into this subject in far more detail than ever before. The 1930 reports were published, like those of 1920, with little analytical text. There were, however, many added details in the 1930 tabulations, including a tabulation of gainful workers by counties, increased age data for counties and the smaller cities, a brief classification of the population of townships and an entire volume devoted to statistics of families, in addition to two volumes on unemployment. The classification of the population as farm and nonfarm, introduced in a limited way in 1920, was carried much further in the form of an almost universal subdivision of the rural population into rural farm and rural nonfarm.

An important innovation in 1940 was the census of housing, which was taken in close connection with the census of population and in which were incorporated certain items previously a part of the population census reports, in particular, tenure and value or rent of home and mortgage debt. This census covered also various items descriptive of housing units, including exterior material, year built, type of structure and state of repair. There were also questions with regard to such facilities as plumbing equipment; water supply; and heating, lighting and refrigeration equipment. Some items from the housing census are published for the larger cities by blocks, this being the first instance in which census statistics have been published for such small areas. A new feature in the 1940 population census itself was the provision for asking a part of the questions with respect to one person in twenty rather than for the entire population, thus providing a 5% random sample as a basis for the tabulation of statistics. This device was introduced primarily to take care of additional questions for which there was no space on the main schedule. The sample questions included usual occupation (in distinction from present occupation), veteran status, social security registration, mother tongue, place of birth of parents, and a group of questions on fertility. These additional questions were asked of those persons whose names fell on certain numbered lines of the main schedule. Brief preliminary cards containing the basic items of colour, sex, age and work status were also punched from these selected lines and tabulated many months in advance of the date on which these important characteristics of the population could have been obtained from the complete tabulation. New questions contained on the main population schedule included one on highest grade of school completed (which replaced the old question on illiteracy) and a question on place of residence in 1935, which formed the basis for the first direct statistics of population migration. The section on work status provided the basis for a count not only of persons seeking work but also of those employed on emergency work projects, as well as of those employed in private industry or on regular government work. Persons not in the labour force were for the first time classified into significant categories, such as housewives, students, persons unable to work, etc.; and there were supplementary questions on extent of unemployment, number of weeks worked in 1939 and amount of wage or salary income during 1939.

The federal census has long made periodical reports upon agriculture and manufactures. Between 1840 and 1925 these reports were made only as parts of the decennial censuses, but in 1919 provision was made for quinquennial censuses of agriculture, those taken in each mid-decade being much narrower in range than the others. Twenty years earlier a similar change had been made in the field of manufactures, and between 1900 and 1920, reports on that subject were issued quinquennially. But after the later date and beginning with 1921, reports on manufactures appeared biennially. The earlier decennial inquiries aimed to cover not merely all manufacturing establishments or factories, but also household or hand industries. The enumeration of the latter was far from complete, and after the census of 1900 the hand industries were excluded.

A census of distribution was authorized by the act providing for the 1930 census. This census covered wholesale and retail trade and construction in 1929. Censuses of distribution or of "business," as the later ones have been termed, were taken in 1933, 1935, 1937 and 1939. These censuses covered service businesses, in addition to the classifications listed above for 1929.

(W. F. W.; L. E. T.)

CENSUS OF AGRICULTURE: *see* AGRICULTURE, CENSUS OF.

CENSUS OF PRODUCTION: see PRODUCTION, CENSUS OF.

CENT. A small copper or bronze coin. In the United States and Canada, it is the one-hundredth part of a dollar, approximately equivalent to a British halfpenny. In Holland the guilder is divided into one hundred cents.

CENTAUREA, a genus of the family Compositae, containing about 500 species, almost all natives of the Old World, with the principal centre in the Mediterranean region. The plants are herbs with entire or cut, often spiny-toothed, leaves and ovoid or globose involucres surrounding a showy head of tubular, oblique or two-lipped florets, the outer of which are usually large and neuter, the inner bisexual. Four species are native in Great Britain. *C. nigra* is the knapweed, common in meadows and pastureland; *C. Cyanus* is the bluebottle or cornflower, well-known as a weed, much grown as a garden annual and the national floral emblem of Germany; *C. Calcitrapa* is the star-thistle, a rare plant with

rose-purple flower-heads enveloped by involucral bracts which end in a long, stiff spine.

In eastern North America, in addition to the species mentioned, the brown knapweed (*C. Jacea*), the scabious knapweed (*C. Scabiosa*), the Tirol knapweed (*C. Vochinensis*), the spotted knapweed (*C. maculosa*), the yellow star-thistle (*C. solstitialis*) and the rayless centaury (*C. melitensis*) are more or less extensively naturalized. On the Pacific coast *C. melitensis,* there known as Napa thistle, is a troublesome weed, especially in California, as is also *C. solstitialis;* less pernicious are the star-thistle, the bluebottle and the Turkistan thistle (*C. repens*). The only native North American species, the basket-flower or American star thistle (*C. americana*) is a robust annual 2 ft. to 6 ft. high, with very showy rose-coloured or purplish flower-heads, 3 in. to 5 in. across.

It is found in dry plains from Missouri to Louisiana, and westward to Arizona and Mexico, and is also grown as an ornamental plant.

The best known garden plants are a dusty miller (*C. Cineraria*), the bluebottle (*C. Cyanus*), the sweet sultan (*C. moschata*) and the mountain bluet (*C. montana*).

CENTAURS (Gr. κένταυροι), in Greek mythology, a race of beings part horse, part man, dwelling in the mountains of Thessaly and Arcadia. The centaurs are usually said to be the offspring of Ixion and Nephele. They are best known for their fight with the Lapithae, caused by their attempt to carry off Deidameia on the day of her marriage to Peirithous, king of the Lapithae, himself the son of Ixion. In later times they are often represented drawing the car of Dionysus, or bound and ridden by Eros, in allusion to their drunken and amorous habits. Their general character is that of wild, lawless and inhospitable beings, the slaves of their animal passions, with the exception of Pholus and Cheiron.

They are variously explained by a fancied resemblance to the shapes of clouds, or as spirits of the rushing mountain torrents or winds, etc. Perhaps the likeliest suggestion is that they are a distorted recollection of some savage tribe, reputed by its neighbours to be composed of monsters. Like the defeat of the Titans by Zeus, the contests with the Centaurs typified the struggle between civilization and barbarism. In early art they were represented as human beings in front, with the body and hind legs of a horse attached to the back; later, they were men only as far as the waist.

See Roscher's *Lexikon, s.v. Kentauren.*

CENTAURUS (the "Centaur"), in astronomy, a southern constellation (invisible in northern lands) rich in bright stars and globular clusters. The two stars α, β are known as the southern Pointers since they point to the Southern Cross. One of these, α Centauri, is the third brightest star in the sky, and it is found to be our nearest neighbour; the distance is 4 light years (parallax $=0.75''$). It is a double star of which the brighter component is almost a replica of the sun, having nearly the same brightness and mass but slightly lower surface temperature; there is also a third widely separated faint companion called Proxima Centauri, because it is slightly nearer to us than the main star.

The constellation also contains ω Centauri which is the finest example of a globular star-cluster; it is probably the nearest object of this class, but the distance is no less than 20,000 light years.

Photographs of it show more than 6,000 stars within a circle of 20′ diameter, but the number must be much greater. (A. S. E.)

CENTAURY, any herb of the genus *Centaurium* family Gentianaceae; also, especially in America, the milkwort (*Polygala paucifolia*).

The common centaury of Europe, *C. confertum,* occurs in dry pastures and on sandy coasts in Great Britain and is often cultivated for ornament.

The centaury presents many varieties, differing in length of stem, degree of branching, width and shape of leaves, and laxity or closeness of the inflorescence.

CENTENARY, the celebration of an event after a hundred years. The word "centennial" (from Lat. *centum,* a hundred, and *annus,* a year), though usually an adjective as in "the Centennial State," the name given to Colorado on its admission to statehood in 1876, is also used as a synonym of centenary.

CENTERING, a term applied to the erection of temporary woodwork to support arches, etc., while they are setting. Thus, in the case of an arch, the carpenter forms a "turning-piece" shaped to take the bricks or masonry, and properly tied and braced. This is strutted in position, when the arch is completed by the bricklayer or mason. As soon as the work is set, the centering is carefully removed, which is called "striking the centering." The same method is used in building brick sewers. The origin of the word "centering" is obvious from the primary use in centred arches, but the same term is applied to the use of scaffold-boards to support concrete floors while they are setting hard. (*See* CARPENTRY.)

CENTERVILLE, a city of south central Iowa, U.S.A., 88 mi. S.E. of Des Moines; county seat of Appanoose county, served by the Burlington, the Rock Island and the Iowa Southern Utilities railways. Pop. (1940) 8,413. Large quantities of coal and of pure gypsum are mined in the vicinity. Quarrying of limestone, stock raising and dairying, railway shops, iron works, a soybean mill, creameries are among the industries. There is a municipal airport. The town was platted in 1846, and chartered as a city in 1870. Until 1849 it was called Chaldea.

CENTIGRADE SCALE: *see* THERMOMETRY.

CENTIME. The one-hundredth part of a franc, the monetary unit of France, Belgium, and Switzerland, is termed a *centime.* It is from Lat. *centum,* hundred. In Italy the hundredth part of the *lira* is called a *centesimo;* in Spain the hundredth part of the *peseta* is called a *centimo.* (*See* METRIC SYSTEM.)

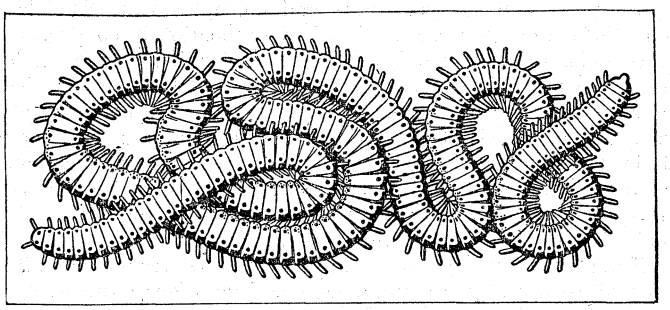
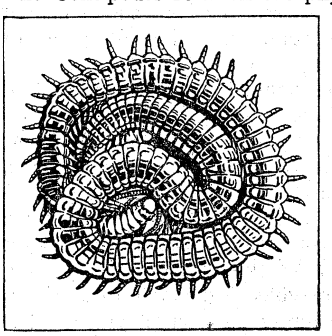


FIG. 1.—THE HYPOTHETICAL ANCESTOR OF THE MODERN CENTIPEDE

CENTIPEDE, an animal with a distinct head, one pair of feelers (antennae) and a long segmented body, each typical segment of which is provided with a single pair of walking legs. The Centipedes form in the phylum Arthropoda (*q.v.*), the distinct class Chilopoda in which well defined subdivisions may be made as follows:—



BY COURTESY OF HUGH MAIN

FIG. 2.—A TYPICAL MEMBER OF THE GEOPHILOMORPHA (ORYA BARBARICA), ONE OF THE LUMINOUS CENTIPEDES

First Sub-class *Epimorpha,* in which the young leave the egg with the full number of body segments and walking legs.

This sub-class comprises two orders:—

(*i.*) *Geophilomorpha* (containing ten families) with *Geophilus* as the typical genus, and

(*ii.*) *Scolopendromorpha* (containing two families), *Scolopendra* being the typical genus.

Second Sub-class *Anamorpha,* in which the young leave the egg with 7 pairs of legs. Afterwards there are periods of growth each of which is followed by a change of skin, resulting in an increase in the number of pairs of limbs until the adult condition is reached. In this sub-class, also, there are two orders:—

(*i.*) *Lithobiomorpha* (containing three families).

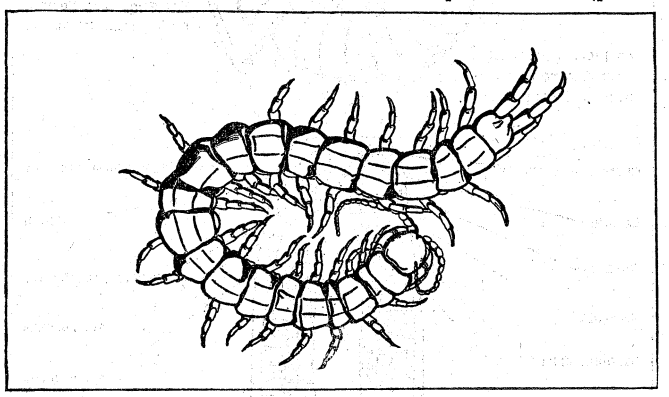
Lithobius is the typical genus, and

(*ii.*) *Scutigeromorpha* (consisting of one family), with the genus *Scutigera* as type.

In considering the anatomy of the centipedes, we picture a

hypothetical ancestor without a distinct head but provided in front of the mouth with a single undivided projecting lobe, the prostomium (seen to-day in the earthworm and its allies); the body otherwise consisted of a long series of similar ring-like segments or somites, each provided externally with a single pair of limbs and internally with its own share of the gut, and of the muscular, nervous, excretory, respiratory, blood-vascular and reproductive systems.

In the modern centipedes the head is distinct and may be regarded as a concentration and fusion of a pre-oral lobe (prostomium), one pre-antennal somite, one antennal somite, one intercalary somite and three somites bearing masticatory appendages (mandibles, first maxillae, second maxillae).

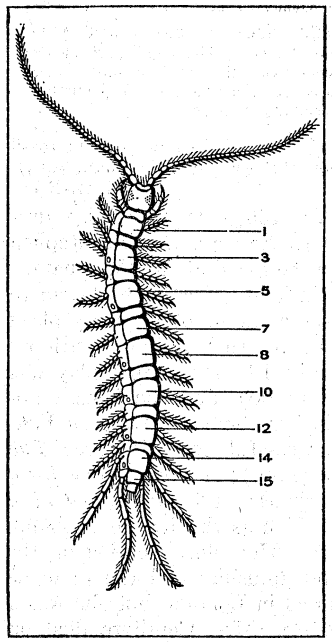


BY COURTESY OF HUGH MAIN

FIG. 3.—SCOLOPENDRA MORSITANS A TYPICAL MEMBER OF THE SCOLOPENDROMORPHA

The segment immediately behind the head bears the poison claws or maxillipedes and this is followed by a variable number of segments, each bearing a single pair of limbs.

The head, body and limbs are invested with cuticle which remains flexible wherever movement of the parts is necessary and elsewhere is thickened by a deposition of horny chitin. In a typical limb-bearing segment consisting of a roof, a floor and side walls, the cuticle covering these is reinforced to form definite protecting and supporting plates or sclerites, differently arranged in different forms. Except at the joints the cuticle of the limbs is similarly hardened.



AFTER VERHOEFF, IN BRONN, "KLASSEN UND ORDNUNGEN DES TIER-REICHS" (WINTER)

FIG. 4.—A TYPICAL MEMBER OF THE LITHOBIOMORPHA, THE COMMON CENTIPEDE OF EUROPEAN FIELDS AND GARDENS

The last three segments of the body (called pre-genital, genital and anal segments) are without walking legs.

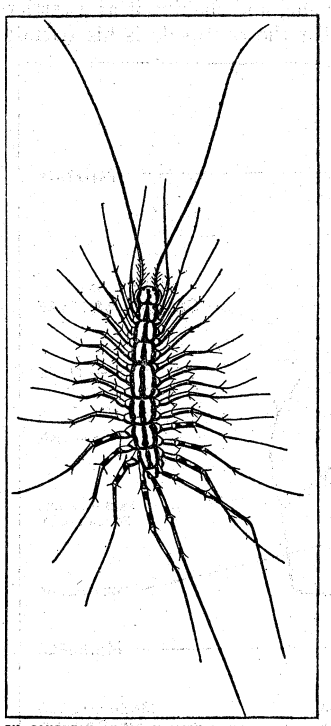
Eyes occur in most Lithobiomorpha, all Scutigeromorpha and in all Scolopendromorpha except one family (Cryptopidae). They are absent in Geophilomorpha. A simple eye (ocellus) or a group of separate ocelli is usual but in Scutigeromorpha the external lenses of the group of units fuse into a single facetted lens.

On each side of the head in Anamorpha a sense organ (organ of Tömösvary) of unknown function occurs; it consists of a group of cells below the chitin associated with an external hollow near the antenna. The frontal organ of *Lithobius* and *Scolopendra* consists of a group of deep-seated nerve cells behind each eye—its use is unknown.

The digestive tube is simple; it receives, in front, the products of the salivary glands and, further back, those of the excretory (Malpighian) tubules. Its opening is in the anal segment.

The main nerve-cord lies below the gut and ends in front in a nerve mass (the sub-oesophageal ganglion) united with the supra-oesophageal ganglion or "brain," which lies above the front of the gut, by a pair of stout nerve cords.

Breathing is by air tubes or tracheae which open at the sides of the body except in the Scutigeromorpha in which the openings are in the middle line of the back.



BY COURTESY OF HUGH MAIN

FIG. 5.—A TYPICAL MEMBER OF THE SCUTIGEROMORPHA (SCUTIGERA), THE HOUSE CENTIPEDE

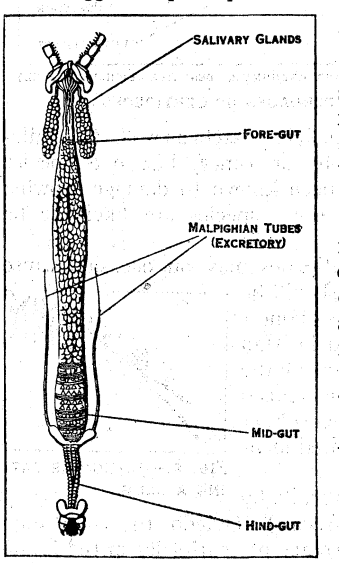
The heart, which lies above the gut, is a simple tube and the blood-circulation is in the direction usual in invertebrates—forward dorsally and backwards ventrally.

The reproductive system, which lies above the gut, varies in different centipedes. In the male the number of testes ranges from one to twenty-four. In the adult female the ovary is always unpaired. The reproductive system opens in the genital segment.

From any detailed consideration of anatomy it is clear that the centipede's nearest relatives are insects and that the relationship with millipedes is much more distant.

Owing to the retiring habits of centipedes comparatively little is known about their reproduction. Although the satisfactory observation of copulation has never been recorded, on anatomical grounds it is believed to take place. In the Anamorpha the female after laying each egg carries it about between the specialised claws at the hinder end of her body and eventually, when it has been smeared with a secretion or earth, or both, lays it down where its covering is sufficient protection against enemies.

The eggs of Epimorpha are laid in an open nest and the female guards them faithfully until hatching takes place.



AFTER VERHOEFF, IN BRONN, "KLASSEN UND ORDNUNGEN DES TIER-REICHS" (WINTER)

FIG. 6.—DIGESTIVE TRACT OF A CENTIPEDE (LITHOBIUS FORFICATUS)

The egg is rich in yolk; this serves as food for the developing centipede which grows from a special area in the lower part of the egg. An examination of the developing animal when the process has been some time in progress may reveal the beginnings of the various head segments and of the walking limbs. When the animal at length leaves the egg its form varies as already indicated, according to the order to which it belongs.

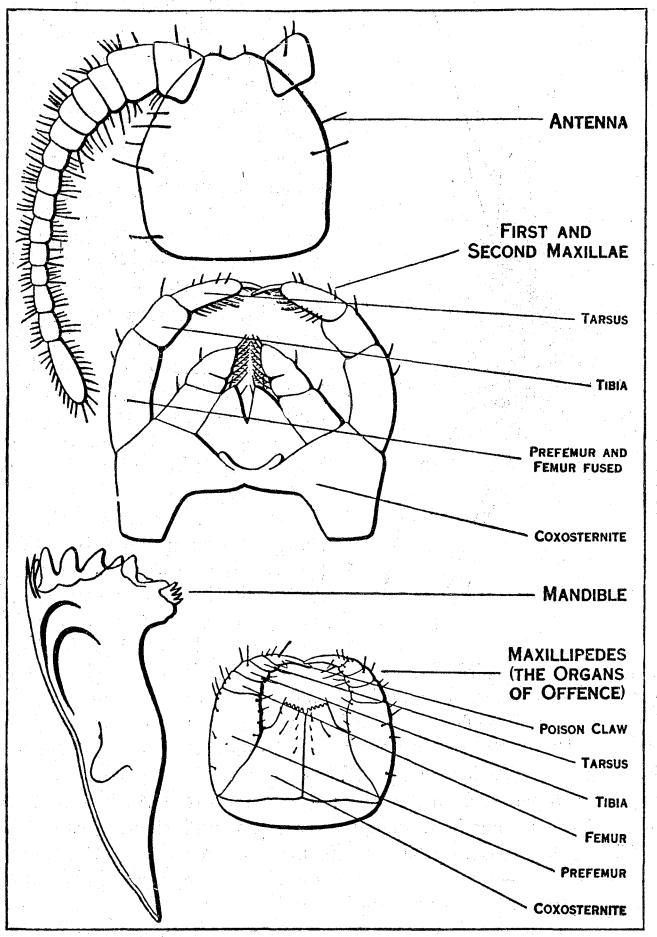
Centipedes as a class have a world-wide distribution.

Fossil centipedes occur in amber of Oligocene age but all older remains tentatively referred to the class Chilopoda are problematical. The least generalised centipedes (the Lithobiomorpha) are the shortest and we are led to conclude that in the evolution of the race the principle of contraction has been at work gradually reducing the number and similarity of the segments of the centipede's body.

Many Geophilomorpha have the power to give light, but as

these animals are blind the property is perhaps accidental. The light is produced by the simultaneous discharge upon the lower surface of the body of two kinds of glands, which occur in the floor of the body segments. When the two fluids mix outside the body a light is produced.

When the gardener hunting for slugs at night with a lantern sees *Lithobius* carrying off a small slug and shaking it as a terrier shakes a rat he rightly assumes that the centipede is his friend;



AFTER VERHOEFF, FROM BRONN, "KLASSEN UND ORDNUNGEN DES TIER-REICHS" (WINTER)

FIG. 7.—TYPICAL HEAD APPENDAGES OF CENTIPEDES

but *Lithobius* may kill and eat beneficial insects as well. Geophilomorpha are certainly carnivorous at times, but one species (*Haplophilus subterraneus*) has been known to damage growing celery, lettuce and onions, and other species are likely to be similarly injurious at times.

The painful bite of large centipedes may on occasion cause danger to life. "The part bitten should be bathed in a solution of ammonia—about 1 in 5" (Hirst). Pseudo-parasitism in Man may be due to accidental invasion of the ear or nasal pasages and adjacent sinuses by Chilopoda; or to swallowing them either accidentally or in a state of impaired mentality.

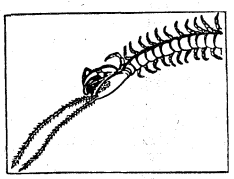
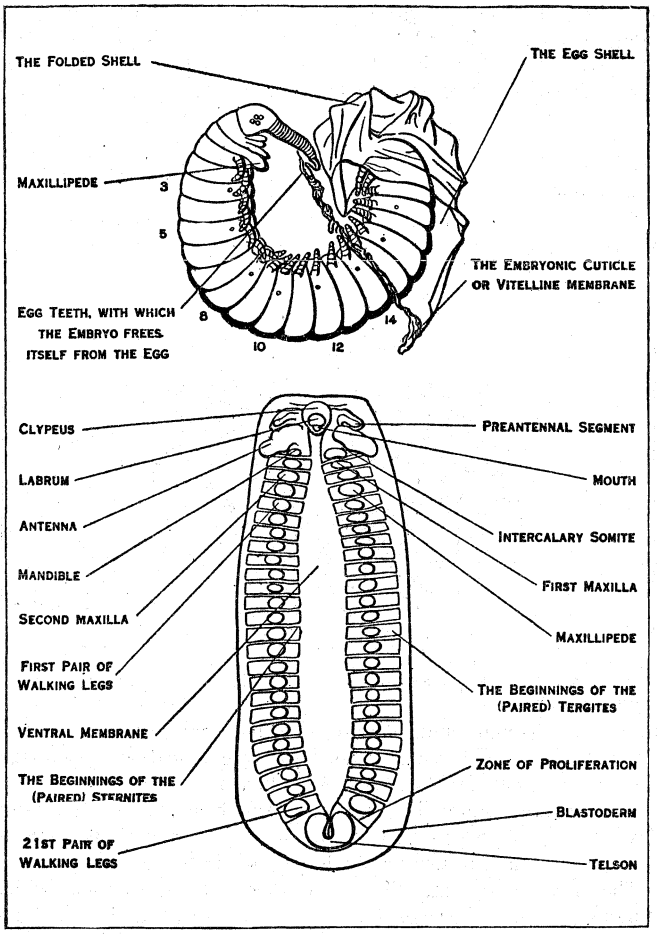


FIG. 8.—LITHOBIUS EATING A SLUG

Brief mention of centipedes is made by early writers (Aristotle, Pliny, Aelian). Oviedo, the companion of Columbus, describes the occurrence of centipedes in the island of St. Domingo, where he was supervisor of gold smeltings, and mentions the bright light emitted by some of them.

The literature in English is very scattered—most of the best modern accounts are in German.

See F. G. Sinclair, "Myriapods" in *Cambridge Natural History*, vol. 5 (1895), useful information in accessible form; K. W. Verhoeff, "Chilopoda" in Bronn's *Klassen und Ordnungen des Tier-Reichs;* K. Graf v. Attems, "Chilopoda" in *Handbuch der Zoologie*, vol. 4 (1926); for luminosity in Centipedes, S. G. & H. K. Brade-Birks, "Luminous



AFTER VERHOEFF, FROM BRONN, "KLASSEN UND ORDNUNGEN DES TIER-REICHS" (WINTER)

FIG. 9.—DEVELOPMENT OF A CENTIPEDE (SCOLOPENDRA CINGULATA) Above, the embryo in the act of leaving the egg. The front part of the egg-shell is already removed, and the back part thrown into folds. The embryonic cuticle is still attached to the end of the antennae. The numbers indicate leg-bearing somites. Below, developing embryo

Chilopoda" in *Annals and Magazine of Natural History* (1920); fossil Centipedes: Zittel's *Text Book of Palaeontology* (edit. Eastman, 1913).

(S. G. B.-B.)

CENTLIVRE, SUSANNA (*c.* 1667–1723), English dramatic writer and actress, married at 16 the nephew of Sir Stephen Fox, and on his death within a year she married an officer named Carroll, who was killed in a duel. Left in poverty, she began to support herself by writing for the stage. Some of her early plays are signed S. Carroll. In 1706 she married Joseph Centlivre, chief cook to Queen Anne, who survived her. Her first play was a tragedy, *The Perjured Husband* (1700), and she herself appeared for the first time at Bath in her comedy *Love at a Venture* (1706). Among her most successful comedies are: *The Gamester* (1705); *The Busy Body* (1709); *A Bold Stroke for a Wife* (1718); *The Basset-table* (1706); and *The Wonder! a Woman keeps a Secret* (1714), in which as the jealous husband, Garrick found one of his best parts. Her plots, verging on the farcical, were always ingenious and amusing, and the dialogue fluent. She never seems to have acted in London, but she was a friend of Rowe, Farquhar and Steele. Mrs. Centlivre died on Dec. 1, 1723. Her dramatic works were published, with a biography, in 1761 (reprinted 1872).

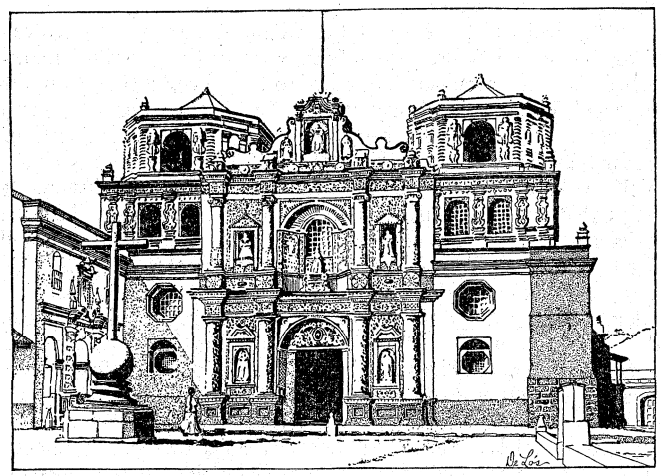
CENTO, a town of Emilia, Italy, province of Ferrara, 18m. S.E. direct from the town of Ferrara, 50ft. above sea-level; it is reached by road (6m. to the west) from the station of S. Pietro in Casale, 15m. S.W. by W. of Ferrara, and also by a steam tramway (18m. N.) from Bologna to Pieve di Cento, on the opposite bank of the Reno. Pop. (1936) 5,677 (town); 22,371 (commune). It is connected by a navigable canal with Ferrara. It was the birthplace of the painter Giovanni Francesco Barbieri (Guercino), and there are several of his works in the town.

CENTO, a composition made up by collecting passages from various works. The Byzantine Greeks manufactured several out of the poems of Homer, among which may be mentioned the life of Christ by the famous empress Eudoxia, and a version of the biblical history of Eden and the Fall. The Romans of the later empire and the monks of the middle ages were fond of constructing poems out of the verse of Virgil. Such were the *Cento Nuptialis* of Ausonius, the sketch of biblical history which was compiled in the 4th century by Proba Falconia, wife of a Roman proconsul, and the hymns in honour of St. Quirinus taken from Virgil and Horace by Metellus, a monk of Tegernsee, in the latter half of the 12th century. Specimens may be found in the work of Aldus Manutius (Venice, 1504; Frankfort, 1541, 1544). In 1535 Laelius Capitulus produced from Virgil an attack upon the dissolute lives of the monks; in 1536 there appeared at Venice a *Petrarca Spirituale;* and in 1634 Alexander Ross (a Scotsman, and one of the chaplains of Charles I.) published a *Virgilius Evangelizans, seu Historia Domini nostri Jesu Christi Virgilianis verbis et versibus descripta.*

CENTRAL AMERICA, geographically that portion of the American continent lying between the Isthmus of Tehuantepec in Mexico, and the Isthmus of Panama, or Darien, in the republic of Panama; politically, the five republics of Costa Rica, Nicaragua, Honduras, Salvador and Guatemala, and the British crown colony of Belize, or British Honduras. The geographical division is commonly known as "the isthmus," lying as it does between the narrowest portion of Mexico (Tehuantepec), immediately north of which Mexico broadens to continental proportions, and Panama, the narrow neck of land now cut by the canal, immediately south of which Panama and then Colombia broaden into the South American continent. The political delimitation of Central America, that is, the giving of the name to the five republics and British Honduras, is based, like most of the present boundaries of Spanish America, on the old Spanish colonial administrative areas. Central America is now, roughly, what was comprised in the captaincy general of Guatemala, on the north of which was the viceroyalty of Mexico, or New Spain, and on the south the viceroyalty of Nueva Granada, out of which have since been carved Panama, Colombia, Venezuela and Ecuador. The inclusion of Panama in Central America, while now common, is the result of a loose lumping of the smaller Caribbean republics of the isthmus into one group in our common thinking, but Panama was never politically associated with the Central American countries and until 1903, indeed, had no political life separate from Colombia. Geologically and climatically, however, Panama might properly be included in Central America, owing to the fact that the geographical division which is called "the isthmus" is thus, also, the natural geological and climatic unit.

Central America, as politically delimited, lies between 8° and 18° 3′ north latitude and between 82° 50′ and 92° 17′ longitude west. The easternmost point of Central America is thus almost directly south of Florida, in the United States, and the most westernly point is almost directly south of Galveston, Texas. The northern boundary is Mexico for a portion of the distance (north of Guatemala and British Honduras), and the Caribbean sea for the long northern boundary of Honduras. On the east is the Caribbean and on the south and west the Pacific ocean. British Honduras stands vertical, north and south, along the eastern edge of the almost uninhabited wilderness of Petén, in northern Guatemala, once the seat of the great "old" Maya empire, and the British colony faces on the Caribbean. The five republics, on the other hand, trail off from north-west to south-east, some 600m. long and 250m. wide at their widest point (between the north-eastern corner of Honduras and the south-western coast of Nicaragua). The longest straight north and south line in the entire isthmus is between the northern coast of Honduras and the peninsula of Nicoya in Costa Rica, about 450m. The total area is approximately 185,000 square miles.

Physical Features.—The main *cordillera* of the American hemisphere traverses Central America, leaving the countries divided into the high plateaux in the centre and the lowland coastal country on either side. Tehuantepec (far to the north), Nicaragua and Panama (to the south of Central America proper) each present, however, the anomaly of low passes through which a transcontinental railway, a river and an interoceanic canal cross, respectively, between the Atlantic and the Pacific. The mountains are elsewhere continuous, and the high plateaux in each country are marked with hundreds of small, fertile valleys, enjoying salubrious climates and great fertility. Part of the fertility is due



THE CHURCH OF LA MERCED AT ANTIGUA, GUATEMALA, THE CHIEF CHURCH OF THE OLD CAPITAL AND ONE OF THE FEW THAT RESISTED THE EARTHQUAKE OF 1773

to the volcanic ashes which form the subsoil and often the soil itself, in these areas. The high peaks of Central America, rising, some of them, far above the granite and conglomerate rocks of the mountains, are volcanic cones, some reaching a height of 13,000ft. above sea-level (the mountains are described in the articles on each of the countries). Volcanoes smoking or silent, mark the landscape in every country, sometimes as many as a dozen volcanoes being visible from one spot, while eruptions in relatively recent years have in some cases caused the rebuilding of railways around or across the blackened lava beds.

Central America boasts the largest lake south of the great lakes of Canada and the United States, and north of Lake Titicaca in Peru and Bolivia. This is Lake Nicaragua, 110m. long by 45m. wide, while Lake Managua, 38m. long by 16m. wide, is connected with it by a short river. Salvador has a number of beautiful lakes as has Guatemala, Lake Atitlán being one of the most beautiful spots in the Central American mountains. The rivers on the Pacific side are most of them short and swift, as the coast is narrow, the Lempa, in Guatemala, Honduras and Salvador being the most important. On the Caribbean side the rivers are longer and more important, the Segovia, or Wanks, being some 450m. long. The Caribbean coast is marked by lagoons and great bays, which are virtually landlocked salt water lakes. (W. Tho.)

Geology.—The trend of the structural lines in South America is not continued in Central America, where the strata are bent into folds whose axes extend nearly east and west. The mountain ranges in Central America are therefore assigned to what is called the Antillean system, as distinguished from the Andean system. Two submarine ridges that extend across the Caribbean sea, one between Honduras and the Sierra Maestra range in Cuba and the other between Cape Gracias a Dios and Jamaica, are regarded as submarine Antillean ranges. An exception to the general eastern direction of the folding is seen in the depression that crosses Honduras from the Gulf of Fonseca to Puerto Cortes, where the trend of the folding is generally northward. This depression may be a trough formed by faulting.

In Guatemala there is a group of eastward-trending ridges composed of old granite and schist, and areas of similar rocks, presumably Archaean or Palaeozoic, are found in British Honduras, Honduras and Costa Rica. In Guatemala these old crystalline rocks are at some places overlain by beds of Carboniferous limestone. The oldest Mesozoic rocks are some isolated beds of sand and clay, possibly of Triassic age, containing the remains of

plants. Large areas of Cretaceous clay, sandstone and conglomerate and an overlying series of beds of limestone are found in Guatemala, Honduras and Costa Rica. The Tertiary rocks, which are widespread, may be divided into two parts. The lower part consists of Eocene and Oligocene beds, chiefly sand and clay, which were evidently laid down in shallow water, near the shore. The upper part includes Pliocene beds, which were also laid down mainly in shallow water.

All the beds up to those of the Oligocene series are involved in the structural folds. The Pliocene beds are generally undisturbed. The Miocene epoch appears to have been a time of uplift and great disturbance throughout the Caribbean region. The two continents were probably brought together by the Isthmus of Panama during that epoch. The record disclosed by a study of the fossils of North and South America confirms this conclusion. It shows that the mammals of South America in middle Tertiary (Oligocene) times included none of those that then inhabited North America. The South American mammals of this time included armadillos, sloths, ant bears and a number of peculiar rodents, among them the water hog, the largest rodent known, none of which are represented by middle Tertiary fossils found in North America. The middle Tertiary North American mammals, on the other hand, included several species of deer, wild hogs, wolves, rabbits, squirrels and other well-known animals. The deposits of late Tertiary (Pliocene) times of both continents, however, show a mingling of animals belonging to both groups, confirming the conclusion indicated by the geologic record—that the two continents were joined late in Miocene times by an uplift of the land that made possible the migration of animals from one to the other. Further confirmation of this conclusion is found in the results of the studies of the sea fishes on both sides of the Isthmus of Panama, which show differences indicating a separation of the fishes in Miocene times.

The volcanoes in Central America stand along the west coast. The volcanic deposits are extensive and deep. The eruptions began near the end of the Cretaceous period and still continue intermittently. The eruptive lavas and ashes are mostly andesite and basalt but include also rhyolite and trachyte, and, at a few places, some phonolite. (G. McL. Wo.)

Population.—The total population of Central America (excepting British Honduras) as estimated by official bureaux of the government of the countries, is 6,950,000. Its composition is varied, from virtually pure-blooded Spanish whites on the highlands of Costa Rica to a mixture of Indian and negro which calls itself "Carib Indian" on the Caribbean coast of Nicaragua, Honduras and Guatemala (*see* Ethnology, p. 128).

HISTORY

Central America was discovered by Christopher Columbus himself on that last fateful voyage when he drove desperately westward from the Caribbean islands in a determination to find the strait to the China seas which he believed existed just beyond the barrier of the great continent that he had revealed to the world. He skirted the coast of Central America for virtually its full length, exploring the inlets and the immense lagoons, to the greatest of which his own crew gave a name in his honour—the Laguna del Almirante ("the Lagoon of the Admiral"). On this voyage, in 1502, Columbus founded in Costa Rica, the first colony in Central America, leaving his brother Bartholomew, in command, but the Indians, whose gold ornaments had been accepted by the Spaniards as assurance that gold was abundant there, quickly dispersed the colony and its survivors rejoined Columbus. No rich source of the gold of these ornaments—rare archaeological treasures to-day—has ever been found in Costa Rica, and the absence of treasure in Central America was doubtless largely responsible for the fact that Central America was not the subject of spoliation. Its location close to what was to become the chief route of shipment to Spain of the treasures of Peru and of the Orient, made its control and its wise political administration important in the eyes of Madrid.

Guatemala was conquered by Pedro de Alvarado, as lieutenant and representative of Hernando Cortés, who himself led his army for part of the way from Mexico through the jungle wilderness in 1522 and 1523. Alvarado was opposed by the highland Indians, and a terrible battle was fought not far from Quezaltenango between the Spaniards and the Indians under Tecum, resulting in a defeat of the Indians which was apparently decisive. Costa Rica was conquered in 1513 by Pedro Arias de Avila, but the entire region from Mexico to Panama was made a portion of the viceroyalty of New Spain or Mexico, and after its organization as a captaincy general Costa Rica was included in the administrative unit. The conquest of the other Central American provinces was largely perfunctory, little opposition being encountered excepting on the Caribbean coast, where the Carib Indians were virtually exterminated.

The captaincy general of Guatemala, including all of present day Central America and a portion of Mexico, declared its independence of Spain, with little bloodshed, on Sept. 15, 1821, and almost immediately thereafter came under the domination of the Emperor Iturbide of Mexico, and was part of his empire. The overthrow of the Mexican empire, however, returned the autonomy of Central America to its own people, the Mexicans retaining the former Guatemala territory now incorporated in the recognized national boundaries, long regarded as a Guatemalan "irredenta."

Central American Union.—On July 1, 1823, the first Central American union was formed, comprising the five old Spanish provinces, now Guatemala, Honduras, El Salvador, Nicaragua and Costa Rica, the only boundaries between the provinces and between Central America and the outside, being those of the old Spanish administration; Belize had been occupied by British traders engaged in the hardwood lumber trade since the 17th century, and the eastern coast of Nicaragua was practically a British protectorate, under the name of "the Mosquito kingdom." By the Clayton-Bulwer treaty of 1850 between the United States and Great Britain, Belize was recognized as a British possession and became British Honduras, while the protectorate of the Mosquito coast was surrendered by Great Britain and the territory eventually reverted to Nicaragua. The boundary between Costa Rica and Colombia was then, and continued to be, in question. The Mexican boundary and that of British Honduras, while somewhat vague in actual location, owing to the undeveloped condition of the country, were firmly established along parallels of latitude or degrees of longitude.

The first Central American union, as formed in 1823, was dominated by the conservative elements of Guatemala, including the clergy and Spanish administrators, and this domination proved irksome to the elements which, distant from Guatemala, had a more liberal idea of the independence and its potential possibilities for themselves. The first opposition to this union broke out in Honduras, where the Federalist, or Liberal, party had grown powerful and had evolved strong leaders. Since that date, the political parties of all the Central American countries have sprung from these two parent stems, and continue the use of the names Conservative and Liberal. Thus, even to-day, it may be safely said that the Conservatives of any one of the countries are closer to the Conservatives of the other countries than they are to the Liberals of their own country, the same being true of the Liberals. The complicated politics of Central America, with its wars and revolutions, are understandable only if that fact is remembered and counted upon.

The bitter struggle which began in the 1820's came to a head the following decade in a rivalry between the great Liberal exponent of union, Francisco Morazán, of Honduras, and the spectacular Conservative champion of secession, Rafael Carrera, of Guatemala.

As dictator of the Federation of Central America (1832–1842), Morazán resorted to force to maintain the union after 1838, when Honduras, Nicaragua and Costa Rica seceded, but when Carrera rose to power in Guatemala and withdrew that state in 1839 and 1840, the union was lost. Morazán tried to reduce Guatemala to submission, but was defeated by Carrera, and forced into exile.

Returning, he attempted once more to revive the union but was captured and executed in Honduras in 1842. Carrera, as dictator of Guatemala (1839–1865), restored the power of the Church,

suppressed Liberalism and union throughout Central America, and maintained political control over all five of the theoretically sovereign republics.

The battle for the union was the occasion of the landing in Nicaragua in 1856 of the American filibusterer, William Walker (*q.v.*), who joined forces with the Liberals in the struggle for the control of Nicaragua and was for a time the Liberal president of that Republic, and was attacked by the Conservative forces of all the countries of Central America, ultimately suffering defeat and death at their hands.

The efforts to form the Central American union lapsed after about 1860, until 1876, when Justo Rufino Barrios, the great Liberal leader of Guatemala, endeavoured to revive the old federal union, under various plans. He was killed in battle in 1885, in the course of an invasion of Salvador, then ruled by the Conservatives, in a final effort to impose the union by force. Futile efforts at union were made in 1887, 1892, 1895, 1897 and 1898.

In 1902, a move of considerable significance in Central American history took place at Corinto, Nicaragua, when representatives of Costa Rica, Nicaragua, Honduras and Salvador drew up a treaty creating a tribunal of Central American arbitrators for the pacific settlement of international disputes. Four years later, a dispute between Guatemala and Salvador reached a point where war was avoided only by the intervention of President Roosevelt of the United States and President Díaz of Mexico. This was followed by a conference on the high seas aboard the U.S. cruiser "Marblehead," one of the shortest and most effective peace conferences on record and known in Central America as the "Peace of the *mal de mer*." As a result there was drawn up in San José, Costa Rica, on Sept. 15, 1906, a new treaty between Costa Rica, Honduras, Salvador and Guatemala, under the provisions of which the presidents of the United States and Mexico were agreed upon as umpires in any future international disputes between the signatory nations.

Nicaragua was not a party to the San José pact, and its president, José Santos Zelaya, declined to join in it. Therefore, in 1907, when Zelaya became involved in a controversy with Honduras over revolutionary activities in the ill-defined borderland between the two countries, Nicaragua offered to arbitrate under the Corinto plan before a commission of Central Americans, while Honduras was willing to arbitrate only under the San José plan, before the presidents of the United States and Mexico. No arbitration was taken, therefore, and the situation grew more serious, involving Salvador and threatening to involve Guatemala. The ultimate result was the mediation of the United States and the calling of the first Central American conference at Washington, which met on Nov. 13, 1907, representatives of all five of the republics being present.

The conference resulted in the signing of a general treaty of peace and amity, including a provision that recognition should be withheld from revolutionary governments until the country suffering the revolution had been reorganized by constitutional means. It also resulted in the creation of a Central American court of justice, located at Cartago, Costa Rica, and composed of one judge from each of the five republics.

The court (later removed to San José) was established on May 25, 1908, and functioned smoothly until Costa Rica and Salvador brought before it their claims for alleged damages from the signing by Nicaragua of the Bryan-Chamorro treaty of 1916, under which Nicaragua ceded to the United States in perpetuity the right to build an interoceanic canal following the channel of the San Juan river, and granted to the United States the right to locate naval bases at the Corn islands in the Caribbean, and on Fonseca bay on the Pacific, upon which Honduras and Costa Rica both fronted.

Costa Rica contended that its rights to the mouth of the San Juan river had not been given due consideration and that the Fonseca bay naval base would constitute a threat to her peace and sovereignty.

In the controversy before the Central American court Nicaragua held that its treaties and relations with other powers were not subject to the scrutiny of the court, and when defeated in this stand, by a vote of four to one, withdrew from the court, and shortly thereafter the court ceased its functions.

Again, in 1920, new agitation for the formation of a Central American Union developed, this time with Guatemala as its centre. In that country, President Manuel Estrada Cabrera, dictator for 22 years and an opponent of union, was overthrown.

Under his successor a pact of union was drawn up, with Guatemala, Salvador and Honduras adhering to it, but the immediate overthrow of the new Guatemalan Government brought about collapse of the whole plan.

In 1922 a second Washington conference of Central American states was called, and met in December. Among the 14 treaties and conventions drawn up was a general treaty of peace and amity providing for non-recognition of governments coming to power by revolution or coup d'état. While not signed by the United States, that country announced its intention to adhere to the principles of the treaty.

The political developments in Nicaragua following the withdrawal of the American marines in 1925 (*see* NICARAGUA) were based theoretically on the literal support of Washington of this policy, and this in turn has brought forward the criticism that with Washington's effort to eliminate the right of revolution as the escape-valve of oppressed peoples, there should go a corresponding provision, by Washington, of the assurance of fair elections at which the majority might express itself, and that Washington should support the legitimate succession when imperilled. The former dictum was accepted by Henry L. Stimson, the investigator sent by President Coolidge in 1927, and an election guarded by U.S. marines was assured for 1928, but the policy of supporting legitimate governments was declared an impossible development of the situation enunciated in the case of Washington's refusal of aid to Vice President Juan B. Sacasa when he was driven out of Nicaragua by the Chamorro revolution in 1925.

The impact of the economic depression which shook the world in 1929 brought about revolutions or at least serious disorders during the revolutionary years 1930 and 1931. Except in Costa Rica, a trend away from democracy was evidenced by the rise of self-perpetuating dictators who effected constitutional changes to protect their own personal interests. These same dictators, however, consistently furthered public works, especially highway development, and education.

Communications.—The geographical situation in Central America is such that peace between the countries, freedom from domestic disturbance within and, probably, the possibility of a federation of the five countries in a union at some future date, is more dependent on communications than on politics. It is probable that peace will be assured with an adequate system of roads within the countries and that international wars will end with the building of railways between countries.

Two of the countries, Guatemala and Costa Rica, have transcontinental railway systems. Practically all the commercial railways in Central America are 36in. gauge. One country, Honduras, has only one general commercial line, the others being owned and operated by banana companies on the Caribbean coast. Nicaragua has only one railway, paralleling the Pacific coast, from the port of Corinto to León, Managua and Granada. Salvador and Guatemala have comparatively adequate railway systems, all—excepting the British-owned line from San Salvador to Acajutla in Salvador—owned by the International Railways of Central America, a United States enterprise.

Since 1930 highway development in Central America has made great advances. Salvador has achieved the most, with a national system well on the way to completion. Guatemala is second, with a fairly general highway plan, partially executed. Honduras has depended more on highways than have the other countries, and has a magnificent and extremely expensive road from the Pacific port of Amapala (San Lorenzo on the mainland is the terminus of the highway) to Tegucigalpa.

In the past Nicaragua has suffered more than any of the other countries from lack of adequate communications, and excepting for the highway from Managua to Matagalpa, open during the dry season and usually passable in the wet season, has been almost un-

developed. On the Atlantic and Pacific sides, the lack of rock for road construction has been a serious obstacle, and in the mountains the absence of settlements has made the construction of roads expensive in proportion to their benefit. The railway to the Atlantic coast has long been an unattainable ideal, and adequate highway development a serious government problem. Costa Rica, with its transcontinental railway system, has been virtually without feeder railways or roads, and concentration of the life of the country on the plateau has been a necessary result. It has planned an adequate highway system, but so far development has been slow.

Construction of the Inter American Highway, which will eventually link the 18 independent republics of the American mainland, has progressed rapidly since 1930, and the Pan American Highway Confederation was able to report the following mileage and road condition in the latter part of 1939:

	Guatemala	Salvador	Honduras	Nicaragua	Costa Rica	Total
Paved	..	72	..	16	47	135
All Weather	273	48	30	17	..	368
Dry Weather	43	53	29	99	66	290
Trails	..	8	31	113	243	395
Total	316	181	90	245	356	1,188

Economic Development.—Economically, Central America is still in an era of paternalistic plantation production, having few factories, a small variety of agricultural products, and importing a great variety of goods in exchange for its staple products: coffee, sugar, hides and bananas. Costa Rica produces little excepting coffee and bananas and a small quantity of gold, importing cattle, wheat, rice and beans from Nicaragua and Salvador. Nicaragua is a producer of coffee and sugar, while cattle and foodstuffs are also listed in its export products. Honduras is a cattle and banana country, but produces much of the food and coffee consumed and considerable tobacco and sugar.

Salvador is a producer of coffee, although it also produces and exports foodstuffs and certain specialties like balsam and indigo. Guatemala is a producer of coffee, sugar and bananas; cattle are fattened on its ranges and slaughtered for the market in Mexico. The countries are as a whole, however, producers of but two crops: coffee and bananas. Coffee is grown under plantation conditions with many disadvantages to the working population. The coffee of Central America is of an exceptional quality, that of Costa Rica being virtually all sold in London for special blends, and that of Guatemala finding its best market in Germany.

The banana industry, while highly productive, is a foreign-owned enterprise, highly organized and not closely identified with the countries.

The opportunities for the development of Central America have always seemed tempting, and British and German capital has found a ready investment as has, in more recent years, American capital, in increasing amounts. The lack of abundant labour supplies has been a deterrent to Central America's economic development, but the proximity of the producing regions to the long coastline and the possibilities of machine development of the agricultural resources have been tempting. Little mining has been done on a large scale, owing to the character of the country, which has few mineralized sections, and these not of great richness. The chief importance of Central America as an economic unit seems to be derived from its proximity to the Panama canal, and from the possibility of the building of another canal through Nicaragua, placing the countries close to the interest and possible economic development of the United States.

BIBLIOGRAPHY.—H. H. Bancroft, *History of Central America* (3 vols., San Francisco, 1883–90); C. Beals, *Banana Gold* (Philadelphia, 1932); S. Bonsal, *The American Mediterranean* (New York, 1912); Corporation of foreign bondholders, *Annual Reports* (London, annual); C. W. Domville-Fife, *Guatemala and the states of Central America* (London, 1913); Foreign bondholders protective association, *Annual Report* (New York, annual); C. L. Jones, *Caribbean backgrounds and prospects* (New York, 1931); C. L. Jones, *Caribbean interests of the United States* (New York, 1916); C. L. Jones, *Caribbean since 1900* (New York, 1936); W. H. Kelchner, *Latin American relations with the League of Nations* (Boston, 1930); C. D. Kepner, Jr. and J. H. Soothill, *The Banana Empire* (New York, 1935); W. H. Koebel, *Central America* (London, 1917); W. R. Manning, ed., *Diplomatic Correspondence of the United States: Inter-American Relations, 1830–1860,* vols. III–IV (New York, 1933–34); P. A. Martin, *Latin America and the War* (Baltimore, 1925); L. Montúfar y Rivera Maestre, *Reseña histórica de Centro-América* (7 vols., Guatemala, 1878–1887); L. A. Moreno, *Historia de la relaciones interestatuales de Centro-América* (Madrid, 1928); D. G. Munro, *The Five Republics of Central America* (New York, 1916); D. G. Munro, *The United States and the Caribbean Area* (Boston, 1934); D. Perkins, *The Monroe Doctrine, 1823–1826* (Cambridge, Mass., 1927); D. Perkins, *The Monroe Doctrine, 1826–1867* (Baltimore, 1933); J. F. Rippy, *Historical Evolution of Hispanic America* (New York, 1932); J. F. Rippy, *Latin America in World Politics* (3d ed., New York, 1938); J. F. Rippy, *Rivalry of the United States and Great Britain over Latin America, 1808–1830* (Baltimore, 1929); W. S. Robertson, *Hispanic American Relations with the United States* (New York, 1923); W. S. Robertson, *History of the Latin American Nations* (rev. ed., New York, 1932); A. B. Ruhl, *The Central Americans* (New York, 1928); E. Squier, *The States of Central America* (New York, 1858); J. L. Stephens, *Incidents of Travel in Central America* (2 vols., New York, 1841); G. H. Stuart, *Latin America and the United States* (rev. ed., New York, 1938); M. W. Williams, *Anglo-American Isthmian Diplomacy, 1815–1915* (Washington, 1916); M. W. Williams, *People and Politics of Latin America* (rev. ed., New York, 1938). *See,* also, publications of the Pan American Union (Washington), Foreign Policy Association (New York), and Department of Overseas Trade (London).

(L. W. BE., M. L. M.)

ETHNOLOGY

The aboriginal inhabitants of Central America differ in speech, in physical type, and in manner of life. Before the Spanish colonization these contrasts were much more marked, and from the study of linguistic and archaeological evidence it is clear that the district comprising southern Mexico and Central America never was an isolated and self-contained ethnic unit. On the contrary, to this focus of highly developed civilizations barbarian tribes had pressed from both the north and the south. Hence to explain the present it is necessary to examine the past.

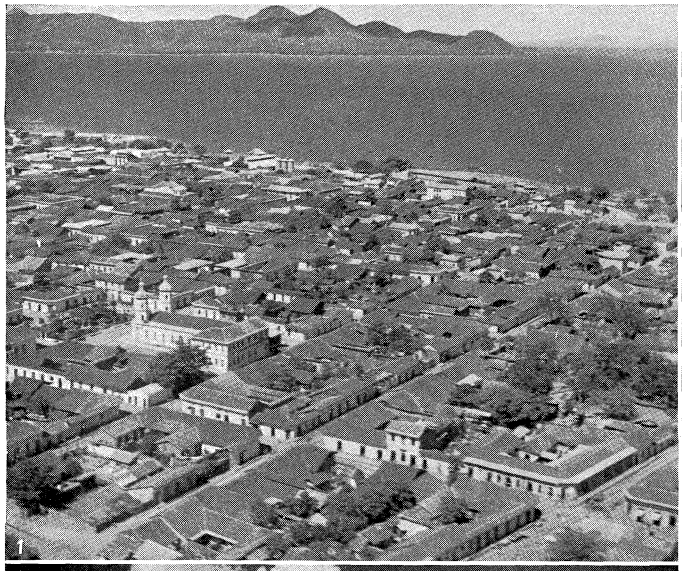
The most ancient people as yet revealed by the spade in Middle America have lost their very name in the mists of the past, and their culture is known to-day simply as the "archaic." It has been traced under lava flows and huge beds of volcanic ash from the Valley of Mexico to Salvador. These people were not primitive, for they understood the arts of weaving and pottery making.

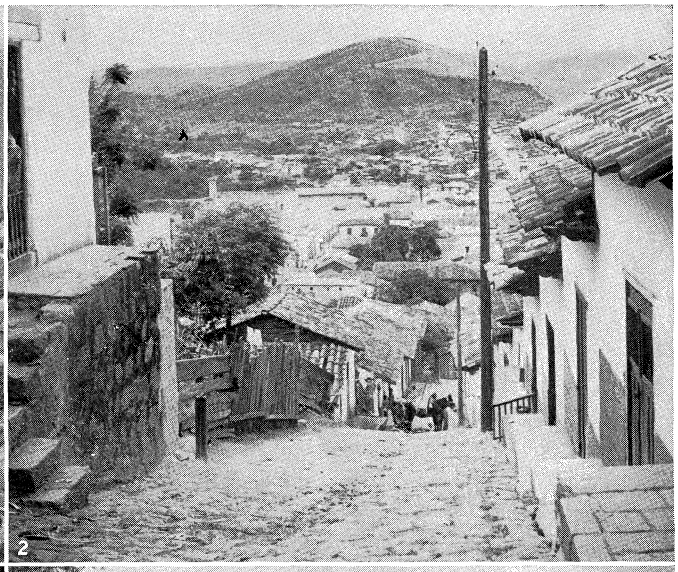


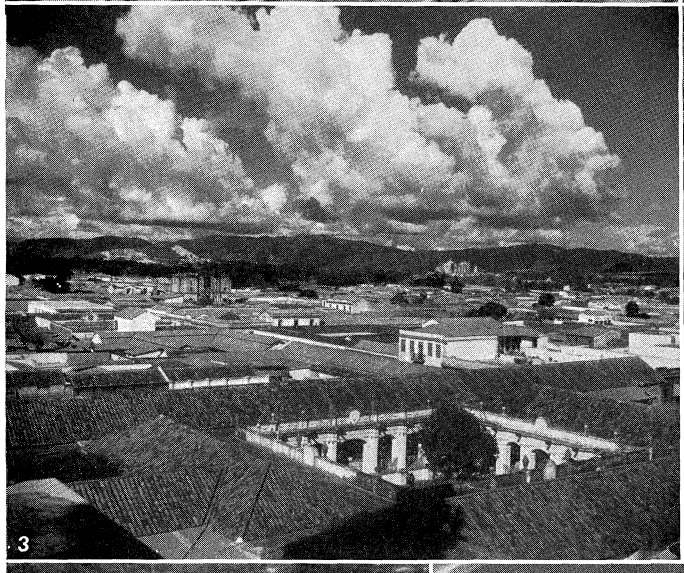
NATIVES OF GUATEMALA AT A MARKET

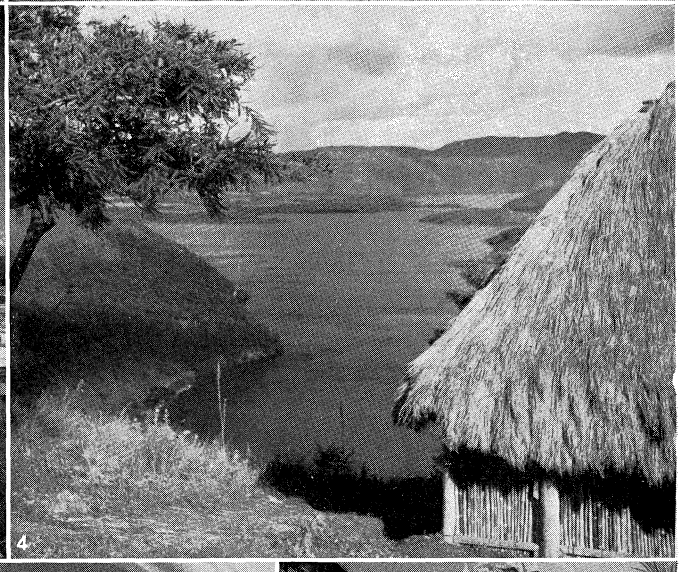
Their cultural status may be compared to that of the present Pueblo Indians. How long ago they flourished cannot be said. There is also reason to believe that at least one other stream of culture existed contemporaneously in Middle America.

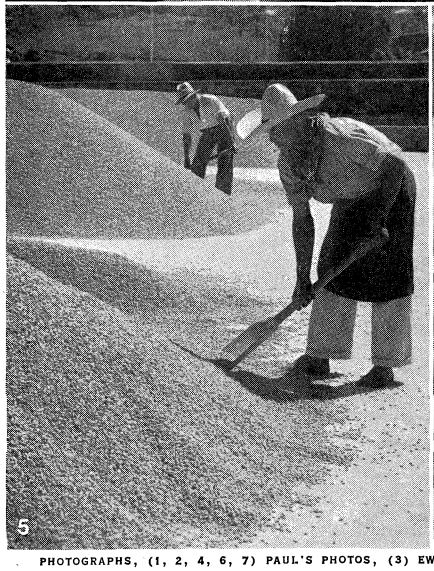
Before the beginning of the Christian era there began an influx of population from South America, represented by archaeological remains and by many tribes speaking dialects of the Chibchan tongue of Colombia and Ecuador. In the 16th century they occupied practically all of Panama and Costa Rica, eastern Nicaragua, and possibly eastern Honduras. These various historic groups probably do not represent the spearhead of the thrust northward.

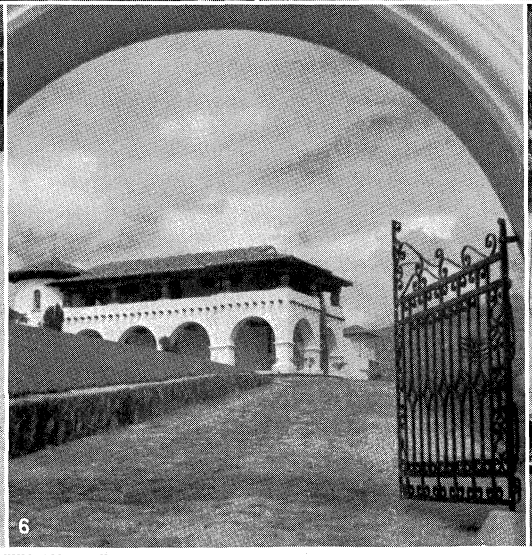


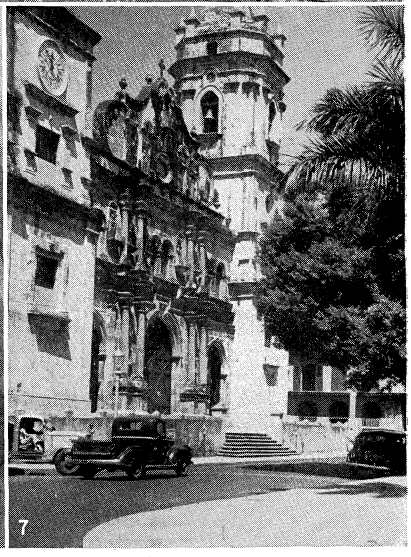












PHOTOGRAPHS, (1, 2, 4, 6, 7) PAUL'S PHOTOS, (3) EWING GALLOWAY, (5) PIX

URBAN AND COUNTRY SCENES IN CENTRAL AMERICA

1. Air view of Managua, capital of Nicaragua, on the southern shore of Lake Managua. In the left centre is the main cathedral with its double towers
2. A typical street in Tegucigalpa, Honduras, with the gutter in the centre instead of along the sides
3. Panoramic view of Guatemala City, Guatemala
4. Overlooking Lake Amatitlan, 17 mi. from Guatemala City
5. Workmen drying and ripening coffee beans in Costa Rica
6. Residence on a coffee *finca* (plantation) on the outskirts of San Salvador, El Salvador. In the coffee-picking season, the larger *fincas* may hire as many as 2,000 men
7. The main cathedral in Panama City

The first comers either may have been the Maya and Chorotega (*see* below), or else some of the small isolated tribes living in areas of refuge, such as the Xinca.

By the beginning of the Christian era two large linguistic groups, Maya and Chorotega, had assumed a definitely historic pattern. Owing to their use of writing and the calendar, definite dates can be applied to their archaeological remains thenceforward. The Chorotega then lived in western Honduras and possibly parts of Guatemala. From this region they were displaced by the Maya, who forced them to move to the north and south. At the time of the Spanish conquest they had settled in southern Mexico and also on the south coasts of Costa Rica, Nicaragua and Honduras. The first great Maya cities arose on the plains of northern Guatemala, to-day an almost uninhabited jungle. Here they erected a host of well-built edifices of stone and concrete. About the beginning of the 6th century A.D. construction ceased, and it has generally been assumed that the Maya immediately abandoned these cities. Recent archaeological studies, however, indicate that they continued to occupy some at least of the older towns. At any rate, it is known, from ancient writings, that the Maya had discovered and partly colonized Yucatan as early as the 4th century. They now proceeded to populate it and also the highlands of southern Mexico and Guatemala. By the 11th century both in Yucatan and Guatemala the Maya had established a series of powerful principalities and again were housed in well-built cities of stone. In Yucatan there arose a league of three princely houses, the Itza, Xiu, and Cocom, who dominated the peninsula in unity for 200 years. In A.D. 1201, a civil war broke out, the Itza capital was sacked with the aid of Toltec mercenaries, and the Itza were forced to withdraw to the jungles of Guatemala, where they maintained their ancient civilization against all attacks until the end of the 17th century. In Yucatan the Cocom family became the overlords of the peninsula, but they were overthrown in turn by a coalition of petty princes organized by the Xiu in 1458. When the Spaniards reached Yucatan it was badly disorganized politically as it had been ravaged for over 300 years by intermittent warfare.

In Guatemala by the 12th century there had also arisen a series of well-organized kingdoms and principalities, of which those of the Quiché (*q.v.*), Cakchiquel, and Zutuhil were the most noteworthy. Here again was enacted a series of bitter wars which terminated only with the Spanish conquest.

According to their traditions the Toltec settled in central Mexico in A.D. 752, and there developed a kingdom which lasted until 1070. By all accounts, it is clear that the Toltec and Maya princes of both Yucatan and Guatemala were friendly, and that intermarriages took place occasionally. Indeed it has been suggested that the Toltec were a Maya tribe who wandered to Mexico and there borrowed the Nahua tongue of their neighbours. Upon the downfall of their empire part of the Toltec went to Yucatan as mercenaries. Others pushed southward and settled in Guatemala, Honduras, Salvador and Nicaragua, where they were encountered by the Spaniards.

The Aztec, the last comers in the Valley of Mexico, founded their capital in 1325 and rapidly rose in military power. Like the Toltec they spoke Nahuatl, a tongue related to Indian languages of the United States, such as the Ute. Although they overran Central America with semi-military trading expeditions, they made no permanent settlements except two small colonies in Salvador and Panama. Two other tribes, the Subtiaba of Nicaragua and the Tlappanec of Guerrero, both small and obscure peoples, show linguistic connection with the United States. Their tongues have recently been connected with the Coahuiltecan languages of northern Mexico and Texas as well as with the Hokan of California. Other small tribes exist in Central America but their linguistic relationship remains doubtful. These include the Xicaque, Lenca and Paya of Honduras and the Xinca of Guatemala. It has been suggested that they are related to each other and to the Mixe-Zoque tongues of southern Mexico.

Finally, on the north coast of Honduras and adjacent portions of British Honduras there live Carib Indians. They came originally from St. Vincent where they caused the English much trouble. In 1796 they were deported at a cost of nearly $5,000,000. Many of them show a strong infusion of negro blood.

Indians of Central America

Stock and dialect	Location	Number
Nahua		
Alaguilac	Guatemala	..
Pipil	Guatemala, Salvador	..
Nicarao, Nahuatlaco, Desaguadero	Nicaragua	..
Bagaces	Costa Rica	..
Sigua	Panama	
Coahuiltec-Hokan		
Subtiaba	Nicaragua	..
Maribichicoa	Nicaragua	..
Perhaps Mixe-Zoque		
Paya	Honduras	*c.*500
Xicaque	Honduras	..
Lenca	Honduras, Salvador	25,000
Xinca	Guatemala	10,000
Chorotega		
Choluteca	Honduras	..
Mangue	Nicaragua	..
Orotiña	Costa Rica	..
Maya		
Lacandon	Mexico, Guatemala	500
Mam	Mexico, Guatemala	115,000
Chuj	Mexico, Guatemala	13,000
Jacaltec	Mexico, Guatemala	36,000
Motozintlec	Mexico, Guatemala	3,000
Ixil	Guatemala	12,000
Aguacatec	Guatemala	4,000
Chorti	Guatemala, Honduras	30,000
Quiché	Guatemala	278,000
Cakchiquel	Guatemala	131,000
Zutuhil	Guatemala	14,000
Uspantec	Guatemala	3,000
Kekchi	Guatemala	80,000
Pokonchi	Guatemala	20,000
Pokoman	Guatemala	50,000
Perhaps Chibchan		
Lislique	Salvador	*c.*3,000
Cacaopera	Salvador	*c.*5,000
Matagalpa	Nicaragua	..
Ulva	Nicaragua	..
Mosquito	Nicaragua	..
Sumo	Nicaragua	..
Chibcha		
Rama	Nicaragua	..
Guatuso (Corobici), Guetar, Voto, Suerre	Northern Costa Rica	300
Cabécera	Costa Rica	..
Bribri	Costa Rica	..
Térraba	Costa Rica, Panama	..
Boruca	Costa Rica, Panama	..
Dorasque	Panama	..
Guaymi	Panama	5,000
Cuna	Panama	25,000
Carib	British Honduras	..

The conditions under which individual Indian tribes live to-day in Central America depends on their inherited culture, their environment, and their culture-contacts with Europeans. In Guatemala throughout the highlands the Indian has been forced to support the European population through a system of peonage little better than slavery. However, he has maintained his racial purity, his language, his distinctive and beautiful costumes, and beneath a veneer of Christianity, much of his ancient religion. In this region, the European domination has meant for the Indian the introduction of new food plants such as coffee, the substitution of taskmasters of his own race by foreigners, and the suppression of certain liberties such as intertribal warfare and religious ritual. Their lot is not enviable, but probably they are as well off materially, excepting the ancient nobility, as before the Conquest. In Honduras, Salvador (except the west) and Nicaragua, most of the Indian population has fused with European blood to form the *ladino* class, which makes up the bulk of the population. Aspiring to a European scale of living, these people often retain many traits of their Indian ancestors, and through poverty are forced to exist in the same manner as the Indians themselves. There is little social discrimination against the *ladino,* so, as he usually

owns little or no property, he often resorts to violent political action as a short cut to wealth. Indeed it is said that the present political divisions in Nicaragua are based on the pre-Columbian hostility of the Mangue and Nicarao tribes.

Along the Atlantic coast of Central America from central Honduras to the south-east there exist scattered Indian tribes who maintain a semi-independence. They live chiefly by hunting and

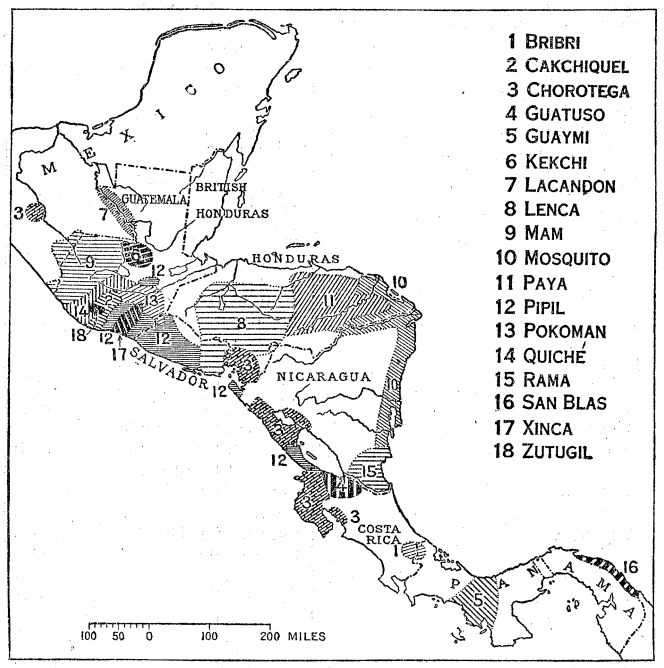


CHART SHOWING THE DISTRIBUTION OF THE CHIEF INDIAN TRIBES OF CENTRAL AMERICA

fishing. All of them are agriculturalists, but in general their food-plants point towards South America rather than North America. European diseases, alcohol, and a jungle environment are leading them towards extinction. The San Blas, who have excluded Europeans from their territory, are the largest and most vigorous of these hunting tribes.

All of the Central American Indians have come under the influence of Christianity. Even some of the wilder tribes call themselves Christians. In general the Indian has not been hostile to the new religion, but has seen no reason for abandoning his own. The result has been a curious blend, finding expression in exotic cults such as the famous Black Christ of Esquipulas. In Central America, as long ago in Europe, the church has had to extend its mantle over paganism which it could not extirpate.

BIBLIOGRAPHY.—D. G. Brinton, ed., *The Maya Chronicles* (Philadelphia, 1882); also *Annals of the Cakchiquels* (Philadelphia, 1885); Brasseur de Bourbourg, ed., *Popol Vuh* (1861); E. G. Squier, *Notes on Central America* (1855); Walter Lehmann, *Zentral-Amerika* (1920); Cyrus Thomas and J. R. Swanton, "Indian Languages of Mexico and Central America," Bul. 1, 44. Bureau of American Ethnology (1911); W. M. Gabb, *On the Indian tribes and languages of Costa Rica,* Proc. Am. Philos. Soc. vol. xiv. (Philadelphia, 1875); Karl Sapper, *Mittelamerikanische Reisen aus Studien aus den Jahren 1888 bis 1900* (Braunschweig, 1902), "Der gegenwärtige Stand der ethnographischen Kenntnis von Mittelamerika," in *Archiv. für Anthropologie,* N.F. Bd. iii. (Braunschweig, 1904). (S. K. L.)

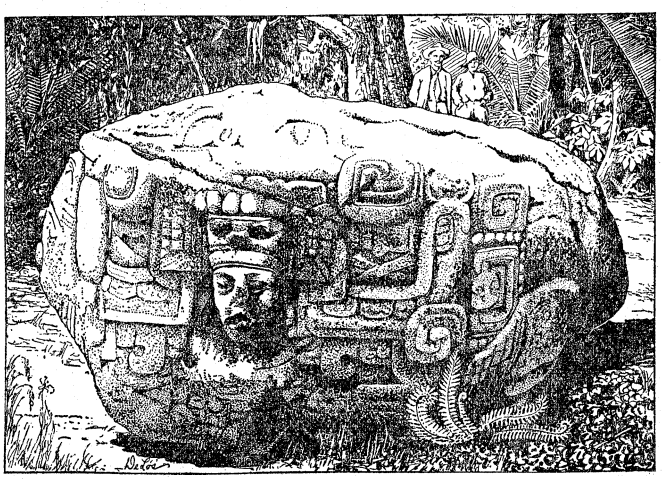
ARCHAEOLOGY

The archaeology of Mexico and Central America cannot be discussed in terms of modern geography. The southern half of Mexico, with Guatemala, British Honduras, the north of the republic of Honduras (at least) and Salvador, constitute an archaeological complex which can only be examined as a whole. Further south, the ancient culture of Nicaragua is still very obscure, although it was evidently subjected to influences from the north. These influences extended into certain regions of Costa Rica, and even of Panama, although, in the two last-named Republics, they were clearly of late introduction, and the indigenous culture displays increasing affinities with that of the Southern Continent. The region as a whole is characterised by great linguistic diversity, but certain main groups may be distinguished which appear to coincide fairly accurately with the archaeological areas. Details may be obtained from the linguistic surveys published by Thomas, Swanton and Lehmann.

The Antilles, ethnologically and culturally belong to South America, and their archaeology is treated in connection with that of the Southern Continent.

The Ancient Maya.—The earliest manifestation of a superior form of culture in the area is associated with the Maya. The term is linguistic, and includes a large number of tribes speaking different dialects spread over a wide area. The culture, in its earliest known phases, attained a high level and is characterised by great proficiency in architecture, stone-carving, pottery and the textile arts, in spite of a complete ignorance of iron, of the principle of the wheel (either for pottery or traction), and of the true arch. A special feature of this semi-civilization was an elaborate "hieroglyphic" script, and a very complicated calendar. The greater part of the recorded inscriptions consist of elaborate calendrical computations, which can now be read, and many of the monuments can be placed in their chronological sequence. The correlation of Maya dating with European chronology, however, is still somewhat obscure, though the most likely theories differ by less than three centuries (*see* CHRONOLOGY and CALENDAR).

Early History.—The earliest phase of Maya culture, to judge from recorded dates, occupied a very definite area, roughly in the shape of an inverted triangle, the base of which extends almost horizontally from the ruined site of Palenque, in the Mexican state of Chiapas, to the Atlantic, with its apex resting on the site of Copán, in the Republic of Honduras. The earliest dates so far recorded have been found at Tikal and Uaxactun towards the north-eastern corner of the area. The continuity of dates at various settlements indicates that the region was in continuous occupation for over four centuries. This period is known as the Early Maya Empire. Towards the close of the period, there is evidence of an extension northwards, resulting in an abrupt desertion of the ancient sites, and a transference of the population to Yucatan. The latest dates at the important Old Empire sites are



MAYAN MONUMENT DISCOVERED IN THE JUNGLE OF QUIRIGUÁ, GUATEMALA

covered by a very short span of years. The cause, or combination of causes, which led to this migration, are still obscure.

The Maya occupation of Yucatan is generally known as the "New Empire," and is distinguished by a modification of the dating system, and certain architectural and artistic peculiarities, best expressed in the important settlements of Chichén Itzá and Uxmal. A further development occurred later, owing to Toltec influences emanating from the Valley of Mexico (*see* below). For this period there exist certain semi-historical documents, the chronicles of the Tutul-Xiu tribe (known as the *Books of Chillán Balam*), which were reduced to writing in post-conquest times and the invaluable account of Bishop Landa (1566) (*see* Bibli-

ography). Though the main body of the early Maya migrated north, it is clear that a branch travelled west, because monuments, bearing dates later than any of those within the early Maya area, have been discovered at Sacchana in the direction of Oaxaca. In fact the Maya calendar, and much of Maya culture, appears to have been adopted by the Zapotec tribes of Oaxaca, and to have spread thence to the Valley of Mexico, though in attenuated form. Here it was developed by the Toltec, the first wave of a stream of immigrants from the north (all speaking dialects of a common language, known as Nahuatl) of which the final wave was represented by the Aztec. The ultimate rise to power of the Aztec resulted in the emigration of large bodies of Toltec from Mexico, and the spread of Toltec influence among the Totonac peoples of Vera Cruz, and the later Maya of Yucatan. An interesting problem is provided by the Huaxtec people, inhabiting the Panuco Valley, north of the Totonac, and separated by them from the main body of Maya to whom they belong linguistically. Stone sculpture has been found in this area, but no trace of a script. Their pottery bears a close resemblance to the pre-Toltec remains of the Mexican Valley, and to certain, apparently, very early pottery discovered in the Maya Area. They represent apparently, a very early branch of the Maya stock, isolated by the intrusion of immigrant tribes before the great development of Maya culture. Further results of the successive incursions of Nahuatl-speaking tribes from the north are indicated in subsequent paragraphs.

Mexican immigration into Yucatan heralded the disruption of the later Maya Empire. For two centuries the country was controlled by a "triple alliance" between the settlements of Chichén Itzá, Uxmal and Mayapan. Dissension arose and the rulers of Mayapan employed Toltec mercenaries to coerce their allies. The Toltec received Chichén Itzá as the reward of their aid, and erected there some of the most imposing buildings in their own traditional style. Subsequent history is concerned with the internecine feuds of the various clans, and internal strife, complicated by pestilence, had seriously reduced the level of Maya culture by the time that the arrival of the Spaniards extinguished it for ever.

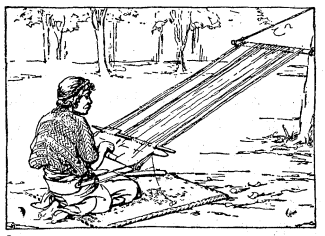
Architecture.—The stone-built settlements consist for the most part of a complex arrangement of pyramidal mounds, often crowned by temples, and other buildings, usually arranged round open courts, in which were erected monolithic stelae and altars. The pyramids are of the "stepped" variety, faced with cut stone blocks, and usually furnished with a stairway on one or more sides. These American mounds, though superficially resembling certain of the pyramids of Egypt, performed a different function. The Egyptian pyramid was fundamentally a tomb; the American pyramid was a substructure for a temple or an altar. Such erections, as a settlement grew in importance, were often enlarged by the addition of another "skin" of masonry. Stone tools alone were available for quarrying and carving, and the remains so far discovered represent a remarkable achievement on the part of a primitive people. The Maya mason was ignorant of the true arch. Buildings were roofed by means of a series of over-stepping courses, which approached one another until they could be united by a series of single slabs. Above this was added a thick layer of solid masonry, and in many cases a lofty "roof-comb," the weight of which kept the false arch firm. But the system entailed great thickness of walls (to withstand the outward thrust of the false arch), and provided for interior chambers only of very restricted width. But the deep entablatures and lofty roof-combs provided a wonderful space for exterior ornamentation, and of this the Maya builder took full advantage. At some sites ornamentation in stucco was applied (notably at Palenque), but in the Later Empire, when the desire for decoration lost all restraint, the stone blocks were carved so that the whole façade of a building became a kind of architectural mosaic. Doorways were usually bridged with wooden lintels, the decay of which has led to the collapse of many of the heavy entablatures. The pillar, as such, was practically non-existent in Old Empire times; broken sections of the wall served the purpose. But as, in later times, buildings became lighter and more commodious, Toltec influence introduced serpent-forms and caryatids (notably at Chichén Itzá). In the erection of buildings relatively small blocks of stone were employed, the bonding of corners was not practised, and mortar was not used. The rapid growth of tropical vegetation, thrusting its roots between unmortared blocks, is mainly responsible for the collapse of Maya structures. In one site alone, the newly-explored site of Lubaantun in British Honduras, has megalithic building been found. Here a hill-terrace, concealed by later masonry, was revealed by excavation, constructed of huge blocks some of which measure $5 \times 4 \times 2$ feet. But the stelae and altars found at most of the important sites are megalithic; huge blocks of stone, covered with intricate carving, the largest of which (at Quirigua) measures some 25 ft. above ground. These stelae were erected to mark the passing of a *katun* (a period of, roughly, 20 years). At the site last mentioned they were replaced for a certain period by the monolithic figures of grotesque monsters. The quarrying, transport, and sculpturing of such huge blocks constitute a remarkable achievement on the part of artisans working by stone-age methods. (*See* Holmes in the Bibliography.) The Maya "cities" were not cities in the ordinary sense. They cannot have been citadels, because the most elementary rules of defence are neglected. They were probably observatories and ceremonial centres, inhabited by the priests and chiefs, whither the population at large repaired to perform their religious ceremonies at stated times.

Religion.—The early Maya religion can only be guessed from the accounts given of the beliefs of the later Maya (overlaid by Mexican influence), recorded by Landa and Cogolludo; such echoes as are provided by Mexican ritual; the tribal traditions of the Quiché people of western Guatemala (contained in the *Popol Vuh*, reduced to writing in post-conquest times, but obviously Toltec in origin); and the Maya sculptures and three surviving Maya manuscripts. (For details *see* the BIBLIOGRAPHY.) The great creator-god of the Maya was Kukulcan (*kukul*=the quetzal-bird; *can*=snake), whose name was literally translated by the Toltec and Aztec as Quetzalcoatl. It appears in the Quiché legends as Gucumatz. His emblem was a feathered serpent, and, in later times, a man with bird and serpent attributes. He was "the feathered snake that goes in the waters," the ripple, born of wind and water, representing breath and movement and therefore life. Another high god was Itzamna, a sky-god, corresponding to the Greek Zeus. He is represented by the Hurakan of the Quiché legend, and exactly paralleled by the Aztec Tezcatlipoca. But more important in popular ritual was the rain-god Chac, whose portrait with pendulous nose is the most frequent in Maya art. The nose was borrowed from the rudimentary trunk of the tapir which was believed to be closely associated with lightning. Highly important also was the death-god, whose portrait as a skull or skeleton is almost as frequent in the sculptures. The sun-god and maize-god appear to have played less important parts, though the former had considerable significance in connection with the calendar. Many other deities of lesser importance are mentioned by the early chroniclers, as presiding over certain arts and occupations (*see* especially the account of the seasonal festivals given by Landa). On the whole, Maya religion was a worship of the powers of nature, plus a mysterious creator- and culture-god, whose worship was of rather an esoteric nature. In the life of the ordinary individual the rain-god was probably of primary importance, because economic life was based on the maize-plant. Of ritual in the early times practically nothing is known, but all evidence seems to indicate that human sacrifice was not practised. On the other hand blood-offerings were made on the part of individual worshippers by piercing the ears or tongue. Human sacrifice seems to have been introduced into Yucatan from Mexico, and was certainly prevalent there at the time of the Spanish conquest, though it was not practised on the same scale as among the Aztec. Burial customs are obscure, because the climate, both humid and tropical, is not favourable to the preservation of human remains. Both inhumation and cremation were practised by the Maya of Yucatan at the Conquest, but cremation seems to have been restricted to certain ruling families who had immigrated from Mexico in Toltec times and later. Certainly there is no evidence which would associate cremation with the Early Maya.

Social Life.—The social life of the Early Maya can only be guessed. Stone-built settlements of such size, bearing evidence of long occupation, could only have been erected and developed by a large, settled population, held under strong control. The evidence of the monuments implies that this control, in early times, was religious. Presumably many of the figures in Maya sculpture represent chiefs, but in every case the priestly aspect of chieftainship is accentuated. Their equipment is of a highly ceremonial nature, even to their stone-bladed spears and axes. In the Later Empire, the reliefs carved under Toltec influence show real fighting-weapons, barbed throwing spears and hooked spear-throwers. The Spaniards found the inhabitants of Yucatan equipped with bows, which do not appear on the monuments. In brief, the evidence seems to indicate that the early Maya were a peaceable people, ruled by priest-kings. Mexican immigration into Yucatan accentuated the secular side of rulership, especially in connection with leadership in war. Later still, the bow was introduced, again from Mexico, and this weapon, at the time of the Conquest, was particularly associated with the upper classes, who were of immigrant (Nahuatl), stock. The introduction of the bow into Mexico and the Maya region marks a definite phase in the cultural development of Central America. As regards the daily life of the late Maya at the time of the Conquest, details can be found in the works of Cogolludo and Landa and in the *Popol Vuh.* They are epitomized in Joyce (*see* Bibliography). But the practice of artificial deformation practised by the Maya from the earliest times needs especial mention. A receding forehead was a canon of beauty, and the desired effect was produced by fastening a board across the head of the infant in its cradle. Hence the rather displeasing (to European eyes) physiognomy shown in the monuments. The filing and inlay of the front teeth (with turquoise or obsidian) was also practised, and inlaid teeth are not infrequent in Early Maya burials.

Economic Life.—The basis of the economic life of the Maya was the cultivation of the maize-plant, of which many varieties were found in America at the time of the Discovery. The wild parent-plant has only recently been identified as the "teosinte" (*Euchlaena mexicana*), indigenous to the uplands of Mexico and Guatemala. But the wide gap which separates the two suggests a long period of intensive cultivation, which would relate the beginnings of American culture to a period far anterior to the earliest dated Maya monument, and has a distinct bearing on the question of the indigenous nature of Maya culture. But though maize was the staple, other food-plants were cultivated, such as cacao and beans. Hunting and trapping occupied much of the time of the male population, and bee-keeping was an important industry. Fishing, where rivers and lagoons provided the opportunity, provided a further food-supply, and various food-animals, such as turkeys and geese, were kept in domesticity. The early monuments, which represent in the main only ceremonial scenes, shed little light on the daily life of the early Empire, but there is no reason to suppose that it differed in essentials from that of their descendants in Yucatan as described by Landa and Cogolludo.

Arts and Crafts.—Judged by the highest standards, the Maya were eminent as wood-carvers, stone-workers, potters and weavers. Their achievements are the more remarkable because they were ignorant of any "useful" metal, of the potter's wheel, and of any but the most primitive form of loom. Examples of early Maya wood-carving are excessively rare, owing to climatic conditions, but the few specimens preserved (mostly from the early site at Tikal) show an extraordinary delicacy in relief-treatment. In the handling of stone, especially the monolithic stelae, the Maya mason showed an almost contemptuous mastery of his material. The mere quarrying of such huge blocks, by means of stone tools, is a remarkable feat, apart from subsequent transport and carving. The earliest dated stelae exhibit a "wood" technique; quadrangular pillars with a human figure in relief practically enclosed in the block. Later sculptures show the figure emerging from the block and approximating to the "round." The earliest sculptures show a highly-sophisticated art, conventionalized and overlaid with symbolical details. It is probable that during the long years which went to the development of Maya culture, wooden monuments were erected which have not survived the climate. In low-relief carving the Maya excelled, and the examples from such sites as Palenque and Menché surpass, in point of perspective, the reliefs of Egypt or Mesopotamia. Sculpture in the round, on a life-size scale, is rare, except at Palenque, but many of the lesser carvings in basalts and jadeites exhibit the same purity of line and aloof dignity as the reliefs. Maya sculptural art is essentially static, and, owing to its religious basis, often overlaid with symbolical detail; but many of the sculptures express movement, although this feature was lost in the more highly conventionalized sculptures of the New Empire.



AN INDIAN OF THE HIGHLANDS OF CENTRAL AMERICA

The Early Maya were masters in the art not only of stone-cutting and polishing, but of stone-flaking. The implements of chert, chalcedony and obsidian, fashioned both by primary and secondary flaking, can hardly be surpassed throughout the world. The art of pottery-making was highly developed under the Early Maya regime. The wheel was unknown, but the various processes of modelling, coiling and even moulding were practised from early times. Ornamentation was provided by means of painting in slip, by incision in the damp clay, by engraving after sun-drying or firing, or by means of stamps. Forms were extremely varied. Tripod bowls and vertical-sided beakers are especially characteristic, but vases in animal form were not uncommon. Apart from the coarse domestic utensils, Maya pottery shows good quality in paste and firing, and certain of the polychrome varieties are excellent examples of slip-painting. At present, investigation has not proceeded far enough to enable Maya pottery to be classified, save very roughly, in any sort of chronological sequence. An intensive study of Maya ceramics from this point of view would undoubtedly produce results of the highest importance. There is strong indication that certain districts within the Maya area were centres of pottery manufacture, whence the products of the local industry were distributed far and wide by exchange and trade. Further investigation in this direction provides a very promising field of inquiry. Pottery figurines, often in the form of ocarinas, are common, and it is recorded that idols on a comparatively large scale were made by the late Maya in this material. (*See* Joyce in Bibliography.)

No specimens of textile art belonging to the Maya Period have survived the climate. But the monuments provide ample evidence that the weaver's art had reached a high degree of proficiency. Many of the figures are shown with garments ornamented with inwoven patterns and furnished with embroidered borders and tasselled fringes. All of these exhibit a perfection of technique which, like the stone-carving, implies a long period of development.

It is a little uncertain whether the Maya of the early period were acquainted with metal in any form. The late Maya certainly knew gold, worked it both by hammering and by the *cire-perdue* process, and also used copper to a limited extent, principally for ornaments. But only a single object in gold has been discovered at an early Maya site and this may well be relatively late in date.

MEXICAN PEOPLES

The Nahuatl-speaking Peoples.—In this section the centre of interest is the Valley of Mexico, where Mexico City (Tenochtitlán) was, at the time of the Conquest, the seat of Aztec power. Excavation, principally at Azcapotzalco, has demonstrated that the earliest remains show close affinity with those of the Huaxtec region, of the Tarascan area (in Guadalajara), and with certain archaic pottery found in the Maya district. Superimposed are objects which can be related with the Toltec, which exhibit a close relation to Maya art of the finer period. Above these are

A.D.	Toltec (Annals of Quauhtitlan)	Colhuacan	Chichimec (later at Tezcoco)	Tepanec (Azcapotzalco, and, later, Tlacopán)	Aztec (of Tenochtitlán)	Aztec (of Tlaltelolco)
752	Mixcoamazatzin "founds" Tula					
895	Quetzalcoatl "dies"					
930	Matlacxochitl					
..	Nauyotzin					
970	Matlaccoatzin					
989	Tlilcoatzin					
994	Uemac (Topiltzin)					
1064	Destruction of Tula					
..	..	Pochotl, son of Topiltzin	Xolotl arrives		Leave Aztlan	
1187	..	..	..	Acolhuatzin		
1225	..	..	Nopaltzin			
1230	..	..	..	..	At Chapultepec	
1240	..	..	..	..	At Tecocolco	
1260	..	..	Tlotzin			
1285	..	Achitometl				
1292	..	..	..	..	At Colhuacan	
..	..	Coxcoxtli				
1325	..	..	Quinatzin (moves to Tezcoco)	..	Arrive Tenochtitlán	
1348	..	..	..	Tezozomoc		
1350	..	..	Techotlala			
1376	..	..	..	..	Acamapitzin	Quaquapitzauac
1396	..	..	..	..	Uitziliuitl	
1400	..	..	Ixtlilchochitl			
1406	..	..	..	..	..	Tlacateotl
1417	..	..	..	..	Chimalpopoca	
1418	..	..	(Nezahualcoyotl in exile)			
1425	..	..	..	Maxtla		
1427	..	..	..	..	Itzcoatl	
1430	..	..	..	Maxtla killed	..	Quauhtlatoa
1431	..	..	Nezahualcoyotl	Totoquiuatzin (at Tlacopán)		
1440	..	..	..	..	Montecuzoma I.	
1464	..	..	..	..	..	Moquiuix
1469	..	..	..	..	Axayacatl	
1470	..	..	..	Chimalpopoca		
1472	..	..	Nezahualpilli			
1473	..	..	..	..	..	Moquiuix killed and Tlatelolco incorporated in Tenochtitlán.
1482	..	..	..	..	Tizoc	
1486	..	..	..	..	Auitzotl	
1489	..	..	..	Chimalpopoca dies		
1502	..	..	..	..	Montecuzoma II.	
1515	..	..	Cacamatzin			
1519	The arrival of the Spaniards.					

the inferior relics of the Aztec régime. So far these results suggest that a common culture, based on agricultural life (with maize as the staple plant), extended throughout. The development of Maya culture in the south had very far-reaching effects upon the Mexican Valley, the Zapotec tribes of Oaxaca acting as intermediaries. The successive waves of Nahuatl-speaking tribes, immigrants from the north (fundamentally hunters) adopted this culture when they became sedentary and developed it, though in rather degraded form, according to their own psychology. In brief, the history of the Nahuatl, summarized from legends collected by the early chroniclers (such as Sahagún and Ixtlilxochitl) supplemented by native pictographical manuscripts, appears to be as set out in the accompanying chronological table. This table, taken from Joyce's *Mexican Archaeology,* is explained in detail in that work. The first wave of immigrants appears to have been constituted by the people known to history as Toltec, who, establishing themselves at the "city" of Tulan, gradually extended their power over the Valley of Mexico, and absorbed, to the best of their ability, those elements of early Maya culture which had percolated to that region. Three centuries of development followed, during which arts and crafts were brought to a high pitch of perfection. So that, when eventually the Toltec "empire" collapsed under further pressure of hunting tribes from the north, the name of the Toltec survived in tradition as the great exponents of culture. The generic name given to these later immigrants is "Chichimec." Like the Toltec, they were speakers of the Nahuatl tongue, and the name survived in Aztec times as applied to the rude hunting-tribes on the northern borders, who still lived under the primitive conditions which characterized the earliest Nahuatl immigrants. The terminology is confusing, because in the widest sense the term Chichimec is equivalent to Nahuatl; in the narrower sense it applies to that branch of Nahuatl who settled at Tenayocán, under the "Chichimec" chief Xolotl, at the time of the Toltec downfall, and who appear to have exercised a loose suzerainty over the remaining Toltec, whose legitimate ruler had moved to Colhuacán. The population of this settlement were termed "Acolhua," but the term was later expanded to include all those "Chichimec" who adopted settled life.

The "Chichimec" (using the word in the narrower sense) in course of time transferred their seat of power to Tezcoco. The next wave of immigration, the Tepanec, settled at Azcapotzalco and later at Tlacopán. The final wave, the Aztec, after some years spent in subordination to the earlier immigrants, finally established themselves on the islands of Tenochtitlán and Tlaltelolco in the Lake of Mexico, and eventually became rulers, not only of the Valley, but suzerains of countries far to the south. (For details *see* Bibliography, Joyce.)

The break-up of the Toltec "empire" led to a whole-sale emigration of Toltec clans, which had far-reaching effects on the

populations to the south and east, resulting in the introduction of Toltec art into Yucatan and Salvador. Further pressure sent Nahuatl influence further afield, with the result that, at the time of the Conquest, tribes speaking Nahuatl were found in Nicaragua (Rivas) and even in Panama (Chiriqui Lagoon). It seems certain that the Nahuatl were responsible for the introduction of the bow into the areas previously dominated by Maya culture, and this weapon no doubt facilitated their progress as conquerors. There is no trace of the bow among the early Maya, but references occur in the tribal legends of the Quiché (*Popol Vuh*) and Kakchiquel (*Annals of Xahila*) in the region of Lake Atitlán in Guatemala; and the bow was the weapon of the immigrant aristocracy in Yucatan at the time of the Conquest. Further, the Aztec historical manuscripts show, in pictographic form, the immigrant Aztec, skin-clad and armed with the bow, overcoming the valley-dwellers clothed in cotton garments but armed only with the *macquauitl*, a wooden club edged with obsidian.

Settled on their islands in the Lake of Mexico, for a century the Aztec played an unimportant part in the politics of the Mexican Valley. But under their fourth historical ruler, Itzcoatl, in the early part of the 15th century, owing to intertribal conflicts, they rose to prominence. A league was formed between Tenochtitlán (including Tlaltelolco), the Acolhua settlement of Tezcoco, and the Tepanec settlement at Tlacopán, and this confederation endured until the Conquest. The Aztec reserved for themselves the direction of the military policy of the confederation, and thereby became the paramount power, owing to the intimate connection of war with religion. Tezcoco, however, was, to the end, regarded as the seat of learning and culture, the Mexican "Athens." One settlement alone held its independence, the "city" of Tlaxcala, where Toltec traditions still survived. Though the league maintained continual hostilities against the Tlaxcalans, no very serious effort appears to have been made to conquer them, owing to the ceremonial nature of Mexican warfare as explained below. The long-enduring hostility felt by the Tlaxcalans for the Aztec led them to ally themselves with the Spaniards to whom they gave invaluable assistance.

The final step in the consolidation of the Aztec "Empire" was the incorporation of the island of Tlaltelolco, which had previously been ruled by its own chiefs, with that of Tenochtitlan. This occurred in 1473, when Axayacatl attacked Tlaltelolco, killed the ruler Moquiuix and incorporated the smaller island with Tenochtitlan. Axayacatl, by means of various expeditions, extended Aztec influence far beyond the confines of the Valley, and his policy of expansion was continued by his successors. Such expeditions were not conquests in the normal sense of the word, owing to the Mexican attitude towards war; but they resulted eventually in a complex system of trade and tribute, extending from the Pánuco River to Central Guatemala. The "tribute-lists" of the Mexican ms. known as the Codex Mendoza (preserved in the Bodleian Library at Oxford) shows the enormous extent of territory from which Mexico City drew "tribute" at the time of the Conquest.

Architecture.—Mexican architecture followed the same lines as that of the Maya, but, in Toltec times led to a development of the pyramid form of substructure to huge dimensions. The site of San Juan Teotihuacán, not far from Mexico City, includes in an enormous complex of mounds, two of the largest of the American pyramids. Aztec tradition associated this site with the name of the Toltec, and recent excavation has revealed sculptured ornament in pure Toltec style. To the west of Mexico, is the well-known low pyramid of Xochicalco, with sculptured decoration of the Toltec period; and in Oaxaca is the large site of Monte Albán, recently excavated, and showing, as regards its plan, a close similarity with that of Teotihuacán. Near to the last is the puzzling site of Mitla. The mosaic-sculpture ornament of Mitla is unique in Central America and bears little relation, from the artistic standpoint, to either Maya or Toltec. It is clearly based on textile designs, and resembles very closely the mural decoration of the Northern Peruvian coast, and the painted designs on certain pottery of the Pueblo area of Arizona and New Mexico. This feature, taken into consideration with the fact that the Mitla buildings were obviously flat-roofed, by means of beams, renders them rather exceptional. It is more than probable that a properly-conducted exploration of the Zapotec sites of Oaxaca would shed much light on the development of early American culture.

Of Aztec buildings, little trace has remained. The two great pyramids of Tenochtitlán and Tlaltelolco, each supporting two shrines, were utterly destroyed by the Conquistadores, but contemporary accounts suggest that they were built on the Toltec model, *i.e.*, stepped pyramids, with a stairway on the west. As regards the shrines, native manuscripts suggest that they were small and flat-roofed, with an embattled pediment, or roof-comb, and built probably of wood. One sole survivor of Aztec religious architecture remains, in ruined form, at Tepoztlan and has been described by Seler. The same author has recorded buildings belonging to the Aztec period in the Huaxtec and Totonac settlements of Papantla and Cempoala. Both here, and in Mexico City, stucco was freely used as a coating to masonry, and the facing of the Totonac buildings was so perfect that the spies sent in advance by Cortés, reported that they were faced with silver plates.

As regards secular buildings, the reports of the Conquistadores provide the only source of information. The houses of the upper class were built on terraces and constructed of stone. The buildings usually enclosed a court, where the girls of the household could walk under the supervision of duennas; and the roofs of the more important buildings were flat and battlemented. In fact there is little trace of the Maya false arch in Aztec buildings.

Less pretentious dwellings were constructed of sunbaked bricks (*adobe*), while the poorest class lived in flimsy structures of reeds and mud, roofed with straw of leaves of *maguey*.

A remarkable architectural achievement on the part of the Aztec was the series of causeways which connected the island with the mainland. In building them, a double palisade was first erected and the space between filled with earth and rubble and faced with stones. The great dam, which led from Iztapalapa to Atzacualco (built by Montecuzoma I. on the advice of Nezahualcoyotl of Tezcoco), was ten miles long, perforated by sluices and was erected in an attempt to control the inundations to which Tenochtitlán was subject. Another work of great economic importance was a double stone aqueduct, which brought water to the city from Chapultepec.

Religion and Burial.—Mexican religion, at the time of the Conquest, was of a highly composite nature; this feature is founded on the history of the people in their role as immigrant conquerors, and is apparent even in Toltec times, although little detail has survived concerning this early people. The Toltec, like all the Nahuatl tribes in their migratory days, were led by chiefs who were also priests. In the case of the Toltec, after they settled in the Valley of Mexico, the priestly side of "kingship" became accentuated, and the gods who presided over the sedentary arts and crafts (which were of necessity borrowed from the people of the valley), became of greater importance. So Quetzalcoatl, the god of Arts and Crafts, of the Calendar, and of general culture, was adopted by the Toltec as their own particular divinity. The word Quetzalcoatl, as explained above, is a literal translation of the name of the great Maya god, Kukulcan, who bore the same attributes of combined bird and snake. Of almost equal importance was the god Tlaloc, the god of rain, the counterpart of the Maya *Chac*. The Nahuatl nomads, when they took to settled life based on agriculture, were forced to borrow the gods of the sedentary population upon whom they imposed themselves, and these gods, or at least the most important of them, were almost certainly derived from the Maya. The original tribal gods of the Nahuatl people were hunting- and war-gods, connected with the stars rather than with the sun, and they could hardly be expected to know anything about agriculture or the arts based on settled life. All evidence seems to show that the Toltec, being the first-comers were more influenced by such elements of Maya religion as had permeated to Mexico than the subsequent immigrants. The latter, especially the Aztec, while accepting the local deities of agriculture and craftsmanship, main-

tained the worship of their tribal god, whom they often invested with qualities and powers borrowed from the adopted deities. A case in point is the Aztec tribal god, Uitzilopochtli, at first a stellar- war- and hunting-god; later associated with the sun, and finally imposed as the most important deity in ritual upon all the tributaries within the Aztec "Empire." The growth of sun-worship is interesting. Certainly the early Maya worshipped a sun-god, and there are indications that he was associated with war, but there is little evidence that either the sun-god or war were of great importance in religious or secular life. But, under the Aztec régime, war, intimately connected with sun-worship, became a religious duty, because the belief had arisen that the sun needed the blood of human hearts as nourishment, and war was necessary in order to procure prisoners for sacrifice. The ceremonial nature of war is a most important feature of Aztec "civilization." The object of war was the capture of prisoners, not the killing of enemies, and warriors obtained promotion in accordance with the number of prisoners which they took. A state of peace within the sphere of Aztec influence would have been a religious calamity; the Aztec therefore held their dependencies very lightly and were not in the least averse to revolt, but rather welcomed it. The introduction and development of human sacrifice (which was not practised by the early Maya) into the Mexican valley, is, according to tradition, responsible for the breakup of the Toltec "Empire" and the migration of Toltec clans eastwards and southwards. In Aztec times the practice was the normal accompaniment of nearly all religious festivals, and had attained such proportions that, according to the native mss. no less than 20,000 human victims were slaughtered on the occasion of the dedication of the great pyramid in Tenochtitlán in the reign of Auitzotl. In Mexican sacrifice, the essential feature was the offering of the heart, but variations of the normal ritual prevailed in ceremonies held in honour of specific deities, many of which had been adopted from surrounding tribes. For instance, the victims offered to the fire-god were thrown into a huge fire before the heart was extracted; the female victims offered to the fertility goddesses were decapitated (a rite representing, symbolically, the reaping of the maize-cob); the prisoners offered to Xipe (the god of young vegetation) were flayed, and their captors wore the skins for the duration of the festival. The casting off of the dead skins, which was performed ceremonially, was a magico-religious act, and was supposed to assist in the resurrection of the food-crop. Mexican religion, though often revolting in its expression, was based on the idea that the powers of nature needed continual regeneration which could only be afforded by human aid in the form of personal sacrifice. Death on the sacrificial stone was the same as death in war; the normal death of a fighting-man; and each was the avenue to the Paradise of the Sun. Most of the victims were identified with the god to whom they were sacrificed, but the principal instance is the youth who was offered up at the feast of Toxcatl held in honour of the High-god Tezcatlipoca. Tezcatlipoca was the "Jupiter" of the Nahuatl pantheon, worshipped by all in common, a creator- and sky-god. The chosen victim was not only his representative, but the vehicle which enabled the god-spirit to associate with mankind, and so ensure the prosperity of the community. But it was essential that the god-spirit should not be weakened by the decay which is the heritage of mortals, consequently the human vehicle, after living in divine state for a year, was sacrificed, and the spirit transferred to another predestined victim in the prime of youth.

Ceremonial cannibalism was an occasional feature of sacrifice, certain individuals being privileged to partake of the body of the victim. But the act was purely ritual, and, in fact, an act of communion, for which many parallels can be found in other parts of the world.

To Quetzalcoatl no human sacrifices were made, and, as it is clear that this god was originally adopted from the early Maya, further support is given to the theory that human offerings were introduced into Mexico by the Nahuatl immigrants.

The composite nature of Aztec religion is equally expressed in the method of disposing of the dead. Both cremation and inhumation were practised, but the two methods bore a definite relation both to the method of death of the individual, and to the worship of certain gods. The fate of the soul varied accordingly. Men killed in battle or by sacrifice reached the Paradise of the Sun; women dying in child-birth had a paradise of their own, because their death was considered a warrior-death. Persons who were drowned, or who perished of dropsical affections were accommodated in a separate paradise belonging to the pre-Aztec fertility- and rain-god Tlaloc. People dying normally had only the dim underworld of the death-god, Mictlantecuhtli, as their future abode. Cremation was the fate of all except those who were destined for Tlaloc's paradise. This fact affords a clear indication that inhumation was the early form of funerary rite, and that cremation was introduced by the Nahuatl immigrants. Much has been recorded on the subject of Mexican religion, the gods, their respective ritual and feast, their attributes and tribal affinities. For details *see* Bibliography under Sahagún, Seler and Joyce.

In their contest with the Spaniards the Mexicans were, in a sense, betrayed by their own religion. There was an ancient legend that the great culture-god, Quetzalcoatl, after instructing the people in the useful arts, departed eastward over the sea, promising to return in a year of a certain date. According to tradition, Quetzalcoatl was white-skinned and bearded and the arrival of the Spaniards, in the appropriate year, led Montecuzoma II., who had been trained as a priest, to adopt a fatally hesitating policy towards them. Again, the fact that the Aztec fought, not to kill, but to capture, on more than one occasion saved the small force of Cortés from annihilation.

Economic Life.—As in the case of the Maya, the economic life of the Mexicans was based fundamentally on maize-cultivation. Since the Aztec, in the earlier period of their settled life, occupied only a very restricted land-area, cultivation was intensive, and the practice of manuring the fields, rare among primitive peoples, had been systematically developed. Even the waters of the lake were pressed into service, and many food-plants were grown on floating rafts loaded with soil. The lake and its marshes provided abundance of fish and wild-fowl, and on the mainland, deer, rabbits and various game-birds afforded a plentiful supply of flesh-food. Two plants of great economic importance need mention. First the cacao, from which the drink known as *chocolatl* (whence our "chocolate") was prepared. Second the *maguey* or Mexican aloe (*agave americana*), the various uses of which are best described in the words of one of the conquerors. "This tree is of the greatest utility. From it is made wine, vinegar, honey, a syrup-like grape-juice. They employ it (*i.e.*, the fibre) in the manufacture of garments for men and women, for foot gear, ropes, the ties used in building houses, the roofing of these houses (the leaves), for sewing needles (the spines), for dressings for wounds and other purposes." From the sap an intoxicating drink was prepared, known as *octli* (at the present day, *pulque*), indulgence in which, however, was controlled by law. Tobacco was smoked in tubes. The hunting instinct of the Aztec, after they became a settled people, found a free vent in trade, and one of the most important sections of the community was the guild of *Pochteca,* or travelling merchants. These grew to be a privileged class, worshipping special gods, and practising private ceremonies. Their extended wanderings helped to spread Aztec influence far into Guatemala and other districts to the south and east, and, apart from their position as traders, they played the part of military spies. The death of one of these merchants, at the hands of a foreign tribe, was never left unavenged in the days of the Aztec supremacy, but afforded an excuse for a military expedition which brought further tribute and sacrificial victims to Tenochtitlán. The economic prosperity of this city at the time of the conquest is amply illustrated in the account of the great mart at Tlaltelolco, described by the so-called "Anonymous Conqueror," and the tribute lists of the Mendoza Codex.

Arts and Crafts.—The Nahuatl tribes, after their settlement, knew and worked gold, silver and copper. Of these, copper alone is useful as a tool, and its use is very limited. In the main, therefore, implements were made of stone or of the natural glass known as obsidian. Expert as they were in the flaking of these materials,

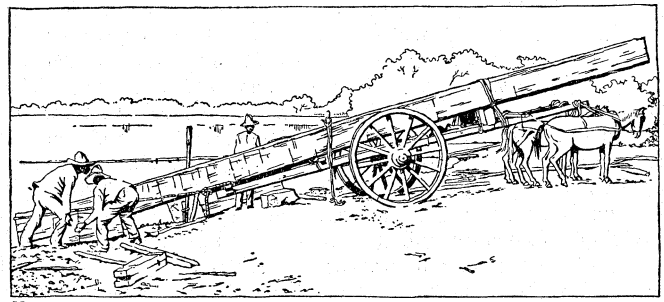
their products do not attain the perfection of the Maya or Zapotec; but their technique in the manufacture of implements, masks, bowls and so forth, of polished stone, obsidian jadeite and crystal, is remarkable. Such works of art were produced by the lengthy process of rubbing and the free use of sand. Hollows were cut by means of tubular drill of cane, also armatured with sand, and the final polish was given with bamboo. To the Aztec, the Toltec were the great masters of stone-cutting, and most, if not all, of the late Mexican lapidaries were of Toltec descent. The Aztec themselves were warriors and political organizers. Nearly all the industrial pursuits were in the hands of close clan-corporations, the great majority of which claimed Toltec ancestry. These industrial corporations worshipped special gods, and practised ceremonies of their own (details in Sahagún and Joyce). Perhaps the most spectacular examples of the lapidaries' art are the mosaics of turquoise, lignite, shell and pyrites, applied, usually, to a wooden foundation, which are amply described in Saville's monograph (*see* Bibliography).

Metal-working in Mexico was, in the main, confined to gold, and there were two separate "guilds" of gold-workers, the beaters and the casters. Casting was done by means of the "cire-perdue" method, and the same process was employed, especially by the Totonac, in dealing with copper, which, owing to the presence of a percentage of tin (as an impurity) was, in fact, an accidental bronze. Gold-foil, of extreme thinness, was produced by the beaters, and frequently applied to wood-carving. Many works of art, known to us by description, have perished in the melting-pot being composed of a metal precious in European economy, with the result that Mexican gold-work is extremely rare in Museums. Wood was used both for building and in the manufacture of various utensils and instruments, especially gongs (*teponaztli*), but, owing to the perishable nature of the material, specimens are scarce (*see* Saville, Bibliography). The art of the potter flourished in Mexico, and though the wheel was unknown, certain classes of ware are remarkable for the perfection of their shape, firing and decoration. For the most part the coiling process was employed, but the use of moulds was also known. The pottery of the Aztec is distinctly inferior from every point of view. Toltec ware shows close affinities with the Maya, but exhibits in the most characteristic examples a peculiar "cloisonné" technique, in which a dark slip, added to the surface of the pot has been cut out to form outlines, and slips of other colours, principally turquoise-blue, inlaid between them. Ware of this class is found in the Totonac area of Vera Cruz, and bears witness to the close association of the Totonac with Toltec culture. But such examples are rare, and as regards the two qualities of form and firing, Totonac pottery (of which the most notable series is preserved in the British Museum), represents the finest achievement of the Mexican potter. In colour and burnish, however, the pottery of Cholula (in the state of Puebla), and of the Zapotec, are paramount. The two classes of ceramic ware show very close similarities, and the colours employed are those of the finest Maya pottery. Puebla was peopled by clans of Toltec origin and the Zapotec country had been permeated by Maya influence. The inference is that the population of Puebla had received, through the Zapotec, the tradition of Maya colouration. In any case under the late Aztec régime, the potters of Cholula were regarded as the masters of the ceramic art, and the table-ware of Montecuzoma and the Aztec nobles was provided by this province.

Good pottery was manufactured also by the Huaxtec and Tarascans, the large figurines of the latter people showing conspicuous freedom and originality in modelling.

The textile art was developed to a high degree by means of a very simple form of loom. Patterns of the most intricate type were inwoven or embroidered, and one of the most important dyes was that produced by the cochineal insect, which constituted an important item of tribute to Mexico City. Very few Mexican textiles have survived, but the native mss. bear witness to the perfection of technique and brilliancy of colouring.

The art of feather-mosaic was extensively practised in Aztec times. Complicated designs were produced by the meticulous application of the small feathers of tropical birds to a background of cloth or maguey (aloe) paper. Practically all the surviving specimens relate to post-conquest times, when, under the influence of missionaries, numbers of sacred pictures were produced in this technique. Complicated arrangements of feathers, secured to a bamboo framework, were worn by warriors of different ranks attached to the back, and military standards were constructed of the same materials. Art can best be studied in museums, or by



UNLOADING A SQUARED MAHOGANY LOG AT THE RIVER BANK FROM A PRIMITIVE, HIGH-WHEELED TRINQUIVAL

means of well-illustrated books devoted to this subject (*see* Joyce, Bibliography). Toltec art shows a very close correspondence with that of the Maya, with a tendency to stylization in angular form. The flowing line was not lost, but the increased conventionalism often gives to Toltec art a slightly "mechanical" aspect. In Aztec times the angularity is accentuated in the mss., but in sculpture there is a great tendency towards simplification combined with a subtle suggestion of ferocity.

Social Life.—The Nahuatl-speaking tribes, being nomadic, were controlled originally by chiefs who were skilled warriors and hunters, supported by an advisory council of elders. Since these tribes recognized gods of their own, who were regarded as tribal leaders, the function of the priest became immensely important. In many cases the office of chief and priest was combined and the priestly aspect of the Toltec rulers is very clearly expressed in tradition. The Toltec were more affected by the eminently peaceful sociology of the Maya than their successors, and the priestly side of "king-ship" became accentuated. Later, successive immigrations of warlike tribes, and the development of the ceremonial importance of war, as the means of procuring victims for sacrifice, led, in Aztec times, to a reversion to type. The Aztec ruler held his position as the supreme war-lord, while the religion, complicated owing to the incorporation of alien gods and their respective ritual, fell into the hands of a specialist priesthood. When the nomadic Nahuatl descended on the Mexican Valley they were faced with a question which was outside their experience. In adopting a settled, agricultural life, they were suddenly aware of the value of land. None of their gods had any control over land, or its produce. The Toltec were the first in the field; later intruders based their territorial claims on intermarriage with women of Toltec stock. The legendary history, combined with the later Aztec practice, whereby brother succeeded brother (under normal circumstances), and, after the extinction of the generation, the succession reverted to the eldest nephew, suggests that rank-inheritance was transferred through the female line. In the latest times, however, this rule was not without exceptions, because, owing to the growing importance of war as an integral part of religion, it was necessary for the candidate for rulership to have passed a certain military rank. The fact that the last Montecuzoma had been trained both as a priest and a warrior, led him, when white strangers arrived in the year of prophecy, to adopt a vacillating policy which resulted in the downfall of his "empire."

The Aztec showed great political genius in the system which they devised for the control of the various peoples from whom they extracted "tribute." They dared not abolish war, because war brought the prisoners which their gods demanded as sacrifice. So, as a rule, they allowed the subject tribes to maintain their own system of government and individual rulers, with the fixed intention of making "punitive" raids on the least excuse.

The inner social system of Mexico under Aztec domination

Chronological Table showing, on the broadest lines, the Time-relation, between the Main Cultural Areas of Central and South America, suggested by archaeological results so far obtained (1927)

<table>
<tr><td rowspan="2">Southern Mexico, Guatemala, British Honduras and Northern Honduras</td><td rowspan="2">Central Mexico</td><td rowspan="2">Approximate date</td><td colspan="2">Peru and Bolivia (Highlands)</td><td>Peru south coast</td><td>Peru north coast</td><td>Ecuador</td></tr>
<tr><td colspan="2">Tiahuanaco I.</td><td>Proto-nasca</td><td>Proto-chimu</td><td rowspan="3">Pre-Inca, probably related to Proto-Chimu.</td></tr>
<tr><td rowspan="2">Early Maya</td><td rowspan="3">Primitive culture allied to the Huaxtec and later Tarascan.</td><td>A.D. 200</td><td colspan="2" rowspan="2">Tiahuanaco II.</td><td rowspan="2"></td><td rowspan="2">Inferior remains at present unclassified</td></tr>
<tr><td>A.D. 300</td></tr>
<tr><td rowspan="2">Middle Maya</td><td>A.D. 800</td><td colspan="4">Period of degeneration</td></tr>
<tr><td rowspan="2">Late Maya (with Toltec and, later, Aztec influences)</td><td rowspan="2">Toltec and successors</td><td>A.D. 1100</td><td colspan="2">Early Inca</td><td>Nasca</td><td>Chimu</td></tr>
<tr><td>A.D. 1400</td><td colspan="2">Late Inca</td><td colspan="3">Late Inca superimposed</td></tr>
<tr><td colspan="2">Spanish conquest</td><td>Aztec</td><td>A.D. 1519</td><td colspan="5">Spanish conquest</td></tr>
<tr><td colspan="2"></td><td></td><td>A.D. 1533</td><td colspan="5"></td></tr>
</table>

provides all the features which might be expected from the incursion of immigrants, who acquired land-interests, either by right of conquest or by intermarriage with the daughters of local chiefs. The conquering chiefs gave land to their principal retainers, and these formed an aristocracy who paid no taxes but owed feudal service to the ruler. Associated with them was a military nobility, who held estates at the ruler's good-will, and whose tenants paid royal taxes. Next came a class of landed freemen, members of "clans," known as *calpulli*. These *calpulli* distributed the land over which they had rights among their members, but any member who, whether by carelessness or by change of abode, allowed his plot to go out of cultivation, lost his holding. The *calpulli* paid taxes in common. Below the freemen ranked the tax-paying rent-holders, and, finally the serfs who paid taxes only to their feudal lords. Apart from these were the members of the official class and their families, who, ranking as warriors and "nobles," paid no taxes, but contributed their personal services, and formed the suite of the ruler. To provide for the education both of the artisan and upper classes full provision was made. The exercise of certain pursuits was in the hands of close corporations (mainly of different tribal stocks); but apart from technical specialists, provision was made for the "higher education" of children. The institution known as the Calmecac provided the education for those who desired to adopt a priestly career, and was under the especial protection of the god Quetzalcoatl, while the candidates for military service entered the Telpochcalli, where, under the aegis of the god Tezcatlipoca, they received a military training. Details of the Aztec constitution are readily available in the works of Sahagún, and the compilation of Joyce (*see* Bibliography).

Nicaragua, Costa Rica and Panama.—Archaeological research in these countries is not as yet sufficiently advanced to enable a connected picture to be drawn of the economic life of the more cultured inhabitants of this area. Intensive excavation, on scientific lines, has been carried out in certain areas, but the gaps are wide. In particular so little is known about southern Honduras and Nicaragua that the southern limit of Maya cultural influence is undefined. Nahuatl colonies existed beyond doubt in the Department of Rivas in Nicaragua, in the peninsula of Nicoya (Costa Rica), and on the edge of the Chiriqui lagoon (Panama). In all of these districts the Nahuatl language was found. In Nicoya and Rivas the pottery shows strong Nahuatl affinities. And in Rivas religion and ritual were purely Mexican in character, as is proved by Oviedo's account. From central Costa Rica, southwards and eastwards, the flora, fauna and ethnography begin to approximate to those of the Southern Continent. The wall-less hut-shelter takes the place of the walled hut; the hammock makes its appearance; cassava (manioc) plays a more and more predominant role as a food-plant. The tribes inhabiting this region have been classified on linguistic lines, and show a great diversity of speech (for details *see* Thomas, Swanton and Lehmann, in the Bibliography). The archaeological areas cross the political boundaries of the present Republics so that it is impossible to discuss the archaeology of each in detail without constant repetition. All available material has been summarized in Joyce's compilation (which includes a full bibliography), and Lothrop's later work (*see* Bibliography).

In Nicaragua stone-building on the scale practised by the Maya and Aztec was unknown, but monolithic sculptures, some of considerable size, have been found on the islands in lakes Managua and Nicaragua. These are not Nahuatl in style, and are believed to have been the work of the Chorotega people, who probably occupied a wider area in ancient times than is indicated by later linguistic surveys. Archaeological evidence, slight as it is, suggests that their original territory was reduced by the expansion of the Matagalpa, Sumo and Ulua peoples. They manufactured good painted pottery, and it is quite possible that their art was a reflection of that of the Maya; but far more exploration is necessary in Honduras before the connection can be proved. The Nicarao (or Niquirian) people in Rivas, were of comparatively late Nahuatl stock, but the pottery found in the area possesses finer qualities than that of the Aztec. Though stone-carving on a large scale is rare, yet the Nicaraguans and Northern Costa Ricans produced smaller examples of sculpture, in the form of figures, bowls and, especially, metates (tripod slabs for grinding maize). In the peninsula of Nicoya, jadeite was worked with great skill, and pendants in the Nicoyan style have been found in regions north and south of the district. Probably more worked jadeite has been recovered from Nicoyan cemeteries than anywhere else in America, yet the source of the material is still unknown. The Nicoyans represent a definite linguistic unit to-day, but archaeological evidence proves, that in the heart of the peninsula was an enclave of Nahuatl immigrants, who manufactured pottery of extremely good technique (both as regards paste and coloured decoration) in which the Mexican tradition is obvious.

On the mainland, opposite the Nicoyan peninsula, is a strip of territory (in Costa Rica) occupied by the Guetar people whose ancient cemeteries have yielded quantities of polychrome pottery, which, though inferior in colour to that of Nicoya, and, again, inferior in quality of paste to that of the tribes to the south and east, nevertheless shows great variety and takes a high rank in the scale of primitive ceramics. In southern Costa Rica, and western Panama, inhabited for the most part by Talamancan tribes, the potter's art was developed to a degree which has its only parallel in Peru. In the quality of technique the so-called "biscuit-ware" of the Talamancans is unsurpassed in the history of hand-made pottery, and the sense of form exhibited in these vases is beyond reproach. In slip-decoration the brilliancy of colour is inferior to that of the ware of Cholula or Oaxaca, and, especially that of Southern Peru. But the Talamancans were masters of the so-called "lost colour" process, whereby elements

of a design were "reserved" by wax-painting on a slip of a certain colour. Upon this a second slip of another colour was added, which, in the firing was released from the waxed portions. Pottery of this class is common in Colombia and Ecuador, and occasional in Peru, while its occurrence in the Isthmian region emphasizes the connection of the Talamancan region with the southern continent. Further evidence of this connection is provided by the gold-work, recovered in large quantities from Talamancan cemeteries. Pendants in human and animal form have been obtained in considerable bulk from this area. The raw material was obtained by the laborious process of picking out grains of gold from river-sands, and the ornaments were partly cast (by the *cire-perdue* process), and finished by hammering. The same processes prevailed in Colombia, and it is not easy to distinguish the products of the two regions. Between the Talamancan district and the southern continent lay a densely forested area, peopled by tribes of lower culture, but on the Pacific coast, especially in the gulf of San Miguel, the first Spanish explorers found settlements engaged in pearl-fishery and a coastal trade southwards. From a chief named Tumaco they received an itinerary by sea to Peru, then undiscovered, and an allusion, in vague terms, to the great Inca Empire. (*See* Joyce, Bibliography.)

Inter-tribal traffic had attained a high degree of development in Central America. The jadeite work of Nicoya is found sporadically in southern Costa Rica, while the gold-work of the Talamancan area has been discovered, not only in Nicoya, but even at Chichén Itzá in Yucatan. The Isthmian region in every respect, flora, fauna and ethnography, combines the characteristics of both North and South America. Apart from the interchange of commercial products by hand-to-hand trade, Mexican influence from the north introduced the practice of cremation into certain restricted areas, where it impinged on certain technical processes (pottery and gold-work) characteristic of the Southern Continent.

BIBLIOGRAPHY.—*Maya and Mexican:* The most important bibliographical work is Dr. Walter Lehmann's *Methods and results in Mexican research,* a version, in English, published in Paris, in 1909, of a paper originally appearing in the *Archiv für Anthropologie,* vol. vi., 1907. The *Manuel d'Archéologie Américaine* of H. Beuchat (Paris, 1912) also contains a full bibliography. *Mexican Archaeology* by T. A. Joyce (1914), is a compilation which gives a full account of Mexican and Maya culture, of which the bibliographies in the works of Lehmann and Beuchat indicate the sources. Special mention may be made of Maudslay's *Biologia Centrali-Americana* (1889–1902); Seler's *Gesammelte Abhandlungen* (1902 onward); the British Museum *Guide to the Maudslay Collection of Maya Sculptures* (1923), with particular reference to the select bibliography appended thereto; *Maya and Mexican Art,* by T. A. Joyce (1927) deals in the main with the arts and crafts of the peoples. Some of the following works are quoted in the bibliographies mentioned above, but are repeated here for convenience. For details concerning the life and beliefs of the Yucatec Maya *see* especially Diego de Landa, *Relación de las Cosas de Yucatán,* a French translation of which was published by Brasseur de Bourbourg in 1864: Cogolludo, *Historia de Yucathan,* Madrid, 1688. Similar contemporary works relating to the Aztec are Bernal Díaz, *History of the Conquest of New Spain,* (ed. by A. P. Maudslay, Hakluyt Society, series II., vols. 23, 24, 25, 30 and 40), the account of the "Anonymous Conqueror," published in French by Ternaux-Compans, and in English by the Cortez Society (edited by M. H. Saville, New York, 1917); and those portions of the mss. of Bernadino de Sahagún which have been published, viz., *Histoire Générale des Choses de la Nouvelle Espagne* (edited by D. Jourdanet and R. Simeon, Paris, 1880), and Seler's posthumous edition, containing much hitherto unpublished material (Stuttgart, 1927). Special works relating to Maya architecture (besides Maudslay, mentioned above) are as follows (a star indicates a bibliography):—W. H. Holmes, *Archaeological Studies amongst the Ancient Cities of Mexico* (Field Museum, Chicago, 1895 and 1897); H. J. Spinden, *A Study of Maya Art**, Memoirs Peabody Museum vol. vi. (Cambridge, Mass., 1913); S. K. Lothrop, *Tulum** (Carnegie Institution, Washington, 1924); and certain chapters in Joyce's works (*see* above). As regards other arts and crafts, the three monographs by M. H. Saville, published by the Museum of the American Indian, New York, are of importance, *The Goldsmith's Art in Ancient Mexico** (1920), *Turquois Mosaic Art in Ancient Mexico** (1922) and *The Wood-Carver's Art in Ancient Mexico** (1925). *Nicaragua, Costa Rica and Panama:* Extensive bibliographies, covering the whole of the literature relating to the archaeology of these countries may be found in the following three works: H. Beuchat, *Manuel d'Archéologie Américaine* (Paris, 1912); T. A. Joyce, *Central American Archaeology* (London, 1916); and S. K. Lothrop, *Pottery of Costa Rica and Nicaragua* (Museum of the American Indian, New York, 1926). For linguistics *see* C. Thomas and J. R. Swanton, *Indian languages of Mexico and Central America* (Bulletin 44, Bureau of American Ethnology, Washington, 1911). (T. A. J.)

CENTRAL AND NORTH AMERICAN LANGUAGES. The population of aboriginal America north of Mexico (about 1,150,000), at the time of the discovery of America by Columbus, spoke an astonishing number of languages, most of which are still spoken, though in many cases by only a bare handful of individuals. Certain of them, like Sioux and Navaho, are still flourishing languages.

They consist of a number of distinct stocks, which differ fundamentally from each other in vocabulary, phonetics and grammatical form. Some of these stocks, such as Algonkin, Siouan and Athabaskan, consist of a large number of distinct languages; others seem to be limited to a small number of languages or dialects or even to a single language. The so-called "Powell classification" of languages north of Mexico recognizes no less than 55 of these "stocks" (*see* the revised map of 1915 issued by the Bureau of American Ethnology), excluding Arawak, a South American stock originally represented in the West Indies and perhaps also on the southwestern coast of Florida.

The distribution of these 55 stocks is uneven; 37 of them are either entirely or largely in territory draining into the Pacific, and 22 of these have a coast line on the Pacific. Only 7 linguistic stocks had an Atlantic coast line. Besides the Pacific coast, in the lower Mississippi and Gulf coast, languages of 10 stocks were spoken (apart from Arawak). The most widely distributed stocks are: *Eskimoan,* which includes Eskimo dialects ranging from east Greenland west to southern Alaska and East Cape, Siberia, as well as the Aleut of Alaska Peninsula and the Aleutian Islands; *Algonkian,* which embraces a large number of languages spoken along the Atlantic coast from eastern Quebec and Cape Breton Island south to the coast of North Carolina, in the interior of Labrador, in the northern part of the drainage of the St. Lawrence, in the country of the three upper Great Lakes and the upper Mississippi, and west into the plains of the Saskatchewan and the upper Missouri; *Iroquoian,* which consists of languages originally spoken in three disconnected areas—the region of Lakes Erie and Ontario and the St. Lawrence, eastern Virginia and North Carolina, and the southern Alleghany country (Cherokee); *Muskogian* (including Natchez), which occupies the Gulf region from the mouth of the Mississippi east into Florida and Georgia and north into Tennessee and Kentucky; *Siouan,* divided into four geographically distinct groups—an eastern group in Virginia and North and South Carolina, a small southern contingent (Biloxi) in southern Mississippi, the main group in the valley of the Missouri (eastern Montana and Saskatchewan southeast through Arkansas), and a colony of the main group (Winnebago) in the region of Green Bay, Wisconsin; *Caddoan,* spoken in the southern Plains (from Nebraska south into Texas and Louisiana) and in an isolated enclave (Arikara) along the Missouri in North and South Dakota; *Shoshonean,* which occupies the greater part of the Great Basin area and contiguous territory in southern California and the southwestern Plains (Texas), also, disconnected from this vast stretch, three mesas in the Pueblo region of northern Arizona (Hopi); *Athabaskan,* divided into three geographically distinct groups of languages—Northern (the valleys of the Mackenzie and Yukon, from just short of Hudson's Bay west to Cook Inlet, Alaska, and from Great Bear Lake and the Mackenzie delta south to the headwaters of the Saskatchewan), Pacific (two disconnected areas, one in southwestern Oregon and northwestern California, the other a little south of this in California), and Southern (large parts of Arizona and New Mexico, with adjoining regions of Utah, Texas and Mexico)—besides isolated enclaves in southern British Columbia, Washington and northern Oregon; and *Salishan,* in southern British Columbia, most of Washington, and northern Idaho and Montana, with two isolated offshoots, one (Bella Coola) to the north on the British Columbia coast, the other (Tillamook) to the south in northwestern Oregon.

The remaining 46 stocks, according to Powell's classification, in alphabetical order, are: *Atakapa* (Gulf coast of Louisiana and Texas); *Beothuk* (Newfoundland; extinct); *Chimakuan* (northwestern Washington); *Chimariko* (northwestern California);

Chinook (lower Columbia river, in Washington and Oregon); *Chitimacha* (southern Louisiana); *Chumash* (southwestern California); *Coahuiltecan* (lower Rio Grande, in Texas and Mexico); *Coos* (Oregon coast); *Costanoan* (western California south of San Francisco Bay); *Esselen* (southwestern California; extinct); *Haida* (Queen Charlotte Islands and part of southern Alaska); *Kalapuya* (northwestern Oregon); *Karankawa* (Texas coast); *Karok* (northwestern California); *Keres* (certain Rio Grande pueblos, New Mexico); *Kiowa* (southern Plains, in Kansas, Colorado, Oklahoma, and Texas); *Kootenay* (upper Columbia river, in British Columbia and adjoining parts of Idaho and Montana); *Lutuami,* consisting of Klamath and Modoc (southern Oregon and northeastern California); *Maidu* (eastern part of Sacramento valley, California); *Miwok* (central California); *Piman* or Sonoran (southern Arizona and south into Mexico as far as the state of Jalisco); *Pomo* (western California north of San Francisco Bay); *Sahaptin* (middle Columbia River valley, in Washington, Oregon and Idaho); *Salinan* (southwestern California); *Shastan* or Shasta-Achomawi (northern California and southern Oregon); *Takelma* (southwestern Oregon); *Tanoan* (certain pueblos in New Mexico, Arizona, and originally also in Chihuahua, Mexico); *Timuqua* (Florida; extinct); *Tlingit* (southern Alaska); *Tonkawa* (Texas); *Tsimshian* (western British Columbia); *Tunica* (Mississippi River, in Louisiana and Mississippi); *Waiilatpuan,* consisting of Molala and Cayuse (northern Oregon); *Wakashan,* consisting of Kwakiutl and Nootka (coast of British Columbia); *Washo* (western Nevada and eastern California); *Wintun* (north central California); *Wiyot* (northwestern California); *Yakonan* (Oregon coast); *Yana* (northern California); *Yokuts* (south-central California); *Yuchi* (Savannah river, in Georgia and South Carolina); *Yuki* (western California); *Yuman* (lower Colorado River valley, in Arizona, southern California and south into all or most of lower California); *Yurok* (northwestern California); *Zuñi* (pueblo of New Mexico). To these was later added, as distinct from Yakonan, *Siuslaw* (Oregon Coast).

This complex classification of native languages in North America is very probably only a first approximation to the historic truth. There are clearly far-reaching resemblances in both structure and vocabulary among linguistic stocks classified by Powell as genetically distinct. Certain resemblances in vocabulary and phonetics are undoubtedly due to borrowing of one language from another, but the more deep-lying resemblances, such as can be demonstrated, for instance, for Shoshonean, Piman, and Nahuatl (Mexico) or for Athabaskan and Tlingit, must be due to a common origin now greatly obscured by the operation of phonetic laws, grammatical developments and losses, analogical disturbances, and borrowing of elements from alien sources.

It is impossible to say at present what is the irreducible number of linguistic stocks that should be recognized for America north of Mexico, as scientific comparative work on these difficult languages is still in its infancy. The following reductions of linguistic stocks which have been proposed may be looked upon as either probable or very possible: 1, *Wiyot* and *Yurok,* to which may have to be added Algonkian (of which Beothuk may be a very divergent member); 2, *Iroquoian* and *Caddoan;* 3, *Uto-Aztekan,* consisting of Shoshonean, Piman and Nahuatl; 4, *Athabaskan* and *Tlingit,* with *Haida* as a more distant relative; 5, *Mosan,* consisting of Salish, Chimakuan and Wakashan; 6, *Atakapa, Tunica* and *Chitimacha;* 7, *Coahuiltecan, Tonkawa* and *Karankawa;* 8, *Kiowa* and *Tanoan;* 9, *Takelma, Kalapuya* and *Coos-Siuslaw-Yakonan;* 10, *Sahaptin, Waiilatpuan* and *Lutuami;* 11, a large group known as *Hokan,* consisting of Karok, Chimariko, Shastan, Yana, Pomo, Washo, Esselen, Yuman, Salinan, Chumash, and in Mexico, Seri and Chontal; 12, *Penutian,* consisting of Miwok-Costanoan, Yokuts, Maidu and Wintun.

A more far-reaching scheme than Powell's, suggestive but not demonstrable in all its features at the present time, is Sapir's.

These linguistic classifications, shown in the next column, do not correspond at all closely to the racial or sub-racial lines that have been drawn for North America, nor to the culture areas into which the tribes have been grouped by ethnographers. Thus, the Athabaskan stock counts among its tribes repres-

Proposed Classification of American Indian Languages North of Mexico (and Certain Languages of Mexico and Central America)

I. *Eskimo-Aleut*

II. *Algonkin-Wakashan*

1. Algonkin-Ritwan
   - (1) Algonkin
   - (2) Beothuk (?)
   - (3) Ritwan
     - (a) Wiyot
     - (b) Yurok
2. Kootenay
3. Mosan (Wakashan-Salish)
   - (1) Wakashan (Kwakiutl-Nootka)
   - (2) Chimakuan
   - (3) Salish

III. *Nadene*

1. Haida
2. Continental Nadene
   - (1) Tlingit
   - (2) Athabaskan

IV. *Penutian*

1. Californian Penutian
   - (1) Miwok-Costanoan
   - (2) Yokuts
   - (3) Maidu
   - (4) Wintun
2. Oregon Penutian
   - (1) Takelma
   - (2) Coast Oregon Penutian
     - (a) Coos
     - (b) Siuslaw
     - (c) Yakonan
   - (3) Kalapuya
3. Chinook
4. Tsimshian
5. Plateau Penutian
   - (1) Sahaptin
   - (2) Waiilatpuan (Molala-Cayuse)
   - (3) Lutuami (Klamath-Modoc)
6. Mexican Penutian
   - (1) Mixe-Zoque
   - (2) Huave

V. *Hokan-Siouan*

1. Hokan-Coahuiltecan
   - A. Hokan
     - (1) Northern Hokan
       - (a) Karok, Chimariko, Shasta-Achomawi
       - (b) Yana
       - (c) Pomo
     - (2) Washo
     - (3) Esselen-Yuman
       - (a) Esselen
       - (b) Yuman
     - (4) Salinan-Seri
       - (a) Salinan
       - (b) Chumash
       - (c) Seri
     - (5) Tequistlatecan (Chontal)
   - B. Subtiaba-Tlappanec
   - C. Coahuiltecan
     - (1) Tonkawa
     - (2) Coahuilteco
       - (a) Coahuilteco proper
       - (b) Cotoname
       - (c) Comecrudo
     - (3) Karankawa
2. Yuki
3. Keres
4. Tunican
   - (1) Tunica-Atakapa
   - (2) Chitimacha
5. Iroquois-Caddoan
   - (1) Iroquoian
   - (2) Caddoan
6. Eastern group
   - (1) Siouan-Yuchi
     - (a) Siouan
     - (b) Yuchi
   - (2) Natchez-Muskogian
     - (a) Natchez
     - (b) Muskogian
     - (c) Timucua (?)

VI. *Aztec-Tanoan*

1. Uto-Aztekan
   - (1) Nahuatl
   - (2) Piman
   - (3) Shoshonean
2. Tanoan-Kiowa
   - (1) Tanoan
   - (2) Kiowa
3. Zuñi (?)

entatives of four of the major culture areas of the continent: Plateau-Mackenzie area, southern outlier of West Coast area, Plains area and Southwestern area.

The aboriginal languages of North America differ from each other in both phonetic and morphological respects. Some are polysynthetic (or "holophrastic") in structure, such as Algonkian, Yana, Kwakiutl-Nootka, or Eskimo. Others, like Takelma and Yokuts, are of an inflective cast and may be compared, for structural outlines, to Latin or Greek; still others, like Coos, while inflective, have been reduced to the relatively analytic status of such a language as English; agglutinative languages of moderate complexity, comparable to Turkish, are common, say Shoshonean or Sahaptin.

The term "polysynthetic" indicates that the language is far more than ordinarily synthetic in form, that the word embodies many more or less concrete notions that would in most languages be indicated by the grouping of independent words in the sentence. The Yana word *yābanaumawildjigummaha'nigi* "let us, each one (of us), move indeed to the west across (the creek)!" is "polysynthetic" in structure. It consists of elements of three types—a nuclear element or "stem," *yā-* "several people move"; formal

elements of mode (*-ha-*, hortatory) and person (*-nigi* "we"); and elements of a modifying sort which cannot occur independently but which nevertheless express ideas that would ordinarily be rendered by independent words (*-banauma-* "everybody," *-wil-* "across," *-dji-* "to the west," *-gumma-* "indeed"). Such constructions are not uncommon in native America but are by no means universal.

Phonetically these languages differ enormously. Some, like Pawnee (Caddoan stock), have a simple consonantal structure, others make all manner of fine consonantal discriminations and possess many strange types of consonants, such as voiceless *l*-sounds, "glottalized" consonants, and velar *k*-sounds, that are infrequent elsewhere. Kutchin, an Athabaskan language of Alaska, possesses no less than 55 consonantal "phonemes," distinct consonantal elements of the total phonetic pattern. A considerable number of the native languages of North America are pitch languages, *i.e.*, they use pitch differences in otherwise similar syllables to make lexical or grammatical distinctions. Such languages are Tlingit, Athabaskan (certain dialects of this group have lost pitch as an inherently necessary element of language), Takelma, Shasta-Achomawi, Yuman, Tanoan. Navaho may serve as an example of such a pitch language. Every syllable in its words is definitely high or low in pitch, or, less frequently, has a falling or rising tone. Thus, *bini'* means "his nostril" if the two syllables have a high tone, "his face" if they have a low tone, and "at his waist, centre" if the first syllable is low and the second high; *yāzīd* means "you pour it (sandy mass) down" if the first syllable is low and the second high, but "I have poured it down" if both are low.

The six major linguistic groups of Sapir's scheme may be characterized as follows:

I. The *Eskimo-Aleut* languages are "polysynthetic" and inflective; use suffixes only, never prefixes, reduplication, inner stem modification, or compounding of independent stems; have a great elaboration of the formal aspect of verb structure, particularly as regards mode and person; and make a fundamental distinction between the transitive and intransitive verb, to which corresponds the nominal case distinction of agentive-genitive and absolutive (or objective).

II. The *Algonkin-Wakashan* languages, too, are "polysynthetic" and, especially as regards Algonkian, inflective; make use of suffixes, to a much less extent, particularly in Algonkian and Ritwan, of prefixes; have important inner stem modifications, including reduplication; have a weak development of case; and illustrate to a marked degree the process of building up noun and verb themes by suffixing to stems local, instrumental, adverbial, and concretely verbalizing elements.

III. The *Nadene* languages, probably the most specialized of all, are tone languages and, while presenting a superficially "polysynthetic" aspect, are built up, fundamentally, of monosyllabic elements of prevailingly nominal significance which have fixed order with reference to each other and combine into morphologically loose "words"; emphasize voice and "aspect" rather than tense; make a fundamental distinction between active and static verb forms; make abundant use of postpositions after both nouns and verb forms; and compound nominal stems freely. The radical element of these languages is probably always nominal in force and the verb is typically a derivative of a nominal base, which need not be found as such.

IV. The *Penutian* languages are far less cumbersome in structure than the preceding three but are more tightly knit, presenting many analogies to the Indo-European languages; make use of suffixes of formal, rather than concrete, significance; show many types of inner stem change; and possess true nominal cases, for the most part. Chinook seems to have developed a secondary "polysynthetic" form on the basis of a broken down form of Penutian; while Tsimshian and Maidu have probably been considerably influenced by contact with Mosan and with Shoshonean and Hokan respectively.

V. The *Hokan-Siouan* languages are prevailingly agglutinative; tend to use prefixes rather than suffixes for the more formal elements, particularly the pronominal elements of the verb; distinguish active and static verbs; and make free use of compounding of stems and of nominal incorporation.

VI. The *Aztec-Tanoan* languages are moderately "polysynthetic"; suffix many elements of formal significance; make a sharp formal distinction between noun and verb; make free use of reduplication, compounding of stems and nominal incorporation; and possess many postpositions. Pronominal elements, in some cases nouns, have different forms for subject and object but the subject is not differentiated, as in types I. and IV., for intransitive and transitive constructions. (E. Sa.)

Bibliography.—J. W. Powell, "Indian Linguistic Families of America north of Mexico," Bureau of Ethnology, 7th *Annual Report*, pp. 1–142 (Washington, 1891); Franz Boas, "Handbook of American Indian Languages," Bureau of American Ethnology, *Bull. 40* (pt. 1, 1911; pt. 2, 1922); P. Rivet, "Langues de l'Amérique du Nord," pp. 607–628 of A. Meillet et M. Cohen, *"Les Langues du Monde* (Paris, 1924).

Mexican and Central American Languages.—The classification of the native languages of Middle America is not in quite so advanced a stage as is that of the many languages spoken north of Mexico. The languages are, some of them, spoken by large populations, numbering millions, as in the case of Nahuatl (or Mexican) and the Maya of Yucatan; others are confined to very small groups, like the Subtiaba-Tlappanec of Nicaragua and Guerrero, or are extinct, as is Waïcuri in Lower California. Nahuatl, Maya (with Quiche, Kekchi, and Cakchiquel, which belong to the Mayan stock), and Zapotec were great culture languages which had developed ideographic methods of writing.

The languages of Middle America may be conveniently grouped into three main sets: A., southern outliers of stocks located chiefly north of Mexico; B., stocks spoken only in Mexico and Central America, so far as is known at present; C., northern outliers of South American stocks. It is quite probable that relationships will eventually be discovered between some of the languages of group B and languages lying further north.

To group A belong three distinct stocks: *Uto-Aztekan,* with two subdivisions, *Sonoran* (or *Piman*), spoken in a large number of dialects in northern Mexico, and *Nahuatl* (or *Aztek*), spoken in central Mexico and in a number of isolated southern enclaves —the Pacific coast of Oaxaca (Pochutla), three disconnected areas in Salvador and Guatemala (Pipil), two areas in Nicaragua and one in Costa Rica (Nicarao), and the Chiriqui region of Costa Rica (Sigua), of which dialects Nicarao and Sigua are now extinct—with *Cuitlateco* of Michoacan as a doubtful member of the stock; *Hokan-Coahuiltecan,* represented by *Hokan* proper, which includes Seri (coast of Sonora), Yuman (in Lower California), and Tequistlateco or Chontal (coast of Oaxaca), by *Coahuiltecan* (Pakawan), of the lower Rio Grande, and by *Subtiaba-Tlappanec,* which is spoken in two small areas in Guerrero, one in Salvador, and one in Nicaragua; and *Athabaskan* (Apache tribes of Chihuahua and Coahuila).

The Middle American languages proper (group B) may, with reservations, be classified into 15 linguistic stocks, which in alphabetic order, are: *Chinantec* (Oaxaca and western Vera Cruz); *Janambre* (Tamaulipas; extinct); *Jicaque* (northern Honduras); *Lenca* (Honduras and Salvador); *Mayan* (Yucatan and neighboring states of southern Mexico, British Honduras, western Honduras, and Guatemala), with an aberrant dialect group, *Huastec,* in the northeastern coast region of Mexico (Vera Cruz, San Luis Potosi, Tamaulipas); *Miskito-Sumo-Matagalpa,* consisting of three distinct language groups: *Miskito* (coast of Nicaragua and Honduras), *Sumo-Ulua* (eastern Nicaragua and southern Honduras), and *Matagalpa* (Nicaragua; a small enclave, Cacaopera, in Salvador); *Mixe-Zoque-Huave,* spoken in four disconnected groups, *Mixe-Zoque* (Oaxaca, Vera Cruz, Chiapas, and Tabasco), *Tapachultec* (southeastern Chiapas; extinct), *Aguacatec* (Guatemala, extinct), and *Huave* (coast of Oaxaca); *Mixtec-Zapotec,* a group of languages that some consider as composed of four independent stocks: *Mixtec* (Guerrero, Puebla, and western Oaxaca), *Amusgo* (Guerrero and Oaxaca), *Zapotec* (Oaxaca), and *Cuicatec* (northern Oaxaca); *Olive* (Tamaulipas; extinct); *Otomian,* consisting of three distinct groups: *Otomi* (large part of central Mexico), *Mazatec* (Guerrero,

Puebla, Oaxaca; includes *Trique* and *Chocho*), and the geographically distant *Chiapanec-Mangue* (*Chiapanec* in Chiapas; *Mangue* and related languages in three disconnected areas in Nicaragua and Costa Rica); *Paya* (Honduras); *Tarascan* (Michoacan); *Totonac* (Hidalgo, Puebla, and coast of Vera Cruz); *Waïcuri* (southern part of Lower California; extinct); *Xinca* (southeastern Guatemala).

The outliers from South America are two: *Carib* (coast of Honduras and British Honduras; transferred in post-Columbian times from the Antilles); *Chibchan* (Costa Rica and Panama). In the West Indies two South American stocks were represented, *Carib* and *Arawak,* the latter constituting an older stream which had overrun the Greater Antilles and penetrated into Florida.

As to the languages of group B, some connect Chinantec, Mixtec-Zapotec, and Otomian in one great linguistic stock, *Mixtec-Zapotec-Otomi.* Both Xinca and Lenca (also Paya and Jicaque?) may be remote southern outliers of the Penutian languages of North America. Waïcuri may have been related to Yuman. It is by no means unlikely that such important Middle American stocks as Mayan, Totonac, and Tarascan may also belong to certain of the larger stock groupings that have been suggested for North America; *e.g.,* Maya may fit into the Hokan-Siouan framework, Tarascan into Aztek-Tanoan.

Middle America, in spite of its special cultural position, is distinctly a part of the whole North American linguistic complex and is connected with North America by innumerable threads. On the other hand, there seems to be a much sharper line of linguistic division, distributionally speaking, between Middle and South America. This line is approximately at the boundary between Nicaragua and Costa Rica; allowances being made for Nahuatl and Otomian enclaves in Costa Rica and for an Arawak colony in Florida, we may say that Costa Rica, Panama, and the West Indies belong linguistically to South America. The Chibchan, Arawak, and Carib stocks of the southern continent were obviously diffusing northward at the time of the Conquest, but evidence seems to indicate that for Mexico and Central America as a whole the ethnic and linguistic movement was from north to south. Middle America may be looked upon as a great pocket for the reception of a number of distinct southward-moving peoples and the linguistic evidence is sure to throw much light in the future on the ethnic and culture streams which traversed these regions.

Two linguistic groups seem to stand out as archaically Middle American: Miskito-Sumo-Matagalpa, in Central America, and Mixtec-Zapotec-Otomi, with its center of gravity in southern Mexico. The latter of these sent offshoots that reached as far south as Costa Rica. The Penutian languages, centered in Oregon and California, must early have extended far to the south, as they seem to be represented in Mexico and Central America by Mixe-Zoque, Huave, Xinca, and Lenca. These southern offshoots are now cut from their northern cognate languages by a vast number of intrusive languages, *e.g.,* Hokan and Aztek-Tanoan. The Mayan languages, apparently of Hokan-Siouan type, may have drifted south at about an equally early date. Presumably later than the Penutian and Mayan movements into Middle America is the Hokan-Coahuiltecan stream, represented by at least three distinct groups—Coahuiltecan (N.E. Mexico), Subtiaba-Tlappanec (Guerrero, Nicaragua), and a relatively late stream of Hokan languages proper (Yuman; Seri; and Chontal in Oaxaca). Not too early must have been the Uto-Aztekan movement to the south, consisting of an advance guard of Nahuatl-speaking tribes, a rear guard of Sonoran-speaking tribes (Cora, Huichol, Tarahumare, Tepehuane). The Nahuatl language eventually pushed south as far as Costa Rica. Last of all, the Apache dialects of Chihuahua brought into Mexico the southernmost outpost of the Nadene group of languages, which extend north nearly to the Arctic. (E. Sa.)

Bibliography.—C. Thomas and J. R. Swanton, "Indian Languages of Mexico and Central America and their Geographical Distribution," Bureau of American Ethnology, *Bull. 44* (Washington, 1911); W. Lehmann, *Zentral-Amerika,* I. Theil, "Die Sprachen Zentral-Amerikas" (Berlin, 1920); P. Rivet, "Langues de l'Amérique Centrale," pp. 629–638 of A. Meillet et M. Cohen, *Les Langues du Monde* (Paris, 1924).

CENTRAL BANK. Central banks are institutions charged with the function of regulating the supply, cost and use of money with a view to promoting national and international economic stability and welfare. They differ from other banking institutions in that they are vested with the public interest and are not operated primarily as profit-making business enterprises.

Evolution.—Modern central banks are the outcome of a long evolution. Originally many of them were established for the purpose of serving the state by extending loans and of providing currency of uniform value in adequate amount for the needs of the country. They became the principal, in many countries the only, issuers of paper money. In modern times the principal function of central banks is regulation of the supply and use of money in the service of commerce and industry, but in times of emergency, such as war, they become in the main instruments for facilitating government finance.

Heavy reliance on central banks for government financing during World War I and the inflationary excesses which subsequently developed led to a movement for strict limitation of government borrowing from central banks, but the necessities of World War II largely subordinated such limitations. In wartime the central bank, as all other institutions, must support the government's war needs and its stabilizing function becomes secondary to this purpose.

During the 1920s and 1930s most countries went through booms and depressions caused largely by nonmonetary factors and not traceable to variations in the supply or cost of money. The viewpoint gradually developed that a central bank is but one of many public agencies which must act in concert if the purpose of establishing and maintaining a stable and expanding volume of national income and a rising level of economic wellbeing is to be achieved.

Older institutions have nothing in their charters indicative of the broad modern concept of central bank functions, but in practice it has been widely recognized. In charters of more recently established central banks, such as the Bank of Canada, it is explicitly stated.

Functions.—With these broad objectives as their goal, central banks have the following principal functions and authorities: (1) creation of money by issuing notes and by creating bankers' balances which through custom or law must be held by commercial banks as reserves in an amount proportionate to their liabilities; (2) influencing the volume, cost and use of money by expanding and contracting bankers' cash, or reserves. This the central bank accomplishes by establishing and varying the rate at which it will make advances or discounts on the initiative of commercial banks or the market; by purchasing or selling on its own initiative such securities as government obligations and acceptances (or bills), and, in some countries, principally the United States, by increasing or decreasing the ratio of reserves to deposits that commercial banks are required to hold. (3) In addition to these general influences on the use of money, some central banks have the power to influence specific uses of money. For example, in the United States the Federal Reserve board of governors has authority to prescribe margins for stock market loans, and also (on an emergency war basis) to regulate certain types of consumer credit. In some countries limited selective regulation of the use of money is undertaken by varying the rate at which paper originating from different types of transactions will be discounted by the central bank. Central banks (4) serve as fiscal agents of the government; (5) perform numerous services for the banking system, among which the most important is check clearance; (6) serve as correspondents of central banks of other countries; and (7) supervise banks with a view to enforcing compliance with banking laws and maintenance of sound banking conditions. This function is performed by central banks of different countries in different ways. In England, for example, which has a highly centralized branch banking system, the central bank performs this function largely through its informal but potent influence on the management of the joint-stock banks. In the United States, where the vast majority of more than 14,000 banks are independent, responsibility for bank supervision is vested in the central bank by law; it is, however, shared with certain

other government agencies.

Banks of Issue.—Most central banks hold a monopoly of note issue, which in the case of some older institutions was acquired by gradual absorption or extinction of rival issues. In modern times the notes of new central banks may be launched while the circulation of older currency, issued by banks or government treasuries, continues temporarily or permanently.

Up to the end of 1944, national governments of the following countries had granted a monopoly of issue to their central banks: *Europe:* France, Belgium, the Netherlands, Switzerland, Norway, Sweden, Denmark, Finland, Estonia, Latvia, Lithuania, Spain, Portugal, Italy, Hungary, Poland, Czechoslovakia, Bulgaria, Rumania, Yugoslavia, Greece, Albania; *Middle East:* Turkey, Egypt, Iran; *Far East and Oceania:* China (monopoly to Central Bank of China, 1942), Japan, Australia, New Zealand; *Africa:* Union of South Africa; *North and Central America:* Mexico, Costa Rica, Nicaragua, Guatemala, El Salvador; *South America:* Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, Paraguay (1943), Venezuela (1939).

Colonial central banks or banks of issue exist in some French, Belgian, Dutch, Portuguese and Japanese colonies. In 1944 the Caisse Centrale de la France d'Outre-Mer (formerly "Caisse Centrale de la France Libre") was authorized to function as a central bank of a unique type, directing the credit policy of colonial banks of issue in Free French territory.

Some leading central banks do not (1945) have a monopoly of note issue. Note circulation of the 12 Federal Reserve banks of the United States, Dec. 31, 1944, amounted to $21,482,000,000 while other paper currency (silver certificates of the U.S. treasury and other note issues of the government) amounted to $2,615,000,000, only part of which was to be retired.

The Bank of England has a monopoly of note issue for England and Wales but eight Scottish banks have fixed quotas totalling £2,676,350 and quotas of six banks in Northern Ireland totalled £2,197,792 (approved by treasury up to Dec. 23, 1944). Issues exceeding these quotas must be covered by gold or other legal tender. After the opening of the Bank of Canada in 1935, chartered bank notes were being reduced by schedule and were eventually to be taken over by the central bank. A similar situation existed in Eire after the Central Bank of Ireland was established in 1942. In British India, government notes circulate with those of the reserve bank. Currency of the State Bank of the U.S.S.R. serves only as bank or deposit currency. The circulating medium, besides coin, is rouble notes of the state treasury. Germany's note circulation (1944) included, besides Reichsbank notes, the notes of the Deutsche Rentenbank, the issue of which was extended by decrees of 1930 and 1939.

During World War II the axis powers set up in several occupied countries new banks of issue or central banks whose notes were designed to supersede the national currency. Disposal of these superimposed currencies, as well as of the military currency circulated by Germany and Japan in occupied countries and by the allies in liberated countries, presented a complicated postwar problem.

Relation to the State.—Relation of the central bank to the state, more particularly to the fiscal authority, varies from country to country, but in general the central bank has responsibility for the volume and cost of money, while the fiscal authority has responsibility for meeting government expenses through taxation and borrowing. It is generally believed that, since the two functions and responsibilities are distinct and may at times indicate different courses of action, the public good is served best by keeping them in separate institutions. It is increasingly recognized, however, that while the central bank has the obligation to formulate its policies in accordance with its own judgment and in ordinary times should have a large measure of autonomy, in times of national emergency the will of the fiscal authority must prevail. At such times the central bank must function chiefly as an adviser, the degree of its influence depending on the confidence which it commands with other branches of the government and the general public.

In some countries the central bank is owned in whole or in part by the state, in others it is privately owned. Private ownership of central banks, however, is in effect merely a contribution of private capital to a public institution operated for a public purpose.

Economic Intelligence.—Enlargement of the objectives which the central bank must aim to achieve has resulted in increasing emphasis on the maintenance of effective economic intelligence services at central banks. The interrelationships of economic forces make it necessary for the policy-making authorities of central banks to keep abreast of all important economic developments, domestic and foreign, with a view to enabling them not only to determine their own policies in the light of all available facts and analyses, but also to be in a position to give sound counsel to other public bodies that formulate other phases of the nation's interrelated economic policies. (*See* BANCA D'ITALIA; BANKING AND CREDIT; BANK OF ENGLAND; BANQUE DE FRANCE; MONEY; REICHSBANK.)

BIBLIOGRAPHY.—Annual reports and other publications of central banks; M. H. de Kock, *Central Banking* (1939); Staff members, Board of Governors, Federal Reserve System, *Banking Studies* (1941); Sir John Clapham, *The Bank of England* (1944). (E. A. GR.)

CENTRAL ELECTRICITY BOARD. A British body corporate appointed by the minister of transport under the terms of the Electricity (Supply) Acts, 1926 and 1935, to organize and control the generation of electricity throughout Great Britain. This it has effected by means of the "grid" system (*see* ELECTRICITY SUPPLY: COMMERCIAL ASPECTS) which, constructed at a cost of some £30,000,000, at the end of 1938 comprised 4,378 mi. of transmission lines and 304 switching and transforming stations with an aggregate transforming capacity of 10,422,000 kva., and during the year had an output of 24,376,000,000 units compared with the 4,016 units sold in the same area in 1925. The board consists of a chairman and seven members; the first chairman, Sir Andrew Duncan, was succeeded in 1935 by Sir Archibald Page, the former chief engineer and manager. The board has borrowing powers up to £60,000,000. Annual reports and statements of accounts are published.

Before the passing of the 1926 act there were over 500 unconnected generating stations in Great Britain, 32 of which supplied half the power; by means of the act much of the capital extravagance entailed by this lack of co-ordination was eliminated, the general level of the cost of production was lowered, and the availability of electricity throughout the country increased; the larger and more efficient generating stations became "selected stations" and were interconnected by the grid with each other and with the systems of authorized undertakers not owning selected stations, and great economies were effected by the use of the more efficient stations for the long-hour or base load and the restriction of the use of the less efficient stations to the short-hour or peak load, many of these latter being completely closed during the summer months. The output of all selected stations is purchased by the board and is sold by them to the distributing authorities, including the owners of the stations themselves, at a tariff fixed by the board and approved by the Electricity Commissioners (*q.v.*); authorized undertakers have the right to demand supplies from the board, and under the 1935 act the board is empowered to supply electricity to railway companies for traction purposes, which it now does in the case of the Southern railway.

At the end of 1938 the selected stations numbered 137 with a total installed capacity of 8,264,160 kw. (as against 3,096,000 kw. in 1925), and the board controlled in addition 35 nonselected stations, the operation of the whole 171 being so controlled that only 30 ran for the full year. Of the 560 distributing undertakings 217 were supplied directly and a further 300 indirectly by the board, which in 1938 produced 97.2% of the electricity consumption of the country.

The offices of the board are in Trafalgar Buildings, Charing Cross, London.

CENTRAL FALLS, a city of Providence county, Rhode Island, U.S.A., on the Blackstone river, 5 mi. N. of Providence; served by the New York, New Haven and Hartford railroad. The

population in 1920 was 24,174, of whom 9,456 were foreign-born white; in 1940 it was 25,248. The river furnishes water power for large manufacturing industries (chiefly cotton mills), which in 1937 had an output valued at $11,714,238. A settlement was made there about 1763. About 1780 a chocolate mill was erected, and until 1827 the town was called Chocolateville. It was incorporated as the Central Falls Fire District of Smithfield in 1847, and in 1896 was chartered as a city.

CENTRALIA, a city of southern Illinois, U.S.A., about 60 mi. E. of Saint Louis, in Marion and Clinton counties. It is on federal highway 51 and state highway 161, and is served by the Illinois Central, Burlington, Southern and the Missouri-Illinois railways. Pop. (1940) 16,343. It is in a fertile fruit-growing and dairying region, and there are coal mines and oil wells in the vicinity. The city has a large wholesale trade. Two of the railroads have division repair shops there, and there are several other manufacturing industries. Centralia was founded in 1853 by the Illinois Central railroad company, and was chartered as a city in 1859.

CENTRALIA, a city of Lewis county, Washington, U.S.A., on the Pacific highway, about halfway between Seattle and Portland. It is served by four transcontinental railways: the Chicago, Milwaukee, St. Paul and Pacific; the Great Northern; the Northern Pacific and the Union Pacific. The population was 8,058 in 1930, and was 7,414 in 1940 by the federal census. Chehalis, the county seat, lies 4 mi. S., and between the two cities are the southwestern Washington fairgrounds. Lumbering, coal-mining, dairying, poultry-raising and berry-growing are some of the occupations of the region. Centralia has saw and shingle mills, furniture and concrete culvert factories and railroad shops. In Borst park, 1½ mi. W. of the city, is a blockhouse built by the early settlers as a stronghold against the Indians. Centralia is situated on the Cochrain Donation Claim. It was laid out by George Washington, a negro ex-slave of Cochrain, who became the owner of the land on the death of his master in 1852, and at first it was called Washington's Addition. Later it was known for a few years as Skookumchuck station, and then as Centerville, until the present name was adopted in 1887. In 1914 a commission form of government was adopted. The municipal water and power system is operated by the city. Once dependent upon lumber industry, the main industries are now railroading and retail trade.

CENTRAL INDIA, a collection of Indian states forming a separate agency, which must not be confounded with the Central Provinces. The Central India agency was formed in 1854 and consists of two large detached tracts of country which, with Jhansi as a pivot, spread outwards east and west into the peninsula, reaching southward to the valley of the Nerbudda and the Vindhya and Satpura ranges. The total area, since Gwalior was removed from the agency, is 52,047 square miles.

Central India (including for the moment Gwalior) may be divided into three great natural divisions; the highlands of the Malwa plateau, with a mean elevation of some 1,500 ft. above sea-level; the low-lying country some 600 ft. above sea-level, comprising the greater part of the eastern section of the agency; and the hilly tracts which lie mostly to the south. The Malwa plateau consists of great undulating plains, separated by flat-topped hills, whose sides are boldly terraced, with here and there a scarp rising above the general level. Its foundation is a bed of sandstone and shales belonging to the Vindhyan series, which underlies the whole of the agency except the northern part of Bundelkhand. On the plateau itself the sandstone is generally overlaid by the Deccan trap, a blackish-coloured basaltic rock of volcanic origin, the high level tableland having been formed by a succession of lava flows, the valleys of Central India being merely "denudation hollows" carved out by the action of rain and rivers. It is apparently the northern limit of what was once a vast basaltic plain stretching from Goona to Belgaum, "one of the most gigantic outpourings of volcanic matter in the world." The sandstone bed on which it rests is visible at a point just north of Goona, and in a small area round Bhilsa and Bhopal. The low-lying land includes roughly that part of the agency which lies to the east of the plateau and comprises the greater part of the political divisions of Bundelkhand and Baghelkhand and the country round Gwalior. The formation is sandstone of the Vindhyan series, except in the north of Bundelkhand where the prevailing rock is gneiss and quartz. The quartz takes the shape of long serrated ridges, trap appearing here and there in intrusive dykes. The hilly tracts lie chiefly to the south of the agency, where the Vindhya, Satpura and Kaimur ranges are met with. The country is rough forest and jungle land little used for cultivation. The greater part of Central India is covered with the well-known "black cotton soil," produced by the disintegration of the trap rock. It is a very rich loamy earth, possessing great fertility and an unusual power of retaining moisture, which makes artificial irrigation little needed. The ordinary "red soil" covers a large part of northern Bundelkhand, and as it requires much irrigation, tanks are a special feature in this country.

Administrative Divisions.—The Central India agency is divided for administrative purposes into the residency of Indore, and the agencies of Baghelkhand, Bhopal, Bhopawar, Bundelkhand, Indore and Malwa. Gwalior was removed from the agency in 1921 and put directly under the Governor-General. Besides Indore there are 13 states of importance, viz., Rewa, Bhopal, Dhar, Barwani, Datia, Orchha, Charkhari, Chhattarpur, Panna, Dewas (senior branch), Dewas (junior branch), Jaora and Ratlam. At the close of the Pindari War in 1818 the whole of this country was in great confusion and disorder, having suffered heavily from the extortions of the Mahratta armies and from predatory bands. It had been the policy of the great Mahratta chiefs, Holkar and Sindhia, to trample down into complete subjection all the petty Rajput princes. Many of these minor chiefs had taken refuge in the hills and forests, and retaliated upon the Mahratta usurpers by wasting the lands which they had lost, until the Mahrattas compounded for peace by payment of blackmail. In this state of affairs all parties agreed to accept the interposition of the British government for the restoration of order, and under Lord Hastings the work of pacification was effected. The policy pursued was to declare the permanency of the rights existing at the time of the British interposition, conditionally upon the maintenance of order; to adjust and guarantee the relations of subordinate and tributary chiefs to their superiors so as to prevent all further disputes or encroachments; and to settle the claims of the ousted landholders, who had resorted to pillage or blackmail, by fixing grants of land or settling money allowances. The resultant states have no general ethnological affinity, such as exists in Rajputana. Their territories are in many cases neither compact nor continuous, consisting of a number of villages here and there, with a nucleus of more or less importance round the chief town. Their relations to the government of India and to each other present many variations. Ten of them are under direct treaty with the government of India; others are held under *sanads* and deeds of fealty and obedience; while a third class, known as the mediatized states, are held under agreements mediated by the British government between them and their superior chiefs.

Population.—The total population of the Central India agency in 1941 was 7,506,427, Hindus largely predominating; but a few Mohammedan groups still exist, either traces of the days when the Mogul emperors extended their sway from the Punjab to the Deccan, or else the descendants of those northern adventurers who hired out their services to the great Mahratta generals. Of the first Bhopal is the only example, while Jaora is the only notable instance of the other. Roughly there are four great sections of the population; the Mahratta section, who belong to the ruling circles; the Rajputs; the trading classes, consisting chiefly of Marwaris and Gujaratis; and lastly, the jungle tribes. The Mahrattas are foreigners, and, though rulers of the greater part of Central India, have no true connection with the soil and are little met with outside cities, the vicinity of courts, and administrative centres. The Rajputs with all their endless ramifications form a large portion of the population. On the Malwa plateau they are pure-blooded aristocrats: on the low country they have got their blood more mixed, and the plateau families as a rule will not intermarry with them. The Marwaris hold practically all the trade of Central India, with the exception of the Bora class of Mohammedans.

They are either Vaishnavite Hindus or else Jains. Their advent into Central India dates, except in the case of one or two families, from the time of the Mahratta invasion only. The Jain portion of this community is very wealthy. The last section, that of the jungle tribes, is semi-civilized and shy, little affected as yet by the Hinduism of the conquerors.

The British agent to the governor-general resides at Indore, and there are British cantonments at Mhow, Neemuch and Nowgong.

CENTRAL PROVINCES AND BERAR. The Central Provinces of India were formed in 1862, and were augmented in 1903 by the Hyderabad assigned districts of Berar, which are leased in perpetuity to the British government by the Nizam, at an annual rent of 25 lacs of rupees. In 1905 most of the Sambalpur district and five Uriya-speaking states were transferred to Bengal, and five Hindi-speaking states from Chota Nagpur received in exchange. The province, therefore, now consists of the four divisions of Jubbulpore, Nagpur, Chhattisgarh and Berar, which are divided into the 19 districts of Saugor, Jubbulpore, Mandla, Hoshangabad, Nimar, Betul, Chhindwara, Wardha, Nagpur, Chanda, Bhandara, Balaghat, Raipur, Bilaspur, Drug, Amraoti, Akola, Buldana and Yeotmal.

The feudatory states of Chhuikhadan, Kawardha, Khairagarh and Nandgaon, belonging to the Eastern States Agency, and the state of Makrai, included in the Bhopal Agency, are within its borders.

South of the Vindhyan plateau are the Nerbudda valley districts extending from Jubbulpore on the east to North Nimar on the west. South of these again is the great Satpura range of hills and plateaus upon which are situated the four plateau districts of Betul, Chhindwara, Seoni and Mandla and the uplands of Balaghat. South of the Satpuras are the three great plains of Berar, Nagpur and Chhattisgarh, all bounded by hills on the south, Chhattisgarh being divided from the rest of the province by the Maikal range.

The province is practically surrounded by states, and at only three points does the boundary touch British territory proper, viz., the Jhansi and Mirzapur districts of the United Provinces, in the north of Saugor, and north of the Sirguja state respectively Khandesh of the Bombay Presidency in South Nimar, and West Berar and the Madras Zamindari Estates on the extreme south-east of Raipur and Bastar. Otherwise the province is hemmed in by the Central India states on the north, Nizam's territory on the south, and the Orissa feudatory states on the east. Only the two Vindhyan districts drain into the Gangetic plain. The waters of the rest of the northern districts and West Berar are carried by the Nerbudda and the Tapti, fed by their many tributaries rising in the Satpuras, into the Arabian sea. South Berar and the Nagpur division drain southwestwards into the Godavari, the principal rivers being the Waingunga, the Wardha, the Paingunga and their numerous tributaries. The eastern and south-eastern portion, Chhattisgarh, is drained by the Mahanadi to the Bay of Bengal. Except for short reaches none of these rivers is navigable throughout the year.

Climate.—In climate the Vindhyan and Satpura districts are comparatively temperate; the Nerbudda valley is hot, and the three great plains south of the Satpuras have the temperature of the Deccan, the heat from March to the middle of June being excessive, but very dry. The three northern tracts enjoy a very pleasant cold season; in the three southern the cold is limited to occasional snaps, and the season is cool rather than cold. But, except in the extreme south of Chanda and the tracts nearest Bengal, where the "rains" produce an exceedingly steamy atmosphere, the Province has the advantage of a reasonably cool, rainy season, since both the cyclonic storms from the Bay of Bengal and the steady current of the south-west monsoon from the Arabian sea bring it moisture-laden clouds. The rainfall varies from 25 in. to 30 in. in the west, and from 50 in. to 60 in. in the east. The monsoon period is divided between early rains, often deficient, middle rains, seldom failing completely, and late rains, premature cessation of which frequently causes severe losses. In 1896 the late rains failed completely, and in 1899 all three periods were failures. These caused the most extensive famines in the history of the Province since it came under British rule.

Agriculture.—A line drawn from Katni in the north to Chanda in the south roughly divides the agriculture of the country. East of that line the principal crop is rice, and the rainfall is heavy. West of it, there are two sections—the northern in which wheat, gram and cold-weather crops are the most important; the southern in which cotton and juar (big millet) are the great staples. The Nerbudda valley and the Vindhyan districts are the great wheat-producing areas; Nimar, Berar and Nagpur (West), mainly composed of Deccan trap, are the great cotton and juar tracts, but while cotton and juar are quite insignificant in the rice country, and rice is insignificant west of the line of division described, practically every district in the Province contains some heavy black soil areas which produce wheat and cold-weather crops. This variety of soil and cropping affords a certain degree of insurance again capricious rainfall. There are about five million acres of rice, three-and-a-half million acres of wheat, two-and-a-half million acres of juar and one-and-a-quarter million acres of cotton. Besides these, there are large areas under oil seeds, linseed, sesamum and niger being the most important. There are pulses and peas of many kinds, and in the hills and light soils, small millet (Kodon and Kutki), the staple food of the aboriginal tribes.

In Berar the system of land revenue settlement is the Ryotwara system, on the Bombay model. In the Central Provinces proper the proprietary system of Agra prevails, but the Central Provinces tenant enjoys by law and tradition a degree of protection greater than in any proprietary province, and with this security against arbitrary ejectment and arbitrary enhancement of rent, he has thriven wonderfully, in spite of fluctuations due to bad seasons and the debts which these bring in their train. Much has been accomplished by the creation and expansion of the Agricultural Department from small beginnings to a well-regulated service with experimental seed and demonstration farms, model cattle farms, scientific research and education to improve the yields and better the lot of the cultivator, while co-operative banks and societies have spread all over the country, affording cheaper credit than the moneylender will offer.

In the rice districts there are numerous irrigation works made by the people themselves, though few of these can stand against protracted drought. Government irrigation works only began to be undertaken 25 years ago, and in that time three large canals and many large and small storage works have been constructed, mainly in the rice districts. These now protect half a million acres from the effects of drought. There are still several large projects under construction and investigation, principally in the Bilaspur district, which had been somewhat neglected in this respect. There are about 20,000 sq. miles of Government forest reserves, and about 9,000 sq. miles of private forests; to which must be added 15,000 sq. miles in the feudatory States. There are valuable sal (*Shorea robusta*) forests in the north-east, and teak (*Tektona grandis*) in almost every district, though teak of fine girth is limited to a few famous reserves. There are many miscellaneous kinds of timber, bamboos and minor produce of commercial value, while there are edible fruits and roots with which the forest tribes supplement their food supply. The mohua tree (*Bassia latifolia*) has a flower which is edible, and from which country liquor is distilled, as well as a nut from which oil is extracted. The Government forests yield an annual revenue of some 50 lacs of rupees.

Population.—Nearly one-fifth of the people are of aboriginal and old Dravidian races, Gonds being the most numerous. Nearly all the rest are immigrants, mostly Hindus, who entered, some in very ancient days, others intermittently (notably when the Moguls conquered the Deccan and exercised suzerainty over the Gond chiefs). Many of these came from Malwa, some from Hindustan, but with the entry of the Mahrattas on the scene 200 years ago, a large influx of Mahrathi-speaking people poured in from the west. On the fringes along the east and south there are Oriya and Telugu immigrants. Mohammedans numbering only $3\frac{1}{2}\%$ of the population are to be found mainly in the towns,

being descendants of settlers who clustered round Mogul posts and certain seats of Government, or such special cities as Burhanpur and Ellichpur. Individual Mohammedan families occupied land in the interior, but while only 9% of the total population is urban, 41% of the Mohammedans live in the towns.

With such heterogeneous elements and origins, there are great diversities of language. There are ten major languages, with many separate dialects of the same. There are 200,000 people returned as speaking many minor languages. In round numbers there are nine millions who speak various dialects of Hindi, and five millions who speak Mahrathi of various degrees of purity, the remaining two millions being divided up among tribal and other minor languages.

The first regular census was taken in the Central Provinces in 1872, in Berar a few years earlier. The figures of that census may be taken as representing the high-water mark of development before railways entered the province. The contrast provided by the 1941 census is notable:

	Population 1872	Population 1941
C.P.—British districts . . .	7,723,535	13,208,718
Berar	2,227,654	3,604,866
Feudatory States.	928,195	. . .
Totals	10,879,384	16,813,584

This increase is shown in spite of a decrease during the decade 1891–1901, due to the great famines and the first ravages of plague, and virtual stagnation in the decade 1911–1921, which included the World War, two serious crop failures, and the great influenza scourge of 1918–1919, which claimed 1½ million victims.

Railways.—Before the railways came there was a burst of activity in the construction of some important trunk roads, some of which were allowed to fall into disrepair when the trunk lines of railway were made. A branch of the East Indian Railway from Allahabad to Jubbulpore was the first railway made in the Province in 1870, while the G.I.P., bifurcating at Bhusawal, in Khandesh, sent one line to meet the East Indian at Jubbulpore, and a second branch through Berar to Nagpur. It was 20 years before the Bengal-Nagpur railway, absorbing a State meter gauge line from Nagpur to the borders of Chhattisgarh (opened in 1881) made a second connection between Bombay and Calcutta via Nagpur and Bilaspur, from which place a branch went over the Ghats and across the Rawa State to join the East Indian at Katni. The Indian Midland Railway, afterwards amalgamated with the G.I.P., made a fresh connection from Itarsi in Hoshangabad, via Bhopal, Gwalior and Jhansi, with Agra and Delhi, and a branch from Bina, through Saugor and Damoh, connecting with Katni followed a few years later. Ten years later saw the next development by the Bengal-Nagpur Railway of narrow gauge lines (2 ft. 6 in.) across the Satpuris from Gondia in Bhandara to Jubbulpore, with branches to Seoni, Chhindwara and Mandla on the Satpura plateau. This was followed by a line from Gondia south-westwards to Chanda, where it met an extension of the Warora Coal Railway to the new coal-field at Ballaspur, a few miles south of Chanda. Connections on the same narrow gauge with this branch to Nagpur and on to Chhindwara followed. A further broad gauge connection between Nagpur and Itarsi was completed in 1926, crossing the Satpura district of Betul with a branch into the Chhindwara coal-field.

Two links, both under construction, alone remain to complete direct broad gauge connections between Southern India and the North, one from Warangal to Chanda, and the other from Vizianagram on the east coast to Raipur. One more link on the meter gauge is required to join the Hyderabad-Godaveri Railway at Hingoli with the Rajputana-Mulwa Railway at Khandwa, via Basim and Akola. When this, too, is accomplished, the network of railways in the C.P. and Berar will be completed, representing a length of 3,000 miles inside the Province. There are also feeder lines in the cotton country of Berar and Wardha, controlled by private companies. All these works represent an outlay of at least £25,000,000 and only a few feeder lines remain to be constructed. There are also 8,000 miles of roads, half being metalled and half gravelled, but with the great increase of motor traffic which is now beginning to penetrate even the remoter areas, there is still an enormous scope for road construction before village cart tracks cease to be the main method of wheel traffic.

Trade and Commerce.—The trade of the country has enormously increased, the value of the rail-borne traffic being about 60 crores of rupees annually. The bulk of the exports are cotton, wheat, rice, oil seeds and other agricultural produce, but coal and manganese are now important items. Coal is unfortunately of too poor a quality to be of any use for metallurgical purposes. There are coal-fields in Narsinghpur, Chanda and Wun (Berar), and in the Pench valley in Chhindwara (*q.v.*). It is used in cotton mills and factories and to some extent on the railways. The manganese deposits in Nagpur, Bhandara, Balaghat and Chhindwara are being vigorously worked, and some 500,000 tons a year are exported. There are plentiful bauxite deposits in Jubbulpore and Balaghat awaiting exploitation. Iron ore is found in many districts, but worked only by indigenous methods in small charcoal furnaces. There are large deposits of excellent ore in Chanda, but for want of coking coal it is practically untouched. There is also valuable limestone in many places, notably near Katni, where lime and cement works are important industries.

Outside the cotton industry (which is represented by 12 spinning and weaving mills and some 300 textile and connected factories, including ginning factories, employing in all about 60,000 people), the gun-carriage factory in Jubbulpore and the Government and railway workshops, organized manufacturing industries are confined mostly to small concerns scattered about in various districts, but the motor trade and electrical installations are increasing. Rural and small hand industries include hand weaving, the manufacture of brass and copper utensils, pottery, shoes, baskets, bamboo matting, carpentry and smithy work, but the larger colonies of handicraftsmen have suffered from the competition of machine-made goods, both local and imported. In the mass, however, cottage and hand industries still have a large output. They depend on agricultural prosperity and suffer with agriculture from the effects of bad seasons.

The Province has also made strides educationally. Colleges and high schools and subsidiary institutions have multiplied in numbers, and there is now a university at Nagpur, with institutions for scientific and professional training, which have increased both in numbers and status. In the 40 years between 1881 and 1921 literacy among males increased from 51 to 103 per mille, and among females from 1 to 8 per mille. Literacy in English is confined to a few castes. 84 per 10,000, or under 1%, of males can read English, but only 9 per 10,000 females, or under 1 per thousand. Great efforts have been made to extend medical relief in hospitals and dispensaries, better knowledge of hygiene and child welfare. The public revenue reflects the general advancement. Twenty years ago it was under two crores of rupees; it is now over six.

HISTORY

These two territories, now under a single administration, have a somewhat different history. The history of Berar is mainly the history of the Deccan, to which it geographically belongs. The Central Provinces were known to the races of the north as the "Forests of the South," inhabited by Rakshas or demons, but ancient Rajput dynasties penetrated to the more open parts of the country, and of these the famous Hai Hai Bansi dynasty ruled Chhattisgarh for many centuries until conquered by the Bhonslas in 1741.

The Gonds.—The rest of the Central Provinces were known as Gondwana, the kingdom of the Gonds, who held the wildest parts of the country. The oldest Gond kingdom was that of Chanda in the south, to which a history of about 800 years is sometimes attributed. In the north was the kingdom of Garha-Mandla, from which sprang the two sub-kingdoms of Deogarh in Chhindwara and Kherla in Betul. This last was overthrown by Hoshang Shah of Malwa, the founder of Hoshangabad. The Gond

kings, who must have established their rule over older Rajput dynasties, are fond of describing themselves as Rajgonds, and of claiming a Rajput origin.

One of these Gond kings, said to have been the 47th of the Garha-Mandla house, named Sangramsha, in 1480 extended his dominion over the Nerbudda valley and the Vindhyan districts, including even the tract now known as the State of Bhopal. Sangramsha lived until 1530, but a successor of his, Chandrasha, was forced to cede the two last-named territories to the Moguls in 1570, but, though these Garha-Mandla chiefs owed a nominal allegiance to the Mogul emperor, they maintained a virtual independence until the weakening of the Mogul power let in the predatory forces of the Mahrattas and (in the north) the Bundela chiefs. The Garha-Mandla Raj was finally overthrown by the Peshwa in 1780.

The Gond Rajah of Deogarh had paid a visit of homage to Delhi, and was so impressed with what he saw there, that he turned Mohammedan, adopting the name of Bakht Buland and establishing a new capital at Nagpur. He was himself an enlightened chief, but one of his grandsons, quarrelling over the succession, invited Raghoji Bhonsla from Berar to help him against his brother.

The Mahrattas.—Raghoji and his Mahrattas accomplished this mission, and returned to their own territory, but later he established himself at Nagpur. Raghoji I., sprung from a peasant family in Satara, was a great leader, and by 1751 had conquered the territories of Nagpur, Chanda and Chhattisgarh. He defied the Peshwa, burnt Poona on the west, and on the east raided Bengal, and extended his sovereignty over Orissa. He died in 1755 and his son Janoji was forced to submit to the Peshwa, but the next rajah, Mudhoji, and, after him, Raghoji II., acquired by purchase the northern territories as well, and the Nagpur State thereafter comprised the whole of the Central Provinces, Orissa, and some of the Chota Nagpur States. By joining Sindia against the British in 1803, and as the result of Wellesley's victories of Assaye and Argaon, Raghoji lost Cuttack, Sambalpur and part of Berar. His successor, Mudhoji (known as Appa Sahib), by a treacherous attack on the British in 1818, was forced to cede the whole of the northern districts. Appa Sahib was allowed to hold the Nagpur territory, but on his further treachery being discovered, he fled, and a minor grandson of Raghoji II. was recognized as rajah by the British government. During his minority the Nagpur territories were administered by the Resident, Sir R. Jenkins, until 1840. Raghoji III. died in 1853, without male issue, and Lord Dalhousie declared the Nagpur State an escheat.

Central Provinces Under British Rule.—The northern territories ceded in 1818 and known as the Sangor Nerbudda territories were administered as part of the Province of Agra. When the Nagpur territories escheated in 1853, they were administered by a commissioner as the Nagpur province. In 1861 they were amalgamated with the northern territories and became the Central Provinces. In 1903, Berar was added to the charge of the chief commissioner. In 1905, on the partition of Bengal, the Sambalpur district and the Uriya States adjacent to it were transferred to Bengal in exchange for five Hindi-speaking States of Chota Nagpur.

The first chief commissioner was the energetic Sir Richard Temple. His successor, Sir John Morris, governed the province for over 15 years, after which came a rapid succession of chief commissioners. Among these were men who made their mark in India, such as Sir Charles Crosthwaite, Sir Alexander Mackenzie, Sir Anthony (afterwards Lord) Macdonnell, Sir John Woodburn, Sir Denzil Ibbetson and Sir John Hewett. Only four of the later chief commissioners were men previously serving in the Central Provinces: Sir Andrew Fraser, Sir Reginald Craddock, Sir Benjamin Robertson and Sir Frank Sly (in whose time the chief commissionership was elevated into a governorship and council). The present governor, Sir Montagu Butler, is a Punjab officer.

The pioneer work of Sir Richard Temple and Sir John Morris, aided by a commission consisting mainly of military officers, provided the province with several important trunk roads, and with a land settlement on the zamindari system. The Tenancy Act of 1883 gave the tenantry of the province a degree of security in their holdings which no other zamindari province in India enjoys to a like extent. The land settlements then made have since been twice revised under a system which will always be associated with the name of Sir Bampfylde Fuller.

The first railway was opened in 1870, and the railway system of the present day extends to nearly 2,000 miles. The two trunk railways between Bombay and Calcutta pass through the north and south of the province respectively. The Marathi-speaking districts in the south and west are more advanced than the Hindi-speaking districts of the north and east.

There have been serious setbacks, for most disastrous famines occurred in 1867, 1897 and 1900, while there were serious crop failures in 1907, 1913, 1918 and 1920, which would have produced similar results but for the vastly improved protection afforded by the increased credit and prosperity of the people. Plague has also taken its toll of the large towns, the worst epidemics known having been in 1903 and 1909.

The influenza outbreak of 1918 accounted for some 800,000 deaths.

The province came under the rule of a popularly elected Congress party ministry in 1937 with the inception of the act of 1935. The ministry resigned in 1939.

History of Berar.—The fertile plain of Berar (the ancient Vidharba) has had a chequered history. It was under the sway of the various dynasties that ruled Southern India until the Mohammedan invasion at the end of the 13th century, when it formed a province of the Bahmani dynasty, but about 1490 a rebellious governor, Imad ul Mulk, declared his independence and established a kingdom, which was again wrested from his descendants in 1572 by the Ahmednagar king. It was ceded by him to the Moguls in 1595, when his own capital was besieged by them, and the Emperor Akbar's sons governed it together with Ahmednagar and Khandesh until Akbar's death in 1605. It then came under the rule of Malik Ambar the Abyssinian. On his death in 1626, the Emperor Shah Jehan once more annexed it.

Towards the end of the 17th century, when Mogul power was waning, Berar began to be overrun by the Mahrattas, who won from Delhi their claim to blackmail (*chanth*). In 1724 Nizam Asaf Jah, establishing the independent line of Nizams of Hyderabad, claimed *de jure* sovereignty over Berar. This claim was disputed by the Bhonsla rajahs, and for some 50 years the inhabitants were harried and ground down by this conflict of authorities. This was ended by Wellesley's victories of Assaye and Argaon in 1803, when the country west of the Wardha river was ceded to the Nizam.

Pindari and Bhil raiders, and also the exactions of their disputing rulers, harried the people. The Nizam pledged the revenues as security for loans taken by him, the result being further exactions from the Farmers General to whom the revenues had been assigned. The British at last intervened, in 1853, and a treaty was made with the nizam by which these territories came under British administration under the title of the Hyderabad Assigned Districts. On the subject of boundaries this treaty was again revised in 1860, and it was agreed that the British government should administer Berar in trust for the Nizam, to whom was given the balance of the revenues after the cost of the Hyderabad contingent and of the administration of these districts had been met. Lord Curzon later concluded a fresh treaty with the nizam whereby the latter agreed to give a perpetual lease of these districts to the British government in return for an annual payment of 25 lakhs of rupees.

The six districts of Berar were reduced to four and a commissioner's division attached to the Central Provinces, but the sovereign rights of the Nizam continued. By an agreement dated Oct. 24, 1936, the King-Emperor reaffirmed the Nizam's sovereignty over Berar, and the Nizam agreed to Berar and the Central Provinces being administered together as one province.

Berar, after centuries of harassment, has become a peaceful and prosperous sub-province, made wealthy by the cotton crop and cotton industry, and cultivated by as prosperous a tenantry as can be found anywhere in India outside the most highly irrigated

tracts. The revenue settlements of Berar are *ryotwari,* namely, made with the peasantry direct.

The system follows generally that of the adjacent districts of Bombay, and village headmen in Berar perform, for a percentage remuneration on the revenue they collect, duties which, in the Central Provinces, are assigned to the *malguzars,* or village proprietors. (R. H. C.; X.)

CENTRAL RAILROAD COMPANY OF NEW JERSEY, THE. This American railway had its beginning in the Elizabethtown and Somerville railroad, incorporated in New Jersey in 1831, and in the Somerville and Easton railroad, incorporated in 1847.

By a supplementary act the name was changed, on April 23, 1849, to The Central Railroad Company of New Jersey. It extended its lines and opened them for operation, as follows: 1852, White House, New Jersey to Phillipsburg, New Jersey, 28 mi.; 1864, Elizabeth, New Jersey, to Jersey City, New Jersey, 11.50 mi.; 1872, Elizabethport, New Jersey, to Brills Junction, Newark, New Jersey, 5.45 mi.

Since its incorporation, the company has grown in mileage largely through merger of other companies. In 1939 the system extended westward from Jersey City, New Jersey, to Scranton, Pennsylvania, and central and southern New Jersey is served through lines extending from Jersey City and Newark, through the centre of the State to Bivalve, and to Greenwich Pier on Delaware bay. A line also serves the New Jersey coast resort points, and steamers are operated between New York and Atlantic Highlands, New Jersey, during the summer months.

In all there were 478.65 mi. of road in New Jersey and 231.39 mi. in Pennsylvania, a total of 710.04 mi. of road, and a total of 1,971.40 mi. of tracks.

The entire line from Jersey City, New Jersey, to Scranton, Pennsylvania, serves a highly industrial region, including steel and cement industries. It is also the route of heavy anthracite shipments from mines to tidewater.

The capital stock outstanding on December 31, 1939, was $27,436,800; the funded debt $50,798,000 ($1,267,000 in company's treasury). (E. W. Sc.)

CENTRAL SCHOOLS. The central school in England is a development of the primary school. It is the successor of the higher standard, higher grade and higher elementary schools, all of them being, like the central school, growths at the top of the elementary school. It differs from them, however, in that: (1) it is selective, (2) an entrance age of 11–12 years is commonly used, (3) the curriculum, less academic than that of a secondary school, commonly has a "bias," technical or commercial. At present it is mainly confined to the towns.

Experiments in the way of selective transfer were made in Manchester, but the definite establishment of the central school dates from the London scheme, drafted in 1910, and begun in 1911. The new schools gained from the beginning a high reputation for efficiency. Their essential features are: (1) Entrance is at the age of 11–12 years (11+), from the surrounding elementary schools, the "contributory schools," (2) the course is planned for four years, (3) each school is either technical or commercial, or, in the case of large schools, technical and commercial (at first, the word "industrial" was used, but this was changed to "technical" in 1927), (4) entrance is based upon (*a*) recommendations of head teachers and inspectors, (*b*) success in intra-school examinations, (*c*) relative success in the London junior county scholarship examinations. These last-mentioned examinations have for their chief object the distribution of scholarships to secondary schools. The "next best" are selected for the central schools.

The success of the London experiment has been due in the main to two facts: (1) That the London elementary education service, by virtue of its great size and its relatively high scale of salaries, contains a large number of extremely capable teachers, head and assistant. (2) The scheme was carefully prepared in detail before it was put in action; and the appointment of the staffs of the new schools, assistants as well as heads, was made with considerable care. The teaching of the staffs of these schools has stood at a remarkably high level since their formation.

The curriculum in a commercial central school includes 4 hours a week French (or German) for the whole course, 1½ hours shorthand (for the third and fourth years), 1 hour or more bookkeeping, in the third and fourth years, 3 to 5 hours typewriting, for the fourth or third and fourth years (optional, and out of school hours), 2 hours experimental (laboratory) science, 2 hours art, one half-day handicraft for the first and second years (boys), or domestic economy for the first, second and third years (girls). On the technical side, 10 to 12 hours a week are given to practical work throughout the course. In the case of boys, this consists of "science (including mensuration), drawing, clay modelling, wood and metal-work," leather work, printing, tile-making, bookbinding, and so forth. In the case of girls, it is described as consisting of "elementary science, domestic economy, drawing, practical handwork, or other approved subjects." If a foreign language is taken in a technical central school, a minimum of 3 hours a week must be given to it. In the case of London central schools with a double bias, it was decided in 1927 to make the course of studies a common one for the first two years for both commercial and technical pupils. In 1927 there were in England 332 central schools (departments) offering a four-year course, and 277 offering a three-year course.

Some of the children leave immediately on reaching the age of 14+. This of course is commonest in the poorer areas, for economic reasons. A pledge signed by the parents, to keep the child at school until the completion of the course, has some moral effect, but it is not legally binding. A considerable number of pupils remain to the age of 15 or 16 years, and in many cases a fifth year course has been added to the original four.

See Spurley Hey, *The Central School* (1924), and articles in *The New Education* (1920) and *The Next Step in National Education* (1927). (R. Jo.)

CENTRE-BOARD or **DROP KEEL,** a drop board or iron plate employed in the smaller kind of sailing boats in place of a fixed keel; it is housed in a trunk or casing so as to be capable of being lowered through the boat's bottom when required to give stability, or to prevent making leeway in a wind, and can be hoisted in shallow water or when running before the wind.

CENTUMVIRI, an ancient court of civil jurisdiction at Rome. The word is derived from *centum,* hundred, and *vir,* man. The antiquity of the court is attested by the symbol and formula used in its procedure, the lance (*hasta*) as the sign of true ownership, the oath (*sacramentum*), the ancient formula for recovery of property or assertion of liberty. Its concern was with matters of debt and of the property of which account was taken at the census. The *centumviri* were never regarded as magistrates, but as *judices,* and as such would be appointed for a fixed term of service by the magistrate, probably by the *praetor urbanus.* But in Cicero's time they were elected by the *Comitia Tributa.* They then numbered 105. Their original number is uncertain. It was increased by Augustus and in Pliny's time had reached 180. The office was probably open in quite early times to both patricians and plebeians.

Bibliography.—A. H. J. Greenidge, *Legal Procedure of Cicero's Time,* pp. 40 *et seq.,* 58 *et seq.,* 182 *et seq.,* 264 (1901); J. E. Sandys, *Companion to Latin Studies* (1921), with useful bibliography.

CENTURION (Lat. *centurio*), in the ancient Roman army, an officer in command of a *centuria,* originally a body of a hundred infantry, later the sixtieth part of the normal legion. There were, therefore, in the legion sixty centurions, who, though theoretically subordinate to the six military tribunes, were the actual working officers of the legion. For the most part the centurions were promoted from the ranks: they were arranged in a complicated order of seniority; the senior centurion of the legion (*primus pilus*) was an officer of very high importance. Besides commanding the centuries of the legion, centurions were "seconded" for various kinds of special service; *e.g.,* for staff employment, the command of auxiliaries. (*See* Roman Army.)

See also J. E. Sandys, *Companion to Latin Studies* (1921) Section 752.

CENTURIPE, a town of Sicily, province of Catania, 2,380ft. above sea-level, 7m. N. of the railway station of Catenanuova-

Centuripe, which is 28 mi. W. from Catania. It was formerly called Centorbi (anc. Κεντόριπα) or Centuripae. Pop. (1936) 9,255 (town); 10,802 (commune). Thucydides called it a Sicel city; it allied itself with Athens against Syracuse, and remained independent (apart from Agathocles' domination) till the first Punic War. Cicero, perhaps exaggerating, called it the largest and richest city in Sicily, with 10,000 inhabitants cultivating a large territory. It appears to have suffered much in the war against Sextus Pompeius, and not to have regained its former prosperity under the empire. Frederick II. partly destroyed it in 1233, and its ruin was completed by Charles of Anjou. Considerable remains of buildings, including Hellenistic houses with wall paintings, thermal establishments and cisterns, and a number of substruction walls on the steep slopes, mostly of the Roman period, still exist; Hellenistic *terra-cottas* and finely painted vases, both of local manufacture, have been discovered, and a large number of tombs have been excavated. It is surrounded by deep ravines, due to erosion.

See G. Libertini, *Centuripe* (Catania, 1926).

CENTURY, the name for a unit (*centuria*) in the Roman army, originally amounting to 100 men, and for one of the divisions into which the Roman people was separated for voting purposes (*see* COMITIA). The word is applied more particularly to a period of 100 years. The "century-plant" is a name given to the agave (*q.v.*), or American aloe, from the supposition that it flowers once only in every 100 years.

CEOS, an island in the Aegean sea (Gr. Κέως mod. ZEA or TZIA), 14 m. off the coast of Attica, in the group of the Cyclades and the eparchy of Syra. Its greatest length is about 15 m. and its breadth about 8 m. Mount Elias in the centre is 1,864 ft. high. Among its productions are lemons, citrons, olives, wine, honey and valonia. There were formerly four towns in the island:—Iulis, about 3 m. from the north-west shore, represented by the town of Zea, Coressia, the harbour of Iulis, Carthaea, in the south-east, at S'tais Polais village; and Poieëssa, in the south-west. Iulis was the birthplace of the lyric poets Simonides and Bacchylides, the philosophers Prodicus and Ariston, and the physician Erasistratus. From its excellent code, the title of Cean Laws passed into a proverb. One of them forbade a citizen to protract his life beyond sixty years. Ceos fought on the Greek side at Artemisium and Salamis; joined the Delian League, and also the Athenian alliance in 377 B.C.; revolted in 363–362, but was reduced again. Athens then assumed monopoly of the ruddle, or red earth, the most valuable product of the island. Ceos was divided in A.D. 1207 among four Italian adventurers; was included in the duchy of Naxos in 1537; passed under Turkish rule in 1566 and thence into the Greek kingdom; in 1941 it was occupied by German troops. Silver coins of Carthaea and Coressia date from the 6th century B.C. *See* Pridik, *De Cei Insulae rebus* (1892).

CEPHALIC INDEX, the percentage of breadth to length in any skull. The longer diameter of a skull, the antero-posterior diameter is taken as 100; if the shorter or transverse diameter exceeds 80 the skull is broad (brachycephalic), if between 80 and 75, it is mesaticephalic, and if below 75, dolichocephalic (*see* RACES OF MANKIND).

CEPHALONIA, largest of the Ionian Islands on the W. of the Greek mainland (Ital. *Cefalonia,* ancient and modern official Greek *Kephallenia,* Κεφαλληνία). Pop. (1928), last census before World War II, 66, 414. Its length is 31 mi. and its breadth varies from about 20 mi. in the southern portion to less than 3 mi. in the promontory opposite Ithaca. The whole island is mountainous, the main range running from northwest to southeast. The ancient Mount Aenos, now Elato or Monte Negro (5,315 ft.), frequently has snow for several months. There are few permanent streams except the Rakli, and springs are likely to fail in dry summers. In the west a gulf runs up from the south, a distance of about 7 mi.; on its east side is the chief town Argostoli (*q.v.*), and on its west the rival city of Lixurion. About a mile west of Argostoli, a stream of sea water running into a chasm in the shore is made to operate "sea-mills." About 5 mi. from Argostoli is the Venetian castle of St. George. The ruins of Crane are close to Argostoli; those of Pale to Lixurion. On the other side of the island the remains of Same are on the bay of the same name, those of Proni or Pronni, farther south above the vale of Rakli. All these have impressive walls, Cyclopean and Hellenic. Near the village of Scala is a nameless site with Roman baths and tessellated pavements, a brick temple and rock-tombs. The inhabitants of Cephalonia have always been industrious in the construction of cultivation terraces. But only a small proportion of the soil is under cultivation, and the grain production meagre. The chief crop is the currant, in which Cephalonia surpasses Zante. The fruit is smaller than that of the Morea, and has a peculiar flavour; it ordinarily finds a market in Holland, Belgium and Germany. The grape vine also is grown, for wine. The olive crop is of importance, and cotton is grown in the low grounds. Manufactures are few: lace from aloe-fibre, Turkey carpets, and basket-work in the villages; and boat-building at both the principal towns. Of all the seven "Ionian Islands" Cephalonia and Zante (*q.v.*) are most purely Greek.

History.—In the Homeric poems the Cephallenes are subjects of Ulysses, but Cephallenia is not mentioned: probably it is represented by Same (*see,* however, under ITHACA). In the Persian War the island took but little part; in the Peloponnesian it sided with the Athenians. The town of Pale supported the Aetolian cause and was vainly besieged by Philip V. of Macedon in 218 B.C. In 189 B.C. all the cities surrendered to the Romans, but Same afterwards revolted, and was reduced only after a siege of four months. The island was presented by Hadrian to Athens, but it appears again later as "free and autonomous." After the division of the Roman empire, it was attached to Byzantium till 1082, when it was captured by Robert Guiscard, who died, however, during the revolt of 1085. In 1204 it was assigned to Gaius, prince of Tarentum, who accepted the protection of Venice in 1215; and after 1225 it was held with Santa Maura and Zante by the Tocco family at Naples. Formally made over to Venice in 1350 by the prince of Tarentum, it fell to the Turks from 1479 to 1500, but Venice held it again till the fall of the republic.

For some time it was administered for the French government, but in 1809 it was taken by the British. Under vigorous governors, like Major de Bosset (1809–13) and Sir Charles Napier (1818–1827), the island advanced in material prosperity, but was several times the scene of political disturbances. It retained longer than the sister islands traces of feudal influence exerted by the landed proprietors, but has been gradually becoming more democratic. Under the Venetians it was divided into eight districts, and an elaborate system of police was in force; after its annexation to Greece it was broken up into twenty demarchies, each with its separate jurisdiction and revenues, and the police system was abolished. In 1941 it was occupied by Italy.

BIBLIOGRAPHY.—A special treatise on the antiquities of Cephalonia was written by Petrus Maurocenus. *See* Holland's *Travels* (1815); Ansted's *Ionian Islands* (1863); Viscount Kirkwall's *Four Years in Ionian Islands* (1864); Wiebel's *Die Insel Kephalonia;* parliamentary papers. Riemann, *Recherches archéologiques sur les Iles Ioniennes* (Paris, 1879–1880); Partsch, *Kephallenia und Ithaka* (1890); Pauly-Wissowa *s.v., see* also CORFU; IONIAN ISLANDS.

CEPHALOPODA, a group of highly organized invertebrate animals of exclusively marine distribution constituting a class of the phylum Mollusca. Some 150 genera of living cephalopods are known, of which the octopus, the squid and the cuttlefish (*qq.v.*) are the most familiar representatives. The extinct forms, however, outnumber the living, the class having attained very great diversity in late Palaeozoic and Mesozoic times. Of extinct cephalopods the Ammonites (*q.v.*) and Belemnites are the most familiar examples.

The Cephalopoda agree with the rest of the Mollusca in general structure and appear to have the closest affinity with the Gastropoda (snails, periwinkles, limpets, etc.). They have a more or less elongate body (visceral mass) covered by a "mantle." The latter secretes a shell and encloses a cavity in which the gills are suspended. The alimentary canal is furnished with the characteristic molluscan rasping tongue or radula. These animals differ from the rest of the Mollusca primarily in that the head and foot are approximated, so that the mouth is situated in the middle of the foot, and the edges of the latter are drawn out into a number

of appendages (arms and tentacles). The area just above the edge of the foot, from which the epipodium of the Gastropoda is developed, is produced to form a peculiar organ of locomotion, the funnel. The majority of living cephalopods possess fins and their shell is in a reduced or degenerate condition, a tendency apparent in many fossil forms. In short the leading feature of cephalopod organization and the dominating theme of their evolution is the development of organs that subserve a vigorous aggressive mode of life unhampered by the heavy calcareous shell that is carried by their more sedentary and inactive relatives. Nevertheless the living *Nautilus* (*q.v.*) and many forms now extinct retain the shell in a complete condition.



FROM WILLEY, "ZOOLOGICAL RESULTS" (QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE)

FIG. 1.—NAUTILUS POMPILIUS (ABOUT 1/12 NATURAL SIZE)

For invertebrate animals the Cephalopoda attain a large average size and the genus *Architeuthis* (giant squids) are actually the largest living invertebrates, the Atlantic species *Architeuthis princeps* attaining a total length of 52ft. (inclusive of the tentacles). The shell of the fossil ammonite (*Pachydiscus seppenradensis*) from Westphalia (Cretaceous) measures 6ft. 8in. in diameter and is the largest shelled mollusc. Though not such a flourishing group as they were in secondary times, the Cephalopoda are still one of the dominating groups of marine animals. They are the principal prey of whales and other marine carnivora and the relentless enemies of Crustacea and small fishes. The bizarre appearance of Cephalopoda, their sinister eyes and the secretive habits of some of the shore-living forms have made them a subject of legend among imaginative peoples. Modern authors have not hesitated to exaggerate the horrors of the attack of a giant squid or octopus; and Denis de Montfort and Victor Hugo have invested them with a melodramatic violence that has taken root in popular fancy. Nor is this reputation for ferocity unmerited, as far as attacks on human subjects are concerned.

Classification.—In the past decade the classification of the Cephalopoda has undergone a considerable amount of revision principally owing to the work of Naef and other German zoologists. The following is the scheme drawn up by Grimpe (1922):

Class. Cephalopoda.
- Sub class 1. Protocephalopoda.
  - Order 1. Nautiloidea.
  - Order 2. Ammonoidea.
- Sub class 2. Metacephalopoda.
  - Order 1. Octopoda.
    - Sub order 1. Cirrata.
    - Sub order 2. Palaeoctopoda.
    - Sub order 3. Incirrata.
  - Order 2. Decapoda.
    - Sub order 1. Sepioidea.
    - Sub order 2. Teuthoidea.
    - Sub order 3. Belemnoidea.

It will be seen that this scheme recognizes the fundamental distinction proposed by Owen, which separates *Nautilus* and its allies from the octopods, squids and cuttlefish. This distinction is without doubt sound, for it rests on the fact that, within the limits of our knowledge, the *Nautilus* has a more primitive organization than the rest of the Cephalopoda. It has a wholly external coiled shell, four gills and kidneys, and other features which we are justly entitled to regard as primitive. It must, however, be recognized that we can deal only with the shell of the extinct nautiloids and the ammonites and we do not know if the rest of their organization was like that of *Nautilus*. It is a fair inference, however, that the living and fossil nautiloids and the ammonoids are a natural group. Grimpe's scheme differs herein from the older classification in raising the main sub-divisions to the status of sub-classes and in thus emphasizing their distinctness as is done in the case of the streptoneurous and euthyneurous gastropods. This is an advantage and may be safely adopted.

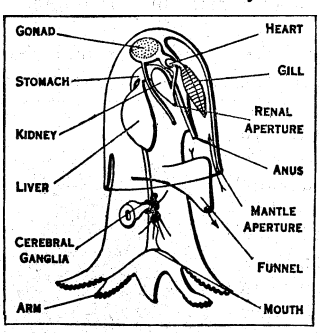
The classification of the Dibranchia proposed by Naef and Grimpe involves a more fundamental change. In its primary division into Octopoda and Decapoda it follows traditional lines. In its secondary division of these groups, however, it departs from the latter for reasons which appear to us well-founded. Among the Octopoda the fossil *Palaeoctopus* merits recognition as representing a separate sub-order. It is, however, in the reorganization of the Decapoda that the new scheme has most to recommend it. The recognition of the three sub-orders Sepioidea, Teuthoidea and Belemnoidea has the advantage of taking into account our knowledge of the phylogeny of the order, and marking the three great tendencies that can be recognized in the evolution of the decapod shell. The older "Oigopsida" are, as far as nearly all their living representatives are concerned, preserved intact. But the Belemnite-like fossil forms are quite reasonably abstracted from them and placed in a separate sub-order. The older "Myopsida," which contained forms with radically dissimilar shells, such as *Sepia* and *Loligo*, are resolved into two sections, one of which (*Sepia, Sepiola, Spirula* and certain extinct forms) is elevated to sub-ordinal rank (the *Sepioidea*), while the other (*Loligo*, etc.) is treated as a section of the Teuthoidea along with the Oigopsida (as above restricted). It may be reasonably objected that this has the effect of placing forms such as *Sepiola* which, like *Loligo*, have a chitinous, non-calcified shell in a different sub-order from *Loligo* and the Oigopsida, and of disregarding certain points of similarity between the *Loliginidae* and *Sepiidae*. Nevertheless it is held that in spite of this fact, *Sepiola* and its allies are more closely allied anatomically to *Spirula*, which has the distinction of being the only living dibranch with a coiled and partly external calcareous shell, than to *Loligo* and the Oigopsida, and that phylogenetically they can thus be attached to the sepioid stock. Concerning the affinities of *Spirula*, a good deal of controversy has taken place. It seems best to accept Chun's view that it is a sepioid form, as the reasons set forth at length by him in his study of this interesting genus (*Wissenschaftliche Ergebnisse der Deutschen Tiefsee Expedn.* Bd. 18, 1915) are sufficiently convincing.



BY COURTESY OF F. M. DUNCAN

FIG. 2.—AN OCTOPUS RESTING ON THE SEA BOTTOM (ABOUT 1/10 NATURAL SIZE)

Anatomy and Physiology.—In fig. 3 is given a diagram illustrating the structure of a cephalopod. Though schematic, this diagram gives a very fair idea of the organization of such forms as the common cuttlefish, squid and octopus. The view has been widely accepted that in the Cephalopoda the surface of the foot has become very much shortened as compared with that of other molluscs, the length of the body being reduced, while its height is increased. This modification of what we may assume to be the original plan of molluscan organization is held to have been brought about by the foot shifting forwards until it became involved in the head, its edges growing round and encircling the mouth. It will be seen in the section on Development that this process is actually indicated in the embryo, so that on this, as well as other grounds, we may regard the current view as to how the cephalopod organization was attained as substantially accurate. As to which surface of a cephalopod should be called anterior and which posterior we are on sound morphological ground if we regard the head and foot as ventral and the mantle-cavity as posterior. Nevertheless in many cephalopods, which move about by swimming, the long axis of the body becomes horizontal, like that of a fish, and the anterior surface might be more appropriately termed "upper" or "dorsal" and the posterior surface "under" or "ventral."



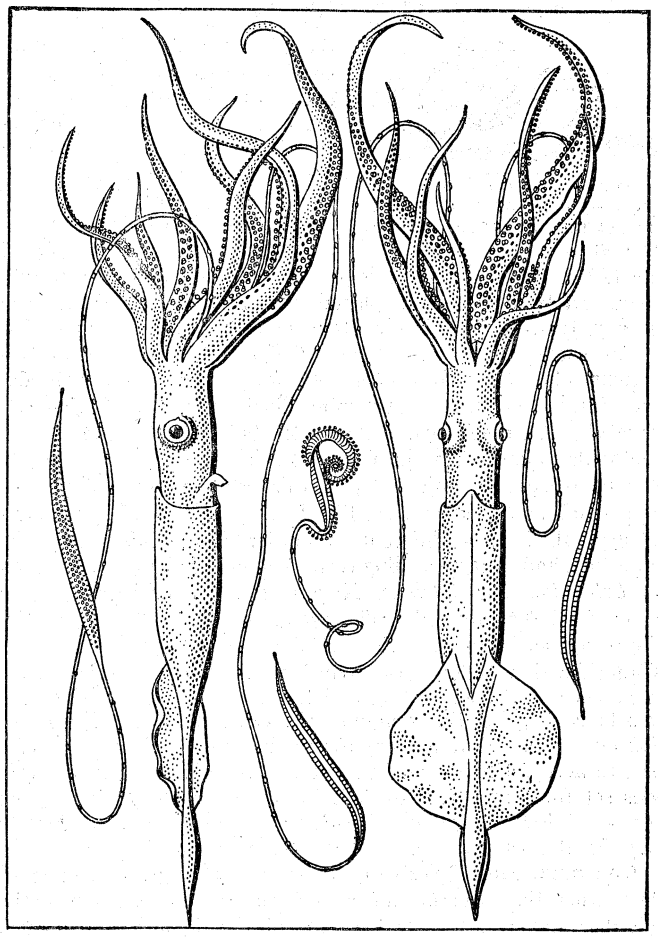
FROM LANKESTER, "TREATISE ON ZOOLOGY" (BLACK)

FIG. 3.—DIAGRAM ILLUSTRATING THE STRUCTURE OF A CEPHALOPOD

The viscera of our typical cephalopod are covered by a dome-shaped or elongated sheath of skin, the mantle, which is in close

contact with the body anteriorly, but posteriorly is free and encloses the mantle cavity, into which the gills project and the anus, kidneys and reproductive system open.

Below the visceral mass are the head and foot which together continue the main mass of the body. On the posterior side of this

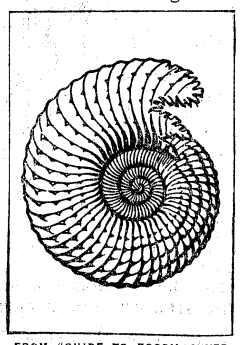


FROM CHUN, "WISSENSCHAFTLICHE ERGEBNISSE DER DEUTSCHEN TIEFSEE-EXPEDITION" (FISCHER).

FIG. 4.—CHIROTEUTHIS IMPERATOR (ABOUT ¼ NATURAL SIZE)

head-foot (cephalo-pedal mass) is a muscular tube, the funnel. The circlet of arms encircles the mouth.

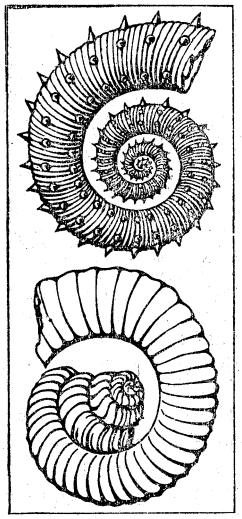
The main divergences of structure have already been indicated in the section on classification; but, for the sake of rendering clear the importance of some of the details which follow, it is necessary to recall two important facts, first that *Nautilus* with its external coiled shell represents a more primitive and less specialized type than do the Dibranchia, a grade of organization seen in many anatomical features, and secondly that the Dibranchia have acquired a more active and vigorous mode of life that has led to certain marked departures in structure and function from the type represented by *Nautilus* and (we may assume) the ammonites. Lastly among the Dibranchia themselves certain important habitudinal divergences are established, and hand in hand with these we must note structural and physiological adaptations, *e.g.*, to a life permanently spent in the great depths of the sea, to a permanent floating life or to a more active and aggressive existence near the surface. The details of cephalopod anatomy and physiology may be studied in any good zoological textbook or in divers special papers and monographs. The following account attempts to eliminate detail and to present the main structural and physiological features of the class in relation to the mode of life of the animals concerned.



FROM "GUIDE TO FOSSIL INVERTEBRATES" (BRITISH MUSEUM)

FIG. 5.—A TRIASSIC AMMONITE. TRACHYCERAS AON (ABOUT ¾ NATURAL SIZE)

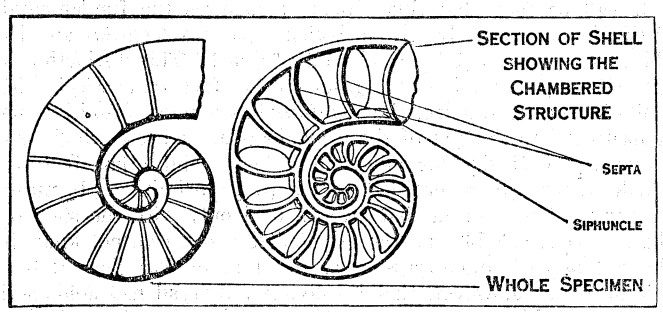
External Anatomy and General Organization.—The nautiloids and ammonites were in all probability mainly shallow-water animals living near the bottom. They relied for protection on a calcareous external shell and their speed of movement was probably inconsiderable. The modern *Nautilus* represents this mode of life pretty closely. The Dibranchia, are as we have seen, on the whole more active, and swimming or floating has become their characteristic mode of locomotion. Accordingly we notice the following features in their external organizations: (1) The mantle, which in the majority of molluscs and in the Tetrabranchia has a passive role and merely contains the viscera and secretes the shell, has become involved in the mechanism of locomotion. It has lost or almost entirely lost the rigid shell and has become highly muscular. Its expansion and contraction promote a locomotor water-current by drawing water into the mantle cavity and expelling it through the funnel. The rapid ejection of this jet of water enables the animal to execute rapid retrograde movements. As a means of sealing the mantle aperture while the locomotor jet is under compression, there is developed an "adhesive apparatus," a cartilaginous stud or ridge on each side of the edge of the mantle and a pair of corresponding sockets on the head into which the studs or ridges fit so that the mantle edge is locked to the head. (2) The funnel in *Nautilus* is represented by two muscular folds which meet in the middle line. In the Dibranchia these folds are completely fused up and form a complete tube. (3) Additional locomotor appendages in the shape of fins are developed from the sides of the mantle. These may become very large and no doubt assist in balancing the animal. (4) In accordance with their active, mainly reptorial mode of life, the circumoral appendages, which are many and feebly developed in *Nautilus*, are fewer in number in the Dibranchia, but more muscular and provided with suckers which in the Decapoda are furnished with horny, often toothed rims. In certain forms the teeth of the suckers are modified as large and formidable hooks. Two of the arms are specially modified in the Decapoda for the capture of prey.



FROM "GUIDE TO FOSSIL INVERTEBRATES" (BRITISH MUSEUM)

FIG. 6.—UNCOILED CRETACEOUS AMMONITES (ABOUT ¾ NATURAL SIZE)
Upper, *Crioceras emericianum*. Lower, *Heteroceras emericianum*

Internal Anatomy.—(1) *Internal supporting structures.* All the Cephalopoda have an internal cartilaginous covering of the main ganglia of the nervous system. In the Dibranchia this is more complete than it is in *Nautilus*. It encircles the ganglia and constitutes a kind of skull. Besides this structure the greater

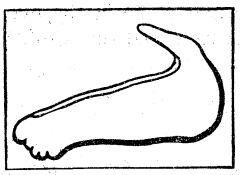


FROM "GUIDE TO MOLLUSCA" (BRITISH MUSEUM)

FIG. 7.—SPIRULA PERONII (ABOUT ⅔ NATURAL SIZE)

mobility of the Dibranchia is secured by other skeletal supports of the muscles which are found at the base of the fins, in the "neck," gills and arms of various forms. (2) *Viscera.* The alimentary system of the Cephalopoda consists of a muscular *buccal* mass furnished with a pair of jaws (mandibles) and a rasping tongue (radula), oesophagus, salivary glands, stomach, coecum, liver and intestine. Efficient mastication is secured by the

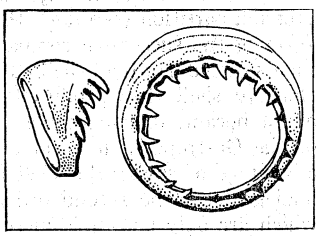
powerful mandibles and sharp-pointed teeth of the radula. In the Octopoda the oesophagus is expanded to form a crop and in the Cirrata, possibly in relation to the special diet of these mainly deep-sea animals, which seem to feed on bottom débris, the radula is frequently degenerate or absent and there is a "second stomach," a capacious dilatation of the intestine. In the Dibranchia the pancreatic element of the liver is partly separated from the latter. Nearly all the members of this subclass have a diverticulum of the intestine situated near the anus in which is secreted a dark fluid ("sepia" or "ink"). This can be forcibly discharged, and the dark cloud thus formed in the water serves as a means of escape from enemies. (*See* section *Distribution and Natural History.*) This so-called ink-sac is absent in *Nautilus* and in certain deep-sea Octopoda.



FROM ROBSON, "ANNALS AND MAGAZINE OF NATURAL HISTORY" (TAYLOR & FRANCIS)

FIG. 8.—ARM-HOOK OF MESONYCHOTEUTHIS HAMILTONI (HIGHLY MAGNIFIED)

Circulatory and Respiratory System.—These systems are very highly developed in the Cephalopoda. Unlike the rest of the Mollusca the blood is conveyed to and from the tissues in vessels instead of mainly through a system of diffuse cavities (*lacunae*), though the vascular system of *Nautilus* is partly lacunar. The process of circulation and oxygenation is more concentrated in the Dibranchia, which have only two cardiac auricles and two gills instead of four auricles and four gills as in *Nautilus*. The mechanism of respiration is likewise more efficient in the Dibranchia, the rhythmical contractions and expansion of the mantle musculature procuring a very effective circulation of water over the gills. The latter are feather-like in general plan, *i.e.*, they consist of a central axis with side-branches disposed down each side of it. There are as many as 40 filaments a side in some Dibranchia; but in the Octopoda they are less numerous, and in abyssal forms (*e.g.*, the Cirroteuthidae) they are very much reduced in number and length.



FROM JATTA, "CEFALOPODI" IN "FAUNA UND FLORA DES GOLFES VON NEAPEL" (STAZIONE ZOOLOGICA DI NAPOLI)

FIG. 9.—TWO VIEWS OF THE HORNY RINGS OF SUCKERS OF TODARODES SAGITTATUS

Note the sharp teeth on the rims

Renal Organs.—The excretion of nitrogenous waste is carried out exclusively by the kidneys; the liver, which in certain other molluscs has an excretory as well as digestive role, does not participate in this function. There are four kidneys in *Nautilus* and two in the Dibranchia.

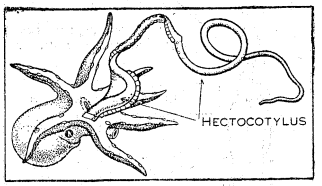
Nervous System.—The chief ganglionic centres of the Cephalopoda are concentrated in the head and are very closely approximated. Such intimate union is not usually found in other molluscs, but is nevertheless seen in certain Gastropoda. This condensation of the central nervous system is seen in *Nautilus* and is carried still further in certain Dibranchia. Features indicative of functional specialization are found in the latter, *e.g.*, in some of the Teuthoidea the cerebral centres are subdivided and the pedal ganglia are likewise divided into brachial and epipodial elements which innervate the arms and funnel respectively. The sense-organs of the Cephalopoda are eyes, rhinophores (olfactory organs), statocysts (organs for the nervous regulation of balance) and tactile structures. The eyes of *Nautilus* are of a more primitive construction than those of the Dibranchia in that they have no retractive lens and the optic cavity is open to the exterior. In the Dibranchia the eyes are very complex and approach those of the Vertebrata in efficiency.



FROM LANKESTER, "TREATISE ON ZOOLOGY" (BLACK)

FIG. 10.—ROW OF TEETH IN RADULA OF AN OCTOPUS (HIGHLY MAGNIFIED)

Reproductive System.—The sexes are separate in the Cephalopoda. No instances of hermaphroditism or of sex-change such as are found in other molluscs have so far been reported in this class. Sexual dimorphism is of fairly regular occurrence; but it is usually expressed in slight differences of size and the proportion of various parts. In the pelagic Argonautidae (Octopoda) the male is very much smaller than the female, and in the cuttlefish (*Doratosepion confusa*) the males are distinguished by the possession of long tail-like prolongations of the fins. In nearly all cephalopods the males are in addition distinguished by the modification of one or more of the appendages as an organ of copulation. The male reproductive system is on the whole a little more complex than the female, chiefly in relation to the method of copulation. The spermatozoa are transferred by the male to the female in long tubes (spermatophores) which are formed in a special sac (Needham's organ) on the course of the male *vas deferens*. These tubes are deposited either in the neighbourhood of the mouth of the female (*Nautilus; Sepia, Loligo* and other Teuthoidea) or in the mantle-cavity (Octopoda; certain Teuthoidea) by means of the copulatory organ (hectocotylus [Dibranchia]: spadix [*Nautilus*]). The latter is a simple spoon-like modification of one of the arms in the Octopoda. In the Decapoda a great diversity of modifications is found which may involve more than one arm. Similarly in *Nautilus* an accessory copulatory organ (*antispadix*) is found. It has recently been suggested that some of the peculiar modifications found in the Decapoda enable the copulatory arm or arms to be used as an organ of stimulation.

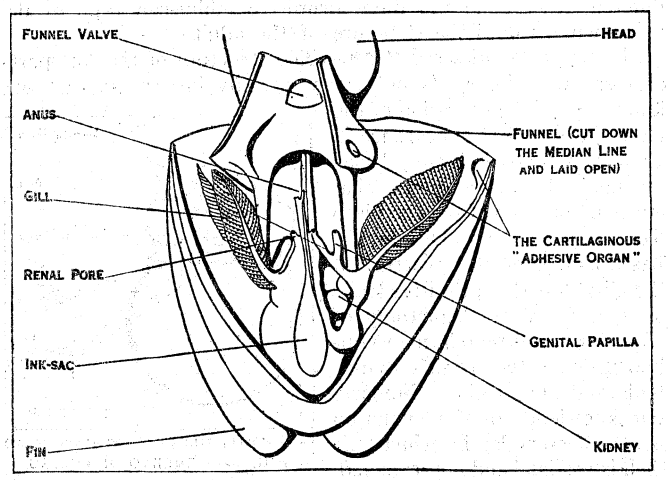


PEGGY COLLINGS AFTER H. MUELLER, 1852

FIG. 11. — MALE OF ARGONAUTA ARGO SHOWING HECTOCOTYLUS; (ABOUT NATURAL SIZE)

Colour Change and Luminescence.—Besides the permanent colour of the skin, the Dibranchia possess a cutaneous system of contractile cells (chromatophores) containing pigment which can be expanded or contracted so as to exhibit or conceal the pigment either of all the cells simultaneously or only of those containing a certain pigment. The circumstances in which these changes are brought about are discussed in the section on *Distribution and Natural History.*

In certain Decapoda, principally those which live at great depths, special light-organs are developed in various regions of the mantle, arms and head. These organs are not found in *Nautilus* and the Octopoda (except in *Melanoteuthis lucens*).



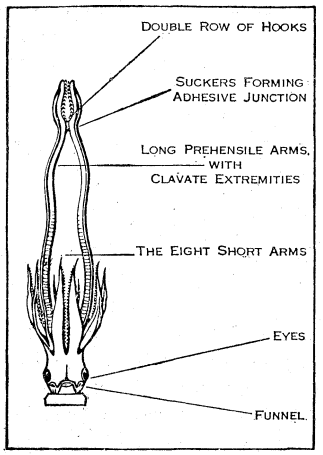
FROM LANKESTER, "TREATISE ON ZOOLOGY" (BLACK)

FIG. 12.—THE MANTLE CAVITY OF A CUTTLEFISH (SEPIA) OPENED IN ORDER TO DISPLAY ITS CONTENTS

They are only sparsely found in the littoral *Sepiidae* and *Loliginidae;* but a special type of light-organ said to produce the peculiar phenomenon of "bacterial light" has been described in certain species of *Sepiola* and *Loligo* (Meyer: Pierantoni: Robson).

Development.—The development of *Nautilus* is unfortunately not yet known, so that if any clues to the phylogeny of the cephalopods may be obtainable from the embryology of their

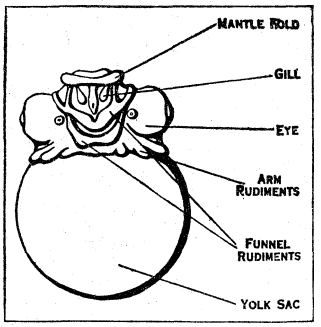
most primitive living representative, they are still withheld from us. The eggs of all cephalopods are provided with a remarkable amount of yolk so that, unlike that of the rest of the Mollusca, the segmentation is incomplete and restricted to one end of the egg. The embryo is likewise localized at that end and the ectoderm appears stretched out over one extremity of a large mass of yolk. Later on, a sheet of cells is developed below the ectoderm, commencing from that edge of the ectoderm at which the anus is subsequently developed; and after this, cells migrating inwards from the ectoderm give rise to the mesendoderm. The development of the various organs need not occupy us; but it is necessary to point out that the mouth in the early stage of development is not surrounded by the arm-rudiments. The latter arise as outgrowths of the lateral and posterior edges of the primordial embryonic area. These outgrowths pass forwards during later development until they reach and encircle the mouth. The funnel arises as a paired outgrowth of the same area, a condition which is retained in the adult *Nautilus,* while in the Dibranchia the two portions fuse together in the median line. The development of the Cephalopoda varies somewhat after the germ layers have been developed, according as to whether there is a yolk-sac or not. The embryo of *Sepia, Loligo* and *Octopus* is provided with a yolk-sac which may become partly internal; while in certain Decapoda presumed to be archaic there is less yolk and the yolk-sac is practically absent ("Oigopsid embryo" of Grenacher). Nevertheless, although we may regard the latter mode of development as less specialized than that of the heavily yolked egg, *e.g.*, of *Sepia,* there is no certain indication in the development of any known cephalopod of those larval phases that characterize the development of other Mollusca. The embryological history of the members of the Cephalopoda reveals as much specialization and differentiation from the more primitive molluscan type of development as does the structure of the adult.



FROM TODD, "ENCYCLOPAEDIA OF ANATOMY" (LONGMANS, GREEN, & CO.)

FIG. 13.—ARMS AND TENTACLES OF A LARGE SQUID, ONYCHOTEUTHIS

Phylogeny and Evolution.—The structure of the soft parts of fossil cephalopods is only very scantly known, so that our knowledge of the evolution of the class since its first appearance in Cambrian times is largely based on the shell. It thus follows that our main division of the class into Tetrabranchia and Dibranchia, based as it is on the structure of the gills and other primitive traits seen in the visceral anatomy of *Nautilus,* has little relation to our knowledge of the primitive nautiloids and ammonoids. Similarly our knowledge of the evolution of the Octopoda, in which the shell is vestigial and non-calcified, is rather compromised by the absence of verifiable fossil remains.

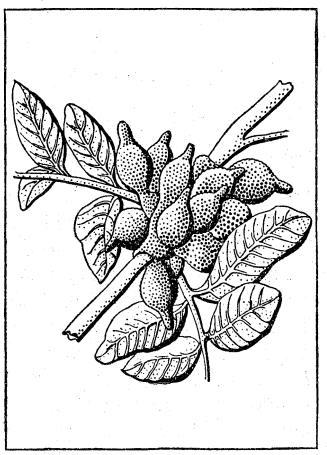


FROM MEYER, "TINTENFISCHE" (KLINKHARDT)

FIG. 14.—EMBRYO OF LOLIGO

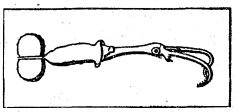
In order to understand the evolutionary history of the Cephalopoda as revealed by the geological record, it is necessary to allude to the shell of *Nautilus,* which, by reason of its general organization, is regarded as the most primitive living cephalopod. This shell is coiled and subdivided into a number of closed chambers, the last of which is occupied by the animal. Throughout the system of chambers runs a median tube, the siphuncle. The earliest forms which we can recognize as cephalopods are found in Cambrian rocks. In *Orthoceras* (fig. 17) we see the unmistakable chambered shell and median siphuncle of the nautiloid. The shell is, however, straight, not coiled. At a later stage we find the shell becoming coiled like that of a true *Nautilus.* This is well seen in the Silurian *Ophidioceras.* In Triassic rocks are found remains closely resembling our modern *Nautilus;* but the latter did not actually appear until the early Tertiary.

This short sketch gives us a clue to the first stage in the evolution of the Cephalopoda. If we accept the view that the Mollusca are a homogeneous group, it is reasonable to suppose that the primitive Mollusca from which the Cephalopoda sprang were provided with a simple cap-like shell not unlike that of a limpet. What circumstances of adaptation or internal momentum dictated the lines on which cephalopod evolution should proceed are not known; but the first result was an elongation of the shell achieved by the deposition of lime salts around the edge of the primitive cap-like shell as the animal progressively shifted its position away from the apex. At each successive growth-period the back of the visceral mass secreted a partition (septum), thus forming the successive compartments of the nautiloid shell. The elongate shell thus produced, which we see in *Orthoceras,* no doubt became unmanageable and liable to injury. As in the case of the Gastropoda, it became coiled, which had the mechanical advantage of saving the shell from accident and making it more manageable. The second order of tetrabranchs, the ammonites, which are only known from fossil forms, was a very large group and the plentiful remains of their shells at certain horizons has provided material for special studies of evolutionary phenomena at once fascinating and baffling. The ammonites are ranked as Tetrabranchia on conchological grounds; but we do not know in fact whether they possessed the anatomical structure of the nautiloids. They differed essentially from the true nautiloids in having a marginal siphon and a persistent embryonic whorl at the apex of the shell (protoconch). It is customary to derive them from Devonian forms with straight shells, such as *Bactrites,* though in fact *Bactrites* itself has certain nautiloid traits. Coiled ammonites appear in the upper Devonian (*Goniatites*), and thereafter follow a great variety of forms. They are distinguished by tendencies towards uncoiling and great complexity of the sutures (line of junction between the septa and the main shell-wall) which illustrate remarkable phenomena of growth (mostly modifications of the principle of Recapitulation). Some lineages (or evolutionary strains) illustrate retrogressive evolution, the later members of such series reacquiring traits seen in earlier stages of the series. These retrogressive stages are especially noticeable in the Cretaceous period, at the end of which the ammonites became extinct. It is not yet safe to say that this group as a whole ran a straight course through increasing complexity to a climax from which they passed to senescence and ultimate decay. It is tempting to read such a plain evolutionary theme into their story; but it seems more likely that as Swynnerton suggests, they were cut off when still a flourishing group by a great secular "revolution" of climate and earth-change, rather than by the exhaustion of their own evolutionary momentum. The history of the dibranchiate Cephalopoda is dominated by one main evolutionary theme. Our modern squids, cuttlefish and octopods are distinguished from the nautiloid forms by the possession of an internal and partly degenerate shell. In one form alone (*Spirula*) the shell is still partly external. The position and state of the shell in the



FROM JATTA, "CEFALOPODI" IN "FAUNA UND FLORA DES GOLFES VON NEAPEL" (STAZIONE ZOOLOGICA DI NAPOLI)

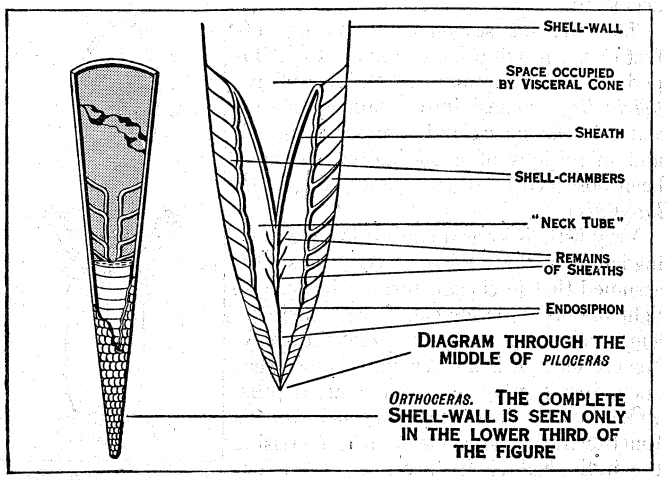
FIG. 15.—EGGS OF THE COMMON CUTTLEFISH, SEPIA OFFICINALIS



FROM ROBSON, "ANNALS AND MAGAZINE OF NATURAL HISTORY" (TAYLOR & FRANCIS)

FIG 16.—LARVA OF CHIROTEUTHIS ("DOVATOPSIS" STAGE)

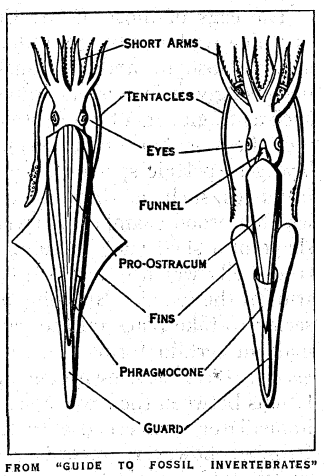
Dibranchia is due to the progressive overgrowth of the shell by the mantle and the formation around the shell of a secondary sheath, the various parts of which eventually become larger than the shell itself. The loss of the true shell probably went hand in hand with the gradual acquisition of an active swimming habit, in which the protection of a rigid outer covering was replaced by greater mobility entailing the development of



FROM "GUIDE TO FOSSIL INVERTEBRATES" (BRITISH MUSEUM)

FIG. 17.—DIAGRAM OF SECTIONS THROUGH THE SHELL OF PALAEOZOIC NAUTILOIDEA, SHOWING THE CHAMBERED STRUCTURE

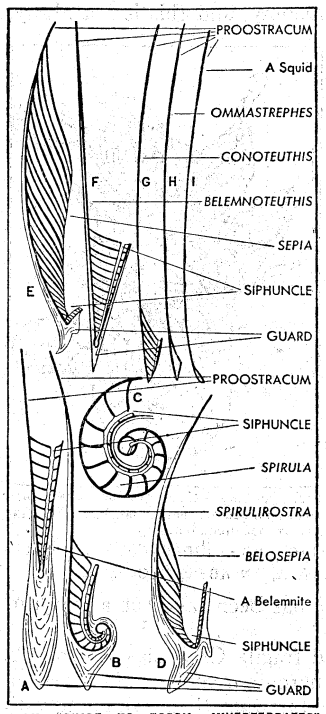
stronger pallial muscles. At the same time the acquisition of a fresh orientation probably entailed a readjustment of the centre of gravity of the animal, the heavy, more or less terminal shell being incompatible with rapid movement in a horizontal position. Of forms which connect the Dibranchia with the Tetrabranchia we have no direct evidence. According to Naef we may distinguish certain orthoceratid nautiloids which show an approach to the oldest Dibranchia; but it is not until Triassic times that we meet in *Aulacoceras* unmistakable evidence of the modification of the shell. This tendency is seen at its best in the Belemnites. It consists primarily in the enclosure of the apex of the shell in an external calcified sheath, the guard, and the development of an accessory plate, the pro-ostracum, at the anterior end of the shell. The forms which exhibit these modifications were undoubtedly dibranchiates, as they possessed the characteristic ink-sac and hooks on their suckers. The belemnites gave rise to several lines of descent. In one of these the guard is reduced and the original shell (phragmocone) is coiled (*Spirulirostra*). Further reduction of the guard and more extensive coiling of the phragmocone produced the shell of the modern *Spirula*. In another line the guard is similarly reduced, and the extension of the phragmoconal septa as closely set and numerous layers up the surface of the pro-ostracum led through the *Belosepia* to the modern cuttlefish. The modern Teuthoidea (*Loliginidae* and "Oigopsida") are distinguished by the loss of phragmocone and guard and the persistence of the pro-ostracum as a horny "pen." These forms appear in the Jurassic and are probably developed from belemnite-like ancestors. Of living Teuthoidea *Ommastrephes* preserves a trace of the phragmocone.



FROM "GUIDE TO FOSSIL INVERTEBRATES" (BRITISH MUSEUM)

FIG. 18.—RESTORATION OF THE ANIMAL AND SHELL OF A BELEMNITE
Left, dorsal view; right, ventral view

Owing to the great reduction of the shell in living Octopoda, in which it persists as fine cartilaginous "stylets" or as somewhat better-developed fin-supports (Cirrata), the stylets, or fin-supports, are usually regarded as vestiges of the shell; but it is possible that this interpretation is wrong. We have no knowledge of the ancestry of this group. The structure of *Palaeoctopus newboldi* from the Cretaceous of Syria affords no clue to the early stages of octopod evolution. This form combines cirromorph and octopod characters; but in general it appears to be more octopus-like. Of the modern Octopoda it is likely that the Cirrata, in spite of much specialization in relation to the abyssal habit, are an older group than the true octopods. As far as the rudiment of the shell is concerned such forms as *Cirroteuthis mülleri* and *Vampyroteuthis* are more primitive than *Octopus, Eledone* and the *Argonautidae*.



FROM "GUIDE TO FOSSIL INVERTEBRATES" (BRITISH MUSEUM)

FIG. 19.—THE BELEMNITE AND ITS DESCENDANTS. SECTIONS THROUGH THE MIDDLE OF THE SHELL

Distribution and Natural History.—The Cephalopoda are exclusively marine animals. No authentic records are available of their occupation of fresh or brackish water. Although they are occasionally carried into estuaries, they do not tolerate water of reduced salinity. In this respect they are comparable with the Amphineura and Scaphopoda among other Mollusca and with the Echinoderma and Brachiopoda. It is interesting, but rather fruitless to speculate as to why so highly organized and dominant a group has never, as far as we know, accommodated itself to fresh water. The fact that there are many littoral species further emphasizes this exclusiveness. One record is known to the author of an octopod being found living at the mouth of a fresh water stream (Hoyle, 1907), and it is interesting to note that certain species have penetrated into those areas of the Suez canal which have a *higher* salinity than that of normal sea water. No differences have so far been recorded in the numerical frequency of the cephalopods of those parts of the ocean which have a relatively low salinity (*e.g.*, under 34 per mille, as in Arctic and Antarctic waters), and those with an average or high salinity (35 per mille and upwards). In areas of extremely low salinity, such as the Baltic sea, cephalopods are very sparsely represented.

Concerning the horizontal (geographical) distribution of cephalopods, as far as it can be dissociated from the vertical distribution (*see* later), little need be said. Many genera and some species are, in the light of modern taxonomy, cosmopolitan in their distribution. Thus the small oigopsids *Cranchia scabra* and *Pyrgopsis pacificus* are found in the Atlantic, Indian and Pacific oceans, though they do not pass into high latitudes. The common European *Octopus vulgaris* and *O. macropus* have, on unimpeachable authority, been recorded from the Far East. On the whole the distribution of the species and some of the genera is very much the same as in other great groups of marine animals, *i.e.*, it is in general determined by the great oceanic "divides." Thus the Canaries current cuts off a north-east Atlantic fauna from an equatorial and south Atlantic one at about latitude 18°N., and the great "divide" off Cape Agulhas (South Africa) separates Atlantic and Indo-Pacific faunas. Nevertheless, these barriers (due to marked changes in salinity and temperature) seem to be by no means rigid in their effects. Several Mediterranean species are found in the south Atlantic and certain species are common to the Atlantic and Indo-Pacific regions; so that the species can only be grouped into faunas in a very broad fashion. Other qualifications have also to be made. In the first place it is very likely that many species which occur at the surface, *e.g.*, in the cold

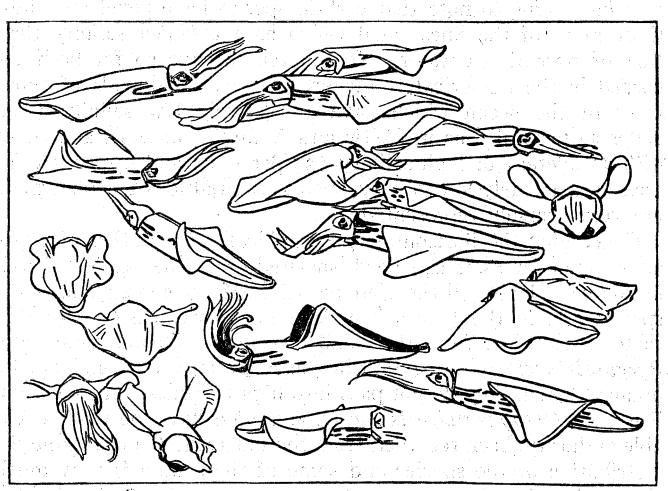
Benguela current of the south-east Atlantic may be found in deeper water in the Indian ocean, so that the Agulhas "divide" may be only effective at the surface and have a limiting effect only on those Cephalopoda which cannot descend to great depths. Secondly, the identification of species from contrasted areas should depend on a very exact taxonomy, and this is not always easy in practice, as the condition and number of specimens collected is not always satisfactory. It will be convenient to consider vertical distribution at the same time as the general mode of life of these animals. *Nautilus* seems to keep near the bottom in the neighbourhood of islands and reefs and has been obtained at a depth of 300 fathoms. It comes into shallow water quite frequently; but Dr. A. Willey believes it breeds in very deep water. The larger Decapoda spend their life swimming at various depths. Some are strictly littoral such as *Sepia* and *Loligo*. Most of the Teuthoidea are pelagic, *i.e.*, they live in the open sea far from land, and some of them have a very considerable vertical distribution. *Chiroteuthis lacertosa* has been taken at a depth of 2,949 fathoms.



FROM JOUBIN, "RÉSULTATS DES CAMPAGNES SCIENTIFIQUES DU PRINCE ALBERT 1er" (INSTITUT OCÉANOGRAPHIQUE)

FIG. 20.—CIRROTEUTHIS UMBELLATA, AN ABYSSAL OCTOPOD

In the adult stage the small and fragile Cranchias (Oigopsida consuta) are to be reckoned as planktonic organisms, *i.e.*, floating more or less at the mercy of currents rather than swimming with or against the latter. The Octopoda mainly dwell on or near the bottom either crawling on the latter or swimming a short distance off it. Some of them, however, *e.g.*, *Eledonella* and *Cirroteuthis*, are not confined to the bottom and are found in mid-water at very considerable depths. Although the large family of the Octopodidae mainly inhabits shallow water, the Octopoda as a whole contain a very large nucleus of deep water forms (one species of *Eledonella* has been taken in 2,900 fathoms), which display well marked adaptations to life in abyssal conditions.



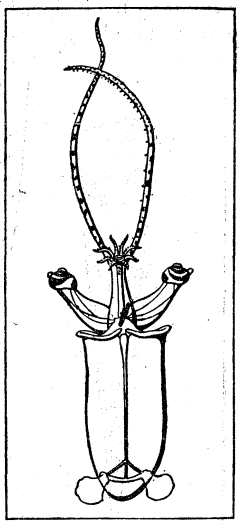
FROM MEHEUT, "ÉTUDE DE LA MER" (LEVY)

FIG. 21.—SQUIDS OF VARIOUS SPECIES SWIMMING

Alcide d'Orbigny in his account of the Mollusca of South America, asserted that the Cephalopoda are in general "sociable," *i.e.*, gregarious, and this statement is certainly true of *Nautilus* which were always found together in droves by the native divers employed by Dr. A. Willey, who observed its habits in New Guinea, etc. Nevertheless, Jatta, who made a special study of the Mediterranean forms, was of the opinion that only certain pelagic forms are thus gregarious (*e.g.*, *Todarodes*, *Ocythöe*). We should avoid concluding that the coincidence of a large number of individuals necessarily implies either a sociable instinct or a desire for the protection afforded by a community, as it may be due to the accidental coincidence of large numbers of individuals ("population maximum") in somewhat restricted breeding or feeding grounds. Nevertheless, Verrill has adduced evidence that the shoaling of young *Loligo pealei* off the coast of New England is not thus accidental.

The breeding season has a marked effect on the distribution of certain Cephalopoda. The common cuttlefish (*Sepia officinalis*) comes into shallow coastal water in the spring and summer to breed, and migrations of a similar nature have been observed in other forms (*Loligo, Alloteuthis*).

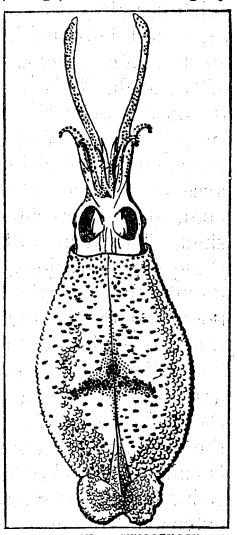
Very little is known concerning the mating habits of the Cephalopoda. It has been assumed that in certain forms with special light organs, *e.g.*, *Sepiola, Loligo,* their organs serve as a means of sexual display. Nevertheless, it is not certainly known that such forms may not mate at depths, which render it likely that such organs function rather as a means of advertising the individual to its prospective partner than as an incitement to coitus. The actual process of coitus has been studied by several naturalists (Racovitza, Drew, Levy, etc.); but, while we know the general lines on which it takes place, the details and particularly those relating to the use of the hectocotylus are not very well known (see *Reproductive System*). Nor again are we informed as to the bionomic significance of some of the more remarkable cases of sexual dimorphism among these animals, *e.g.*, of the highly elongate and fringed arms of *Sepia burnupi* and *lorigera* (Massy, Wülker) and the still more remarkable dimorphism in *Doratosepion confusa* (Massy and Robson, Robson and Carleton).



FROM CHUN, "WISSENSCHAFTLICHE ERGEBNISSE DER DEUTSCHEN TIEFSEE-EXPEDITION" (FISCHER)

FIG. 22.—BATHOTHAUMA LYROMMA

The eggs of most of the Cephalopoda, of which we know the reproductive habits, are laid inshore, and are usually fastened down singly or in clusters on bottom débris such as fragments of coral, stems of plants, etc. Less is known concerning the egg-laying of pelagic species, except in special instances such as that of *Argonauta,* in which a brood chamber is developed in the shape of a shell (not homologous with the true shell) which is secreted by the dorsal arms of the female. Brooding over the eggs seems to take place on the part of the female in certain forms (*e.g.*, *Octopus vulgaris*). Little is known concerning the relations between the sexes apart from those immediately concerned with reproduction. Grimpe, however, records that in captivity *Sepia officinalis* is strictly monogamous though capable of reproduction.

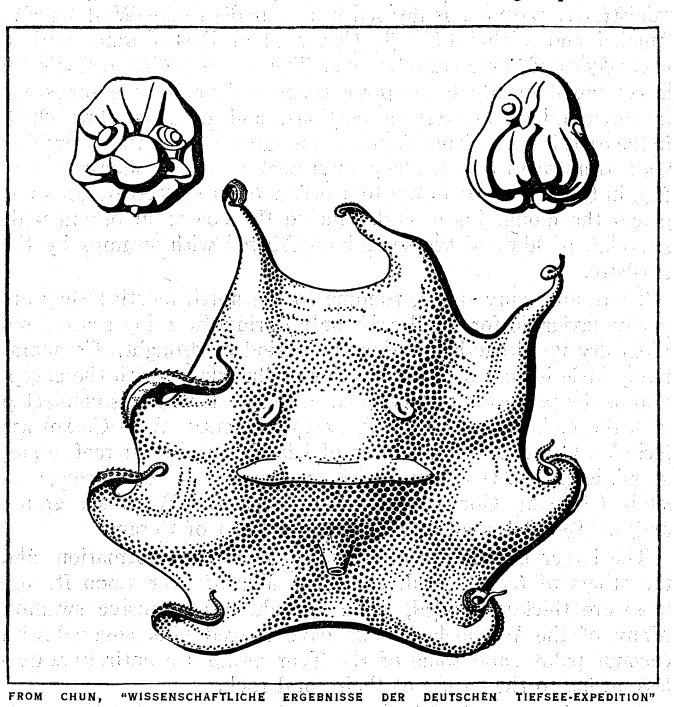


FROM CHUN, "WISSENSCHAFTLICHE ERGEBNISSE DER DEUTSCHEN TIEFSEE-EXPEDITION" (FISCHER)

FIG. 23.—CRANCHIA SCABRA

The majority of living Cephalopoda are carnivorous and live principally on Crustacea. Small fishes and other molluscs, however, often form part of their diet and there is some evidence that in nature certain species are cannibals. In the Channel Isles *Octopus vulgaris* partly subsists on the ormer (*Haliotis*) and has been made responsible (though on insufficient evidence) for a marked decrease in the numbers of that mollusc. The Cirrata whose reduced musculature and radula indicate a loss of activity and of masticatory power probably feed on bottom-débris or minute plankton. The latter in the shape of copepods, pteropods, etc., are probably the food of the smaller pelagic Decapoda. The Cephalopoda are in their turn preyed upon by whales, porpoises,

dolphins, seals and sea-birds. The stomachs of whales are often found to contain fragments of Cephalopoda (mandibles and sucker-rings), and it is held that the wax-like substance known as ambergris, which is used in perfumery and is found floating at sea or drifted ashore, is composed largely of cephalopod tissue voided by whales. It is not to be doubted that large squids main-



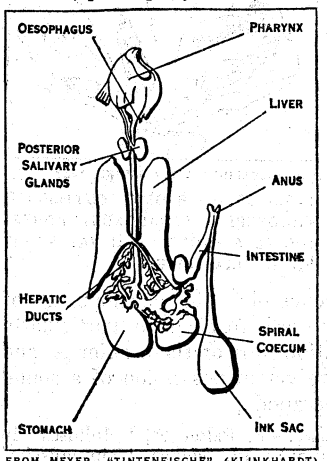
FROM CHUN, "WISSENSCHAFTLICHE ERGEBNISSE DER DEUTSCHEN TIEFSEE-EXPEDITION" (FISCHER)

FIG. 24.—TWO HIGHLY MODIFIED OCTOPODS
Two upper figures, *Opisthoteuthis medusoides;* lower, *Opisthoteuthis extensa*

tain a desperate struggle with any whale that may attack them, as specimens of the latter are sometimes taken with the marks of sucker-rings imprinted in their skin.

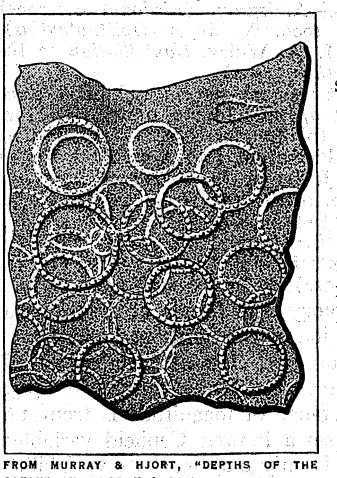
The colour-changes produced in the skin of most cephalopods by the contraction and expansion of the chromatophores have been variously interpreted as affording protective or obliterative colouration or as an expression of certain emotions. It is likely that both these effects are secured by this means. The common octopus has been observed to assume a very close mimetic resemblance to the colour of its background. On the other hand the present author has made observations on colour changes in *Sepiola atlantica* which are the reverse of protective, as judged by the human eye. The chief means of avoiding capture is, however, provided by the "ink" which is expelled from the ink-sac when the animal is attacked. It was originally thought that the ink formed a kind of "smoke-screen" behind or in which the animal was hidden from its enemy. Recent observations, however, tend to suggest that the jet of ink, when shot out, remains as a definitely shaped object in the water and serves as a "dummy" to engage the attention of the enemy, while the cephalopod changing its colour, so that it is almost transparent, darts off in another direction. Whether this explanation is applicable to all cases is uncertain; and in any case it is uncertain why, if many cephalopods can assume something approaching protective transparency, it should be necessary to add to the means of concealment. The matter is plainly in need of further investigation. The Cephalopoda as a whole are not distinguished by individual eccentricities of behaviour. It is worth while, however, to mention three interesting cases. (1) Many pelagic squids and cuttlefishes keep very near the surface when swimming, and one of them, "the flying squid," *Ommastrephes bartrami,* often shoots out of the water in rough weather and has been several times carried by its leaps on to the decks of ships. (2) The male of the pelagic octopod *Ocythoe* is often found inhabiting the discarded case of the Tunicate *Salpa,* a habit in which it resembles the Crustacean *Phronima.* (3) Sasaki has described a very remarkable habit and structural modification in the small cuttlefish *Idiosepius paradoxus.* The latter, which is found in Japanese waters, is often found adhering to sea-weeds by means of a rudimentary sucker developed in the dorsal region of the mantle. No instances of parasitism, and only one doubtful case of commensalism have been recorded among these animals.

Economic Uses.—The Cephalopoda are of considerable value to man, principally as a direct source of food. They also constitute a large part of the diet of certain animals, such as whales and seals, which are of economic importance and in certain parts of the world they are regularly caught on a large scale as bait for certain valuable food-fishes. Squids, cuttlefishes and octopods are eaten by man in many parts of the world. Information concerning the people who regularly eat these animals is by no means complete as yet. The "Anglo-Saxon" people (possibly the Nordic race generally) do not as a rule eat them, even when a regular supply is available. They are largely consumed by south European (Mediterranean) peoples and in India, Indo-China, Malaysia, China, Japan and the Pacific islands. Concerning the littoral natives of Africa and central South America no certain information is available. In the Mediterranean region cephalopods have been eaten since early times. They are either fried or boiled for the table; but in the East, *e.g.,* Indo-China and south India, they are also sun-dried for human consumption. In Japan the squid fishery attains a very great importance and in one year over 77,161 short tons of squid were landed (Imperial Japanese Government statistics). *Ommastrephes sloanei* is the chief form taken in these fisheries. The bait fisheries of south India are a very important local activity and in North America the cod-fishermen rely very largely on various squids for baiting their lines. The only other important material obtained from cephalopods is "cuttle bone" (the internal shell of the *Sepiidae*). The uses of this article are described in the article CUTTLEFISH. Among primitive peoples and in ancient times in Europe various parts of cephalopods have been used in magical operations and in medicine. Cuttle bone has been used as a remedy for leprosy and for various disorders of the heart.



FROM MEYER, "TINTENFISCHE" (KLINKHARDT)

FIG. 25.—ALIMENTARY SYSTEM OF A CUTTLEFISH (SEPIA)

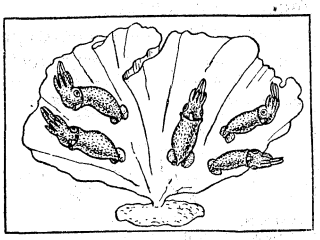


FROM MURRAY & HJORT, "DEPTHS OF THE OCEAN" (MACMILLAN & CO.)

FIG. 26.—SKIN OF WHALE SCARRED BY THE SUCKERS OF ARCHITEUTHIS
Note the marks of the sucker-teeth on the circumference of each ring

Historical.—The study of the Cephalopoda was initiated by Aristotle who devoted much attention to the group. The modern investigation of their morphology may be dated from Cuvier who gave them the name by which they are now known. H. de Blainville (1777–1850) and Alcide d'Orbigny (1802–57) laid the foundation of the systematic study of the group, the great monograph *Mémoire sur les Céphalopodes Acétabulifères* of d'Orbigny being a landmark in systematic zoology. This work includes descriptions of fossil forms as well as of living species. R. Owen contributed substantially to our knowledge of the morphology of the class, particularly by his *Memoir on the Pearly Nautilus* (1832). A. Kölliker may be said to have founded the embryological study of cephalopods (1843) and Alpheus Hyatt (1868)

led the way in early palaeontological studies of these animals. The rarer pelagic and deep sea forms were only obtained slowly and, although the Cirrata were known as early as 1836 (Eschricht), it was not until toward the end of the last century that the "Challenger" expedition and the researches of W. Hoyle and A. E. Verrill obtained the first substantial contribution to our knowledge of these forms. Since then, C. Chun, I. Steenstrup, A. Appelöf, G. Pfeffer, L. Joubin, A. Naef, S. S. Berry, G. Grimpe, M. Sasaki and A. Massy have contributed to our knowledge of the living forms, while L. Branco, J. Foord and G. C. Crick, S. Buckman and R. Abel have organized the study of fossil forms. Particular mention must be made of the work of Naef, who subjected the living and fossil forms to a synthetic treatment. Apart from our lack of information concerning the development of *Nautilus* there still remains much work to be done, particularly on the habits and oecological relationships of these animals, and it is to be doubted whether we are yet in possession of a sound systematic arrangement of the Decapoda.



PEGGY COLLINGS AFTER SASAKI, 1923

FIG. 27. — PYGMY CUTTLEFISH (IDIOSEPIUS PARADOXUS) ADHERING TO A FROND OF ULVA; ABOUT ½ NATURAL SIZE

BIBLIOGRAPHY.—A. General Treatises.—P. Pelseneer, "Mollusca" in Lankester's *Treatise on Zoology* (1905); W. Meyer, "Tintenfische" (1913); A. Naef, *Fauna e Flora del Golfo di Napoli* (Monogr., XXXV., 1921–23); J. Thiele, "Mollusca" in Kükenthal and Krumbach's *Handbuch der Zoologie* (1926). All these contain bibliographies.

B. Systematic.—W. Hoyle, "A Catalogue of Recent Cephalopoda," *Proc. R. Phys. Soc. Edinburgh* (1889–1907); Naef, *op. cit.;* G. Pfeffer, "Cephalopoden" in *Ergebn. Plankton Expedn.* (Bd. ii, F., 1912); G. Grimpe, *Sitzber. Naturf Ges. Leipzig* (ix, 1922); G. C. Robson, *A Monograph of Recent Cephalopoda,* vol. 1 (1929), vol. 2 (1932).

C. Distributional.—Mediterranean: A. Naef, *op. cit.* (Bibl.). Atlantic: G. Pfeffer, *op. cit.* (Bibl.); L. Joubin, *Res. camp. Sci. Albert I* (Monaco), *passim.* Atlantic and Indian Oceans: C. Chun, *Wiss. Ergebn. Deutsche Tiefsee Expedn.* (Bd. xviii, 1910, 1915). South Africa: G. Robson, *Proc. Zool. Soc. London* (1924). Indian Ocean: A. Massy, *Rec. Indian Museum* (1916). Pacific: S. S. Berry, *Bull. Bureau Fisheries* (xxx, xxxii, 1910, 1912).

D. Monographs of special forms.—A. Isgrove (*Eledone*) Liverpool Mar. Bio. Comm. Memoir No. xxiii, 1909. W. Meyer (*Opisthoteuthis*), *Zeitschr. Wiss. Zoologie* (85, 1906). A. Willey, *Contribution to the Natural History of the Pearly Nautilus* (1902).

E. Special Subjects (Important general papers published since 1905).—(a) Deep-sea forms: Chun, *op. cit.;* Joubin, *op. cit.;* Robson, *Proc. Zool. Soc. London* (1926). (b) Luminescence: Berry, *Biolog. Bulletin,* 2 parts, 1920 (Bibl.); U. Pierantoni, *Pub. Staz. Zool. Napoli* (2, 1918). (c) Breeding Habits: J. Drew, *Journ. Morphology* (22, 1911); A. Levy, *Zool. Anzeigr.* (39, 1912). (d) Hectocotylus: Hoyle, *Rept. Brit. Assocn.,* p. 520 (1907); Robson, *Proc. Malac. Soc. London* (1926). (e) *Spirula:* Chun, *op. cit.;* Joubin, *op. cit.* (1920). (f) Palaeontology: R. Abel, *Paläobiologie der Cephalopoden* (1915); Naef, *Die Fossilen Tintenfische* (1922). (G. C. R.; X.)

CEPHEUS, in Greek mythology, the father of Andromeda (*q.v.*); in astronomy, a constellation of the northern hemisphere. The star δ Cephei is the type star of a class of variables called Cepheids (*see* STAR). It was discovered by Goodricke in 1785. The period is 5·37 days and the range of magnitude is from 3·6 to 4·2. The star β Cephei is also a famous Cepheid variable; although its range of brightness is only 0·05 mag. its variability was detected by Professor Paul Guthnick of Berlin University by photoelectric measurements.

CEPHISODOTUS, the name of a near relative, and of the son of, Praxiteles, both sculptors like himself. The former must have flourished about 400 B.C. A noted work of his was Peace bearing the infant Wealth, of which a copy exists at Munich. Peace is a Madonna-like figure of a somewhat conservative type. He made certain statues for the city of Megalopolis, founded in 370 B.C. (*See* H. Stuart Jones, *Ancient Writers on Greek Sculpture* § 182–185 [1895].) Of the work of the younger Cephisodotus we have no remains; he flourished in the latter part of the 4th century B.C., and was noted for portraits of Menander, of the orator Lycurgus, and others. (*See* J. Overbeck, *Antike Schriftquellen,* p. 255.)

CERAM, an island of the Netherlands Indies, in the Molucca group. It lies 3° S. and between 127° 45′ and 131° E., and is due east of Buru, from which it is divided by the Manipa or Buru strait, in which are the islands of Manipa, Kelang and Boano. It is 216 mi. long, and has an area, with adjacent islands, of 6,621 sq.mi. Politically, it comes under the residency of Amboina, and for administrative purposes is divided into four districts—West Ceram, Amahai and Wahai (Middle Ceram) and East Ceram, with a *controleur* and three *gezaghebbers.* The island, which geologically is composed mostly of eruptive rocks and crystalline limestone in the middle and western portions, and of crystalline chalk in the east, is very mountainous, a fine range of mountains traversing it from east to west. The highest peak is that of Binaya (9,600 ft.), in the central part, and four others exceed 6,000 ft. In some places the mountains extend right to the coast; in others wide stretches of lowland are sometimes fringed with swamps by the seashore.

There are many rivers, running to the north mostly; they are partly navigable for small craft only during the rainy season and often dry up altogether during the period of drought. Comparatively little is known of the interior of the island, with the exception of the peninsula of Hoalmoal in the west, which is connected with the main island by a low, narrow isthmus. With Ceram are included Ceram Laut, a cluster of islands on a coral reef, about 20 mi. long, also Gisser and Kilwaru, the Goram (or Gorong) Islands (Suruaki, Goram and Manawoka), the Watubela group, and the Teor Isles, all of which lie southeast of Ceram.

The larger islands are of Tertiary (Miocene) formation, and the others of recent coral. None has hills of over 1,000 ft. and most are thickly wooded, while Suruaki has extensive swamps. Many of the Watubela islands have rugged hills covered with coconut palms, and some of the Teor group are entirely waterless, owing to the nature of their coral rock.

Ceram is covered with dense tropical forests, which provide excellent timber (ironwood is general) and yield a variety of forest products, including cajeput oil, damar and wild nutmeg, and in the swamps of the coast and valleys the sago palm thrives abundantly. Both the flora and the fauna of the island lack variety and characteristic specimens; of a forest in the centre A. R. Wallace wrote: "I have never been in a forest so utterly desert of animal life as this appeared to be." The cassowary is the outstanding feature of the fauna, which includes deer, cuscus, pig, shrews, cockatoos, lories, hornbills and birds of paradise, and there are many species of fish in the rivers. The climate is hot and moist, the rainfall being a heavy one, and earthquakes occur. Ceram had in 1930 a population of 95,636, largely in coastal regions and composed mostly of immigrants from Java, Macassar, Ternate and other parts of the archipelago. The people are partly Christian and partly Mohammedan. The Christians live mainly in the west (the Mohammedans in the southeast) and dress and live in the style of the Christian Amboinese, to whom they are nearly related. Fishing and agriculture are the chief pursuits. Most of the tropical fruits of Malaya are grown, also rice, maize, sugar cane, tobacco and coconuts; sago flour is produced and cajeput oil distilled. Trade in these products is in the hands of Chinese, Arabs and Macassars, but there are also some coconut, spice and other plantations under European supervision and copra is the chief article of export. There is a small oil field near Bula Bay (east coast), producing 117,946 tons of crude oil in 1939. The people of the coasts are semi-civilized; not so those of the interior, who are of a mixed Malay-Papuan stock; the practice of head-hunting, however, is becoming a thing of the past. They are largely pagan in religion, wear little in the way of clothing, live in houses built on piles and use as weapons the bow and arrow, *parang* and lance. They are hunters and fishers, and collect forest products, keep pigs and dogs, have a patriarchal social system and a form of marriage sometimes endogamic, sometimes exogamic. Women have a good position among them and are well treated, and, especially among the mountain folk, morality is high. Weaving is known in some parts, and weapons and plaited goods are manufactured. China plates and dishes are considered objects of the highest value, and the people like

long ceremonial feasts. There is a secret society among the people of the west, the *Kakihan,* the main object seeming to be maintenance of old customs in the face of foreign influence, but it has also a strong religious significance, initiation being a form of death and resurrection ritual; and the people generally are divided into the two divisions of *Pata-siwa* (the Ternate party) and *Pata-lima* (the Tidore party). The Ceramese are a strong and muscular people, cheerful and honest, but inclined to be very excitable, and extremely independent. The natives of the middle and east are far more peaceful in their ways than those of the west, but civilization is making headway among all, as the result of increasing trade facilities and the provision of schools in many districts, maintained by the Dutch government, with Amboinese headmasters. Amahai, in the south (centre), has a good harbour. Other ports of call are Piru (west), Wahai (north), Tehoru (south) and Bula Bay (east); roads are nonexistent. There is an airfield at Bula Bay. Ceramese, a language without either script or literature (yet the people sing songs of former ages which have been handed down orally), is divided into thirty-five different dialects, and is nearly related to the indigenous language of Amboina. Malay is used commonly on the coasts. The people of the Ceram Laut Islands (pop. 6,000), Gisser and Kilwaru are Mohammedan. They are fishers, build boats, weave sarongs, manufacture knives and live in quite well-built wooden houses, in tidy villages, generally by the seashore. Gisser, with Kilwaru, is a trade centre for the region of southeastern Ceram and the islands and is a port of call for vessels of the Royal Packet Navigation Co.

The population of the Goram Islands, which are more fertile than those of Ceram Laut, is also about 6,000, and Mohammedan, the people being fishers and traders and the women good weavers. The Watubela islanders are Mohammedan also; they produce scarcely anything beyond copra, which they trade for the products they lack. Boano has a population of 1,300, Christian and Mohammedan, and an infertile soil, which drives its people to seek a livelihood on neighbouring islands, and Manipa has nearly 1,000 inhabitants, who grow a good deal of sago.

In the mid-17th century a fort established at Cambello extended Dutch influence, with help from Ternate, which claimed suzerainty. The power of Amboina later helped the Dutch to acquire the whole island in spite of trouble when they destroyed clove plantations in order to uphold Amboina's monopoly. Later still, there were expeditions against the natives of the interior, but after 1910 all was quiet. During World War II, Ceram was occupied by the Japanese in Feb. 1942.

BIBLIOGRAPHY.—A. R. Wallace, *The Malay Archipelago* (1890).

(E. E. L.; X.)

CERAMICS or **KERAMICS,** a general term for the history and art of making pottery. (*See* POTTERY AND PORCELAIN.)

CERARGYRITE, the name usually applied by mineralogists to naturally-occurring silver chloride, though sometimes taken to include the bromide and iodide as well, or mixtures of them. It crystallizes rarely in the cubic system, but usually forms horn-like masses, known to miners as horn-silver. It is very soft, being easily cut with a knife, and usually of a dirty grey or yellowish colour. It is an important ore of silver, occurring in considerable quantity in the oxidation zone of silver lodes in dry climates, such as Chile, Peru, and Broken Hill in New South Wales, where the surface waters are rich in chlorides, bromides and iodides.

(R. H. RA.)

CERATOSAURUS, an extinct carnivorous dinosaur whose remains are found in the Upper Jurassic of Colorado. Like its relatives the Allosaurus (*q.v.*) and Tyrannosaurus (*see* DINOSAURIA), it was bipedal in progression. The single species, *C. nasicornis,* reached a length of 20 ft. and, as its name implies, was distinguished by a small horn on the nose. (*See* REPTILES.)

CERBERUS, in Greek mythology, the dog who guarded the entrance to the lower world. According to Hesiod (*Theog.,* 311), he was a 50-headed monster, the offspring of Typhon and Echidna. He was variously represented with one, two or (usually) three heads, often with the tail of a snake or with snakes growing from his head or twined round his body. One of the tasks imposed upon Hercules was to fetch Cerberus from below to the upper world, a favourite subject of ancient vase paintings.

CERCIDIPHYLLUM, a genus of plants of the Trochodendraceae family. *C. japonicum,* the katsura tree, native to Japan, is a hardy, ornamental, shrubby tree of pyramidal habit, almost fastigiate when young, with handsome light green foliage, purplish when unfolding and turning bright yellow or partially scarlet in autumn. Commonly there are several trunks, usually 20–30 ft. in height, but sometimes attaining 100 ft.

C. japonicum var. *sinense,* from western China, usually consists of a single trunk which may exceed 100 ft. It is the largest of all broad-leaved trees known from China; the trunk is often free of branches for nearly 50 ft. above the ground and may attain a girth of 25 ft. or even more. (J. M. BL.)

CERDIC (d. 534), founder of the West Saxon kingdom, is described as an ealdorman who in 495 landed with his son Cynric in Hampshire, where he was attacked at once by the Britons, under Natanleod. Nothing more is heard of him until 508, when he defeated the Britons with great slaughter. Strengthened by fresh arrivals of Saxons, he gained another victory in 519 at Certicesford, the modern Charford, and in this year took the title of king. Turning westward, Cerdic appears to have been defeated by the Britons in 520 at Badbury or Mount Badon, in Dorset, and in 527 yet another fight with the Britons is recorded. His last work was the conquest of the Isle of Wight (530), probably in the interest of some Jutish allies.

See E. Guest, *Origines Celticae* (1883); Bede, *Historiae ecclesiasticae gentis Anglorum libri,* v, ed. C. Plummer (Oxford, 1896); Gildas, *De excidio Britanniae,* ed. Th. Mommsen (1898); Nennius, *Historia Brittonum,* ed., Th. Mommsen (1898); *Anglo-Saxon Chronicle,* edited by C. Plummer (Oxford, 1892–99).

CERDONIANS, a Gnostic sect, founded by Cerdo, a Syrian, who came to Rome about 137, but concerning whose history little is known. Most of what the Fathers narrate of Cerdo's tenets has probably been transferred to him from his famous pupil Marcion, like whom he is said to have rejected the Old Testament and the New, except part of Luke's Gospel and of Paul's Epistles. (*See* MARCION AND THE MARCIONITE CHURCHES; also GNOSTICISM.)

CEREALIS (CERIALIS), **PETILLIUS** (1st century A.D.), Roman general, a relative of the Emperor Vespasian. In A.D. 61 he was in Britain as legate of the ninth legion, which was overwhelmed by the Britons. In the civil war of 69 he supported Vespasian, and in 70, after holding the consulship, he put down the revolt of Civilis (*q.v.*). In 71, as governor of Britain, where he had as a subordinate the famous Agricola, he defeated the powerful Brigantes. Tacitus says that he was a bold soldier rather than a careful general.

See Tacitus, *Annals,* xiv, 32; *Histories,* iii, 59, 78; iv, 71, 75, 86; v, 21; *Agricola,* 8, 17. *See* also B. Henderson, *Civil War and Rebellion in the Roman Empire* (1908).

CEREALS. Cereals are those members of the grass family which have edible starchy seeds. Rice, wheat, rye, barley, oats, maize (known as corn in the Americas), sorghum and some of the millets are the common cereals. All are summer or winter annuals and are grown primarily for the seed which is used for human food or as feed for livestock.

Cereals have provided the basis on which the civilizations of the world have been developed. When ancient man discovered these plants which provided a source of food and learned how to grow them, roving bands were transformed into settled communities. The growing of these crops required much less of primitive man's time to provide the necessary food for himself and family and feed for his animals, thus leaving time to develop the arts and sciences which distinguish civilized man from the savage. Cereal grains now as in ancient times provide more food with a smaller expenditure of effort than any other crops. Because of their low moisture content they are easily stored and transported. Grain storehouses have been found in the excavated ruins of many ancient cities: wheat and barley in those in Mesopotamia, Egypt, Greece and Rome, and maize in the ruins and caves of the Mayas, Aztecs, Incas and other Indian peoples of the western hemisphere.

Wheat, rice and rye are grown primarily for human food, while maize, barley, oats and sorghum are grown mostly for livestock

feed although in some countries even these are important food crops. Because they can be easily shipped without loss or deterioration in quality and are grown in some countries in great excess of local needs, wheat and rice are shipped in large quantities into countries which do not produce enough starchy foods to meet their domestic needs. On the other hand a large part of the maize, barley, oats and sorghum, especially in the English-speaking nations, is fed to livestock on the farms where it is grown and is sent to markets in the form of meat, dairy and poultry products. During World War II a large amount of wheat and maize was used in the United States to produce alcohol for the manufacture of munitions and synthetic rubber.

Wheat is the aristocrat of cereals and is grown on a larger world acreage than any other crop. It is adapted to a wider range of climatic conditions than any other crop with the possible exception of barley. However the important wheat-growing regions of the world are confined to the temperate zones where the annual rainfall is between about 13 and 35 inches. Barley, oats and rye are grown in much the same areas except that winter wheat and rye are grown extensively in some areas where barley and oats will not survive when fall-sown and when spring-sown will not yield as well as winter wheat.

Because rye will survive more severe winters and will produce larger yields of grain on soils of low fertility than other cereals, it is the main food grain in certain regions of Europe and Asia. Oats are grown most extensively in the corn belt of North America because they fit so well into rotations with corn and clover, and in the cooler regions of Europe.

Rice is the principal cereal grown in the warmer humid areas of the temperate zone and in the tropics where water for irrigation is available and the land is of suitable topography and soil type for flooding. The crop is submerged in four to eight inches of water most of the time from seeding to maturity. It responds with high yields to the intensive methods of production practised in the densely populated areas of the orient where it forms the chief article of food.

Corn is grown mainly in the temperate zones in regions having a rainfall above eight inches for the three summer months or where the land is irrigated as in Egypt. Unknown outside the Americas before being taken to Europe by Columbus, it is now one of the principal crops in the Danube basin and in other regions of the old world.

Sorghum is a very important crop in parts of Africa, Asia and the southern great plains of the United States where it is too hot and dry for corn to be grown successfully.

Wheat, barley, oats, rye and rice are known also as the small grains. They are grown in close drills and are not cultivated during the growing season. Maize and sorghum are grown in rows about 42 inches apart and are cultivated during the growing season to control weeds. The coarse stalks and leaves of maize and sorghum either with or without the ears and heads are often fed to livestock as occasionally, also, are the finer-stemmed millet and oats. More often the small grains and millet are cut for hay before they are mature. Sometimes the small grains are used for fall, winter or spring pasture.

In the major cereal-growing regions of the world such as the prairies and plains of the United States and Canada, the grain belt of Australia, the pampas of Argentina and the Ukraine of Russia, preparation of the land, seeding and harvesting of the crop are done very efficiently by machinery which has been developed during the last hundred years. For example, it is estimated that in 1830 about 58 hours of man labour were required to grow, harvest, thresh and clean an acre of wheat yielding 20 bushels while with the machines in common use in 1940 only 3 man-hours of labour were required.

Like man, each of the cereal crops is subject to destructive diseases and also to drought and other adverse weather conditions which have caused great losses to growers and have sometimes resulted in famines. The ancient Greeks and Romans had special gods for cereal crops and held festivals to prevail upon them to protect the growing crops from rusts and smuts and to bring forth a good harvest. During the last 40 years scientists have devised methods for controlling many of these diseases and have developed improved varieties which are highly resistant to many of these diseases as well as to adverse weather conditions. Improved cultural practices and better varieties are adding hundreds of millions of bushels to cereal production each year. (*See* also BARLEY; MAIZE; MILLET; OATS; RICE; RYE; SORGHUM; WHEAT.)

(B. B. B.)

Cereals in Diet.—The dietary properties of the entire seed of wheat, rice, barley, rye, maize, oat and millet resemble each other in most respects. They are all deficient in calcium and vitamin A (except yellow maize), and the biological value of their protein moiety is lower than that of the proteins of milk, meats and eggs. When any one of these cereals is supplemented with calcium, vitamin A and a source of proteins of animal origin, it is rendered complete nutritionally.

Under the chronic conditions of scarcity of foods which prevailed generally in most parts of the world before the invention of modern farm machinery from 1840 on, cereals remained the most important food crop, although the yields were low because of inferiority of varieties and poor cultivation technique throughout Europe. With the development of modern machinery and improved selection through plant breeding, wheat production has been enormously increased. The price range of cereal products is small as compared with prices of the more expensive foods such as meats, milk, eggs, fruits and vegetables other than the potato. Bread grains and potatoes are the cheapest foods. Whenever economic conditions prevail which lower the incomes of families or increase the cost of foods, the tendency has been for people to subsist more largely on bread and potatoes. Since the potato is not constituted so as to make good the deficiencies of cereals, such dietaries as are largely derived from these sources are nutritionally inadequate. Much malnutrition in Europe and elsewhere in recent decades has been due to this cause.

Before the year 1879 the milling of wheat was done in the same manner as in the days of Moses, viz., between millstones. This precluded production of flour more refined than could be achieved by sifting out the coarser particles. With the invention of the roller mill, the wheat berry could be separated into more than 20 mill streams, each of different composition. Especially important from the nutritional standpoint is the removal of the germ and the outer layers of the wheat, which are, with the exception of the outermost or bran layer, the most nutritious parts of the grain. Modern white flour is essentially free from fat, which in whole meal grows rancid on long storage. It contains only the protein moiety of the grain which has the lowest nutritive value. In addition, most of the vitamins and mineral elements, except phosphorus and potassium, are milled out and go into stock feed. Modern white flour is milled for commercial expediency rather than in the interest of the people's health. Because of the hazards of marketing a more highly nutritious flour for breadmaking, it is clear that there is much to justify modern milling processes from the economic point of view. As a World War II measure Canada introduced a long extraction wheat flour known as Canada Approved Flour, which represented about 85% of the wheat berry as compared with ordinary flour which is refined to the least nutritious 70% of the wheat. Later, England adopted the practice of manufacture of a similar flour. Such flour is superior to ordinary white flour in nutritive value, being superior in vitamin and mineral nutrient values and in the quality of its proteins. In the interest of health it would be advisable to adopt such flour to the maximum extent to which commercial transport and storage of flour permit.

The practice of improving the quality of commercially baked bread by the use of skim milk instead of water in preparing the bread mix became general in the United States after World War I. As much as six per cent of nonfat milk solids in bread improves greatly the nutritive value of the loaf by compensating for all of the nutritive deficiencies of white flour except iron. Four to six per cent milk bread becomes stale less rapidly than does bread made without milk, crumbs less on cutting, and otherwise makes a highly desirable bread. This method of improving bread has become popular with bakers.

With the development of the synthetic production of several of the vitamins and consequent lowering of their cost, a movement was started to "enrich" bread made from white flour by the addition of thiamin, riboflavin, niacin and iron, with calcium and phosphorus additions optional. While it is true that such "enrichment" of a white flour bread may safeguard the health of people whose dietaries are of low quality, it is not clear that it is a wise policy to pay for the inclusion of these vitamins and iron in the diets of good to high quality which, there are good reasons for believing, represent those of a large majority of the people. An excess of vitamins has not been shown to be of benefit.

It is a wise policy to promote the manufacture of bread of the highest possible nutritive value. It would seem desirable nutritionally to include small percentages of wheat germ, corn (maize) germ, dried brewers' yeast, rice polishings, as well as the maximum amount of nonfat milk solids, in commercial bread formulae. Such a policy would go far toward justifying the milling of highly refined flour of good keeping quality. At the same time the nutritionally superior parts of the grain which have hitherto been used largely for animal feeding would be used to improve human nutrition.

Maize meal (corn meal) and corn grits are widely used as human foods, especially in the southern United States, in parts of Italy, Rumania, Egypt and elsewhere. Since maize contains about one-fifth as much niacin as does wheat, pellagra, which is due to niacin deficiency, has been common only where corn is extensively used as a bread grain or as corn-meal mush (polenta). The milling of maize by modern machinery produces a meal for human consumption which is as much depleted in nutrients as is white flour. Barley and rye are extensively used as human food only in areas where wheat does not yield well. These cereals are profitable agricultural crops in the thin sandy soils of northern Europe (rye) and in regions too hot and dry or too wet and cold for wheat. There are varieties of barley which yield a harvest under conditions too extreme for wheat production. Where rye and barley are used as bread grains they are not milled and refined as is wheat but are employed as essentially whole meal products. Oats, which are prepared for human consumption as rolled oats and oatmeal, are the only cereal marketed solely as a whole grain product. Machinery for their degermination has not been perfected.

Where wheat or other cereals are marketed for use as breakfast cereals, it is advisable to provide products which represent the entire seed because of their superior food values.

Rice is second only to wheat in the quantity grown and used as human food. Being the one cereal which grows in swampy land, it forms the principal food of many millions of people in the warmer and wetter areas of the world. The flavour of whole rice is generally less relished than is that of polished rice. Polishing is desirable from the same commercial standpoint as is the refining of white flour. Both products keep well. Polishing removes the bran and aleurone layers from the surface of the kernel and also the germ. Polished rice closely resembles white patent wheat flour in dietary properties. Attempts have been made, and some progress achieved, in the distribution of "undermilled" rice and steamed rice. The former product contains some of the outer layers (silverskin) of the grain, and some germ. In the preparation of steamed rice the grain is steeped in water warm enough to facilitate permeation of the grain and gelatinization of the surface starch. These processes which serve to retain the thiamin content of rice have been promoted as a means of preventing the disease beri-beri which afflicts people whose diet is too largely derived from polished rice.

Sorghums, and also the seeds of several grasses popularly known as millets, are among the hardiest of the cereals in withstanding drought. They are extensively employed as human food in semiarid regions throughout the world. They are the least palatable of the cereals and are eaten from necessity rather than from choice. The use of these seed grains is most common in the U.S.S.R., northern Asia and Africa.

Because of great improvements in cereals through plant breeding, the use of appropriate machinery for the preparation of the soil, for planting, cultivation, harvesting and threshing of cereals, their production has been enormously increased within the past hundred years. They are our least expensive and most important foods as sources of calories, thiamin and protein, notwithstanding the latter is of rather poor quality as compared with foods of animal origin. Because of their dietary deficiencies, especially when refined derivatives of cereals are eaten, the ideal way to use cereals in the diet is in menus in which occur liberal amounts of milk and milk products, meats, eggs, fish, poultry, together with appropriate amounts of green and yellow vegetables and some fresh vegetable foods suitable for eating in the uncooked state for their antiscorbutic properties. The fact is well established that none of our common foods is complete nutritionally when eaten as the sole source of nutriment. The keynote to successful nutrition is the proper selection of foods, each deficient in one or more respects, but so constituted as to supplement each other's shortcomings and to make collectively a complete diet. (*See* also BREAD AND BREAD MANUFACTURE; FLOUR AND FLOUR MANUFACTURE.)

BIBLIOGRAPHY.—J. Russell Smith, *The World's Food Resources* (1919); McCollum, Orent-Keiles and Day, *The Newer Knowledge of Nutrition* (1939); H. C. Sherman, *The Chemistry of Food and Nutrition* (1941). (E. V. M.)

CEREBELLUM: *see* BRAIN; also EQUILIBRIUM, ANIMAL.

CEREMONIAL. In the military sense the prescribed drill and formations for certain specific occasions such as parades, reviews, guard duty, funerals, trooping the colours and lining streets, as distinct from drill applicable to field exercises.

CERES, goddess of the growth of food plants, worshipped, alone or with the god Cerus, over a considerable part of Italy. (Oscan *Keri—;* probably connected with *cre-are, cre-sco;?* "creatress"). Her cult was early overlaid by that of Demeter, who was widely worshipped in Sicily and Magna Graecia, *cf.* DEMETER. On the advice of the Sibylline Books, a cult of Ceres Liber and Libera was introduced into Rome in 496 B.C., to check a famine. Liber and Libera seem to represent the *Iakchos* and *Kore* of the Eleusinian cult. The ritual of this worship was largely if not wholly Greek. The temple, which was built on the Aventine in 493 B.C., and was of Etruscan shape but decorated by Greek artists, became a centre of plebeian activities, religious and political. Ceres was regarded as the patroness of the corn trade, which seems to have been early in plebeian hands. The chief festivals of this cult were:

(1) *Ludi Ceriales,* introduced before 202 B.C., and ultimately lasting from April 12–19;

(2) an annual festival, instituted before 217 B.C., celebrated in secret by the women and apparently dealing with the union of *Kore* and *Hades;*

(3) from 191 B.C. on, a fast (*ieiunium Cereris*), held every five years, but later every year on Oct. 4. All these are on Greek lines.

See Wissowa, *Religion und Kultus* (2nd ed.), pp. 192 *et seq.*, 297 *et seq.*

CERIGNOLA, a town of Apulia, Italy, in the province of Foggia, 26 mi. S.E. by rail from the town of Foggia. Pop. (1936) 37,163 (town); 39,540 (commune). It was rebuilt after a great earthquake in 1731. It has a considerable agricultural trade and also trade in merino and mattress wool. In 1503 the Spaniards under Gonzalo de Cordoba defeated the French under the duc de Nemours below the town—a victory which made the kingdom of Naples into a Spanish province in Italy. Cerignola lies on the Via Traiana between Herdoniae and Canusium.

CERIGOTTO, called locally Lius (anc. *Aegilia* or *Ogylos;* mod. official Gr. *Antikythera*), an island of Greece, between Cythera (Cerigo) and Crete, about 20 mi. from each. The inhabitants are mainly Cretan refugees, and in favourable seasons export wheat. It was long a resort of pirates. Close to its coast in 1900 an ancient ship was discovered, laden with bronze and marble statues. Cerigotto was occupied by Germany in 1941.

CERINTHUS (*c.* A.D. 100), a Christian heretic, known to St. John. Hippolytus (*Haer.* vii, 33) credits him with an Egyptian training, but there can be no truth in the notice given by Epiphanius (*Haer.* xxviii, 4) that Cerinthus had led the Judaizing opposition against Paul at Jerusalem.

According to Irenaeus (*Adv. haeres.* I. 26 1), Cerinthus taught that the world had been made by angels, from one of whom the god of the Jews, the Israelites had received this imperfect law. The only New Testament writing which he accepted was a mutilated Gospel of Matthew. Jesus was the offspring of Joseph and Mary, and on Him at the baptism descended the Christ, the divine power, revealing the unknown Father, and endowing Him with miraculous power. This Christ left Jesus before the Passion and the resurrection. According to Philastrius and St. Epiphanius, Cerinthus admitted circumcision and the observance of the Sabbath. Gaius, the priest (*c.* 200) and Dionysius of Alexandria (*q.v.*) accused him of a crude form of Chiliasm. Cerinthus is a blend of judaizing Christian and Gnostic.

CERIUM, the commonest metallic element belonging to the rare earth group, discovered in 1803 by Klaproth and independently by Berzelius and Hisinger. Cerium (symbol Ce, atomic number 58, atomic weight 140·2) occurs most abundantly in the minerals monazite, cerite and allanite, accompanied by the other members of the group. It is formed by electrolysis of fused anhydrous chloride. It is of an iron-grey colour, about as soft as lead, and is attacked slowly by cold water and more rapidly by hot water. It melts at 623°C. It burns brilliantly when heated in the form of wire, and is a powerful reducing agent. It forms alloys with other metals, the best known being that with iron which is used because of its well known property of giving off showers of brilliant sparks when struck or filed. Of all the rare earths it is most easily purified. This is due to the fact that it is the only one that forms a higher series of compounds (CeX_4). These compounds readily suffer hydrolysis with the precipitation of basic substances practically free from other earths. The purification is readily brought about by carefully boiling the mixed nitrates with potassium bromate and then gradually adding coarsely ground marble to keep down the acidity. The precipitated basic nitrate is washed with a 1% solution of nitric acid. The product may be purified if necessary by repeating the process.

The common oxide, produced when the salts of cerium with volatile acids are heated, is the dioxide CeO_2. This oxide, which is a pale-yellowish powder, is insoluble in nitric and hydrochloric acids, but soluble in sulphuric acid. The salts corresponding to this oxide are of the type $Ce(SO_4)_2$ and possess a yellow or orange-red colour. The salts derived from trivalent cerium [type $Ce_2(SO_4)_3$] are much more stable, colourless and show no absorption spectrum. Cerium compounds have a few uses. The oxalate is used to prevent various forms of sickness such as sea-sickness, etc. Cerium nitrate is used in the manufacture of Welsbach mantles, in the ceramic and textile industries, etc. (*See* RARE EARTHS.) (C. J.)

CERNUSCHI, HENRI (1821–1896), Italian politician and economist, was born at Milan. He played a part in the revolutionary movement and was compelled to leave Italy in 1850. He then settled in France, where he made a large fortune. Cernuschi is best known as an ardent champion of bimetallism, and the word itself is commonly supposed to have originated with him—at least in its English form it is first found in his *Silver Vindicated* (1876).

Among his other works may be mentioned *Mécanique de l'échange* (1861); *Le Bimétallisme en Angleterre* (1879); *Le Grand Procès de l'Union latine* (1884); *Illusion des sociétés coopératives* (1886).

CEROGRAPHY, the art of painting in wax; from the Gr. κηρός, wax, and γράφειν, to write. (*See* ENCAUSTIC PAINTING.)

CERRO DE PASCO, a mining town of Peru, capital of Pasco province, 75° 30′ 13″ W., 10° 53′ S., about 110 mi. N.E. from Lima by air and 297 mi. by rail. Pop. (1940) 19,187; altitude 13,973 ft. Located amid a cold desolate region without tree or shrub, Cerro de Pasco has been famed in history as one of the world's richest silver-mining districts, second in South America only to Potosí. In a period of one century and a half, an estimated $500,000,000 value in silver was produced in the district. Today, nearly all Peruvian copper and a large portion of the country's gold, silver, lead and bismuth comes from Cerro de Pasco and its immediate vicinity. The town is riddled with tunnels and entrances to ancient mines, with attendant debris. The adobe houses and rough streets are unevenly arranged, and thick smoke and evil smells contaminate an otherwise healthful, though harsh, climate Newcomers are apt to suffer from *soroche,* a sickness caused by rarefied atmosphere. The inhabitants are mostly Indian labourers and their families. Except in a model village 200 ft. above the plant, which houses the mining staff, only a few buildings, as hotels, clubs and commercial houses, are modern.

Copper-mining dates from 1898. Production is mainly in the hands of the North American-controlled Cerro de Pasco Mining corporation, which has built a railway to Oroya, 82 mi. away, connecting there with the State railway to Lima. A 25 mi. spur brings bituminous coal from the Goyllarisquisga and Quishuarcancha mines, whose entire output is used by the corporation. The Cerro de Pasco corporation owns smelters, including one of the world's largest at Oroya, and a large hydro-electric plant.

(L. W. BE.)

CERRO GORDO, a mountain pass, 60 mi. N.W. of Vera Cruz, along the National highway from the coast to the capital of Mexico. At this place, Maj.-Gen. Winfield Scott, in his advance from the gulf to Mexico City during the war between the United States and Mexico (1846–48), met his first stout resistance. The leading column commanded by Brig.-Gen. D. E. Twiggs had been stopped by fire from the frowning cliffs of Cerro Gordo (April 12, 1847). When Scott arrived upon the scene (April 14), he immediately ordered certain officers, among them Capt. Robert E. Lee, to make definite reconnaissances. Learning from these the dispositions of the enemy and knowing that there was but one highway westward, he formulated a plan for a wide turning movement in order to gain and attack the Mexican rear. Twiggs' division was to occupy La Atalaya, a prominent hill in front, without bringing on a general engagement. There he was to wait until Brig.-Gen. James Shields' brigade should complete a long detour, when a simultaneous attack would be delivered. Brig.-Gen. G. J. Pillow's brigade was to oppose the batteries immediately in front. Scott's whole force numbered about 8,500 as against 12,000 to 18,000 Mexicans under Gen. Santa Anna. Twiggs' movement on April 17 upon La Atalaya was so impetuous as to bring on a premature assault upon El Telégrafo, the commanding position beyond. Although La Atalaya was taken as planned, the small group of Americans attacking El Telégrafo was repulsed. Before dark and the ensuing rain, Shields arrived in support of Twiggs. The next morning, April 18, the attack upon El Telégrafo being renewed, Col. W. S. Harney's troops, after a rugged climb under fire, took the crest by a gallant onslaught. Shortly thereafter Shields' appearance in the open at the Mexican left hastened Santa Anna's flight, already begun. Some 40 cannon, 40,000 muskets and at least 5,000 prisoners were captured by Scott. The Mexican casualties have been estimated at about 1,100, whereas the American loss is given as 64 killed and 353 wounded.

BIBLIOGRAPHY.—J. H. Smith, *The War with Mexico,* vol. i. (1919); G. B. McClellan, *The Mexican War Diary* (1917); C. M. Wilcox, *History of the Mexican War* (1892); W. A. Ganoe, *The History of the United States Army* (1924); *Original Correspondence and Reports in Old Files Section,* adjutant general's office (Washington, D.C.).

(W. A. G.)

CERTALDO, a town of Tuscany, Italy, in the province of Florence, 35 mi. S.S.W. by rail and 18 mi. direct from the town of Florence. Pop. (1936) 5,290 (town); 12,094 (commune). It was the home of the family of Giovanni Boccaccio, who died and was buried here in 1375. His house of brick, was restored in 1823. A statue of him was erected in the principal square in 1875. The Palazzo Pretorio, or del Vicariato, the residence of the Florentine governors, recently restored to its original condition, has a picturesque façade and court. The picturesque town lies on a hill 426 ft. above sea-level.

See R. Pantini, *S. Gimignano e Certaldo* (Bergamo, 1904).

CERTHIIDAE: *see* TREE-CREEPER.

CERTIFICATE OF DEPOSIT, a written receipt from a bank acknowledging the deposit therein of a certain sum of money. Under such certificate, money may be deposited either on a demand basis or a time basis, but in either case it cannot be drawn against by cheque. To withdraw funds deposited under a certificate of deposit it is necessary to present the certificate itself, properly endorsed. In the United States certificates of de-

posit are negotiable when properly endorsed and are usually acceptable as security for loans. (*See* WARRANT.)

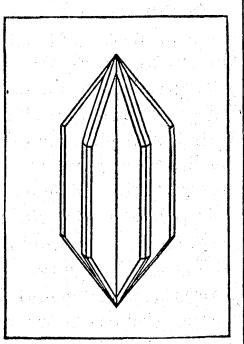
CERTIFICATE OF INDEBTEDNESS, a term used in the United States to describe a short-term note representing floating indebtedness. Corporations frequently borrow large sums for short periods, and as evidence of the debt give the lenders these certificates of indebtedness in various denominations. Where the issuer fails to pay the certificates at maturity, they are regarded as unsecured promissory notes, and the holders have the recourse of general creditors. The U.S. Treasury issues certificates of indebtedness, known as Treasury certificates, to obtain temporary funds, pending the receipt of tax payments.

CERTIFIED CHEQUE, a cheque regularly drawn against a depositor's account in a bank but having stamped or written on the face the word "certified" or "accepted," or the phrase "good when properly indorsed," or "good through clearing house," or some other expression commonly used, and the signature of a bank official, usually a cashier or paying teller, qualified to make certifications. The certification is the bank's guarantee that the signature of the drawer is genuine and that there are and will be sufficient funds to his credit to pay the cheque. A certified cheque becomes an obligation of the bank itself instead of merely an order upon the bank by the drawer. Immediately upon the certification of a cheque, the amount certified is set aside from the drawer's account specially for the purpose of paying the cheque; and other cheques which may be presented ahead of that certified will not be allowed to withdraw the funds so segregated. The advantage of the certified cheque is that it will not be refused payment on the ground of "no funds," or "not sufficient funds."

A cheque may be certified at the request of either the drawer or a holder. If certified at the request of a holder, however, both the drawer and the indorsers, if any, are released from obligation and the holder must look for payment to the bank alone, and the bank is absolutely liable unless the cheque was "raised," either before or after the certification. When a bank certifies a cheque at the request of the drawer, the latter is not released from liability, and if the bank should fail before the cheque is presented for payment, the holder will have recourse against the drawer.

(J. H. B.)

CERTIFIED PUBLIC ACCOUNTANT, an American designation the use of which is restricted by State law to accountants who have met the legal requirements of the State or States in which they seek recognition. In addition to meeting certain educational and professional demands, candidates must also submit to written examinations in the subjects prescribed. Upon fulfilling the conditions of the particular State, the accountant receives a certificate which entitles him to use the expression certified public accountant after his name, or the abbreviation, C.P.A. There are no regulations, either State or Federal, which prohibit an accountant who has not received a certificate from engaging in professional practice, but certain assignments which are made by courts of law can be handled only by Certified Public Accountants; without this certificate, accountants are finding it increasingly difficult to gain a footing in the profession. (*See* ACCOUNTANCY AND ACCOUNTANTS.)



GROUP OF CERUSSITE
A native lead ore which occurs in three colours, in solid or granular form

CERUSSITE, a mineral consisting of lead carbonate, $PbCO_3$, and forming an important ore of lead; it contains 77·5% of the metal. The name is derived from the Latin *cerussa,* "white lead." It crystallizes in the orthorhombic system, and often forms pseudo-hexagonal twins like those of aragonite, with which it is isomorphous. It also occurs in compact granular or fibrous forms. It is usually colourless or white, sometimes grey or greenish, and is usually more or less transparent: some well-formed crystals have a brilliant lustre. Its hardness is 3–3·5 and density 6·5. It effervesces with dilute nitric acid. Cerussite occurs in large quantities in the upper oxidized portions of lead.

CERUTTI, GIUSEPPE (1738–1792), French author and politician, was born at Turin. He taught at the Jesuit college at Lyons and wrote an *Apologie* (1762) for his order. His *Mémoire pour le peuple français* (1788) advocates the claims of the *tiers état.* He was a member of the Legislative Assembly and a friend of Mirabeau, whose funeral oration he pronounced. He, with Rabaut Saint-Étienne and Grouvelle, founded the weekly sheet *La Feuille villageoise,* addressed to the villages of France to inform them of the progress of the Revolution.

On the *Mémoire pour le peuple français,* see F. A. Aulard in *La Révolution française,* tom. xv. (1888).

CERVANTES SAAVEDRA, MIGUEL DE (1547–1616), Spanish novelist, playwright and poet, was born at Alcalá de Henares. He was the second son of Rodrigo de Cervantes, an apothecary-surgeon, and Leonor de Cortinas. The exact date of Cervantes' birth is not recorded; he was baptized on Oct. 9, 1547, in the church of Santa María la Mayor at Alcalá. There are indications that Rodrigo de Cervantes resided at Valladolid in 1554, at Madrid in 1561, at Seville in 1564–65, and at Madrid from 1566 onwards. It may be assumed that his family accompanied him, and it seems likely that either at Valladolid or at Madrid Cervantes saw the famous actor-manager and dramatist, Lope de Rueda, of whose performances he speaks enthusiastically in the preface to his plays. In 1569 a Madrid schoolmaster, Juan López de Hoyos, issued a work commemorative of Philip II.'s third wife, Isabel de Valois, who had died on Oct. 3, 1568. This volume, entitled *Hystoria y relación verdadera de la enfermedad, felicissimo tránsito, y sumptuosas exequias fúnebres de la Serenissima Reyna de España Doña Isabel de Valoys, nuestra Señora,* contains six contributions by Cervantes: a sonnet, four redondillas, and an elegy. López de Hoyos introduces Cervantes as "our dear and beloved pupil," and the elegy is dedicated to cardinal Espinosa "in the name of the whole school." It has been inferred that Cervantes was educated by López de Hoyos, but this conclusion is untenable, for López de Hoyos' school was not opened till 1567. On Oct. 13, 1568, Giulio Acquaviva, reached Madrid charged with a special mission to Philip II.; he left for Rome on Dec. 2, and Cervantes is supposed to have accompanied him. This conjecture is based solely on a passage in the dedication of the *Galatea,* where the writer speaks of having been "camarero to cardinal Acquaviva at Rome." There is, however, no reason to think that Cervantes met Acquaviva in Madrid; the probability is that he enlisted as a supernumerary towards the end of 1568, that he served in Italy, and there entered the household of Acquaviva, who had been raised to the cardinalate on May 17, 1570. All that is known with certainty is that Cervantes was in Rome at the end of 1569, for on Dec. 22, of that year the fact was recorded in an official information lodged by Rodrigo de Cervantes with a view to proving his son's legitimacy and untainted Christian descent.

There is evidence, more or less, that he enlisted in the regular army in 1570; in 1571 he was serving as a private in the company commanded by Captain Diego de Urbina which formed part of Miguel de Moncada's famous regiment, and on Sept. 16 he sailed from Messina on board the "Marquesa," which formed part of the armada under Don John of Austria. At the battle of Lepanto (Oct. 7, 1571) the "Marquesa" was in the thickest of the conflict. As the fleet came into action Cervantes lay below, ill with fever; but, despite the remonstrances of his comrades he vehemently insisted on rising to take his share in the fighting and was posted with 12 men under him in a boat by the galley's side. He received three gunshot wounds, two in the chest, and one which permanently maimed his left hand—"for the greater glory of the right," in his own phrase. On Oct. 30, the fleet returned to Messina, where Cervantes went into hospital, and during his convalescence received grants-in-aid amounting to 82 ducats. On April 29, 1572 he was transferred to Captain Manuel Ponce de León's company in Lope de Figueroa's regiment; he shared in the indecisive naval engagement off Navarino on Oct. 7, 1572, in the capture of Tunis on Oct. 10, 1573, and in the unsuccessful expedition to relieve the Goletta in the autumn of 1574. The rest of his military service was spent in garrison at Palermo and Naples, and shortly after the arrival of Don John at Naples

on June 18, 1575, Cervantes was granted leave to return to Spain; he received a recommendatory letter from Don John to Philip II., and a similar testimonial from the duke de Sessa, viceroy of Sicily. Armed with these credentials, Cervantes embarked on the "Sol" to push his claim for promotion in Spain.

On Sept. 26, 1575, near Les Trois Maries off the coast of Marseilles, the "Sol" and its companion ships the "Mendoza" and the "Higuera" encountered a squadron of Barbary corsairs under Arnaut Mami; Cervantes, his brother Rodrigo and other Spaniards were captured, and were taken as prisoners to Algiers. Cervantes became the slave of a Greek renegade named Dali Mami, and, as the letters found on him were taken to prove that he was a man of importance in a position to pay a high ransom, he was put under special surveillance. In 1576 he induced a Moor to guide him and other Christian captives to Oran; the Moor deserted them on the road, the baffled fugitives returned to Algiers, and Cervantes was treated with additional severity. In the spring of 1577 two priests of the Order of Mercy arrived in Algiers with a sum of 300 crowns entrusted to them by Cervantes' parents; the amount was insufficient to free him, and was spent in ransoming his brother Rodrigo. Cervantes made another attempt to escape in Sept. 1577, but was betrayed by the renegade whose services he had enlisted. On being brought before Hassan Pasha, the viceroy of Algiers, he took the blame on himself, and was threatened with death; struck, however, by the heroic bearing of the prisoner, Hassan remitted the sentence, and bought Cervantes from Dali Mami for 500 crowns. In 1577 the captive addressed to the Spanish secretary of State, Mateo Vázquez, a versified letter suggesting that an expedition should be fitted out to seize Algiers; the project, though practicable, was not entertained. In 1578 Cervantes was sentenced to 2,000 strokes for sending a letter begging help from Martín de Córdoba, governor of Oran; the punishment was not, however, inflicted on him. Meanwhile his family were not idle. In March, 1578 his father presented a petition to the king setting forth Cervantes' services; the duke de Sessa repeated his testimony to the captive's merits; in the spring of 1579 Cervantes' mother applied for leave to export 2,000 ducats' worth of goods from Valencia to Algiers, and on July 31, 1579 she gave the Trinitarian monks, Juan Gil and Antón de la Bella, a sum of 250 ducats to be applied to her son's ransom. On his side Cervantes was indefatigable, and towards the end of 1579 he arranged to secure a frigate; but the plot was revealed to Hassan by Juan Blanco de Paz, a Dominican monk, who appears to have conceived an unaccountable hatred of Cervantes. Once more the conspirator's life was spared by Hassan, who, it is recorded, declared that "so long as he had the maimed Spaniard in safe keeping, his Christians, ships and city were secure." On May 29, 1580 the two Trinitarians arrived in Algiers: they were barely in time, for Hassan's term of office was drawing to a close, and the arrangement of any ransom was a slow process, involving much patient bargaining. Hassan refused to accept less than 500 gold ducats for his slave; the available funds fell short of this amount, and the balance was collected from the Christian traders of Algiers. Cervantes was already embarked for Constantinople when the money was paid on Sept. 19, 1580. The first use that he made of his liberty was to cause affidavits of his proceedings at Algiers to be drawn up; he sailed for Spain towards the end of October, landed at Denia in November, and made his way to Madrid. He signed an information before a notary in that city on Dec. 18, 1580.



PATIO OF CERVANTES' HOUSE

These dates prove that he cannot, as is often alleged, have served under Alva in the Portuguese campaign of 1580: that campaign ended with the battle of Alcántara on Aug. 25, 1580. It seems certain, however, that he visited Portugal soon after his return from Algiers, and in May 1581, he was sent from Thomar on a mission to Oran. Construed literally, a formal statement of his services, signed by Cervantes on May 21, 1590 makes it appear that he served in the Azores campaigns of 1582–83; but the wording of the document is involved, the claims of Cervantes are confused with those of his brother Rodrigo (who was promoted ensign at the Azores), and on the whole it is doubtful if he took part in either of the expeditions under Santa Cruz. In any case, the stories of his residence in Portugal, and of his love affairs with a noble Portuguese lady, who bore him a daughter, are simple inventions. From 1582–83 to 1587 Cervantes seems to have written copiously for the stage, and in the Adjunta al Parnaso he mentions several of his plays as "worthy of praise"; these were *El Trato de Argel, La Numancia, La Gran Turquesa, La Batalla naval, La Jerusalén, La Amaranta ó la de Mayo, El Bosque amoroso, La Unica y Bizarra Arsinda*—"and many others which I do not remember, but that which I most prize and pique myself on was and is, one called *La Confusa*, which, with all respect to as many sword-and-cloak plays as have been staged up to the present, may take a prominent place as being good among the best." Of these only *El Trato de Argel* and *La Numancia* have survived, and, though *La Numancia* contains many fine rhetorical passages, both plays go to prove that the author's genius was not essentially dramatic. In Feb. 1584 he obtained a licence to print a pastoral novel entitled *Primera parte de la Galatea*, the copyright of which he sold on June 14, to Blas de Robles, a bookseller at Alcalá de Henares, for 1,336 *reales*. On Dec. 12 he married Catalina de Palacios Salazar y Vozmediano of Esquivias, 18 years his junior. The *Galatea* was published in the spring of 1585. It was only twice reprinted—once at Lisbon (1590), and once at Paris (1611)—during the author's lifetime; but it won him a measure of repute; it was his favourite among his books, and during the 30 years that remained to him he repeatedly announced the second part which is promised conditionally in the text. However, it is not greatly to be regretted that the continuation was never published, though the *Galatea* is interesting as the first deliberate bid for fame on the part of a great genius. It is an exercise in the pseudo-classic literature introduced into Italy by Sannazaro, and transplanted to Spain by the Portuguese Montemōr; and, ingenious or eloquent as the Renaissance prose-pastoral may be, its innate artificiality stifles Cervantes' rich and glowing realism. He himself recognized its defects; with all his weakness for the *Galatea*, he ruefully allows that "it proposes something and concludes nothing." Its comparative failure was a serious matter for Cervantes who had no other resource but his pen; his plays were probably less successful than his account of them would imply, and at any rate play-writing was not at this time a lucrative occupation in Spain. No doubt the death of his father on June 13, 1585, increased the burden of Cervantes' responsibilities; and the dowry of his wife, as appears from a document dated Aug. 9, 1586, consisted of nothing more valuable than five vines, an orchard, some household furniture, four beehives, 45 hens and chickens, one cock and a crucible.

It had become evident that Cervantes could not gain his bread by literature, and in 1587 he went to Seville to seek employment in connection with the provisioning of the Invincible Armada. He was placed under the orders of Antonio de Guevara, and before Feb. 24 was excommunicated for excessive zeal in collecting wheat at Ecija. During the next few months he was engaged in gathering stores at Seville and the adjacent district, and after the defeat of the Armada he was retained as commissary to the galleys. Tired of the drudgery, and without any prospect of advancement, on May 21, 1590 Cervantes drew up a petition to the king, recording his services and applying for one of four posts then vacant in the American colonies; a place in the department of public accounts in New Granada, the governorship of Soconusco in Guatemala, the position of auditor to the galleys at Cartagena, or that of *corregidor* in the city of La Paz. The petition was referred to the Council of the Indies, and was annotated with the words: "Let him look for something nearer home." In Nov. 1590 he was in such straits that he borrowed money to buy himself a suit of clothes, and in Aug. 1592 his sureties were called upon to make good a deficiency of 795 *reales* in his accounts. His thoughts turned to literature once more, and on Sept. 5, 1592, he signed a

contract with Rodrigo Osorio undertaking to write six plays at 50 ducats each, no payment to be made unless Osorio considered that each of these pieces was "one of the best ever produced in Spain." Nothing came of this agreement, and it appears that, between the date of signing it and Sept. 19, Cervantes was imprisoned (for reasons unknown to us) at Castro del Río. He was speedily released, and continued to perquisition as before in Andalusía; but his literary ambitions were not dead, and in May 1595 he won the first prize (three silver spoons) at a poetical tourney held in honour of St. Hyacinth at Saragossa. Shortly afterwards Cervantes found himself in difficulties with the exchequer officials. He entrusted a sum of 7,400 *reales* to a merchant named Simón Freire de Lima with instructions to pay the amount into the treasury at Madrid; the agent became bankrupt and absconded, leaving Cervantes responsible for the deficit. By some means the money was raised, and the debt was liquidated on Jan. 21, 1597. But Cervantes' position was shaken, and his unbusinesslike habits lent themselves to misinterpretation. On Sept. 6, 1597 he was ordered to find sureties that he would present himself at Madrid within 20 days, and there submit to the exchequer vouchers for all official moneys collected by him in Granada and elsewhere. No such sureties being available, he was committed to Seville gaol, but was released on Dec. 1, on condition that he complied with the original order of the court within 30 days. He was apparently unable to find bail, was dismissed from the public service, and sank into extreme poverty. During a momentary absence from Seville in Feb. 1599, he was again summoned to Madrid by the treasury, but does not appear to have obeyed; it is only too likely that he had not the money to pay for the journey. There is some reason to think that he was imprisoned at Seville in 1602, but nothing positive is known of his existence between 1600 and Feb. 8, 1603: at the latter date he seems to have been at Valladolid, to which city Philip III. had removed the court in 1601.

Since the publication of the *Galatea* in 1585 Cervantes' contributions to literature had been limited to occasional poems. In 1591 he published a ballad in Andrés de Villalta's *Flor de varios y nuevos romances;* in 1595 he composed a poem, already mentioned, to celebrate the canonization of St. Hyacinth; in 1596 he wrote a sonnet ridiculing Medina Sidonia's tardy entry into Cadiz after the English invaders had retired, and in the same year his sonnet lauding Santa Cruz was printed in Cristóbal Mosquera de Figueroa's *Comentario en breve compendio de disciplina militar;* to 1597 is assigned a sonnet (the authenticity of which is disputed) commemorative of the poet Herrera; in 1598 he wrote two sonnets and a copy of quintillas on the death of Philip II.; and in 1602 a complimentary sonnet from his pen appeared in the second edition of Lope de Vega's *Dragontea.* Curiously enough, it is by Lope de Vega that *Don Quixote* is first mentioned. Writing to an unknown correspondent (apparently a physician) on Aug. 14, 1604, Lope de Vega says that "no poet is as bad as Cervantes, nor so foolish as to praise *Don Quixote,*" and he goes on to speak of his own plays as being odious to Cervantes. It is obvious that the two men had quarrelled since 1602, and that Lope de Vega smarted under the satire of himself and his works in Cervantes' forthcoming book; *Don Quixote* may have been circulated in manuscript, or may even have been printed before the official licence was granted on Sept. 26, 1604. It was published early in 1605, and was dedicated to the seventh duke de Béjar in phrases largely borrowed from the dedication in Herrera's edition (1580) of Garcilaso de la Vega, and from Francisco de Medina's preface to that work.

The mention of Bernardo de la Vega's *Pastor de Iberia* shows that the sixth chapter of *Don Quixote* cannot have been written before 1591. In the prologue Cervantes describes his masterpiece as being "just what might be begotten in a gaol"; on the strength of this passage, it has been thought that he conceived the story, and perhaps began writing it, during one of his terms of imprisonment at Seville between 1597 and 1602. Within a few weeks of its publication at Madrid, three pirated editions of *Don Quixote* were issued at Lisbon; a second authorized edition, imperfectly revised, was hurried out at Madrid; and another reprint appeared at Valencia with an *aprobacion* dated July 18, 1605. With the exception of Alemán's *Guzmán de Alfarache,* no Spanish book of the period was more successful. Modern criticism is prone to regard *Don Quixote* as a symbolic, didactic or controversial work intended to bring about radical reforms in Church and State. Such interpretations did not occur to Cervantes' contemporaries, nor to Cervantes himself. There is no reason for rejecting his plain statement that his main object was to ridicule the romances of chivalry, which in their latest developments had become a tissue of tiresome absurdities. It seems clear that his first intention was merely to parody these extravagances in a short story; but as he proceeded the immense possibilities of the subject became more evident to him, and he ended by expanding his work into a brilliant panorama of Spanish society as it existed during the 16th century. Nobles, knights, poets, courtly gentlemen, priests, traders, farmers, barbers, muleteers, scullions and convicts; accomplished ladies, impassioned damsels, Moorish beauties, simple-hearted country girls and kindly kitchen-wenches of questionable morals—all these are presented with the genial fidelity which comes of sympathetic insight. The immediate vogue of *Don Quixote* was due chiefly to its variety of incident, to its wealth of comedy bordering on farce, and perhaps also to its keen thrusts at eminent contemporaries; its reticent pathos, its large humanity, and its penetrating criticism of life were less speedily appreciated.

Meanwhile on April 12, 1605, Cervantes authorized his publisher to proceed against the Lisbon booksellers who threatened to introduce their piratical reprints into Castile. By June the citizens of Valladolid already regarded Don Quixote and Sancho Panza as proverbial types. Practically nothing is known of Cervantes' life between 1605 and 1608. A *Relación* of the festivities held to celebrate the birth of Philip IV., and a certain *Carta á don Diego Astudillo Carrillo* have been erroneously ascribed to him; during these three years he apparently wrote nothing beyond three sonnets, and one of these is of doubtful authenticity. The depositions of the Valladolid enquiry show that he was living in poverty five months after the appearance of *Don Quixote,* and the fact that he borrowed 450 *reales* from his publisher before Nov. 1607 would convey the idea that his position improved slowly, if at all. But it is difficult to reconcile this view of his circumstances with the details concerning his illegitimate daughter revealed in documents recently discovered. Isabel de Saavedra was stated to be a spinster when arrested at Valladolid in June, 1605; the settlement of her marriage with Luis de Molina in 1608 describes her as the widow of Diego Sanz, as the mother of a daughter eight months old, and as owning house-property of some value. These particulars are perplexing, and the situation is further complicated by the publication of a deed in which Cervantes declares that he himself is the real owner of this house property, and that his daughter has merely a life-interest in it. This claim may be regarded as a legal fiction; it cannot easily be reconciled with Cervantes' statement towards the end of his life, that he was dependent on the bounty of the count de Lemos and of Bernardo de Sandoval, cardinal-archbishop of Toledo. In 1609 he joined the newly founded confraternity of the Slaves of the Most Blessed Sacrament; in 1610 Lemos was appointed viceroy of Naples, and Cervantes was keenly disappointed at not being chosen to accompany his patron. In 1611 he joined the Academia Selvaje, and there appears to have renewed his former friendly relations with Lope de Vega; in 1613 he dedicated his *Novelas exemplares* to the count de Lemos, and disposed of his rights for 1,600 *reales* and 24 copies of the book. The 12 tales in this volume, some of them written very much later than others, are of unequal merit, but they contain some of the writer's best work, and the two picaresque stories—*Rinconete y Cortadillo* and the *Coloquio de los perros*—are superb examples of their kind, and would alone entitle Cervantes to take rank with the greatest masters of Spanish prose. In 1614 he published the *Viage del Parnaso,* a burlesque poem suggested by the *Viaggio in Parnaso* (1582) of the Perugian poet Cesare Caporali. It contains some interesting autobiographical passages, much flattery of contemporary poetasters, and a few happy satirical touches; but, though

it is Cervantes' most serious bid for fame as a poet, it has seldom been reprinted, and would probably have been forgotten but for an admirably humorous postscript in prose which is worthy of the author at his best. In the preface to his *Ocho comedias y ocho entremeses nuevos* (1615) he good-humouredly admits that his dramatic works found no favour with managers, and, when this collection was first reprinted (1749), the editor advanced the fantastic theory that the *comedias* were deliberate exercises in absurdity, intended to parody the popular dramas of the day. This view cannot be maintained, but a sharp distinction must be drawn between the eight set plays and the eight interludes; with one or two exceptions, the *comedias* or set plays are unsuccessful experiments in Lope de Vega's manner, while the *entremeses* or interludes, particularly those in prose, are models of spontaneous gaiety and ingenious wit.

In the preface to the *Novelas exemplares* Cervantes had announced the speedy appearance of the sequel to *Don Quixote* which he had vaguely promised at the end of the first part. He was at work on the 59th chapter of his continuation when he learned that he had been anticipated by Alonso Fernandez de Avellaneda of Tordesillas, whose *Segundo tomo del ingenioso hidalgo don Quixote de la Mancha* was published at Tarragona in 1614. On the assumption that Fernandez de Avellaneda is a pseudonym, this spurious sequel has been ascribed to the king's confessor, Luis de Aliaga, to Cervantes' old enemy, Blanco de Paz, to his old friend, Bartolomé Leonardo de Argensola, to the three great dramatists, Lope de Vega, Tirso de Molina and Ruiz de Alarcón, to Alonso Fernandez, to Juan José Martí, to Alfonso Lamberto, to Luis de Granada, and probably to others. Some of these attributions are manifestly absurd (for example, Luis de Granada died 17 years before the first part of *Don Quixote* was published) and all of them are improbable conjectures; if Avellaneda be not the real name of the author, his identity is still undiscovered. His book is not devoid of literary talent and robust humour, and possibly he began it under the impression that Cervantes was no more likely to finish *Don Quixote* than to finish the *Galatea*. He should, however, have abandoned his project on reading the announcement in the preface to the *Novelas exemplares;* what he actually did was to disgrace himself by writing an insolent preface taunting Cervantes with his physical defects, his moral infirmities, his age, loneliness and experiences in gaol. He was too intelligent to imagine that his continuation could hold its own against the authentic sequel, and malignantly avowed his intention of being first in the field and so spoiling Cervantes' market. It is quite possible that *Don Quixote* might have been left incomplete but for this insulting intrusion; Cervantes was a leisurely writer and was, as he states, engaged on *El Engaño á los ojos, Las Semanas del Jardín* and *El Famoso Bernardo,* none of which has been preserved. Avellaneda forced him to concentrate his attention on his masterpiece, and the authentic second part of *Don Quixote* appeared towards the end of 1615. The last 14 chapters are damaged by undignified denunciations of Avellaneda; but, apart from this, the second part of *Don Quixote* is an improvement on the first. The humour is more subtle and mature; the style is of more even excellence; and the characters of the bachelor and of the physician, Pedro Recio de Agüero, are presented with a more vivid effect than any of the secondary characters in the first part. Cervantes had clearly profited by the criticism of those who objected to "the countless cudgellings inflicted on Señor Don Quixote," and to the irrelevant interpolation of extraneous stories in the text. Don Quixote moves through the second part with unruffled dignity; Sancho Panza loses something of his rustic cunning, but he gains in wit, sense and manners. The original conception is unchanged in essentials, but it is more logically developed, and there is a notable progress in construction. Cervantes had grown to love his knight and squire, and he understood his own creations better than at the outset; more completely master of his craft, he wrote his sequel with the unfaltering confidence of a renowned artist bent on sustaining his reputation.

The first part of *Don Quixote* had been reprinted at Madrid in 1608; it had been produced at Brussels in 1607 and 1611, and at Milan in 1610; it had been translated into English in 1612 and into French in 1614. Cervantes was celebrated in and out of Spain, but his celebrity had not brought him wealth. The members of the French special embassy, sent to Madrid in Feb. 1615, under the Commandeur de Sillery, heard with amazement that the author of the *Galatea,* the *Novelas exemplares* and *Don Quixote* was "old, a soldier, a gentleman and poor." He now worked assiduously at *Los Trabajos de Persiles y Sigismunda,* which, as he had jocosely prophesied in the preface to the second part of *Don Quixote,* would be "either the worst or the best book ever written in our tongue." It is the most carefully written of his prose works, and the least animated or attractive of them; signs of fatigue and of waning powers are unmistakably visible. On April 18, 1616, Cervantes received the sacrament of extreme unction; next day he wrote the dedication of *Persiles y Sigismunda* to the count de Lemos—the most moving and gallant of farewells. He died at Madrid in the Calle del León on April 23; he was borne from his house "with his face uncovered," according to the rule of the Tertiaries of St. Francis, and on April 24 was buried in the church attached to the convent of the Trinitarian nuns in the Calle de Cantarranas. There he rests (the story of his remains being removed in 1633 to the Calle del Humilladero has no foundation in fact) but the exact position of his grave is unknown. Early in 1617 *Persiles y Sigismunda* was published, and passed through eight editions within two years; but the interest in it soon died away, and it was not reprinted between 1625 and 1719. Cervantes' wife died without issue on Oct. 31, 1626; his natural daughter, who survived both the child of her first marriage and her second husband, died on Sept. 20, 1652. Cervantes is represented solely by his works. The *Novelas exemplares* alone would give him the foremost place among Spanish novelists; *Don Quixote* entitles him to rank with the greatest writers of all time: "children turn its leaves, young people read it, grown men understand it, old folk praise it." It has outlived all changes of literary taste, and is even more popular to-day than it was three centuries ago.

BIBLIOGRAPHY.—L. Rius *Bibliografía crítica de las obras de Miguel de Cervantes Saavedra* (1895–1905); *Obras completas,* ed. R. Academia Esp. (1917–23); ed. R. Schevill and A. Bonilla-San Martín (1914–23); *Complete Works* (Glasgow, 1901–06)—ed. James Fitzmaurice-Kelly; *Don Quijote* (Madrid, 1916–17), ed. F. Rodríguez Marín; *Don Quixote* (London, 1898–99), ed. James Fitzmaurice-Kelly and John Ormsby; *Novelas ejemplares,* ed. F. Rodríguez Marín (1914–17); *Entremeses,* ed. E. Cotarelo y Mori (1911).—*See:* A. Morel-Fatio *L'Espagne de Don Quichotte* in *Études sur l'Espagne* (1895, 2me serie); R. Foulché-Delbosc *Étude sur "La tia fingida,"* in the *Revue hispanique* (1899), vol. vi. pp. 256–306; Julián Apraiz *Estudio histórico-crítico sobre las Novelas ejemplares de Cervantes* (1901); Francisco A. de Icaza *Las Novelas ejemplares de Cervantes* (1901); Francisco Rodríguez Marín *El Loaysa de "El Celoso Extremeño"* (Sevilla, 1901); P. Groussac *Une Énigme littéraire; le Don Quichotte d'Avellaneda* (1903); Alonso Fernández de Avellaneda *El ingenioso hidalgo Don Quixote de la Mancha* (Barcelona, 1905)—ed. M. Menéndez y Pelayo; J. Cejador y Frauca *La Lengua de Cervantes* (1905–06); C. Pérez Pastor *Documentos Cervantinos hasta ahora inéditos* (1897–1902); J. Fitzmaurice-Kelly *Miguel de Cervantes Saavedra, A Memoir* (1913); F. Rodríguez Marín *Nuevos documentos cervantinos hasta ahora inéditos* (1914); J. Fitzmaurice-Kelly *Cervantes and Shakespeare* (1916); R. Schevill *Cervantes* (1919); Miguel de Unamuno *The Life of Don Quixote and Sancho* (1914; Eng. trans., 1927). (J. F.-K.)

CERVERA, PASCUAL CERVERA Y TOPETE (1839–1909), Spanish admiral, was born at Medina Sidonia. As a sub-lieutenant he took part in the naval operations on the coast of Morocco during the campaign of 1859–60. Then he was engaged in operations in the Sulu Islands and the Philippines, and afterwards on the West Indian station during the first Cuban War (1868–78), returning to Spain in 1873 to serve on the Basque coast against the Carlists. He distinguished himself in defending the Carraca arsenal near Cadiz against the Federals in 1873. He became minister of marine in 1892, in a cabinet presided over by Sagasta, but he withdrew from the cabinet when he found that his colleagues, from political motives, declined to support his reforms and, on the other hand, unwisely cut down the naval estimates. When in 1898 the Spanish-American War (*q.v.*) broke out, he was chosen to command a squadron composed of four first-class cruisers, which was totally destroyed by the superior

forces of the enemy. After the war, Cervera and his captains were honourably acquitted by the supreme naval and military court of the realm. In 1901 he became vice-admiral, in 1902 chief of staff of the Spanish navy, and in 1903 was made life senator.

See A. Risco, *Apuntes Biograficos del Cervera y Topete* (Toledo, 1920).

CESAREVICH (better TSESAREVICH), the title until 1917 of the heir-apparent to the Russian throne. The full official title was *Nasliednik Tsarevich; i.e.*, "heir of Caesar," and in Russian the heir to the throne was commonly called simply *Nasliednik*, the word *Tsarevich* never being used alone. *Tsarevich* means any son of the emperor. The Cesarewitch handicap race at Newmarket, founded in 1839, was named after the prince, afterwards Alexander II. of Russia, who paid a state visit to England that year.

CESARI, GIUSEPPE (1568?–1640), called Il Cavaliere d'Arpino, also Il Giuseppino, Italian painter, born in Rome. His father was a native of Arpino. Cesari ranks as the head of the so-called "Idealists" of his period, as opposed to the "Naturalists," of whom Michelangelo da Caravaggio was the leader. Lanzi stigmatized Cesari as not less the corrupter of taste in painting than Marino was in poetry. The defects of drawing and perspective in his work may be seen in his frescoes in the Capitol at Rome, which occupied him at intervals during 40 years. He died in Rome in 1640. His brother Bernardino assisted in many of his works.

CESAROTTI, MELCHIORE (1730–1808), Italian poet, was born on May 15, 1730, at Padua, where he held the chair of rhetoric, and in 1768 the professorship of Greek and Hebrew. Cesarotti is best known as the author of an admirable translation (2 vols., 1763) of Ossian, which raised up many imitators of the Ossianic style. He also produced a number of prose works on aesthetics. He died at Padua on Nov. 3, 1808.

See the complete edition of his works (42 vols., Pisa, 1800–13); G. F. Barbieri, *Memoirs* (Padua, 1810); L. Alemanni, *Un Filosofo delle lettere* (Turin, 1894).

CESENA (anc. CAESENA), a town and episcopal see of Emilia, Italy, province of Forlì, 12m. S.E. by rail from the town of Forlì, on the line between Bologna and Rimini, 144ft. above sea-level. Pop. (1936) 20,043 (town); 61,314 (commune). The town is at the foot of the Apennines, and is crowned by a mediaeval fortress (Rocca). The fine early Renaissance library was built for Domenico Malatesta in 1452 by Matteo Nuti, and its internal arrangements, with the original desks to which the books are still chained, are well preserved. It also contains a picture gallery. There are some fine palaces in the town. On the hill to the south-east the handsome church of S. Maria del Monte, after the style of Bramante, has carved stalls of the 16th century. The ancient Caesena was a station on the Via Aemilia and a fortress in the wars of Theodoric and Narses. In 1357 it was unsuccessfully defended by the wife of Francesco Ordelaffi, lord of Forlì, against the papal troops under Albornoz. In 1377 it was sacked by Cardinal Robert of Geneva (afterwards Clement VII., antipope). It was then held by the Malatesta of Rimini until 1465, when it came under the dominion of the Church. Both Pius VI. (1717) and Pius VII. (1742) were born at Cesena.

CESNOLA, LUIGI PALMA DI (1832–1904), Italian-American soldier and archaeologist, was born at Rivarolo, near Turin, Italy, on July 29, 1832, of an ancient but impoverished family. Educated for a military career, he served with distinction against Austria (1848–49) and in the Crimean war, and going to New York in 1860, founded there a training school for army officers. He fought in the American Civil War as colonel of a New York cavalry regiment, received mention for bravery in several encounters, was wounded and imprisoned, and after the war was brevetted brigadier-general. Renouncing his Italian titles, he received a presidential appointment as U.S. consul to Cyprus (1865–77), where he made extensive excavations of ancient pottery at Larnaca and Salinos, and verified and surveyed the sites of Paphos, Soli and Pali. In 1872 the New York Metropolitan Museum purchased his collection, which became the nucleus for subsequent extensive acquisitions. In 1879 he was appointed director of the museum, a post which he filled until his death, and in which he displayed foresight and energy. The authority of his restorations was questioned in an article in the *New York Herald* (Aug. 1880), but the question, on being referred to a special committee, was decided in his favour. In 1897 he received a Congressional medal of honour for conspicuous military services. He died in New York on Nov. 21, 1904. He is the author of *Cyprus, Its Ancient Cities, Tombs, and Temples* (1877), and of a *Descriptive Atlas of the Cesnola Collection of Cypriote Antiquities* (1884–86). His brother, Alessandro Palma di Cesnola, born in 1839, conducted excavations at Paphos (where he was U.S. vice-consul) and Salamis, on behalf of the British Government. These are described in *Salaminia* (1882). (*See* CYPRUS.)

For the Cesnola controversy, *see* D. D. Cobham's *Attempt at a Bibliography of Cyprus* (4th ed., 1900). (W. B. P.)

CESPEDES (in Ital. CEDASPE), **PABLO DE** (1538–1608), Spanish poet, painter, sculptor and architect, was born at Cordova and educated at Alcalá de Henares, where he studied theology and oriental languages. On leaving the university he went to Rome, where he became the pupil and friend of Federigo Zuccaro, under whose direction he studied particularly the works of Raphael and Michelangelo. In 1560, while he was yet in Rome, proceedings were taken against him by the Inquisition at Valladolid, but they were dropped. He returned to Spain a little before 1577 and received a prebend of the cathedral at Cordova, where he resided till his death. Cristobal de Vera, Juan de Peñalosa and Zambrano were among his pupils. His best picture is a "Last Supper" at Cordova, but there are good examples of his work at Seville and at Madrid. Cespedes was author of several opuscules in prose on subjects connected with his profession. His poem on "The Art of Painting," partly preserved by Pacheco, is esteemed the best didactic verse in Spanish. It contains a glowing eulogy of Michelangelo. The few remaining fragments were first printed by Pacheco in his treatise *Del arte de la pintura*, in 1649.

CÉSPEDES Y MENESES, GONZALO DE (1585?–1638), Spanish novelist, was born at Madrid, and published his celebrated romance, the *Poema trágico del Español Gerardo, y desengaño del amor lascivo* in 1615–17. His treatment of political questions in the *Historia apologética en los sucesos del reyno de Aragón, y su ciudad de Zaragoza, años de 91 y 92* (1622), having led to the confiscation of the book, Céspedes took up his residence at Saragossa and Lisbon. While in exile he issued a collection of short stories entitled *Historias peregrinas y exemplares* (1623), and wrote the first part of his *Historia de Felipe IV.* (1631), a fulsome eulogy which was rewarded by the post of official historiographer to the Spanish king. Céspedes died on Jan. 27, 1638. His novels, though written in an affected style, display considerable imagination and insight into character. The *Poema trágico* was utilized by Fletcher in *The Spanish Curate* and *The Maid of the Mill.*

The *Historias peregrinas* had been reprinted (1906) with a valuable introduction by Sr. Cotarelo y Mori.

CESS, a term formerly more particularly applied to local taxation, in which sense it still is used in Ireland; otherwise it has been superseded by "rate." In India it is applied, with the qualifying word prefixed, to any taxation, such as "irrigation-cess" and the like, and in Scotland to the land-tax. The word is a shortened form of "assess"; and the spelling is due to a mistaken connection with "census."

CESSIO BONORUM, in Roman law, a voluntary surrender of goods by a debtor to his creditors. It did not amount to a discharge unless the property ceded was sufficient for the purpose, but it secured the debtor from personal arrest. The creditors sold the goods in satisfaction, *pro tanto*, of their claims. The procedure of *cessio bonorum* avoided infamy, and the debtor, though his after-acquired property might be proceeded against, could not be deprived of the bare necessaries of life. The main features of the Roman law of *cessio bonorum* were adopted in Scots law, and also in the French and several other legal systems. In England it exists under the internal regulations of certain commercial bodies, such as the recognized Stock Exchanges. In Scotland the

process of *cessio bonorum* was abolished by the Bankruptcy (Scotland) Act 1913. (*See* further, BANKRUPTCY.)

CESTI, MARC' ANTONIO (1618–1669), Italian musical composer, was born at Florence (or according to some authorities at Arezzo) in 1618. He was a pupil of Carissimi, and is known principally as a composer of operas, notable for the pure and delicate style of their airs, the most celebrated of which were *La Dori* (Venice, 1663) and *Il Pomo d' oro* (Vienna, 1668).

CESTIUS, LUCIUS, surnamed PIUS, Latin rhetorician, was a native of Smyrna, a Greek by birth. According to Jerome, he was teaching Latin at Rome in the year 13 B.C. As an orator in the schools he enjoyed a great reputation. As a public orator, on the other hand, he was a failure. Specimens of his declamations will be found in the works of Seneca the rhetorician.

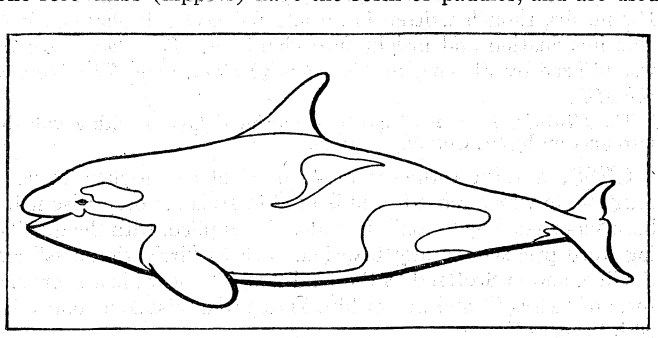
See Seneca, *Controv.*, ix. 3, 12; J. Brzoska, in Pauly-Wissowa's *Realencyklopädie,* iii. 2 (1899) and *Suasoriae,* vii. 13 (for anecdotes).

CESTODA: *see* TAPEWORMS.

CESTUI, CESTUY: *see* TRUST AND TRUSTEES.

CETACEA, an order of mammals (from the Gr. *κῆτος,* a whale), divisible into three suborders:—Archaeoceti, exclusively fossil; Mystacoceti, whalebone whales; and Odontoceti, toothed whales, comprising sperm whales, bottle-nosed whales and dolphins. The term "whale" does not indicate a natural division of the order, and it is used here to mean any member of the Cetacea, irrespective of size. The lengths of these animals are mostly between 4 and 100 feet. Their ancestors were probably land mammals, whose structure has been modified in many respects to adapt them for life in the water, from birth to death. Whales are warm-blooded, breathing air by lungs, without scales in their skin, with hands of the 5-fingered type, with skeleton, brain, heart and blood-vessels mammalian in structure, reproducing like other mammals and nourishing their young with milk; in all these respects differing essentially from fishes, to which they have a merely superficial resemblance. Certain species swim habitually in large schools. A few live entirely in fresh water. The majority are marine, some frequenting the coasts, but others oceanic, rarely approaching land. Many undertake extensive migrations and have a wide distribution. Whales have been known to follow a ship for several consecutive days, and Racovitza has used this as an argument for the view that they do not sleep.

External Form (fig. 1.).—Whales swim mainly by the tail, which is produced into two horizontal flukes, not supported by any part of the skeleton, and are thus easily distinguished from fishes, in which the tail is vertical. A dorsal fin, similarly without skeleton, is generally present. The mouth has immovable lips. The fore limbs (flippers) have the form of paddles, and are used



AFTER LUTKEN

FIG. 1.—KILLER (GRAMPUS ORCA), THE LARGEST OF THE DOLPHINS

principally for maintaining the balance of the body and for steering. External hind limbs are wanting. The neck is short and rarely distinguishable in the living animal. The nostrils (blowholes) have been shifted to the upper side of the head, at some distance from the tip of the snout or beak (except in the sperm whale). The part in front of the blowhole may resemble a forehead, but it really belongs to the beak. Eyes are well developed, but there are no external ears and the outer opening of the ear is minute. The skin is smooth, hairs being usually absent in the adult, except as occasional vestiges. The vent is at the root of the tail, behind the reproductive opening, on either side of which, in the female, is a groove containing a teat. The umbilicus (navel) is often visible farther forwards, especially in young individuals.

Other Distinguishing Characters.—The brain-case is short and lofty; the nasal canals pass nearly vertically downwards in front of it, and the facial part is prolonged horizontally forwards as a rostrum. The auditory bones are highly modified; the tympanics are shell-like and loosely attached to the skull. The neck vertebrae are of the typical mammalian number (7), short, often fusing with one another; the second, if free, has no prominent odontoid process, the structure on which the head turns in other mammals. The lumbar and caudal vertebrae are freely movable, the interlocking processes of their upper arches disappearing from the thorax backwards. The ribs are very movable on the vertebrae and sternum (breast-bone). The clavicles (collar-bones) are wanting. The flippers show no external division into hand, fore arm and upper arm, and are without definite joints at the elbow and wrist. They contain the typical mammalian bones, but the finger-joints (phalanges) are more numerous in some of the digits than in other mammals. Digits are 5 or 4 without nails. The pelvis is represented by a small curved bone on each side, embedded in the flesh near the reproductive opening; it does not articulate with the vertebral column, which has no fused sacral vertebrae. In right whales and the sperm whale each half may carry a small bony or cartilaginous vestigial hind limb. The brain is large, its cerebral hemispheres much convoluted. Olfactory organs are almost absent, the nasal passages being functionally continuous with the larynx. The diaphragm is very oblique, the stomach has several distinct chambers. The main arteries and veins break up into plexuses of vessels known as *retia mirabilia.* The kidneys are lobulated. The male organ is usually completely retracted, thus not interrupting the smooth contour of the body. The testes are within the abdomen, the uterus bicornuate, the placenta diffuse.

Respiration.—A large whale usually rises to breathe every 5–10 minutes, but the interval may be at least 45 minutes. The blowholes (fig. 2) are either two longitudinal slits (whalebone whales) or a single crescentic slit (toothed whales). On reaching the surface, the whale exposes and opens its nostrils, which are closed during submergence, and discharges the exhausted air from its lungs. This is done with considerable force, often producing an audible sound, and the animal is said to blow. The moist air projected upwards is visible from a long distance, in the case of the larger whales, as a column containing particles of condensed water (the spout) formerly regarded as a fountain of water ejected from the head. Expiration is followed immediately by inspiration, and the whale then sinks horizontally. It repeats these actions several times, rising to the surface on each occasion without exposing much more than the part of its head which carries the blowholes. When it has thus thoroughly changed the air in its lungs, it rises in a different manner. The back is strongly arched and much of it becomes visible. The back fin, if present, appears to be situated on a rotating wheel, rising from behind, reaching the summit of the arched back and descending into the water in front. The whale then leaves the surface and is said to sound. The maximum depth of its dive has been supposed to be at least 100 fathoms. The right whales, humpback and sperm whale (but not the rorquals) usually throw their tails above the surface as they sound; and at other times, like many of the dolphins, they leap completely clear of the water. Differences in these respects, and in the form and direction of the spout, enable whalers to distinguish species.

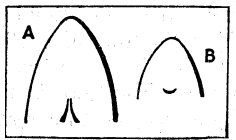


FIG. 2. — BLOWHOLES, FROM ABOVE
A. Whalebone whale
B. Dolphin

The horizontal position of the tail-flukes facilitates rising to the surface and returning to the depths, movements of vital importance to the Cetacea. Another effective adaptation to aquatic life is the course taken by the air in passing to the lungs. The larynx and epiglottis form a tube passing through the pharynx into the lower end of the nasal passages (fig. 3). Here it is grasped by the soft palate, and the blowholes thus become continuous with the

windpipe and lungs, the mouth being used solely for feeding—as in recently born marsupials, but not as in other adult mammals, which can breathe through either the nose or the mouth.

Prolonged submergence involves other demands on the respiratory organs. The thoracic cavity of the Cetacea is unusually extensible, and thus provides for a corresponding expansion of the lungs, depending on the loose attachments of the ribs and the

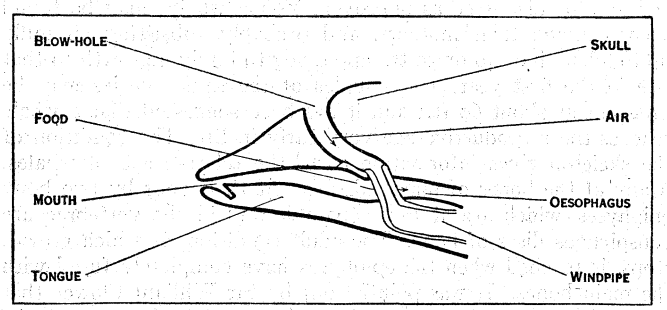


FIG. 3.—MEDIAN SECTION OF THE HEAD OF A PORPOISE, TO SHOW THE COURSE TAKEN BY AIR AND BY THE FOOD

considerable projection of the oblique diaphragm into the cavity of the contracted thorax. Whales have a larger amount of blood, in proportion to their size, than other mammals, and this involves an increased capacity for carrying oxygen to the tissues by means of haemoglobin, the red colouring matter. The very deep red colour of the muscles seems to imply that these structures also hold a specially large quantity of oxygen. The characteristic retia mirabilia are further adaptations. In the common porpoise, for instance, the upper and lateral parts of the thorax are covered by an elaborate arterial rete mirabile, lying just outside its lining membrane. Branches of this plexus extend upwards into the neural canal of the vertebral column, an arrangement which ensures an adequate supply of oxygen to the spinal cord and brain. Although physiological evidence cannot be quoted, the retia mirabilia probably act as reservoirs, the arterial portions containing a large supply of oxygen, the amount of which may largely influence the duration of submergence. The venous portions probably hold exhausted blood, which would otherwise circulate too freely. The principal danger to which a diver is exposed is the liberation of gas-bubbles into his blood, due to diminishing water-pressure, if the ascent to the surface is too rapid. The retia may perhaps have the function of retaining bubbles and of preventing their access to the general circulation.

Hair.—Whales maintain a constant high temperature, not very different from that of man. A hairy coat has been discarded, as a means of avoiding the loss of heat, in favour of blubber; but a few vestigial hairs may occur—an unmistakable sign of the origin of Cetacea from land mammals. In *Inia* numerous scattered hairs occur on the beak. Whalebone whales have hairs, in *Rhachianectes* up to 40 mm. long, on parts of the head and lower jaw; and in dolphins a few long hairs are found on the beak, before birth.

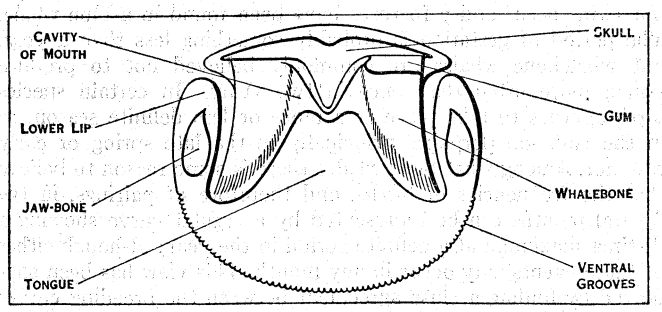
Skin and Colour.—The outer, horny layer of the epidermis is thin and readily separates from the body after death. The deeper layer is nearly always pigmented in certain parts, which then appear black, or varying shades of gray, brown or blue. The commonest type of colouration is dark above and white below, the relative extent of these regions varying with the species, the white area sometimes increasing with age. Many dolphins have a black streak extending from the eye to the flipper, perhaps representing the lower limit of the ancestral dark region. Some whales are completely black or white. In certain cases the normal white is replaced by a bright yellow colour. A. G. Bennett found that in Antarctic rorquals this is due to an external film composed of an enormous number of diatoms. These unicellular algae were found all over the skin, but were not conspicuous on the dark parts. In the common porpoise and its allies the skin of the edge of the dorsal fin or flippers bears a series of small, horny tubercles, which have been considered by some authors to indicate an affinity to Edentate mammals, a conclusion not universally accepted. The deeper part of the skin (dermis) is usually inconspicuous, but is better developed in the Delphinapterinae. The white whale, belonging to this subfamily, has a thick epidermis and a rather thinner dermis, and its skin has been used commercially as "porpoise leather."

Blubber.—This characteristic part of a cetacean is formed of tough fibrous tissue enclosing an enormous amount of oil. It invests every part of the whale, but is thicker in certain regions, for instance near the dorsal fin. In the sperm whale the maximum thickness is as much as 14 in., and in the Greenland whale 20 inches. In the latter, according to Scoresby, 4 tuns of blubber, by volume, yield 3 tuns of oil. In a whale of 70 tons the blubber weighs about 30 tons, and 2 tuns of oil may be extracted from each of the gigantic lower lips. The blubber of the rorquals now hunted is thinner, and in the smaller dolphins it does not much exceed one inch. Although specially important in retaining heat, the insulating properties of this layer probably afford protection against an excess of warmth in tropical waters. Blubber is little developed in newly born whales, and perhaps for this reason the parent resorts to warmer water to give birth to her young. It varies in condition at different times, a whale being often lean on its first arrival in polar seas, where the blubber improves in quality owing to the large amount of food found in those waters. The stomachs of whales captured in temperate latitudes are sometimes empty, and blubber is probably a reserve material which can be drawn on when food is scarce. It may further help materially to prevent the crushing of the tissues, during a deep dive, by the enormous pressure of the superjacent water.

Food.—Dolphins typically eat fishes, to which diet they are adapted by their teeth, generally numerous and uniformly conical; but cuttlefish also may be eaten. The stomach of a species of *Sotalia* has been found to contain vegetable matter. The Killer is exceptional in eating marine mammals and birds, in addition to fishes. The sperm whale and the bottle-nosed whales (Ziphiidae) are mainly dependent on cuttlefish, some of which must be obtained at considerable depths; but these also take occasional fishes. A diet of cuttlefish is often associated with a reduction of the number of teeth, in certain dolphins, the sperm whale and the Ziphiidae.

Whalebone.—The whalebone whales feed exclusively on plankton (*q.v.*), including fishes. They obtain food by means of a whalebone sieve, and the adequacy of the method may be estimated by the fact that two tons of plankton have been taken from the stomach of a blue whale. Plankton is specially abundant in the cold waters of both polar regions, and whales visit them to profit by this plenty.

Whalebone or baleen is derived from the skin lining the mouth and has nothing to do with true bone. The sieve is composed of



AFTER DELAGE

FIG. 4.—TRANSVERSE SECTION OF A RORQUAL'S HEAD TO SHOW WHALEBONE

two sides, each running longitudinally along the entire length of the outermost part of the palate, and being continuous with its fellow at the front of the beak. A side consists of as many as 300–400 transversely placed, flexible, and horny blades, embedded at their base in a substance known as the gum, and with a short interval between each two. The blades are longest and widest at the middle of the series and progressively smaller towards both ends, where they become very short. Seen from the front or back, an isolated blade appears roughly triangular (fig. 4), the shortest side embedded in the gum, the outer border straight, and the inner

border slightly convex. On the inner aspect of each principal blade is a transverse row of a few very short blades; and all the blades are produced into long hairlike structures, composed of the same substance as the whalebone itself. Owing to the presence of these hairs, the sieve, seen from its inner side, resembles a doormat or the fleece of a sheep. Between the two sieves lies the tongue, which is of immense size, in contrast with the much smaller tongue of the toothed whales.

The two halves of the lower jaw are greatly arched outwards, the mouth being thus enormous. The blades are bent backwards by the closure of the mouth, recovering a vertical position, by their own elasticity, as it opens. The great lower lip overlaps the outer edges of the blades, and the water must thus escape from the mouth through the chinks between these structures. The whale feeds, after sounding, by swimming through a shoal of plankton with its mouth open. Water enters at the front end; and, before it leaves, the food has been strained off by the hairy fringes of the baleen plates. The mouth is then closed, the tongue having no doubt helped to force out the water, while licking the food off the sieve. The characters of the baleen afford one of the most convenient ways of distinguishing species of whalebone whales. The blades are longest in the Greenland whale, where they may reach the astonishing length of 15 feet.

Sense Organs.—The olfactory organs are greatly reduced, and it is doubtful whether whales have the sense of smell. The nasal passages, however, are of vital importance, since they serve as the sole method of admitting air to the lungs. The eyes are small, with arrangements for withstanding water pressure. W. Scoresby stated that vision is acute in the Greenland whale, which is dull of hearing in the air, but is readily alarmed by even a slight splashing in the water. The external auditory passage is narrow and opens by a minute hole on the head, not far behind the eye. In whalebone whales it is blocked by a large mass of wax, several inches in length, and it cannot be of much service in hearing. It is believed that vibrations in the water reach the ear through sacs given off by the Eustachian tubes or through the bones and other tissues of the head. The tympanic bones are dense and conchlike, well developed and attached to the periotic by two slender pedicles. There can be little doubt that the auditory organs are of real importance.

Breeding.—The Cetacea are in all respects typically mammalian in their reproduction. The young is nourished in the uterus by a placenta, and is not born until it has attained a form essentially that of the adult, sometimes exceeding one-third the length of the mother. In the common porpoise ($5\frac{1}{2}$ ft.) the newly born young is about 2 ft. long, and in the largest whalebone whales at least 20 feet. A single young is typically produced, but twins occur and 7 foetuses have been found in a blue whale. The period of gestation is probably something less than a year, but whalebone whales are commonly believed not to produce young more often than once in two years. In certain species birth appears to take place at a more or less definite season, as in the common porpoise, principally in the late spring or early summer. Among whalebone whales there is some reason to believe that the frequencies of births, and therefore of pairings, in the several months can be represented by a regular curve showing a distinct maximum at a definite period in the year; although either of these events may occur in any month. This view has been supported by finding a close agreement between the breeding curves of northern and southern races of the same species, with the significant difference that the maxima are about six months apart, corresponding with the difference in seasons between the two hemispheres. Tropical species, such as the sperm whale, perhaps have no definite breeding period.

Migrations.—The principal movements of many whales are largely connected with the two functions of feeding and reproduction. The humpback, for instance, appears in large numbers in sub-antarctic waters in the spring (October) and remains there till the summer. As the season advances it becomes less numerous, but it is found off the south and west African coasts at the time that would be expected on the assumption that it is moving northwards. At the height of the southern winter it is found even as far north as the equator, and it travels southwards again as the spring returns. It is probable that this species, like others, seeks warmer water in which to bring forth its young and that pairing takes place at about the same time. Its journey to the far south is for the purpose of feeding.

Growth and Age.—Little can be said of the duration of life in whales; and statements that large individuals must be of great age may be dismissed as unproven. Young whales may be found accompanying their mothers, and probably subsisting on milk, up to a length of 40 or 50 ft., appearing to imply a growth to that size in the first year. The females of the same species may be pregnant at about 60 ft.; and it has been suggested that a whale reaches the reproductive age very early in life. The condition of the skeleton gives information as to the relative age of whales. Many of the bones of mammals grow at their ends by two bony epiphyses, which are at first separable and in the vertebrae are conspicuous discs of bone. The adult condition, at which growth stops, is reached when the epiphyses have completely fused with the main bones. It was pointed out by Sir William Flower that fusion begins at the two ends of the vertebral column; the cervical and caudal vertebrae commencing the process, which gradually extends from both ends towards the middle. This obviously gives some information as to the relative age of adolescent individuals, but it leaves untouched the question of the duration of life.

Species Hunted.—The whaling industry (*see* WHALE FISHERIES) has been mainly based on about nine species, of which all but the sperm whale are whalebone whales. The Basques hunted the Atlantic right whale (*Eubalaena glacialis*) at an early date, and the industry was specially flourishing in the 12th and 13th centuries. The arctic fishery began about 1611 and was based on the Greenland whale (*Balaena mysticetus*). The hunting of the sperm whale (*Physeter catodon*) began about a century later; and the southern right whale (*Eubalaena australis*) was captured in large numbers by some of the vessels subsequently engaged in this industry. The Pacific gray whale (*Rhachianectes glaucus*) was taken in considerable numbers on the coast of California before the middle of the 19th century. Modern whaling depends mainly on two species of rorqual, the great blue whale (*Sibbaldus musculus*) and the fin whale (*Balaenoptera physalus*) though the sei whale (*B. borealis*) is not unimportant in certain localities. The humpback (*Megaptera nodosa*) has at times been the most important constituent of the catch of modern whalers, who in one or two localities take a few specimens of Bryde's whale (*Balaenoptera brydei*). The following, of less importance commercially than the great whales, have also been systematically captured by whalers or fishermen at various times:—the narwhal (*Monodon monoceros*), the white whale (*Delphinapterus leucas*), the pilot whale (*Globicephala ventricosa*), the bottle-nosed whale (*Hyperoodon rostratus*), the common porpoise (*Phocoena phocoena*), and others of the smaller dolphins.

History gives a melancholy record of the results of intensive whaling. The Atlantic right whale is no longer to be found on the Biscay coast, and, though it made some recovery during the 19th century, it was believed at one time to have become extinct. The southern right whale, once extremely common on the coasts of South Africa and Kerguelen, and in other localities, is occasionally represented in whaling returns by a very few specimens. The Greenland whale disappeared successively from the bays of Spitsbergen, the Greenland sea, Davis straits and the region of Bering straits. There is no indication of the reappearance of these animals off Spitsbergen or Jan Mayen, where they were formerly present "in immense numbers"; and, though a few probably linger in some of the old localities, the Greenland trade is dead. The Pacific gray whale was nearly exterminated off the coast of California, and was thought to be extinct. It has recently reappeared in small numbers, and a few are being taken by the Japanese in their own waters. The capture of humpbacks has seriously declined. In 1844 the United States alone had 315 vessels employed in the chase of the sperm whale, but one fishing ground after another had to be abandoned. Sperm whales are still taken at whaling stations, off the coasts of Natal and

the British Isles and in the Straits of Gibraltar, but the large fleets formerly engaged in the chase of these animals have ceased to exist. Of the important species, the blue whale, the fin whale, the humpback, the sei whale and the sperm whale alone survive in considerable numbers; and the disappearance of the first two would involve the extinction of the greater part of the industry.

The invention of an improved harpoon gun in 1865 gave a new impetus to whaling, and this has culminated in the extraordinary success of operations in the dependencies of the Falkland Islands and Ross sea. The reintroduction of pelagic whaling, by methods far more efficient than those formerly practised, has resulted in new dangers to the whales.

The facts are ominous, and history is likely to repeat itself unless adequate steps can be taken in time. Experience has shown that whales do not readily come back to an old locality, even when they have been free from pursuit for many years. The number of whales recently taken in sub-antarctic waters has several times exceeded 30,000 in a single season, and in 1937–38 it was more than 46,000. History gives no justification for the belief that whaling can continue indefinitely at this rate, and the necessity of controlling the industry is urgent.

Commercial Products.—Whalebone, the most valuable product of the Greenland whale, was at one time worth £2,000 a ton. That of the rorquals is shorter and of inferior quality. Oil is produced by all Cetacea, but the sperm oil of the sperm whale and Ziphioids differs in constitution from the train oil or whale oil of other whales. Spermaceti and ambergris are products of the sperm whale. Guano and other materials are obtained by grinding the dried flesh and bones of large whales. Meat of good quality is available from nearly all Cetacea. The flesh of dolphins was formerly esteemed a delicacy; and it had the advantage, in Roman Catholic countries, of being considered fish which could be eaten on fast days. The common porpoise was formerly hunted on a large scale for its meat. Ivory is obtained from the tusk of the narwhal and from the teeth of the sperm whale. Leather can be prepared from the skin of the white whale.

CLASSIFICATION

Suborder 1.—ARCHAEOCETI. The *Basilosauridae, Dorudontidae* and *Protocetidae* of the Eocene and Oligocene, constituting this group, are believed to have been derived from the Creodonta, the primitive fossil members of the Carnivora; but Gregory thinks that they may have descended from Insectivora of the type represented by *Pantolestes*. Their skull characters are intermediate between those of their supposed ancestors and those of recent Cetacea in the position of the nostrils, the relations of the maxillae and the dentition, which consists of 3 incisors, 1 canine, 4 premolars, and 3–2 molars on either side of each jaw. The first 4 or 5 teeth are conical and single-rooted, and the other teeth are double-rooted, with serrated crowns. A milk dentition is found.

The recent Cetacea have no milk teeth, and there is no differentiation into incisors, canines and molars. The *Squalodontidae* (Oligocene to Pliocene), included in the Odontoceti, are believed to have descended from the Archaeocetes and to have given rise to some at least of the recent toothed whales. The origin of the Mystacoceti is uncertain.

Suborder 2.—MYSTACOCETI, whalebone whales. Whalebone present; teeth wanting in the adult, numerous and vestigial in the embryo; lower jaw large, its halves curved outwards (fig. 5, B) and loosely united in front; blowholes two longitudinal slits (fig. 2, A); skull symmetrical, the nasal bones relatively well developed, maxillae not covering the orbital plates of the frontals; first pair of ribs alone joining the sternum, which consists of one piece. The females are slightly larger than the males.

Family 1.—*Rhachianectidae,* with *Rhachianectes glaucus,* Pacific gray whale (fig. L, p. 170; 45 ft.). Head small, less than one-quarter the total length; dorsal fin wanting; flippers 4-fingered. R. C. Andrews considers *Rhachianectes* the most primitive of the Mystacoceti, in view of the occurrence of long hairs scattered over the entire head and lower jaw, the short and relatively few baleen blades, the free neck vertebrae, the large pelvis, and other characters. The lower side of the throat region has two or three grooves. *Rhachianectes* prefers shallow water, swimming even in the surf and occurs in the North Pacific, from California northwards to the Arctic ocean and off Japan and Korea.

Family 2.—*Balaenidae.* Skull much arched; baleen long and narrow; ventral grooves wanting; neck vertebrae fused.

Neobalaena marginata, pygmy whale (20 ft.), is doubtfully placed in this family. It differs from the right whales in its small head, about one-fifth the total length, in its less arched rostrum, in having a dorsal fin and in its 4-fingered flippers. It is known from New Zealand and Australia.

Balaena and *Eubalaena,* right whales. Dorsal fin wanting; flippers broad, with 5 fingers; head one-quarter to one-third the total length.

Balaena mysticetus, Greenland whale (fig. A, p. 170; 60 ft.). Head enormous, one-third the total length; rostrum greatly arched, providing room for exceptionally long baleen, up to 15 feet. Arctic, circumpolar, and formerly abundant off Spitsbergen, both sides of Greenland and the North Pacific to Beaufort sea, but reduced by whaling to the verge of extinction.

Eubalaena glacialis, Atlantic right whale or Biscay whale (fig. B, p. 170), about the same size, but differing from *B. mysticetus* in its less arched head, its shorter baleen (up to 9 ft.) and the shape of its lower lip. It was formerly common in the Bay of Biscay and it has been recorded from the Mediterranean. It has been hunted, in recent years, off Iceland, Norway and the British Isles. It visits the eastern United States, its northern range in the Atlantic coinciding nearly with the southern limit of the Greenland whale; but, like other right whales, it avoids the tropics.

Eubalaena australis, southern right whale. Resembling *E. glacialis,* but found off Australia, Kerguelen and other parts of the southern sea, where 193,522 were killed by American whalers in 1804–17. A few are still taken off South Georgia, the South Shetlands and the African coasts. The *Eubalaena,* hunted in Japan, may be a distinct species.

Family 3.—*Balaenopteridae,* rorquals and humpback. Rostrum less arched than in Balaenidae, baleen blades shorter and broader; dorsal fin present; skin covering the throat with numerous, conspicuous, longitudinal grooves; flippers narrow; neck vertebrae free. At least 90% of the whales now hunted belong to this family.

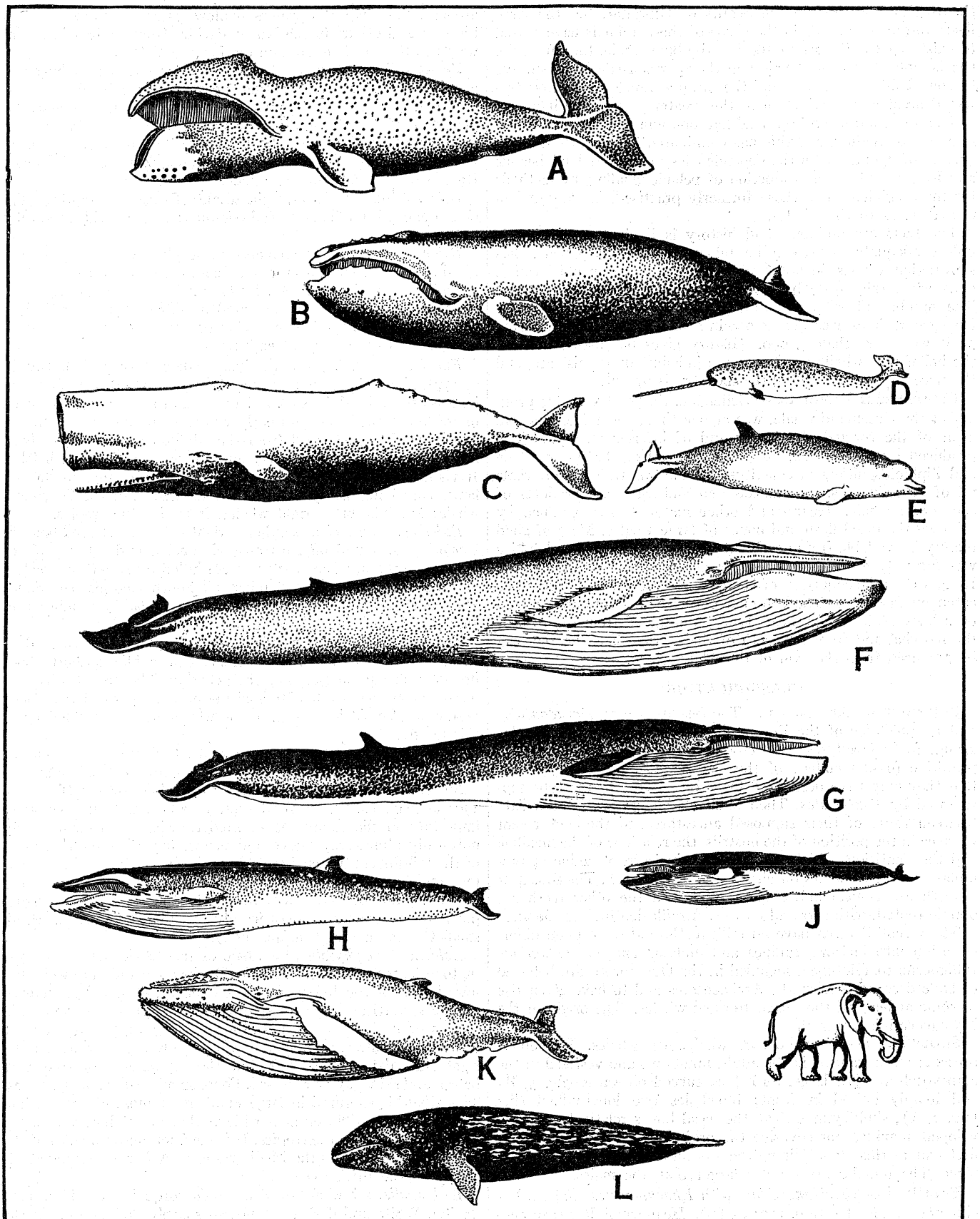
Balaenoptera and *Sibbaldus,* rorquals. Body relatively slender; dorsal fin well marked; flippers small, narrow and pointed.

Sibbaldus musculus, blue whale or Sibbald's rorqual (fig. F. p. 170; at least 100 ft.) is the largest of all animals and the most important in the estimation of modern whalers. Colour nearly uniformly bluish-gray above and below, including both surfaces of the tail-flukes; baleen jet black, with black fringes. Cosmopolitan, on the assumption that (as in others of the family) the northern and southern races belong to the same species, from polar to temperate seas, occasionally reaching the equator. Food, small Crustacea (Euphausians, etc.).

Balaenoptera physalus, fin whale or razorback (fig. G, p. 170; up to at least 80 ft., in the south). Dark above and pure white below, including the lower surface of the tail-flukes. Baleen with alternate, vertical stripes of slate colour and yellow or white, the fringes similarly light in colour, the anterior 3 or 4 ft. of the right series nearly always completely white; lower jaw white on the right side, dark on the left, but the asymmetry of colour of baleen and skin may be reversed. Food, small Crustacea and fishes. This whale is captured in large numbers at most of the whaling stations. Its distribution is as wide as that of the blue whale, but it is rarely found in the tropics. It is common on both sides of the Atlantic, and it enters the Mediterranean. A few are stranded annually on the British coasts.

B. borealis, sei whale or Rudolphi's rorqual (fig. H, p. 170; 52 ft.). White and dark parts not so sharply delimited as in the fin whale; lower surface of tail-flukes bluish-gray; baleen black, its fringes white, silky and curling. Temperate parts of all the oceans, not wandering so near the poles as the two preceding species. Food, Crustacea, less often fishes.

B. brydei, Bryde's whale. Nearly as large as the sei whale, from which it differs in having straight hairs on its baleen blades, and



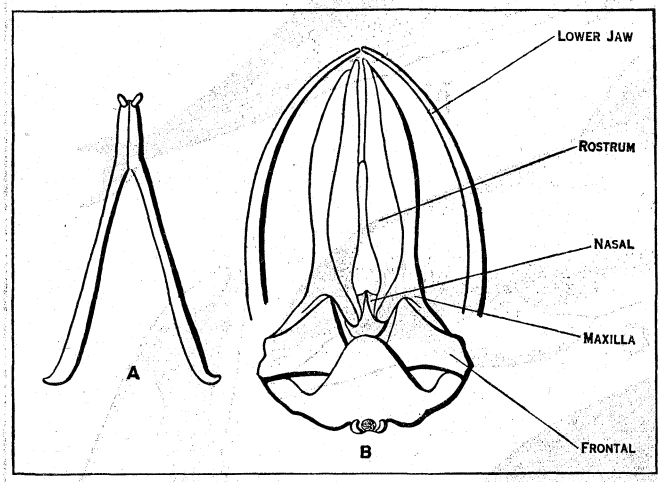
FROM (B) ALLEN, "WHALEBONE WHALES OF NEW ENGLAND," (C) SCAMMON, "MARINE MAMMALS OF N.W. AMERICA," (E) "NATUURKUNDIGE VERHANDELINGEN," (F, G, J, K) "CHRISTIANIA VIDENSKAPSSELSKAPS FORHANDLINGEN," (H, L) ANDREWS, "MEMOIRS OF THE AMERICAN MUSEUM OF NATURAL HISTORY"

VARIOUS TYPES OF WHALES

A, Greenland whale (after Scoresby). B, Atlantic right whale. C, sperm whale. D, narwhal (after Scoresby). E, bottle-nosed whale (after Vrolik). F, blue whale (after Sars). G, fin whale (after Sars). H, sei whale. J, lesser rorqual (after Sars). K, humpback whale (after Sars). L, Pacific grey whale (African Elephant, "Jumbo," 11 feet high, reproduced to same scale)

in its food, which consists principally of fishes. South and West Africa, apparently reaching the West Indies.

B. acutorostrata, lesser rorqual (fig. I, p. 170; 33 ft.). Coloration as in the fin whale (without asymmetry of colour); a conspicuous white area on the outer side of the flipper. Baleen and its fringes all white or yellowish. Food, largely fishes, but also Crustacea. Temperate and polar latitudes of both hemispheres, including the British and both North American coasts, but not hunted.

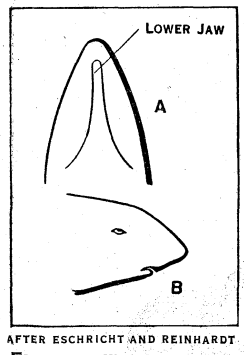


AFTER ESCHRICHT AND REINHARDT

FIG. 5.—A. LOWER JAW OF TOOTHED WHALE (ZIPHIUS, MALE); B. SKULL OF WHALEBONE WHALE (MEGAPTERA) FROM ABOVE

Megaptera nodosa, humpback (fig. J, p. 170; 52 ft.). Body thick, dorsal fin evanescent; flippers enormously long, nearly one-third the total length. Colour variable, sometimes nearly all black, but with varying amounts of white in other individuals; flippers sometimes pure white; baleen and its fringes black. Food, fishes and Crustacea. Cosmopolitan, from the Arctic to the Antarctic ocean, and more frequenting warm water than the rorquals. The humpback was almost the only species hunted at the commencement of the great antarctic whaling enterprise, beginning 1905, and was almost equally important on the African coasts. The numbers frequenting the whaling localities have greatly diminished.

Suborder 3.—ODONTOCETI, toothed whales. Teeth present throughout life; whalebone wanting; lower jaw more or less triangular (fig. 5, A), the front part often narrow, the two halves firmly united; blowhole single (fig. 2, B); skull asymmetrical, nasals reduced, maxillae covering the orbital plates of the frontals; several pairs of ribs joining the sternum, which consists, in the young at least, of several pieces.



AFTER ESCHRICHT AND REINHARDT

FIG. 6.—WHALE HEADS A. HEAD OF A SPERM WHALE FROM BELOW; B. HEAD OF A KOGIA WHALE FROM THE SIDE

Family 1.—*Physeteridae,* sperm whales. Teeth numerous in lower jaw, vestigial or absent in upper jaw in recent forms.

Physeter catodon, sperm whale (fig. C, p. 170; 63 ft.). Size gigantic; head immense, about one-third the total length; snout enormous, truncated, extended beyond the narrow, ventrally situated mouth (fig. 6, A); lower teeth 20–26 on each side, of great size, up to 4 lb. in weight, conical; about 8 pairs of smaller, often malformed, upper teeth; left nasal passage alone developed, the single blowhole curved, on the upper, left side of the snout, near its front end; dorsal fin reduced to a low hump, continued as a ridge towards the tail; colour black or brown all over, sometimes marked with white, especially in aged individuals. Male up to 63 ft., female not often exceeding 35 feet. The sperm whale occurs in all tropical waters, but stragglers, nearly always old males, reach both polar seas. It is polygamous, a school of females being accompanied by one or two large males. The sperm oil produced by this species is everywhere mixed with spermaceti, most of which is obtained from a receptacle, the case, occupying much of the snout, to the right of the single nasal passage, and capable of containing nearly 500 gal. of mixed oil and spermaceti. The sperm whale dives to a great depth, in pursuit of cuttlefish, its main food, though it also eats fishes. The case is supposed, by its buoyancy, to support the gigantic skull and to facilitate a rapid return to the surface. Ambergris is a morbid concretion of the intestine, commanding a high price.

Kogia, lesser sperm whale (about 10 ft.) resembles *Physeter* in general characters, except for the blowhole, which is located on top of the head, the single nasal passage, and the presence of a spermaceti organ; but the head (fig. 6, B) is relatively much smaller. Lower teeth, about 12 on each side, long, delicate, and curved; upper teeth wanting. Indian ocean and coasts of Australia, and recorded from eastern North America, Brittany and Holland.

Family 2.—*Ziphiidae,* beaked whales. Allied to the *Physeteridae* and producing sperm oil, but teeth much more reduced. A pair of longitudinal grooves in the throat region (fig. 9, A–C). Dorsal fin behind the middle of the body; tail (fig. 7, A) not notched at the junction of the flukes, flippers small; functional teeth (fig. 8, A, B) 1–2 pairs in the lower jaw, generally below the gum in females; minute vestiges of teeth may occur in either jaw. Food, cuttlefish. The rostrum becomes consolidated into a hard, bony mass in *Ziphius* and *Mesoplodon,* and these fragments are found in British late Tertiary deposits.

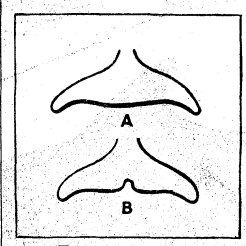


FIG. 7.—TAILS
A. Tail of Ziphioid
B. Tail of dolphin

Berardius has 2 pairs of large teeth at the front end of the lower jaw (fig. 8, A). *B. bairdi* (40 ft.), North Pacific, is the largest Ziphioid. *B. arnuxi,* New Zealand, Argentina, not uncommon in antarctic waters.

Ziphius cavirostris, Cuvier's whale (26 ft.) has one pair of teeth at the tip of the lower jaw, much more massive in males (fig. 5, A) than in females, in which they remain beneath the gum. Cosmopolitan, and not uncommon at certain times along the British coasts.

Hyperoodon rostratus, bottle-nosed whale (fig. E, p. 170; male, 31 ft.; female, 25 ft.). Teeth small, one pair (occasionally two pairs) at the tip of the lower jaw, alike in both sexes, remaining concealed till a late period, but then piercing the gum, at least in old males. Distinguished from *Ziphius* by a large bony crest on the upper side of each maxilla. With increasing age these crests become immense in the male, producing a notable alteration in the head, the forehead (fig. 9, B) becoming enormous and truncated. Common in the North Atlantic, where it has been extensively hunted to the north of Scotland; and frequently stranded on the British coasts, though rare in the eastern United States. *H. planifrons,* Australia, New Zealand and Argentina.

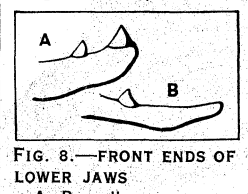
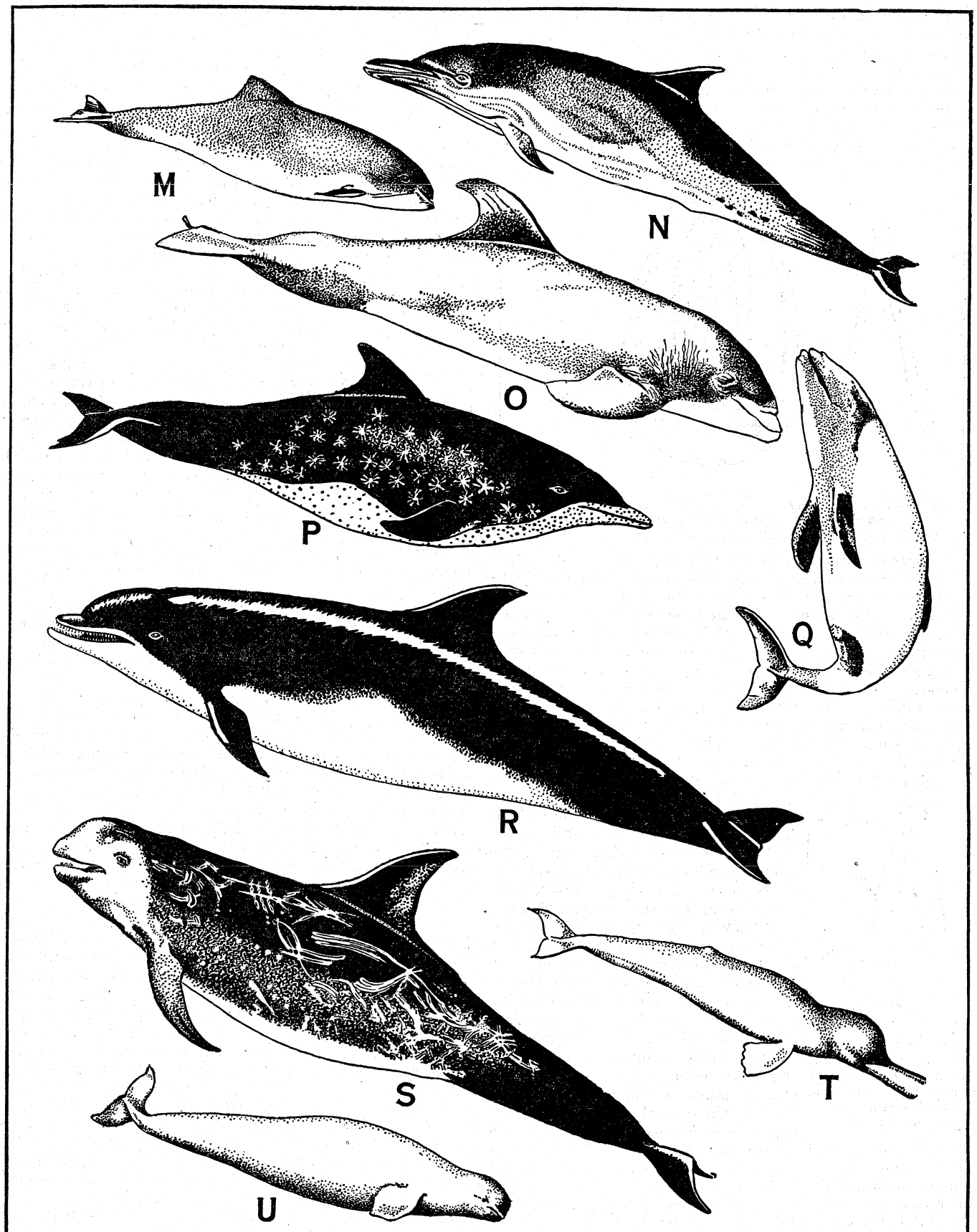


FIG. 8.—FRONT ENDS OF LOWER JAWS
A. Berardius
B. Mesoplodon bidens

Mesoplodon (fig. 9, C). Teeth, one pair (fig. 8, B), smaller in females and usually remaining beneath the gum, typically near the angle of the mouth, but in three species at the tip of the jaw. Of these, *M. mirus* has been stranded on the Irish coast; and *M. pacificus,* described in 1926 from a Queensland skull, appears to be about 25 ft. long, and would therefore be the largest *Mesoplodon. M. bidens,* Sowerby's whale (15 ft.), has its teeth in the typical position (fig. 8, B). Up to 1914 nearly half the records were British strandings, the others being from the Baltic to the eastern United States. *M. layardi,* of South Africa, Australia and New Zealand, has an extraordinary modification of its teeth, which curve over the beak, nearly meeting and preventing the mouth being opened to more than a small extent. *Mesoplodon* is oceanic, like other Ziphioids; but its species (about ten) appear to have a relatively restricted distribution.

Family 3.—*Platanistidae.* Inhabiting rivers or estuaries. Neck vertebrae larger than usual, not fused; pterygoid bones completely covering palatine bones on ventral aspect of skull; outer borders of maxillaries prolonged into incurved fanlike structures that largely roof over the facial depression; beak slender; flippers



BY COURTESY OF (M, O) THE TRUSTEES OF THE BRITISH MUSEUM; (N, Q) FROM "TRANSACTIONS," 1880 (ZOOLOGICAL SOCIETY OF LONDON); (P) LUTKEN, "VIDENSK SELSK, SKRIFTER" (DET KONGELIGE DANSKE VIDENSKABERNES SELSKAB, COPENHAGEN); (R, S) W. H. FLOWER IN "TRANSACTIONS" (ZOOLOGICAL SOCIETY OF LONDON); (U) R. COLLETT, "NORGES PATTEDYR" (H. ASCHEHOUG & CO., OSLO)

COMMON PORPOISE, WHITE WHALE AND TYPES OF DOLPHINS

M, Common Porpoise (after Harmer). N, Common Dolphin (after Flower). O, White-beaked Dolphin (after Harmer). P, Steno rostratus. Q, Commerson's Dolphin (after Harmer). R, Bottle-nosed Dolphin. S, Risso's Dolphin. T, Susu (after Anderson). U, White Whale

large and broad, with few phalanges. Food, fishes, captured by probing the mud with the long, narrow jaws, which have numerous teeth; as well as Crustacea and probably other small animals.

Platanista gangetica, Susu (fig. T, p. 172; 8 ft.). Blind; dorsal fin reduced; remarkable, large bony crests at the base of the rostrum. Teeth about 30 on either side of each jaw. Ganges, Indus and Brahmaputra, nearly to their head waters.

Family 4.—*Iniidae.* Inhabiting rivers and fresh-water lakes. Neck vertebrae large, not fused; pterygoid bones not completely covering palatine bones on ventral aspect of skull; maxillary with a more or less fenestrated process projecting backward freely below level of orbit; beak elongated; flippers large and broad. Food, mainly fishes.

Lipotes vexillifer (8 ft.), with a reduced dorsal fin, is whitish all over, its upper jaw curved upwards. Teeth about 32. Tung Ting lake, about 600 mi. from the mouth of the Yangtze Kiang river.

Inia geoffrensis (8 ft.), also with a reduced dorsal fin. The beak is covered with numerous short hairs, a primitive feature. Teeth, 26–32. Amazon river, from near its head waters.

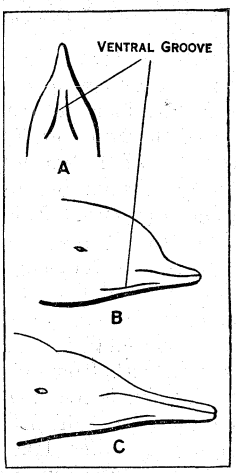


FIG. 9.—HEADS OF ZIPHIOIDS
A. Hyperoodon, young, from below
B. Hyperoodon, side view
C. Mesoplodon bidens, adult female

Family 5.—*Delphinidae,* dolphins (fig. 1) and porpoises. Dorsal fin present or absent; Tail (fig. 7, B) with a notch at the junction of the flukes.

Subfamily A.—*Delphininae.* Dorsal fin present, except as noted below. Fore flippers generally pointed and sickle-shaped. Neck vertebrae mostly fused with one another. Teeth (except *Gramphidelphis*) in both jaws, usually numerous. The numbers recorded below (on either side of each jaw) do not include the reduced teeth commonly found at the front end on both jaws below the gum. Alisphenoid not overspread by pterygoid and no external reduplication of pterygoid.

Delphinus delphis, common dolphin (fig. N, p. 172; 8 ft.). Beak about 5 in. long in middle line, separated from rest of head by a distinct groove (fig. 10, A), a character obvious in representations of this animal on Greek coins and elsewhere. Mainly black above and white below, the sides with longitudinal streaks of white, brown, yellow or gray. Palate of skull with two deep, longitudinal grooves. Teeth 40–50, diameter 3–3.5 millimetres. The "dolphins," which pursue flying fish and change colour when dying, are fishes (*Coryphaena*), not to be confused with the cetacean. Cosmopolitan, common in the Atlantic and Mediterranean, frequently stranded on the British coasts, but rarely on the east side of England. Food, fishes and cuttlefish. The stomach of a Mediterranean specimen was found by Dr. J. Schmidt to contain 15,191 otoliths (ear bones), indicating the recent consumption of more than 7,500 small fishes.

Stenella, with many species, often spotted or with longitudinal dark lines on the sides, is oceanic. Beak and teeth as in *Delphinus,* but palate of skull not grooved.

Lissodelphis peronii. Black and white, sharply delimited, the white including the flippers and continued past the mouth to the upper side of the "forehead." Dorsal fin wanting. Teeth as in *Delphinus.* Southern seas, with one record from New Guinea.

Lagenorhynchus. Beak short, usually distinct (fig. 10, B); sides generally with oblique light areas; upper and lower keels of root of tail strongly marked; vertebrae numerous, about 73–92. The two following British species, also found in eastern United States, reach 9 ft., the beak 2 in. long in the middle line:—*L. albirostris,* white-beaked dolphin (fig. O, p. 172); upper lip white; teeth 22–25, diameter 7 millimetres.—*L. acutus,* white-sided dolphin; upper lip black; very distinct light areas on the sides; teeth 30–34, diameter 4 millimetres. Other species in Indian, Pacific and Southern oceans.

Cephalorhynchus (fig. Q, p. 172). Small dolphins, about the size of the common porpoise, from southern seas, usually conspicuously coloured and without sharply marked beak. Teeth 25–31, small.

Steno rostratus (fig. P, p. 172; 8½ ft.). Mainly dark, spotted with white; beak long, distinct; teeth 20–27, large, with slightly rugose crowns. Atlantic, Pacific and Indian oceans.

Sotalia. Resembling *Steno,* but teeth more numerous (up to 35), with smooth crowns. Species of *Sotalia* occur in fresh water in China (colour, milky white) and the Amazon. *S. tëuszii,* from the Cameroons, has been found to contain leaves, mangrove fruits, and grass in its stomach. Other species, from the tropical parts of the Indian and Atlantic oceans.

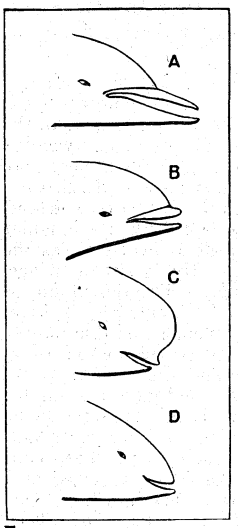


FIG. 10.—DOLPHIN HEADS
A. Delphinus
B. Lagenorhynchus
C. Globicephala
D. Phocoena

Tursiops. Beak rather longer than in *Lagenorhynchus,* teeth larger. *T. truncatus,* bottle-nosed dolphin (fig. R, p. 172; 10–11 ft.), is common in British seas and off the eastern United States. Dark above and white below; teeth 20–23, large, diameter 8.5–10 millimetres. Other species from the Mediterranean, Red sea, North Pacific, Australia and New Zealand. The natives of Moreton bay, Queensland, are said to co-operate with schools of dolphins (probably *Tursiops*) in beach fishing, the dolphins driving the fishes ashore and being rewarded for their assistance by fishes offered on the points of spears.

Gramphidelphis griseus, Risso's dolphin (fig. S, p. 172; 11 ft.). Nearly uniformly grayish; beak wanting, forehead prominent; flippers long; teeth completely absent in upper jaw (except for rare vestiges); lower teeth, 2–7, confined to the front end of the jaw, large, diameter 14 millimetres. Apparently cosmopolitan, reaching Britain and the eastern United States. "Pelorus Jack," an individual which was well known in New Zealand, a few years ago, from its habit of accompanying steamers in Pelorus sound, is believed to have belonged to this species.

Globicephala. Forehead greatly swollen and prominent (fig. 10, C); flippers specially long. *G. ventricosa,* pilot whale, blackfish or caa'ing whale (28 ft.) is black all over. Teeth 7–11, large, diameter 10–11 mm., at the front end of the jaws. Large schools have frequently been driven ashore, 1,540 individuals having been killed in two hours, in 1845, at the Shetland Islands. It is known that 117,456 individuals were captured at the Faeroe Islands between 1584 and 1883. Both sides of the Atlantic and in the Pacific, Indian ocean and southern seas.

Pseudorca crassidens, false killer (19 ft.). Teeth 8–10, almost as large as those of the killer; black all over, flippers narrow. Originally described by Owen from a subfossil skeleton from the Lincolnshire fens. Two skeletons have recently been found in the Cambridgeshire fens. A school of more than 100 specimens was stranded in the Bay of Kiel in 1861, and a school of about 150 on the east coast of Scotland in 1927. It is said to occur in large parties off New Zealand and Tasmania, and it has been recorded from India, Queensland, both sides of North America and Argentina.

Orcella brevirostris (7 ft.). Head as in *Gramphidelphis,* dorsal fin low; rostrum of skull very short; teeth 12–14, small. Ascends the Irrawaddy river, Burma, to 900 miles from the sea, and occurs in the Bay of Bengal, and off Singapore and Borneo.

Phocoena and the two following have teeth with an expanded, spade-shaped crown, differing from the conical teeth of other dolphins. *P. phocoena,* common porpoise (fig. M, p. 172; 5½ ft.), is black above and white below, with some variation. Head short, without beak (fig. 10, D), dorsal fin triangular, commonly with small, horny tubercles on its front edge. Male reproductive opening unusually far forward, below the dorsal fin; teeth 22–26. The porpoise was formerly much in request as an article of diet, and there were important fisheries off Normandy and at the entrance to the Baltic. It frequents coasts and often ascends rivers. It is

specially characteristic of the Atlantic coasts, on both sides, and it reaches the Azores. The porpoise of the Black sea and eastern Mediterranean has been considered distinct. Other species from South America.

Neomeris. Resembles *Phocoena* in having skin tubercles, but has no dorsal fin. Teeth 16–21. India and Japan (marine); Tung Ting lake and other parts of the Yangtze Kiang, hundreds of miles from the sea.

Phocoenoides, with two species from the North Pacific, also has skin tubercles. Teeth 19–22, much smaller than in *Phocoena;* vertebrae specially numerous, 95–98, as compared with 64–67 in *Phocoena phocoena.*

Grampus orca, killer or grampus (male 31 ft.; female, 16 ft.).—Beak wanting; dorsal fin large; flippers very broad, not pointed; teeth exceptionally large and strong, diameter 2 in.; colour-pattern bold, the black and light parts sharply delimited (fig. 1). The white (or yellow) extends over the lower jaw and the lower side of the tail flukes; and, just behind the dorsal fin, is produced backwards as a lobe defined below by a tongue of black passing forwards from the tail; a conspicuous white area, above and behind the eye; and a less distinct triangular mark behind and below the dorsal fin. The male is nearly twice the length of the female and all its fins increase greatly in size with age, to an extent disproportionate to the body length. The dorsal fin, at first recurved as in the female, becomes an erect triangle 5½ ft. high. The flippers reach a size of 6x4 ft., their enlargement being due mainly to the inordinate growth of the cartilage of the phalanges. Food, fishes and marine mammals and birds. Eschricht found the remains of 13 porpoises and 14 seals in the stomach of a killer, and gave reasons for believing that seals are flayed after being swallowed, the skins being then disgorged. The story that killers combine to attack a large whale, forcing its mouth open and eating the tongue, has recently been confirmed by R. C. Andrews. Although a killer should be regarded as a dangerous animal there seems to be little evidence that it willingly attacks man. The motive for a combined assault, by a party of killers, on an ice floe, as recorded in *Scott's Last Voyage,* may have been the capture of the dogs (mistaken for seals), and not of the man. *G. orca,* if all killers belong to one species, is cosmopolitan, extending from pole to pole, though it is apparently not often found in the tropics. It is not uncommon in British and American waters.

Feresa. Relatively little is known regarding this porpoise.

Subfamily B.—*Stenodelphinae.* Dorsal fin present; neck vertebrae free; flippers broad and bluntly rounded distally; beak slender. Teeth, 58–62 on either side of upper and lower jaws, of normal delphine type. Alisphenoid overspread by pterygoid; external and internal reduplications of pterygoid large.

Stenodelphis (or *Pontoporia*) *blainvillii* (5 ft.). Dorsal fin well developed; jaws long and delicate; teeth 50–60. La Plata estuary.

Subfamily C.—*Monodontinae.* No dorsal fin; neck vertebrae free; flippers broad. Teeth tusklike in manner of growth, reduced to one or two forward projecting tusks. Alisphenoid not overspread by pterygoid; no external reduplication of pterygoid.

Monodon monoceros, narwhal (fig. D, p. 170; 15–20 ft.). Adult grayish-white, with leopardlike spots, sometimes whitish when old; young unspotted; teeth unlike those of any other animal, reduced (except for vestiges in the foetus) to a single upper pair. In females these remain concealed in the bone, but the left one exceptionally develops as in the male. The right tooth of the male remains similarly concealed, but the left tooth, the horn of the traditional Unicorn, grows spirally to an enormous length, up to 9 ft., 4½ in., projecting forwards from the upper lip. In rare cases the asymmetry may be reversed, the right tooth becoming the tusk; or the animal has two tusks, about equally developed. One or two "bidental" specimens have been recorded as female, but further evidence on the sex is required. Arctic, rarely reaching Britain. Large numbers of narwhals are killed by the Eskimos in certain parts of Greenland, where the males protrude their tusks through holes in the ice when they rise to breathe.

Subfamily D.—*Delphinapterinae.* Dorsal fin wanting; neck vertebrae free; flippers broad; dermis of skin more developed than usual. Teeth tusklike in manner of growth; not more than ten teeth on either side of upper jaws, and eight in lower jaws. Alisphenoid overspread by pterygoids; reduplications of pterygoids small. Food, mainly cuttlefish, but also fishes.

Delphinapterus leucas, white whale or Beluga (fig. U, p. 172; 18 ft.). Adult pure white all over, young dark brown-gray; teeth 8–10, diameter 20 millimetres. Arctic and circumpolar, reaching the St. Lawrence and (rarely) the British coast. Formerly hunted on a large scale.

BIBLIOGRAPHY.—*General works.* F. E. Beddard, *A Book of Whales* (1900); J. T. Jenkins, *History of the Whale Fisheries* (1921); K. A. von Zittel, *Text-book of Palaeontology,* vol. iii (1925); H. Winge, "Interrelationships of Cetacea," *Smithson. Misc. Coll.* lxxii, No. 8 (1921); G. S. Miller, Jr., "The Telescoping of the Cetacean Skull," *Smithson. Misc. Coll.,* lxxvi, No. 5 (1923); *Whaling.*—W. Scoresby, *Account of the Arctic Regions* (Edinburgh, 1820); R. C. Andrews, *Whale Hunting with Gun and Camera* (1916); *Rep. Interdepartmental Comm. Dependencies of Falkland Islands,* 1920, Stationery Office, Cmd. 657; S. Risting, *Av Hvalfangstens Historie* (History of Whaling) (Oslo, 1922). *Special works.*—F. W. True, "Whalebone Whales of W. North Atlantic," *Smithson. Contr.* xxxiii (1904); G. M. Allen, "Whalebone Whales of New England," *Mem. Bost. Soc. Nat. Hist.,* viii, No. 2, p. 105 (Boston, Mass., 1916); R. C. Andrews, "California Grey Whale," *Mem. Amer. Mus. Nat. Hist.,* N.S., i, part 5, p. 227 (1914), and "Sei Whale," *ibid.;* part 6, p. 289 (1916); F. W. True, "Review of the Delphinidae," *Bull. U.S. Nat. Mus.,* No. 36 (1889); S. F. Harmer, *British Cetacea Stranded 1913–1926,* Brit. Mus. Nat. Hist. (1927); R. Collett, *Norges Pattedyr* (Norwegian Mammals), p. 543 (Oslo, 1911–12); E. J. Slijper, *Die cetaceen vergleichend-anatomisch und systematisch; ein beitrag zur vergleichenden anatomie des blutgefäss-, nerven- und muskelsystems, sowie des rumpfskelettes der säugetiere, mit studien über die theorie des aussterbens und der foetalisation* (The Hague, 1936); R. Kellogg, "The History of Whales—Their Adaptation to Life in the Water," *Quart. Rev. Biol.,* vol. 3, no. 1, pp. 29–76, no. 2, pp. 174–208 (1928); *idem, A Review of the Archaeoceti,* Carnegie Inst., Washington, publ. 482, pp. xv–366 (1936); *idem,* "Adaptation of Structure to Function in Whales," Carnegie Inst., Washington, publ. 501, pp. 649–82 (1938); *idem,* "Whales, Giants of the Sea," *Nat. Geog. Mag.,* vol. 77, no. 1, pp. 35–90 (1940); N. A. Mackintosh and J. F. G. Wheeler, "Southern Blue and Fin whales," *Discovery Reports,* Cambridge, vol. 1, pp. 257–540 (1929); L. Harrison Matthews, "The Humpback Whale, Megaptera nodosa," *Discovery Reports,* Cambridge, vol. 17, pp. 7–92 (1937); *idem,* "The Sperm Whale, Physeter catodon," *Discovery Reports,* Cambridge, vol. 17, pp. 93–168 (1938); *idem,* "The Sei Whale, Balaenoptera borealis," *Discovery Reports,* Cambridge, vol. 17, pp. 183–290 (1938).

(S. F. H.; X.)

CETATEA ALBA, a town of Rumania (Akkerman, in old Slav, *Byelgorod, i.e.,* white town) in lat. 46° 12′ N., long. 30° 19′ E., on the right bank of the estuary (liman) of the Dniester, 12 mi. from the Black sea. The town stands on the site of the ancient Milesian colony of Tyras. Centuries later it was rebuilt by the Genoese and named Mauro Castro. The Turks captured it in 1484. In 1770, 1774 and 1806 the Russians captured it, but each time returned it to the Turks. In 1826 a treaty was concluded there between Russia and the Porte, when Russia secured considerable advantages: the terms of the treaty were not observed and war broke out in 1828. In 1881 it was definitely annexed to Russia, but in March 1918, when Bessarabia was united with Rumania, Cetatea Alba became a Rumanian town. The harbour is too shallow to admit large vessels, but there is a trade in wine, salt, fish, wool and tallow. The salt is obtained from the saline lakes (limans) in the neighbourhood. The town and its suburbs contain beautiful gardens and vineyards. It is surrounded by ramparts and commanded by a citadel. Pop. (1930) 33,495. Rumania ceded the town, with Bessarabia, to the U.S.S.R. in June 1940, but regained it in 1941 during the German invasion of the soviet union.

CETHEGUS, the name of a Roman patrician family of the Cornelian gens. Two individuals are of some importance:—

(1) MARCUS CORNELIUS CETHEGUS, pontifex maximus and curule aedile, 213 B.C. In 211, as praetor, he had charge of Apulia; later, he was sent to Sicily, where he proved a successful administrator. In 209 he was censor, and in 204 consul. In 203 he was proconsul in Upper Italy, where, in conjunction with the praetor P. Quintilius Varus, he defeated Mago, Hannibal's brother, in Insubrian territory, and obliged him to leave Italy. He died in 196. He had a great reputation as an orator, and is characterized by Ennius as "the quintessence of persuasiveness" (*suadae medulla*). Horace (*Ars Poët.* 50; *Epistles,* ii, 2. 117) calls him an authority on the use of Latin words.

See Livy xxv, 2; 41, xxvii, 11, xxix, 11, xxx, 18.

(2) GAIUS CORNELIUS CETHEGUS, the boldest of Catiline's associates, joined the conspiracy in the hope of getting his debts cancelled. When Catiline left Rome in 63 B.C., Cethegus remained behind as leader of the conspirators with P. Lentulus Sura. He undertook to murder Cicero and other prominent men, but was hampered by the dilatoriness of Sura. He was condemned to death, and executed, with Sura and others, on the night of Dec. 5.

See Sallust, *Catilina,* 46–55; Cicero, *In Cat.* iii, 5–7; Appian, *Bell. Civ.* ii, 2–5; *see* also CATILINE.

CETINA, GUTIERRE DE (1518?–1572?), Spanish poet and soldier, was born at Seville. He served under Charles V in Italy and Germany, but retired from the army in 1545 to settle in Seville. Soon afterwards, however, he sailed for Mexico, where he spent most of the rest of his life. He was killed in a street brawl in Los Angeles. A follower of Boscan and Garcilaso de la Vega, Cetina adopted the doctrines of the Italian school and, un-

der the name of Vandalio, wrote an extensive series of poems in the newly introduced metres; his sonnets are remarkable for elegance of form, but his other productions are mostly adaptations from Petrarch, Ariosto and Ludovico Dolce. His works have been well edited by Joaquín Hazañas y la Rúa (Seville, 1895).

See A. M. Withers, *The Sources of the Poetry of Gutierre de Cetina*, etc. (1923).

CETINJE (Serbian, *Tsetinye*), capital of former kingdom of Montenegro, Yugoslavia, in a narrow plain deep in the limestone mountains, 2,068 ft. above the sea. Pop. (1931) 6,367. On one peak stands the white dynastic tomb erected by its last ruler, and on another the old bell tower formerly used for the heads of Turks. The country is bare and stony, with cultivated rich red soil in rock crevices. Winter snow and spring and autumn floods make communications difficult. Cetinje contains two parallel streets of whitewashed cottages, connected by smaller ones; the church (1478) of a fortified monastery, visited by pilgrims to the tomb of Peter I (1782–1830); the old palace, the residence of the late King Nicholas and his heir; the court of appeal; a school; barracks; a seminary for priests and teachers, established by the tsar Alexander II (1855–81); a library and reading room; a theatre; a museum; a hospital; a bank, and a war memorial. The girls' school founded by the tsaritsa Marie was closed in 1913. Near the old palace stood the celebrated plane tree beneath which Prince Nicholas gave audience until the end of the 19th century. Near the modern palace, in a glass house, guarded by a sentry, is a contour map of the country, some 60 ft. long, on which every fort, town, village, road and stream is depicted. A zigzag highway, a triumph of engineering, winds through the mountain passes between Cetinje and Cattaro, passing the impregnable Mt. Lovčen. Here Peter II (1830–51), the poet ruler, is buried. He introduced a prison and a printing press, but the latter was soon melted down for bullets. There is little trade, though mineral waters are manufactured. Cetinje owes its origin to Ivan the Black, who was forced in 1484 to withdraw from Zhabliak, his former capital. In 1941, with the dismemberment of Yugoslavia, the town and the whole of Montenegro came under Italian control.

CETTE (SÈTE), a seaport of southern France in the department of Hérault, 18 mi. S.W. of Montpellier, at the junction of the P.L.M. and Midi railways. Pop. (1936) 35,306. After Marseille it is the principal commercial port on the south coast of France. The port was created in 1666 by the agency of Colbert, minister of Louis XIV, and according to the plans of Vauban; toward the end of the 17th century its development was aided by the opening of the Canal du Midi. The older part of Cette occupies the foot and slope of the isolated Mont St. Clair (590 ft.), situated on a tongue of land between the Mediterranean and the lagoon of Thau. This well-built quarter is bounded on the east by the Canal de Cette, which leads from the lagoon of Thau to the Old Basin and the outer harbour. Across the canal lie the newer quarters, which chiefly occupy two islands separated from each other by a wet dock and bounded on the east by the Canal Maritime, parallel to the Canal de Cette. A lateral canal unites the northern ends of the two main canals. A huge breakwater protects the entrance to the harbour, which is one of the safest in France. The outer port and the Old Basin (the fishing harbour) are enclosed by a mole to the south and by a jetty to the east. Behind the outer port lies an inner basin which communicates with the Canal Maritime. The entire area of the harbour, including the canals, is 111 acres with a quayage length of more than 8,000 yards. The public institutions of Cette include tribunals of commerce and of maritime commerce, councils of arbitration in commercial and fishing affairs, an exchange and chamber of commerce. Cette is much resorted to for sea bathing. The town is connected with Lyons by the canal from the Rhône to Cette, and with Bordeaux by the Canal du Midi. The shipping trade is carried on with South America, the chief ports of the Mediterranean, and especially with Spain. The chief exports are wines, brandy and chemical products; the chief imports are coal, timber, petroleum and chemical substances. Small craft are employed in the sardine, tunny, cod and other fisheries. Shellfish are obtained from the lagoon of Thau. There are factories for the pickling of sardines, for the manufacture of liqueurs and casks, and for the treatment of sulphur, phosphates and nitrate of soda. The Schneider company of Creusot also have metallurgical works at Cette, and there are wire-making establishments.

CETUS ("The Whale"), in astronomy, a constellation of the southern hemisphere, fabled by the Greeks to be the monster sent by Neptune to devour Andromeda, but which was slain by Perseus. It contains the long-period variable star Mira Ceti (*o* Ceti), which was the first star recognized to be variable (by Fabricius in 1596). It usually ranges from the ninth to the third magnitude in about 340 days; but this kind of variation is always rather irregular. It has recently been found to have a companion distant rather less than a second of arc. The companion was first suspected from spectroscopic observations; when looked for visually it was easily seen, but it is difficult to understand why it had escaped notice in a star which was so continually studied. The companion is itself a very interesting star, possessing an unusual type of spectrum with bright lines. (A. S. E.)

CETYWAYO (d. 1884), king of the Zulus, was the eldest son of King Umpande or Panda and a nephew of the two previous kings, Dingaan and Chaka. Cetywayo was a young man when in 1840 his father was placed on the throne by the aid of the Natal Boers; and three years later Natal became a British colony. Cetywayo had inherited much of the military talent of his uncle Chaka, the organizer of the Zulu military system, and chafed under his father's peaceful policy towards his British and Boer neighbours. Suspecting Panda of favouring a younger son, Umbulazi, as his successor, Cetywayo made war on his brother, whom he defeated and slew at a great battle on the banks of the Tugela in Dec. 1856. In the following year, at an assembly of the Zulus, the management of the affairs of the nation was entrusted to Cetywayo, though the old chief kept the title of king. Cetywayo was, however, suspicious of the Natal government, which afforded protection to two of his brothers. The feeling of distrust was removed in 1861 by a visit from Theophilus Shepstone, secretary for native affairs in Natal, who induced Panda to proclaim Cetywayo publicly as the future king. Friendly relations were then maintained between the Zulus and Natal for many years. In 1872 Panda died and Cetywayo was declared king, Aug. 1873, in the presence of Shepstone, to whom he made promises to live at peace with his neighbours and to govern his people more humanely. These promises were not kept. Cetywayo's attitude became menacing; he allowed a minor chief to make raids into the Transvaal, and seized natives within the Natal border.

Sir Bartle Frere, who became high commissioner of South Africa in March 1877, was convinced that the Kafir revolt of that year on the eastern border of Cape Colony was part of a design or desire "for a general and simultaneous rising of Kafirdom against white civilization"; and in Dec. 1878 Frere sent the Zulu king an ultimatum, which, while awarding him the territory he claimed from the Boers, required him to make reparation for the outrages committed within the British borders, to receive a British resident, to disband his regiments, and to allow his young men to marry without the necessity of having first "washed their spears." Cetywayo, who had found a defender in Bishop Colenso, vouchsafed no reply, and Lord Chelmsford entered Zululand, at the head of 13,000 troops, on Jan. 11, 1879, to enforce the British demands. After the initial disaster of Isandhlwana and the defense of Rorke's Drift the Zulus were utterly routed at Ulundi (July 4). Cetywayo became a fugitive, but was captured on Aug. 28. His kingdom was divided among 13 chiefs and he himself taken to Capetown, whence he was brought to London in Aug. 1882. While he was in England the Gladstone government decided upon his restoration. Restoration, however, proved to refer only to a portion of his old kingdom. Even there one of his kinsmen and chief enemies, Usibepu, was allowed to retain the territory allotted to him in 1879. Cetywayo was reinstalled on Jan. 29, 1883, by Shepstone, but his enemies, headed by Usibepu, attacked him within a week, and after a struggle of nearly a year's duration he was defeated and his kraal destroyed. He then took refuge in the native reserve, where he died at Ekowe, on Feb. 8, 1884.

His son Dinizulu was exiled to St. Helena (1889–98), and was then allowed to return home and become a chief. He was arrested in Dec. 1907 for alleged complicity in a Zulu revolt, and in Nov. 1908 was tried before a special court. His defense was undertaken by Mr. W. P. Schreiner. The charge of treason was not proved, but he was convicted of harbouring rebels and sentenced to four years' imprisonment.

The Life of Sir Bartle Frere, by John Martineau, vol. ii, ch. 18 to 21, contains much information concerning Cetywayo.

CEUTA (Arabic SEBTA), a Spanish military and convict station and seaport on the north coast of Morocco, in 35° 54′ N., 5° 18′ W. Pop. (census, 1940), 59,115. It is situated on a promontory connected with the mainland by a narrow isthmus, and marking the southeastern end of the Straits of Gibraltar, which between Ceuta and Gibraltar have a width of 14 miles. The promontory terminates in a bold headland, the Montagne des Singes, with seven peaks, of which the highest, the Monte del Hacko—the ancient Ablya, one of the "Pillars of Hercules"—rises 636 ft. above the sea.

Ceuta occupies in part the site of a Carthaginian colony, which was succeeded by a Roman colony said to have been called *Ad Septem Fratres* and also *Exilissa* or *Lissa Civitas.* From the Romans the town passed to the Vandals and afterwards to Byzantium, the emperor Justinian restoring its fortifications in 535. In 618 the town, then known as Septon, fell into the hands of the Visigoths. It was the last stronghold in North Africa which held out against the Arabs. At that date (A.D. 711) the governor was Count Julian, who, to avenge a family wrong, invited the Arabs to conquer Spain. The Arabs called the town Cibta or Sebta, hence the Spanish form, Ceuta. It was repeatedly captured by rival Berber and Spanish-Moorish dynasties but became, nevertheless, an important industrial and commercial city, being noted for its brassware and its trade in ivory, gold and slaves. It is said to have been the first place in the west where a paper manufactory was established. In 1415 the town was captured by the Portuguese. It passed to Spain in 1580 on the subjugation of Portugal by Philip II, and was definitely assigned to the Spanish crown by the Treaty of Lisbon in 1688. The town has been several times unsuccessfully besieged by the Moors, one siege, under Mulai Ismail, lasting 26 years (1694–1720). In 1810, with the consent of Spain, it was occupied by British troops, but was restored to Spain at the close of the Napoleonic Wars. Its territory was enlarged after the war between Spain and Morocco in 1860.

Ceuta consists of two quarters, the old town, covering the low ground of the isthmus, and the modern town, built on the hills forming the north and west faces of the peninsula. Between the old and new quarters, and on the north side of the isthmus, lies the port. The fortifications date from the Portuguese occupation. For civil purposes Ceuta is attached to the province of Cadiz. It is a free port. Trade increased markedly during World War II.

CEVA, TOMASSO (1648–1736), Italian mathematician, was born at Milan on Dec. 20, 1648. He taught mathematics at the Jesuit college in Milan, and was a member of the order. While at the Brera college he co-operated with Saccheri in a number of mathematical researches. In 1678 Ceva published some work containing the theorem which is now known by his name and which deals with the concurrency of straight lines through the vertices of a triangle. He died at Milan on Feb. 3, 1736.

CEVA, a town of Piedmont, Italy, province of Cuneo, 33m. E. by rail from the town of Cuneo, on the line to Savona, 1,270ft. above sea-level. Pop. (1936) 2,982 (town); 6,946 (commune). The mediaeval fortress (defending the confines of Piedmont towards Liguria) was destroyed by the French in 1800, after cession to them in 1796. Cevan cheese (*caseus cebanus*) was famous in Roman times. A branch railway runs from Ceva through Garessio, with its marble quarries, to Ormea (2,398ft.), 22m. to the south through the upper valley of the Tanaro. From Ormea a road runs south to (31m.) Oneglia on the Ligurian coast.

CÉVENNES, a mountain range of southern France, forming the south and east fringe of the Plateau Central and part of the watershed between Atlantic and Mediterranean basins. It consists of a narrow ridge some 320 m. long, with numerous lofty plateaux and secondary ranges branching from it. The northern division, nowhere over 3,320 ft., is called the mountains of Charollais, Beaujolais and Lyonnais, from the Col de Longpendu (west of Châlon-sur-Saône) in a southerly direction to the Col de Gier. The central Cévennes, comprising the volcanic chain of Vivarais, incline south-west and extend as far as the Lozère group. The northern portion of this chain forms the Boutières range. Farther south it includes the Gerbier des Joncs (5,089 ft.), the Mont de Mézenc (5,755 ft.), the culminating point of the entire range, and the Tanargue group. South of Mont Lozère, where the Pic Finiels reaches 5,584 ft., lies the range strictly called the Cévennes. This region stretches south to include the Aigoual and Espérou groups. Under various local names (the Garrigues, the mountains of Espinouse and Lacaune) and with numerous offshoots, the range extends south-west and then west to the Montagne Noire. In the south, the Cévennes separate the barren region of the Causses from sunny Languedoc, where olive, vine and mulberry flourish. Northwards the contrast between the two slopes is less striking.

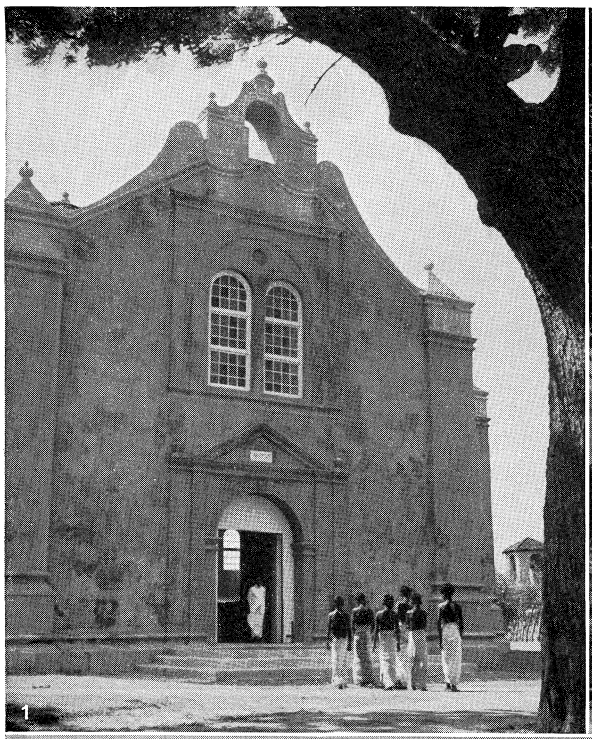
The Cévennes proper are a folded belt of Palaeozoic rocks along the south-east border of the central plateau of France. Concealed in part by later deposits, these folds extend from Castelnaudary to near Valence, where they sink suddenly beneath the Tertiary and recent deposits of the Rhône valley. Rocks from Cambrian to Carboniferous are included in the folded belt, and the gneiss and schist which form so much of the chain consist, in part at least, of metamorphosed Cambrian beds. The structure is complicated by extensive overthrusting from the south-east. The principal folding is of Hercynian age. Permian and later beds lie unconformably upon the denuded folds, and in the space between the Montagne Noire and the Cévennes proper the folded belt is buried beneath the horizontal Jurassic strata of the Causses. Folding was renewed along the south-east margin at the close of the Eocene period. The Secondary and Tertiary beds of Languedoc were crushed against the central plateau and were frequently overfolded, but the ancient Palaeozoic chain acted as part of the unyielding massif, and the folding did not extend beyond its foot.

The Cévennes form the watershed between the basins of the Loire and the Garonne to the west and those of the Saône and Rhône to the east. In the south the Orb, the Hérault and the Vidourle flow directly into the Gulf of Lyons; farther north, the Gard, the Cèze and the Ardèche flow to the Rhône. The Vivarais mountains and the northern Cévennes approach the right banks of the Rhone and Saône closely, and short torrents flow down to those rivers; on the west side the streams are tributaries of the Loire, which rises at the foot of Mont Mézenc. A short distance to the south on the same side are the sources of the Allier and Lot. The waters of the north-western slope of the southern Cévennes drain into the Tarn. In the Lozère group and the southern Cévennes generally, is good summer pasturage for huge flocks. Silkworm-rearing and the cultivation of peaches, chestnuts and other fruits are also carried on. In the Vivarais cattle are reared, while on the slopes of the Beaujolais are flourishing vineyards.

CEYLON, a large island and British colony in the Indian ocean, separated on the northwest from India by the Gulf of Manaar and Palk strait. It lies between 5° 55′ and 9° 50′ N. and between 79° 42′ and 81° 53′ E.; its extreme length from north to south is 270 mi.; its greatest breadth is 140 mi.; area, 25,332 sq.mi. The Maldive Islands (*q.v.*) are a dependency of Ceylon.

The coast is beset on the northwest by numerous sand-banks, shoals and rocks, and the island of Manaar, which forms an integral part of Ceylon, is almost joined to the island of Rameswaram by the chain of sand-banks named Adam's Bridge (*q.v.*). Of the channels through these shoals, Manaar Passage and Paumben Passage, the latter is the better though negotiable only by vessels of light draught. The west coast from Puttalam southward, and the whole south coast are fringed by coconut palms which grow almost to the water's edge. Along these shores there are numerous inlets and lagoons, often linked by canals, mostly constructed during the Dutch occupation. The east coast is more rugged and lacks the luxuriant vegetation of the west and south

CEYLON











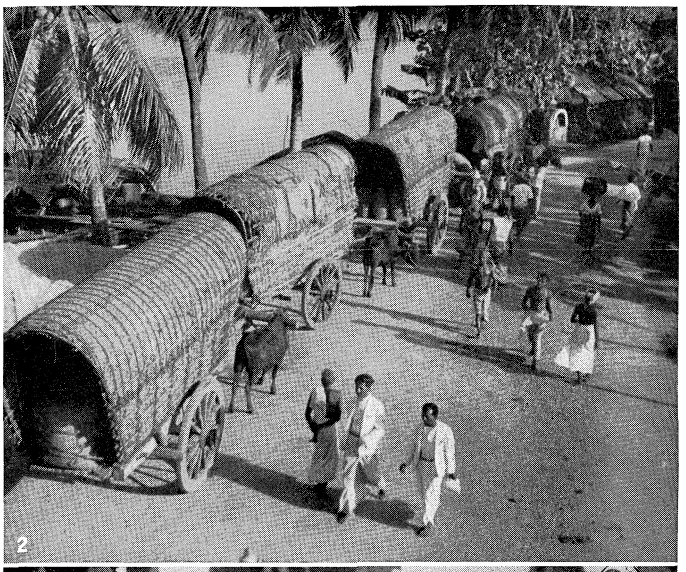
PHOTOGRAPHS, (1, 3, 4, 5) WERNER COHNITZ-PIX, (2) DEANE DICKASON FROM EWING GALLOWAY

THE CITIES OF CEYLON

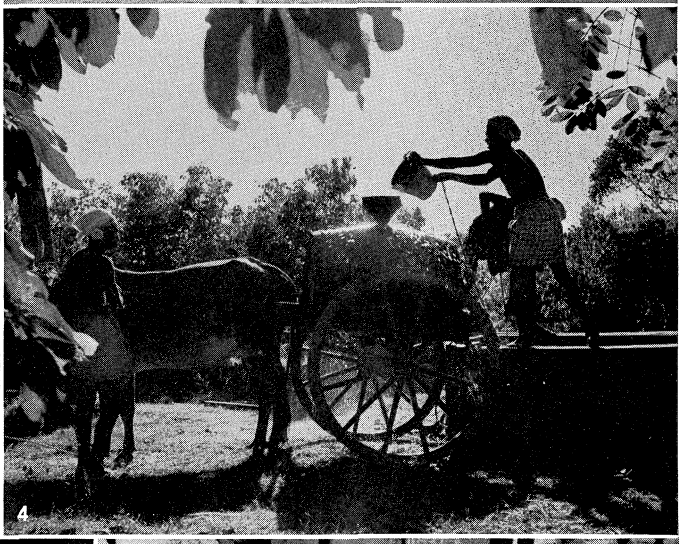
1. Dutch church in the fortified town of Jaffna built in 1705, during the Netherlands occupation
2. Clock tower and lighthouse in the downtown district of Colombo, the capital
3. An elaborate mosque in Colombo
4. Rickshas and motor cars go side by side on the streets of Colombo
5. Entrance to a warehouse in Galle, a seaport on the southwest coast

CEYLON

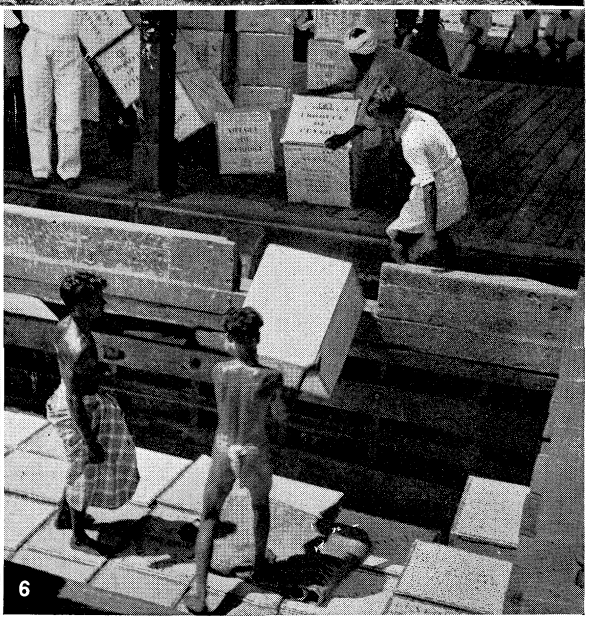












PHOTOGRAPHS, (1, 2) FRITZ HENLE, (3-6) WERNER COHNITZ-PIX

NATIVE OCCUPATIONS IN CEYLON

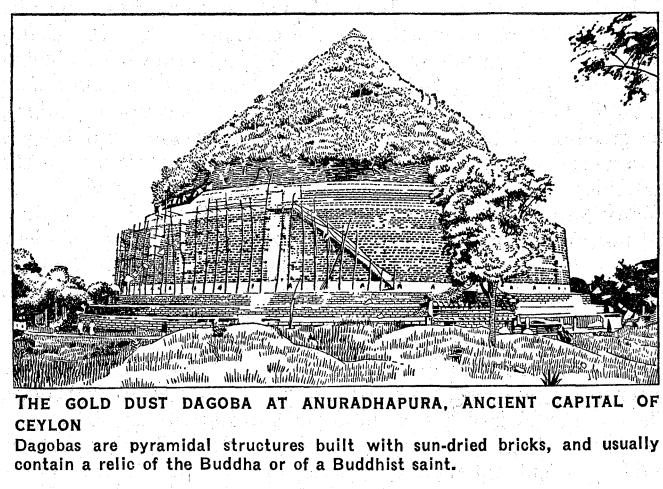
1. A fishing boat anchored alongside a beach
2. Oxen are common beasts of burden on the island
3. Coolies loading coco-nuts on a plantation north of Colombo
4. Natives drawing water from a well for transportation in ox-drawn water carts
5. Sinhalese and South Indian workers reporting for work on a rubber plantation
6. Loading crates of tea for export at the docks of Colombo

of the island. Deep water is usually available close to the shore, though there are a few dangerous rocks, well known to navigators.

Mountains.—A massif occupies the centre of the southern portion of the island covering 4,212 sq.m., the foothills rising from the flat plains 45 to 70 m. from the coast. The highest peak, Pedrutalagala (8,296 ft.), dominates the hill-station of Nuwara Eliya (6,000 ft.); Adam's Peak (*q.v.*) is visible to vessels approaching the harbours on the west coast and from Colombo. This massif intercepts the rains of both monsoons, whereas the arid "dry zone," which extends northward uninterruptedly from the neighbourhood of Dambulla, was only rendered habitable by a large population in ancient times by one of the most elaborate and skilful irrigation systems ever devised. This fell into disuse and, though much restoration work has been undertaken during the period of the British occupation of Ceylon, malaria has hitherto defeated all attempts to colonize this area anew. The rainfall of the south-west is far heavier than that of the north-east monsoon, and as a consequence the western and southern districts near the mountains are far more fertile than those on the east side. Practically the whole west side of these mountains, up to an altitude of 5,000 ft., is under tea; but on the eastern flanks the natural forest of the west and south slopes is replaced by rolling downs of rank grass strewn with great boulders. These are termed *patnas,* and till recently were regarded as unsuitable for tea; large areas have now been converted into tea-estates. At the time of the conquest of Kandy (1815) the mountains were covered with virgin forest; the Kandyan villagers had their homesteads in the deep valleys, and cultivated rice on any available flat ground and also on terraces cut out of the hillsides to a height of only a few hundred feet above the valley-levels.

The plateau of Nuwara Eliya, the famous health-resort, is 6,000 to 6,200 ft. above sea-level. It enjoys an almost perfect climate from September to April, though even during those months rainy days are common. From May to August rain falls almost daily. The Horton Plains (7,000 ft.), though they have not so far been extensively developed and are mainly used by anglers, possess an even more invigorating climate than that of Nuwara Eliya. The other principal hill stations in Ceylon are Badulla, Bandarawela, Diyatalawa, Hatton and Kandy (*q.v.*).

Rivers.—The largest river is the Mahaweli Ganga which, draining the west slopes of the mountains, falls into the sea at Trincomalee, on the east coast, after flowing for a distance of 206 miles. Like all rivers of Ceylon, it is navigable only in the lower



THE GOLD DUST DAGOBA AT ANURADHAPURA, ANCIENT CAPITAL OF CEYLON

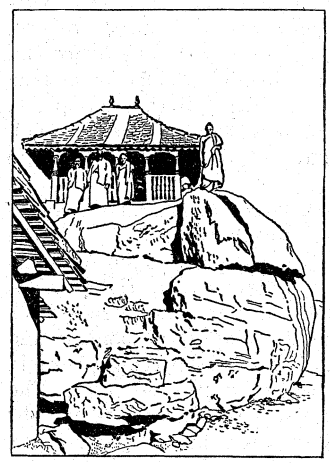
Dagobas are pyramidal structures built with sun-dried bricks, and usually contain a relic of the Buddha or of a Buddhist saint.

reaches, where tobacco and other crops are grown by Sinhalese and Tamil cultivators. Its rapid-beset course is a scenic feature near Kandy and in the botanic gardens of Peradeniya, the finest in the tropics. The Kala Ganga falls into the sea at Kalutara, and the Kelani Ganga debouches near Colombo. Against the latter's floods engineering-works have from time to time been constructed. In the northern part of the island many water-courses are dry most of the year, but all rise in sudden spate after heavy rain. The lakes which abound in north and east Ceylon are all in some measure, and many entirely, artificial. Of these the largest is Giant's Tank (9.3 sq.mi.), in the Northern Province; Minneri and Kalawewa, in the North Central Province, are about 6.2 sq.mi. each.

Trincomalee, on the east coast, is one of the finest natural harbours in the world. Galle was the principal harbour of Ceylon on the west coast until Colombo, by elaborate harbour-works which were begun towards 1880, was made the chief port of the island.

(H. Cl.; X.)

Geology.—The greater part of the island is occupied by ancient crystalline rocks in which pyroxene-gneisses are intrusive in the older ortho-gneisses and belong to the Charnockite series of Southern India. They are characterized by enstatite and a varying proportion of monoclinic pyroxene, hornblende and biotite. Typical Charnockite is a quartz-plagioclase-enstatite granite. By increase of ferro-magnesian minerals the rocks graduate into noritic varieties, rich in garnet. Except in the centre of some of the larger intrusive masses the rocks show marked mineral banding and granulitic structure. Veins and sills of pegmatite are common and frequently contain compounds of thorium and uranium as accessory minerals. A narrow band of Tertiary sediments borders the north-west coast and forms the Jaffna peninsula in the north. A small outlier of the same rocks is found on the south coast. Recent deposits of sand, mainly the result of marine agencies, fringe the rest of the coast as sand-bars enclosing lagoons and coastal flats, while the river valleys are filled with recent alluvium. In the low country the crystalline rocks are generally overlain by a thick mantle of laterite, resulting from their decomposition. The economic minerals of importance are—(1) graphite (plumbago) (2) gem stones. Graphite is found in the southwest quarter of the island in veins which may be regarded as a special type of pegmatite, and gem stones (most important of which are sapphire and other varieties of corundum) occur in river-gravels on the southwest flank of the main mountain mass. Fine quality mica and magnesite and quantities of vanadium were found during World War II.



BUDDHIST SHRINE ON THE SUMMIT OF ADAM'S PEAK, SHOWING THE CLEFT IN THE ROCK THAT IS ATTRIBUTED BY BUDDHISTS TO THE FOOTSTEP OF BUDDHA

Climate.—The south-west and north-east monsoons are the distinctive feature. The former is very regular in its approach, appearing along the south-west coast between May 10 and 20; the latter reaches the north-east coast between the end of October and the middle of November. The south-west monsoon brings rain to the western and southern coasts but does not reach the opposite side of the island. The mountains of the south-west sharply mark the wet and dry regions. The influence of the north-east monsoon is more general. The mountains in the north-east are lower and farther from the sea than those on the south-west, and rain is carried farther inland, giving general precipitation. The length of the day, owing to the proximity of the island to the equator, does not vary more than an hour at any season. Colombo is situated in 79° 50′ 45″ E., and the day is further advanced there than at Greenwich by 5 h. 19 m. 23 s.

Flora.—On sandy shores a screw-pine (*Pandanus tectorius*), *Clerodendron inerme, Scaevola frutescens, Cerbera Manghas, Thespesia populnea, Dolichandrone spathacea, Ipomaea Pescaprae, Spinifex littoreus, Lippia nodiflora* and *Crinum asiaticum* are common. On muddy shores, a mangrove formation with *Bruguiera conjugata, B. sexangulata, Rhizophora conjugata, R. mucronata, Sonneratia acida, Avicennia marina, Ceriops Tagal, Aegiceras corniculatum, Lumnitzera racemosa* and *Acanthus ilicifolius* is found.

On the south and west coasts the Coconut palm has been extensively planted, while on the north it is replaced by the Palmyra

palm (*Borassus flabellifer*), but neither of these is a native of Ceylon.

In the dry north and east occur *Salvadora persica* (the Mustard tree of Scripture), *Azima tetracantha, Acacia eburnea, Carissa spinarum, Ziziphus Jujuba* and *Randia dumetorum,* in the low-growing scrub-jungle near the coast. Further inland are forests with valuable timber trees, Satin-wood (*Chloroxylon Swietenia*), Ebony (*Diospyros Ebenum*), Tricomalee wood (*Berria cordifolia*), Milla (*Vitex pinnata*), Ranai (*Alseodaphne semecarpifolia*), etc. The beautiful Indian Laburnum (*Cassia Fistula*), *C. Roxburghii, C. auriculata* (which yields the Ranavara Tea), *Crataeva Roxburghii, Derris scandens* (like a white Wistaria) and *Ixora coccinea* are conspicuous. The Riti or Upas tree (*Antiaris toxicaria*), the bark of which was formerly used by the Veddas for making clothing, is found in this part of the island. Herbaceous plants belong mainly to the families Leguminosae, Acanthaceae, Scrophulariaceae Asclepidaceae and Cucurbitaceae. Ferns and orchids are comparatively rare.

The wet south-west and its affinities has mainly Malayan affinities, but with local species. The trees grow much higher than in the dry zone. Forty species of Dipterocarpaceae are confined to this region, and species of *Palaquium* (Sapotaceae), *Calophyllum* (Guttiferae) and *Diospyros* are also numerous. These forests produce the valuable woods Nedun (*Pericopsis*) Mooniana and Calamander (*Diospyros quaesita*). The few herbaceous plants in the forests are mainly Rubiaceae, Acanthaceae and ferns. The Wesak flower (*Dendrobium Macarthiae*) among orchids and the ribbon fern (*Ophioglossum pendulum*) are the most interesting of the epiphytes, which though more numerous than in the dry zone are less common than in the montane zone. The curious pitcher-plant (*Nepenthes distillatoria*) and the beautiful *Burmannia disticha* are common in open marshy places. *Acrostichum aureum* is a conspicuous fern in similar places, especially near the sea. *Helminthostachys zeylanica* a curious fern related to the Moonwort is found on wet sandy soil.

At higher altitudes the trees are smaller and usually flat-topped with numerous species of *Syzygium, Elaeocarpus* and *Lauraceae; Calophyllum Walkeri, Michelia nilagerica, Meliosma Arnottiana* and *Gordonia zeylanica* are ornamental. The undergrowth consists chiefly of various species of *Strobilanthes.* Climbing plants are less common than in the low country but include the lovely rose-red *Kendrickia Walkeri.* Many shrubs and herbs belong to genera represented in England, *e.g.,* bramble, violet, butter-cup, sundew and ladies' mantle.

Tree-ferns and filmy-ferns are especially noticeable; mosses, liver-worts (except Lejeuneae) and many families of lichens are more abundant than at lower elevations; orchids are also common, the daffodil orchid (*Ipsea speciosa*) and the hyacinth orchid (*Satyrium nepalenae*) are found on the ground on the patanas, while the lily-of-the-valley orchid (*Eria bicolor*), *Dendrobium aureum* and *Coelogyne odoratissima* are common epiphytes. Large open tracts of grass, called *patanas* and *talavas* by the Sinhalese, originally produced by periodic burning of the forest, are gradually extending. In the dry zone they have coarse grasses like *Aristida setacea, Heteropogon contortus,* and, about Batticaloa, of Iluk (*Imperata cylindrica*). In the wet zone up to about 5,000 ft. they consist mainly of mana grass (*Cymbopogon confertiflorus*) a fern (*Gleichenia linearis*) often with a few stunted trees such as the Patana oak (*Careya coccinea*). Above this elevation the grasses are mainly *Arundinella villosa, Chrysopogon zeylanicus,* and *Ischaemum ciliaris* var. *longipilum;* herbaceous plants are more numerous, the purple osbeckias being especially noticeable. Rhododendron arboreum, with large red flowers, is the only woody plant common on the patanas at this elevation. Large numbers of foreign species include *Lantana aculeata,* found everywhere along roadsides and on the patanas, the water-hyacinth (*Eichhornia crassipes*) blocking the irrigation channels of the rice fields in the low moist zone, *Mikania scandens* and *Ageratum conyzoides.* Timber trees like Jak (*Artocarpus integrifolia*) and Sapu (*Michelia champaca*) are also of foreign origin.

Fauna.—The elephant of Ceylon is considered a local subspecies of the Indian form, with tusks rarely developed. Elephants are still numerous in wilder parts, though much scarcer than when the greater part of the island was under forests. They are found at all elevations up to 7,500 feet. At intervals, a herd is driven by an army of beaters into a strong stockade or kraal in the jungle. Each is then noosed with the aid of tame elephants, and tied to trees by the legs. After a short period of discipline they become reconciled, but many captives die within a year. Tame elephants are used in building operations, transporting machinery etc., but chiefly in ceremonial processions.

The small oxen are hardy and capable of drawing heavy loads. Buffaloes (*Bubalus bubalis*) are common, wild and tame. Tame ones plough rice fields and tread out grain but otherwise lead a semi-wild life.

Ceylon possesses four deer—the Sambhur or "Ceylon Elk" (*Rusa unicolor*), the Spotted Deer (*Axis axis*), the Muntjac or "Barking Deer" (*Muntiacus malabaricus*) and the Hog Deer (*Hyelaphus porcinus*), the last probably introduced by the Dutch. A little Chevrotain, the "Mouse Deer" (*Moschiola meminna*), is also common. There are no antelopes in Ceylon.

There are five species of monkeys, one the small Rilawa (*Macacus sinicus*) which is found everywhere, and four known by the name of "Wanduru" (*Pithecus ursinus, P. vetulus* and subspecies, *P. philbricki* and *P. priam*). The only other member of the Primates is the little Slender Loris (*Loris tardigradus*) which creeps about the trees at night, and feeds on small birds, insects and fruit. Twenty-four Chiroptera have been identified: the large fruit eating bat or "Flying-fox" (*Pteropus giganteus*) roosts in large colonies in tall trees, often choosing those on small islands. At night it does much damage in mango groves, etc.

The tiger is not found in Ceylon, but the leopard (*Felis pardus*) and several smaller wild cats are common. The only carnivore ordinarily dangerous to man is the Sloth Bear (*Melursus ursinus*) found in the wilder parts. Jackals (*Canis lanka*), Otters (*Lutra lutra*), Palm Cats (*Paradoxurus*) and several species of Mongooses are common. Rats and Squirrels of many species are found, also a Porcupine (*Acanthion leucurus*) and a Hare (*Lepus singhala*). The Dugong (*Halicore dugong*) occurs in the shallow seas to the north and north-west of the Island and is captured for food to some extent. The only representative of the Edentata is the Pangolin (*Manis crassicaudata*).

Some 372 species of birds are recorded, about 120 being winter migrants from Asia, and 50 others accidental or occasional visitors. About 60 species or subspecies of resident birds are more or less distinct from the nearest Indian forms. Among these endemic species, the more noteworthy are the Ceylon jungle-fowl (*Gallus lafayettii*) the blue magpie (*Cissa ornata*), the yellow-eared bulbul (*Kelaartia penicillata*), the grey-headed babbler (*Turdoides cinereifrons*), the red-faced malkoha (*Phaenicophaës pyrrhocephalus*), the green-billed coucal (*Centropus chlororhynchus*) and Legge's flowerpecker (*Acmonorhynchus vincens*). The avifauna of the high rainy south, includes most endemic species and shows a close affinity to that of the Travancore hills, while the birds of the dry, flat north are more like those of the Carnatic. Bulbuls, babblers, barbets, kingfishers and crows of many kinds are ubiquitous. Thrushes, flycatchers, chats, drongos, mynahs and sunbirds are all well represented, while cuckoos, parroquets and woodpeckers are many and varied. Hawk-eagles, hawks and owls are numerous in species. Pigeons of many kinds, and game birds are common, the latter including peafowl, junglefowl and two species of francolins. The large artificial lakes in the dryer parts of the island are frequented by large numbers of herons, storks and other waders, and by resident and migratory species of teal, etc. Terns form the principal element in the sea fowl, the few species of gulls being winter visitors only, as are also nearly all the snipes, plovers and shorebirds.

Probably the only kinds of poisonous snakes to be feared are the Cobra (*Naia tripudians*) and the "Tic Polonga" or Russell's Viper (*Vipera russelli*). Other venomous species are either very slightly so or very rare. The Python or Rock Snake (*Python molurus*) is found in the jungles and Rat Snakes (*Zaocys mucosus*), and Green Whip Snakes (*Dryophis mycterizans*) are common.

Two species of crocodile occur, *Crocodilus palustris,* in the artificial lakes, and the larger *C. porosus,* in the rivers and estuaries. Both are much shot for their hides, as are the large terrestrial Monitor or "Tallagoya" (*Varanus bengalensis*) and its larger relative, the aquatic "Kabaragoya" (*Varanus salvator*). The commonest lizards are several species of the genus *Calotes,* known as "Bloodsuckers." There are also many Skinks and Geckoes, but the flying lizards (*Draco*) are unrepresented. Some 37 species of frogs and toads are recorded. The only other Amphibian is the legless Caecilian, *Ichthyophis glutinosus.* (J. PN.; X.)

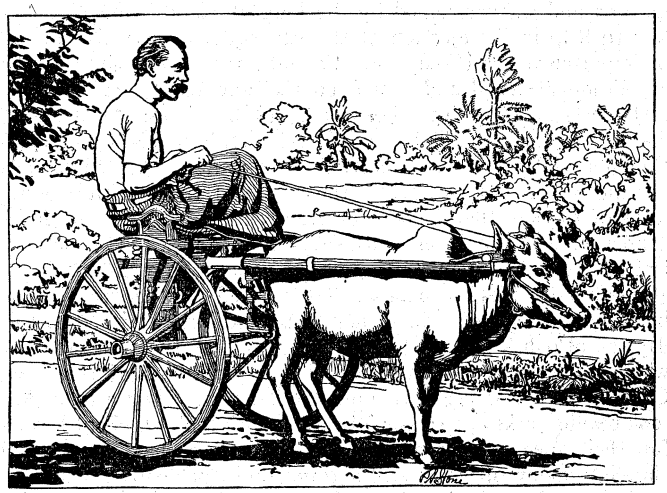
Population.—The estimated population of Ceylon in 1857 was about 1,700,000. The first decennial census was taken in 1871, and thereafter the population showed a steady increase. During the decade 1921 to 1931 the increase was 17.97%. The total population in 1931, exclusive of military and shipping elements, was 5,306,871 (that of Colombo being 284,155), and the population in 1936 was estimated at 5,631,200 and in 1940 at 5,981,000. The estimates of racial figures for 1931, 1936 and 1943 are as follows:

	1931	1936	1943
Europeans	9,153	10,200	11,000
Burghers and Eurasians	32,315	36,800	40,000
Sinhalese	3,473,030	3,775,500	4,113,000
Tamils	1,417,477	1,402,100	1,527,000
Moors	325,913	356,700	389,000
Malays	15,977	16,800	18,000
Others	32,564	33,100	36,000
	5,306,871	5,631,200	6,134,000

Altogether there are representatives of some 70 races in Ceylon. The Veddas, who live in rock shelters and run wild in the woods, are the aborigines. On July 1, 1943 the estimated population of Ceylon was 6,134,000 (Colombo 345,000). The birth rate in 1942 was the highest since 1937 and the infant mortality the lowest ever recorded, while the marriage rate was the highest since 1902 and the death rate the lowest in the 20th century.

HISTORY

This island was known to Brahmanical literature under the name of *Lanka,* to the Greeks and Romans as *Taprobane,* to the Mohammedan seamen and merchants, who for so long had a monopoly of the sea-borne trade of the Indian ocean, as *Serendib,*



BY COURTESY OF THE CANADIAN PACIFIC STEAMSHIPS

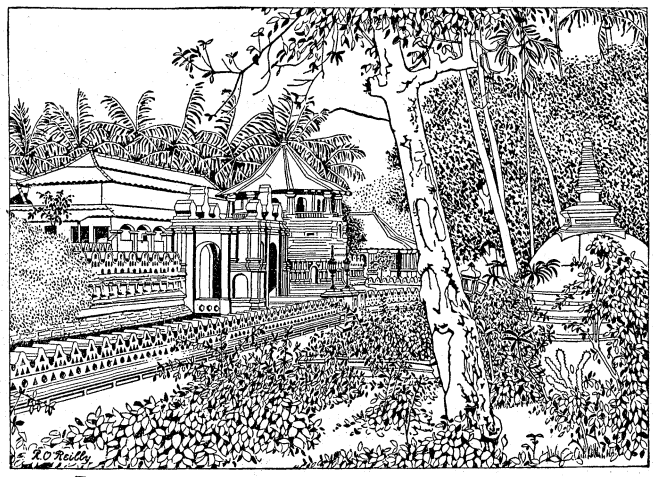
RACING BULLOCK CART IN CEYLON DRIVEN BY A NATIVE DRESSED IN LOCAL MALE FASHION. HE WEARS A SKIRT, AND A COMB

which it has been suggested is a corruption of the Sanskrit *Sinhaladvīpa,* and to the Portuguese as *Zeylan,* from which is derived its modern name. The presumed aboriginal inhabitants of the island were the people today called Veddas, a few of whom still occupy certain rock shelters in the Eastern province of the island. A careful and scientific examination of these people was made in 1910 by Professor and Mrs. C. D. Seligman. Though their language is said to have certain Indian affinities, they seem ethnologically to be related to the rather lightly coloured, wavy-haired race which is found surviving as somewhat the higher of the two principal aboriginal races in many parts of southeastern Asia. The Veddas are probably related to the *Sĕmang* or *Pangan* of the Malay peninsula and the Andaman islanders. Of the latter race, however, no trace has ever been found in Ceylon. The Veddas are regarded by the Sinhalese as of *goigama*—viz. husbandman—caste.

The great Hindu epic, the *Ramayana,* tells of the conquest of the greater part of the island by the hero Rama who, with his army, crossed Adam's bridge (*q.v.*) by the aid of the monkey god *Hanuman* and his host, the object of his invasion being, as in the case of *Menelaus,* the recovery of his wife, Sita, who had been abducted by *Rawana,* king of Lanka. The invaders would appear to have penetrated deep into the heart of the massif which occupies the centre of the southern portion of Ceylon. Unlike most oriental countries, Ceylon can boast a written history of considerable antiquity, the *Mahavansa.* This chronicle tells of the landing of Vijaya, the first Sinhalese king, in 504 B.C., accompanied by a small band of Aryan-speaking followers who must, it is thought, have sailed from some point on the northern or northeastern shores of the Bay of Bengal, since the greater part of southern India has, from time immemorial, been inhabited by people of Dravidian stock. Vijaya married a local princess—quite possibly a Vedda—and is said to have become the king of all Ceylon. It is noteworthy that, until the Sinhalese had been driven from out the flat plains north of Dambulla by successive invaders from southern India, they appear never to have attempted to populate at all densely the forest, which of old covered the hills and valleys of the central massif and the rich, moist areas in the plains immediately surrounding it. Instead, they established themselves throughout the vast, flat, arid country to the north of Dambulla, which extends to Puttalam on the west, to Kalkuda, some 20 mi. north-northwest of Batticalao, on the east, northward to Point Pedro in the Jaffna peninsula, and northwest to Talaimannar. This country (Pihiti was its ancient name) they rendered capable of supporting a considerable population by the construction of one of the most elaborate irrigation systems ever attempted by mankind. It may, however, safely be concluded that Ceylon is more thickly populated than it has been at any previous period of its history.

The Sinhalese kings had long been established at Anuradhapura, though their earliest capital was at Raja-Ratta, when in 307 B.C. the island was visited by Mahinda, a Buddhist priest and a son of Asoka, who is piously believed to have reached Mihintale from his father's capital, Magadha, accompanied by a few disciples, by levitation. A branch of the sacred Bo-tree, seated beneath the shade of which Gautama attained to Buddhahood, was imported from Magadha and planted at Anuradhapura in 288 B.C.; it is therefore 2,200 years old. Tradition tells that Gautama himself visited Ceylon, in the course of his ministrations, on three occasions, the last descent being on Adam's peak (*q.v.*). Though he is said personally to have undertaken the instruction of the people, there is nothing to show that Buddhism won any foothold in Ceylon until the beginning of the 3rd century B.C. From that time onward, however, up to the present time, it has been the religion to which the vast majority of Sinhalese adhere, though in Maka-Sen (A.D. 275) Ceylon had its Julian the Apostate, and its Messalina in queen Lila-Watti (A.D. 1202). Buddhism is essentially a tolerant, non-proselytizing philosophical system, and as it spread Buddhist temples and monasteries were established in all parts of Ceylon. In the course of time, too, the Buddhist church acquired ownership to much of the most fertile land, donated to it by the kings or by wealthy individuals. Buddhism became the state religion of Kandy, the king of which was head of the church. The word *Mahavansa* means *The Genealogy of the Great* and, as was to be expected, the priestly chroniclers, who wrote in Pali, a tongue not understood by the people, had nought to say about them. They also tell with apparent fidelity the long, tangled story of successive murderous strivings for the throne and of the frequent invasions of northern and central Ceylon by princes and armies of southern India, one of which led to the usurpation of the throne of Anuradhapura for a period by the Tamil Elala, who was slain by the Sinhalese kingly and saintly hero Dutegemunu (*c.* 190 B.C.). The ruins of Anuradhapura,

as we know them today (they were buried in jungle and completely deserted and neglected until about 1845) are interesting but disappointing, in that it is not easy to reconstruct from them any very vivid picture of the city in its prime. The upper structures were of timber, and all have long ago perished, leaving only the foundations for the instruction of archaeologists. The



THE TEMPLE OF THE SACRED TOOTH AT KANDY, CEYLON
The tooth in this temple is said to have belonged to the Buddha, although the Portuguese claim to have captured the original tooth during their suzerainty over Ceylon (1517–1600), and to have burned it in the market-place of Goa

massive *dagobas*—the pyramidal structures which are veritable hills laboriously constructed of small sundried bricks—and some of the buildings of Polonnaruwa are in a somewhat better state of repair. Both these ancient capitals, which had for centuries been completely deserted and surrendered to the jungle by the Sinhalese, have become under British rule places of monthly pilgrimage to which hundreds of thousands of pious Buddhists annually resort. A great deal of archaeological and epigraphical work has been done under government auspices by the archaeological department established by Sir William Gregory (1872–77); but the history of Ceylon under its Sinhalese kings is mainly a chronicle of royal crimes, virtues and delinquencies; of the long drawn out struggle with invading princes and armies from southern India, and of internecine strife between the Sinhalese kings of Pihiti (viz., northern Ceylon) and the chiefs of Rohuna and Maya-Ratta, the two districts or provinces into which the then sparsely populated southern portion of the island was divided. The last great revival of the glory of Sinhalese monarchy took place under Prakrama Bahu who was crowned king of Pihiti in 1153 at Polannaruwa, and in 1155 king of all Lanka, after successful war against Rohuna. His reign is lovingly styled "The Golden Age of Lanka" by the past-praising Sinhalese of today; but his wars, his invasion of Pegu in Burma and of the Pandyan country in southern India, his enormous activity as a builder of nonremunerative works, such as his palace with its reputed 4,000 apartments, dancing halls, *dagobas,* monasteries and temples, as well as his construction and restoration of innumerable irrigation tanks, must have imposed an almost unendurable strain upon the energies of his subjects. Fanatically religious, he lavished land and treasure upon the priesthood, who repaid him by giving him in the *Mahavansa* a superhumanly excellent character; he persecuted ruthlessly heretical Buddhist sects, which by the hierarchy was also accounted to him for righteousness; he endowed Brahmans, in a fine but hardly consistent, spirit of religious toleration; and, in imitation of Asoka, he imposed vegetarianism upon his overwrought people, and punished with great severity the taking of animal life, either in the water or on the land. The people must have been reduced in large numbers to a condition indistinguishable from slavery, and it is certain that this great monarch did much to ruin his country economically by his improvidence. Ceylon, or more properly Pihiti, had been conquered and annexed by Indian princes on several occasions, but in 1408, in revenge for an insult offered to an envoy a Chinese army invaded the island and carried King Vijaya Bahu IV into captivity. For 30 years Ceylon remained tributary to China.

Ceylon was first visited by the Portuguese when Francisco de Almeida landed there in 1505. He found an island divided into seven kingdoms, each ruled by its separate monarch, and each frequently at odds with one or more of its neighbours. In 1517 a fort was erected at Colombo by orders of the viceroy at Goa, with the permission of the king of Cotta; and from this time onward until the end of the 16th century the Portuguese were constantly at war with one or another of the native kingdoms. It is claimed that, when attacking and conquering Jaffna (Jaffnapatam) they obtained possession of the Tooth relic and, in spite of the enormous ransom offered for it, publicly burned it in the market place at Goa in obedience to the archbishop, who would not suffer the viceroy to make money out of the sale of what he accounted an idol. By the Sinhalese priesthood, who still possess a Tooth relic the shrine of which is at Kandy, it is asserted that the object captured at Jaffna was a false tooth. The Portuguese won a firm foothold on the western littoral, and they succeeded in converting the bulk of the *karawa* or fisher-caste Sinhalese to Christianity. Conversions upon a considerable scale, but almost invariably among the lower caste sections of the population, were similarly effected in other parts of the island; as estimated in 1936 Christians numbered 555,000, or nearly 10% of the total population of Ceylon, more than 95% being Roman Catholics. The proselytizing fervour and cynical rapacity of the Portuguese won for them hosts of enemies among the natives of all ranks, while their inherited traditional hatred for the *Moors*—by which term they described all Mohammedans—rendered them peculiarly odious to the latter, whose trade and shipping monopolies they had destroyed. The French, the Dutch and the British, when in turn they set the Bull of Alexander VI at defiance and forced their way into the Indian ocean, were accordingly welcomed as deliverers by the people of the east generally; and the trading centres which they had established in the beginning with such dauntless courage, and where they had exploited and persecuted the native populations so ruthlessly, fell before the Dutch and the British, fighting often in alliance with native potentates.

The Dutch admiral Spilberg landed on the east coast of Ceylon in 1602 and was welcomed by the king of Kandy who besought him to help in the ejection of the hated Portuguese. No action of importance was taken, however, until 1638–39, when a Dutch expedition attacked and destroyed the Portuguese forts on the east coast. In 1644 Negombo, which had once before been unsuccessfully attacked, fell to the Dutch; and in 1656 and 1658 Colombo and Jaffna were successively captured. The Dutch thus became masters of practically the whole of the maritime provinces of Ceylon, the kingdom of Kandy alone retaining its independence. The Dutch forthwith set about the task of the methodical and efficient administration of the country in a fashion never attempted by the Portuguese. They taxed the people heavily, but the land registers which they instituted have endured to this day, as also has Roman-Dutch law, many of the provisions of which are now deeply ingrained in the traditions of the Low-Country Sinhalese peasantry and landholders. They also undertook public works upon a considerable scale; built excellent houses for their own accommodation, public offices, law courts and churches, many of which still survive; and the roads which they made opened up the interior and greatly stimulated the trade of the island. Tolerant to Buddhism, Hinduism and Mohammedanism, they persecuted the Catholics persistently, but the religion which had been acquired by thousands of Sinhalese and by the Ceylon-born Tamils of Jaffna and Mannar was too deeply rooted in the peoples' hearts for its extirpation to be possible. Throughout the Dutch period Kandy maintained its independence.

The British, who had dispatched an embassy to the king of Kandy from Madras as early as 1763 without result, after various naval skirmishes in the neighbourhood of Trincomalee and Batticalao, sent a well equipped force against the Dutch in Ceylon in 1795, met with only a feeble resistance and in less than a year had obtained possession of the island. The Dutch rule had lasted for about 140 years, a period equal to that of Portuguese domina-

tion; but while the latter left Ceylon more distracted and no more developed than they had found it on their arrival, the Dutch administration, if somewhat harsh, and unimaginative, worked genuine and permanent improvement in almost every branch of the social and economic life of the people. The Dutch practice, followed by them for so long in almost all their overseas possessions, of taking over oppressive local systems of taxation, which had only been endurable because evasion was so common, and thereafter applying them with ruthless efficiency, made their rule highly unpopular; and even today the Burgher population, who are the descendants of the former Dutch rulers and settlers, are far from being loved by the Sinhalese. These Ceylonese Dutchmen, though many of their families have dilutions of oriental blood in their veins have retained their national character, their sturdy self-esteem, their traditions and high ideals of probity and conduct in a very remarkable degree. Over a long period they had a practical monopoly of the clerical work in most public departments, and held most positions of trust in public departments and commercial houses.

At first Ceylon was administered from Madras, but an attempt to apply the Madras revenue system and the employment of a host of Malabar collectors led to a rebellion, and in 1798 Ceylon became a crown colony. The treaty of Amiens (1802) formally ceded Ceylon to Great Britain; and the following year Kandy was invaded and occupied. The garrison was shortly afterward treacherously massacred after it had been induced to lay down its arms. It was not till 1815, however, that the Kandyan chiefs (with some of whom at an earlier period governor North had carried on discreditable intrigues against their king) invoked the aid of the British to rid themselves of this tyrant of Malabar stock whose cruelties had surpassed endurance. The Kandyan kingdom was thus voluntarily handed over to the British crown which guaranteed its people civil and religious liberty and the maintenance of their ancient customs. An insurrection which broke out shortly after was easily suppressed, and the second treaty (1818) which followed it did not materially alter in any respect the status of the Kandyan chiefs and people *vis-à-vis* the crown. The pacification and opening up of the mountain country by the construction of roads led immediately to a great incursion of Low Country Sinhalese, Mohammedan and Hindu traders, and European coffee planters. These latter penetrated into the virgin forest and, aided in the task of clearing by the Sinhalese villagers, carved out estates for themselves. The indigenous inhabitants declined to work for a wage on the European estates, save as artisans, etc., and it was found necessary to import as voluntary immigrants large numbers of Tamil coolies from the arid districts of southern India. Attempts to introduce cinchona were only partially successful, but very soon tea began to be planted and by the end of the century it was covering a far larger area than coffee had ever done. Then came rubber planting, an enterprise in which, for the first time, Sinhalese planters took an active part, their energies having in the past been confined to the cultivation of coffee, which ended in disaster, to some cocoa planting and to coconut planting, which was and still is the major Ceylonese native agricultural industry. Large fortunes were also made by Ceylonese in plumbago mining. The consequent acquisition of wealth by the natives of Ceylon, and especially by men of the *karawa* caste, brought about a social upheaval, and led to an agitation for political reform, the real object of which (though stimulus was imparted to it by the Morley-Minto reforms in British India) was to break the monopoly which the highest caste *goigama* aristocracy had till then enjoyed of representing Sinhalese interests in the legislative council. During the agitation that preceded the granting of these claims, ill-feeling based on caste prejudice and upon the angry passions which such prejudice aroused, and racial animosity began for the first time to become vocal in Ceylon. The first scheme of reform was worked out in 1909 by Col. Seely, then under secretary of state for the colonies, and accepted by governor McCallum, in spite of the protests of his executive councillors and the obvious inapplicability of Seely's scheme as originally framed by him to local circumstances. The first election of a representative of the educated Ceylonese was fought purely on caste lines, a high caste Tamil being chosen with the aid of the high caste Sinhalese vote, caste prejudice thus proving to be a stronger passion than racial bias. A state of growing unrest was thus created, and this was increased by the outbreak of World War I. A religious fracas at Gampola in 1915 between the Buddhists and Mohammedans resulted in riots which were quelled only after imposition of martial law, but in spite of this Ceylon emerged from the war comparatively unscathed.

The political problems in Ceylon were rendered particularly difficult of solution because of the very heterogeneous population. The Low Country Sinhalese, more sophisticated than the Kandyans, were spread throughout the Kandyan provinces and claimed, as Buddhists, a share in the management of Kandyan temporalities. The Kandyans, on the other hand, viewing penetration of their country by Low Country Sinhalese with dislike, remembered that these folk aided the Portuguese, the Dutch and the British in their several attacks on the Kandyan kingdom. Therefore they regarded any system of government that places the supreme power in the hands of a majority with acute apprehension. These feelings are in some degree shared by the Ceylonese Tamils, though in their case it is they who invaded the country occupied by the Low Country Sinhalese. The Burghers were still more apprehensive; while the Europeans, who represented huge financial interests, alike in the world of commerce and in agricultural enterprise, were only .181 of the total population of the island.

The Low Country Sinhalese and Tamils formed in 1919 the Ceylon National congress, but the latter withdrew in 1921 because, fearing Sinhalese predominance, they insisted that any change in the constitution should make provision for communal electorates. Meanwhile, in 1920, the composition of the legislative council was altered to 14 official and 23 unofficial members, and by another change in 1924 that body comprised 36 unofficial members (three of whom were Europeans and the majority of whom were elected) and 12 official. At the same time three unofficial Ceylonese (two Sinhalese and one Tamil) and one European had been added to the executive council. Responsibility for the good administration of the island continued, none the less, to be vested solely in the governor, who was unable to discharge it save by the good will of the unofficial majority in the legislative council or by the exercise of his power of veto, which could easily be countered by a refusal to vote supply. Because of the resulting impasse, the working of the constitution was investigated during 1927–28 by the Donoughmore commission, and as outcome of that body's recommendations a new constitution came into force in 1931. Both the legislative and the executive councils were dissolved and their place was taken by a state council having legislative and also executive functions. The new council consisted of 3 official members, 50 elected members and not more than 8 members nominated by the governor. The three official members *ex officio* were the chief secretary, legal secretary and financial secretary (formerly, respectively, known as the colonial secretary, attorney general and treasurer); while they could take part in debates they could not vote, and thus there was no longer an official minority. All elected members were elected on a territorial basis (the franchise being very wide), communal representation being abolished. The members of a new council proceeded by secret ballot to divide their total number (excluding the three officials, known as officers of state) into seven executive committees to administer seven of the ten groups into which the government departments were divided; each of the remaining three groups was supervised by an officer of state. Each executive committee elected a chairman, and these seven chairmen, termed ministers, and the three officers of state constituted a board of ministers; the three officials, who had no vote, served in an advisory capacity, the most important function of the board being the preparation of the annual estimates of revenue and expenditure.

In World War II it became necessary for Ceylon not only to grow many of the foodstuffs hitherto imported but vastly to increase its exports. As a producer of tea it ranked second only to India, and after Japanese occupation of the Malayan territories the island became the British empire's principal source of plantation

rubber. A steel-rolling plant was established in 1941 and numerous factories were opened for the manufacture of new products. In 1942 Ceylon was placed under the supreme control of a British admiral, who left administration to the civil authorities until such time as the threat of Japanese attack might compel him to intervene. The British cabinet undertook to grant the colony full responsible internal government after conclusion of hostilities.

See L. A. Mills, *Ceylon under British Rule, 1795–1932* (1933); D. Hussey, *Ceylon and World History*, 3 vols. (1936); C. B. Elliott, *The Real Ceylon* (1939); H. W. Codrington, *A Short History of Ceylon* (1939); Lord Holden, *Ceylon* (1939); W. T. Keble, *Ceylon, Beaten Track* (1940); *Colonial Report* (annual); *Times of Ceylon Green Book* (annual).

Education.—The schools of Ceylon are not divided on a basis of race or nationality. All schools maintained by the government or in receipt of state aid must admit pupils irrespective of race, nationality or religion. Attendance at school between 6 and 14 is compulsory wherever school accommodation is provided within a reasonable distance of the residence of the pupil. Pupils have alternative courses of instruction—in the vernacular languages; in the vernacular languages plus a working knowledge of English; in English, not merely for those whose mother tongue is English, but for those who at the beginning of school life have no knowledge of that language. In 1940 there were 1,993 government schools and 1,802 state-aided schools; and there was also a certain number of temple schools, known as Pirivenas, primarily intended for the Buddhist priesthood, which are not compelled to adopt the syllabus of work used by the ordinary schools. In addition, there are technical, agricultural and industrial schools, and a school for the deaf and blind. The Ceylon Medical college, established in 1870, was recognized in 1887 by the General Medical Council of the United Kingdom, and Ceylon University college, opened in 1921, prepared students for the examination of the University of London. In 1942 these institutions were merged to constitute the University of Ceylon.

Language.—Sinhalese is spoken by about two-thirds of the population. Tamil is used alike by more than 500,000 Ceylonese Tamils, by Ceylon and Indian Moormen, who number about 290,000, and by the Tamil immigrant labourers, a floating population of about 700,000. A Batavian dialect of Malay is spoken by descendants of Malayan troops imported by the Dutch. An archaic corrupt form of Portuguese is in use among descendants of the earliest European invaders. The aboriginal Veddas speak a language of their own, the affinities of which are obscure. English is in general use among the people of the upper and middle classes of all communities. A dictionary of Sinhalese was published in 1938 at public expense. Sinhalese is an Aryan language closely related to Pali (*q.v.*). Though minor dialectal differences occur, the spoken language is practically the same throughout Ceylon. Sinhalese possesses little literature of value, Pali having been used for the composition of the famous chronicle of the Mahawansa and for most of the poems, etc., of any merit written in Ceylon. Many of these, however, have been translated into Sinhalese.

Religion.—According to an official estimate made in 1936, the population of Ceylon was composed of Buddhists 3,467,200, Hindus 1,229,300, Christians 555,000, Moslems 378,700 and others 1,000, making a total of 5,631,200. Buddhism, the predominant religion, was introduced in the 3rd century B.C. The large Buddhist priesthood from time to time has produced many learned men; but the natural religion of the peasantry still finds expression in many observances probably of pre-Buddhist origin. Ceylon Buddhism, moreover, recognizes many Hindu gods and goddesses. Christian practice has prompted Young Men's and Young Women's Buddhist associations, and Islam the doffing of shoes on entering Buddhist temples. The simple faith of the people leads enormous numbers of pilgrims to the principal shrines and temples at each full moon, and to the universal observance of such Buddhist feasts as Wesak, the birthday of Gautama. Adherence to Buddhism, however, has done nothing to wean the Sinhalese as a whole from the consumption of alcohol, though there is among educated Sinhalese and Tamils alike a vigorous temperance movement. The large number of crimes of violence among the Sinhalese shows that Buddhist teaching has not succeeded in imbuing them with a sense of the sanctity of human life; while, though they for the most part hesitate to take animal life, their treatment of domestic animals is cruel and callous in the extreme.

Agriculture.—The natural soils are composed of quartzose gravel, felspathic clay and sand, often of a pure white blended with or overlaid by brown and red loams, due to decay of vegetable matter, or disintegration of gneiss and hornblende formations. The whole consists of a sandy and calcareous soil admixture, which in ancient times yielded large crops of rice and other foodstuffs, owing to an elaborate system of irrigation. The soil of the maritime provinces is sandy, but large tracts of quartzose sand along the shore are very suitable for coconut and cinnamon cultivation. From this light sandy belt as far as the foothills, the land is mainly composed of flats which yield large rice crops, and of low hilly undulations, large areas of which up to a height of some 2,000 ft. are under rubber. The soil of the mountain area, though frequently containing great quantities of quartzose sand and ferruginous clay, is often of a fine loamy character, suitable for coffee and for tea cultivation. The south and west sides of these mountains have been cleared of forest up to a height of 5,000 ft., and in a few instances above that level. In the low country large extents of land formerly under tea have been converted into rubber estates, tea of the best quality being obtainable only at higher altitudes. Acreages under the chief crops were estimated in 1938 as follows:

Crop	Acres	Crop	Acres
Coconuts	1,100,000	Palmyra	50,000
Rice	850,000	Cacao	34,000
Rubber	604,111	Citronella	33,000
Tea	556,650	Cinnamon	26,000
Chenas, Vegetable and other crops	140,000	Tobacco	14,000
Arecanuts	69,000	Cardamoms	6,000

The prosperity of Ceylon depends entirely upon its agriculture. Its principal industry of this nature, other than the rice, coconuts and fruit produced by the indigenous population, was coffee planting, introduced by British planters shortly after 1815. The bulk of the coffee was cultivated on estates under European management and financed by European capital, but considerable quantities were also grown by the indigenous population. Towards 1880 the coffee then covering vast areas, principally in the hill country, was stricken by leaf disease. Cinchona and other crops were tried as a substitute, and eventually tea. In a couple of decades it had equalled, and presently outstripped, the coffee industry. Rubber was introduced during the closing years of the 19th century and, unlike tea, found great favour with Ceylonese agriculturalists and capitalists. In 1943, after the Japanese had seized most of the world's sources of quinine, Ceylon undertook for the first time the cultivation of cinchona. The principal native agricultural industries continue to be coconuts and rice. Chena cultivation, that is, the growing of crops on jungle land newly cleared by burning, is an important feature of peasant agriculture in the sparsely populated areas of the dry zone. The cultivation of cotton has been successfully established as a peasant industry, chiefly in the Southern and Central provinces.

Commerce.—The most prominent article of export from Ceylon is tea, approximating in value two-thirds of the total export trade. Rubber is second in importance, the bulk of the product going to the United States. The extent to which Ceylon depends on imported food is denoted by the fact that rice alone normally represents almost a quarter of the total value of all imports. Burma was the leading supplier until loss of that country to Japan in World War II compelled the colony to grow sufficient for its own needs. Cotton piece goods ranked second in value among imports; in the years immediately preceding the conflict Japan had the largest share of the market. The table on p. 183 gives value of imports, domestic exports and re-exports for 1934–38.

The bulk of the trade of Ceylon was with British countries. In 1938, 72.10% of the exports went to parts of the empire (53.94% going to the United Kingdom) and 12.64% to the United States. The empire enjoyed 67.18% of Ceylon's import trade in 1938 (the share of the United Kingdom being 20.64%), and Japan,

Year	Total Imports Rs. '000	Total Exports		Excess of Exports over Imports Rs. '000
		Exports (domestic) Rs. '000	Exports (Other than domestic) Rs. '000	
1934	216,996	241,193	22,617	46,814
1935	227,501	230,041	23,072	25,612
1936	214,338	244,415	24,060	54,137
1937	242,600	310,198	20,365	89,475
1938	235,529	263,535	20,215	49,294

with 6.54%, was the principal foreign importer. Imports in 1942 were valued at Rs.274,000,000, and exports reached the record figure of Rs.507,000,000. (W. B. Pn.)

CÉZANNE, PAUL (1839–1906), French painter, was born at Aix, the ancient capital town of Provence, on Jan. 19, 1839. His father was a banker. Paul was educated at the *lycée* of the town, where he formed an intimate friendship with Émile Zola, the novelist. The two boys were both inspired by a love of the classics, particularly of Virgil, through whom, perhaps, Cézanne realized the beauty of his native country. Both decided to consecrate themselves to art. Zola settled down early to a literary career in Paris, but Cézanne endeavoured to comply with his father's wish that he should carry on the family bank. But after two unsuccessful attempts the father allowed Paul to settle in Paris and attended the art school. He arrived there in 1863.

Cézanne became known as one of the most extreme of the young revolutionary painters, the bitterest in his denunciation of official art and of Ingres who, then in his old age, was regarded as the head of the reactionaries. In this way he became acquainted with the group of painters who encircled Manet, and who afterwards became known as the impressionists. But Cézanne's work in his early years shows no sign of this frequentation. At this period he was most influenced by Delacroix and by the Baroque painters whom Delacroix studied, by Rubens and Tintoretto. His ambition was to create grandiose compositions of a purely imaginative description, expressive of his own internal moods, using either violently dramatic themes—"Les Assassins," "L'Autopsie," "Lazare" —or lyrical motives—"Le Jugement de Paris," "Déjeuners sur l'herbe." He also painted a series of portraits in which dramatic and psychological effects were undertoned. In these the influence of Courbet is evident. They are painted with broad strokes, the palette-knife ploughing up and planting down an exceedingly thick and dense impasto. In all these early works the colour is reduced to a few simple notes in which black, white and earth reds and yellows predominate. The tension of Cézanne's imaginative life shows itself in the tumultuous vehemence of these early compositions. He trusts to his inner convictions with a blind and reckless courage which was unfortunately not supported by the gifts necessary to make such an imagery plausible, or to give verisimilitude to the contorted poses of his Tintorettesque nudes. His outlook on nature seems to have been confined for the most part to the search for motives of chiaroscuro suitable to the dramatic effects of his imaginative designs. He showed at this stage nothing of the curiosity about natural effects of colour which distinguished the impressionist group. He was, in fact, far more concerned with expressing the exaltation of his own feelings, inspired by literature or imaginative brooding, than with the phenomena of the visible world. A few still-lifes of this period show, however, how much greater his native endowment was in this direction than in the one he was consciously pursuing; but even in these the dramatic evocations of the thing seen are what chiefly interested him.

During the years 1872–73 a great change came over Cézanne. He spent the summers of these years at Anvers-sur-Oise in the company of Camille Pissarro, who was one of the impressionists. Pissarro was some years older than Cézanne and had already discovered his personal style and perfected a methodical and precise technique adapted to it. Cézanne, who had hitherto trusted to the inspiration of his imaginative ideas for his daring, but rather fortuitous technique, here for the first time underwent a methodical course of training. He learned for the first time to look on nature with a curious and contemplative gaze, and he learned a precise and methodical technical process, by which to record the results thus obtained. Above all, the whole world of "atmospheric" colour was thus revealed to him. Certain pictures painted by Cézanne in these years approximate very nearly to Pissarro's work, but they show Cézanne's greater power of organizing form, and the greater profundity of the conceptions which his contemplation of natural appearance provoked in his intensely passionate nature. For these years, then, Cézanne may be counted an impressionist.

But Cézanne's response to appearances gave him a notion of design more vigorously constructed, and evocative of far deeper feelings, than any that the impressionists envisaged. To them the weft of colour which nature revealed to their specialized visual sense was all that mattered; out of that each artist could choose unconsciously those harmonies which specially appealed to him. But Cézanne always believed in some underlying reality of a more permanent kind, more consonant with the deeper instincts of human nature. The impressionist vision was both too casual and too imperfectly organized for him. It missed part of the truth which the older masters had apprehended. Cézanne summed up his own attitude by saying that his ambition was to do Poussin over again after nature, *i.e.*, to incorporate into a clearly organized formal unity, like Poussin's, the vision of natural appearance as enriched by impressionist researches. From this point Cézanne's personal vision and his personal expression of it were established. Such changes as his style underwent in the succeeding decades were only gradual modifications of what he had established once for all. The essentials of that style were due, as we have seen, to the special use he made of the impressionist vision. They were based upon the most rigorous construction of the design by means of the interplay of clearly articulated planes. But the movement of these planes, their salience and recession, was interpreted quite as much by changes in local colour as by the definition of form by light and shade. A characteristic of Cézanne's completely realized manner is the extreme simplicity of the approach, the fact that objects are presented in full frontal aspect. In nearly all his portraits the sitter is placed nearly in the centre of the canvas, the head and body being seen nearly in full face. In the landscapes a similar treatment is found; objects are extended in planes parallel to the picture plane, and frequently the main mass will be centrally placed. Such extreme symmetrical simplicity of approach takes us back to the practice of the Italian Primitives. It is violently opposed to the principles of Baroque composition as followed by most of Cézanne's predecessors and by himself in his early period.

Such an exaggeratedly simple disposition would probably strike us as crude and uninteresting if it were not that within the volumes which he places before us in this elementary fashion, his analysis of changes of surface and plastic movement is pushed to an extraordinary degree, and this is accompanied by innumerable slight modulations of colour, so that the whole surface takes on something of the infinity of natural appearance. This practice he developed with ever-increasing power. In the '70s and early '80s, the almost laborious scrutiny of infinitesimal colour changes led him to load the canvas with repeated layers of colour, though without ever losing purity and intensity. Later on he was able to get the same multiplicity of surface with thinner layers of colour. Together with this he tended also to simplify the colour changes, adopting even a regular principle of colour sequences to express movements away from the highest relief of any given volume. All this was strictly in keeping with his philosophical conception of the aim of painting. In everything he did he sought a synthesis in which the most rigorously logical plastic structure should be combined with the utmost liveliness of surface; that is to say, he sought, without losing the infinitude of natural appearance, to give to it an intelligibility and a logical coherence which it lacks. This, no doubt, is more or less the problem of all painting; what distinguishes Cézanne is his endeavour to attain this synthesis when each of the opposite terms is at its highest pitch.

To the last decade of the 19th century belong some of his most celebrated works: the portrait of Geffroy, which is perhaps unequalled in modern art for the completeness of its realization, the complexity and assurance of its harmonies; several versions of a composition of men seated at a café table and playing cards, in

which the primitive simplicity of the arrangement gives an elemental grandeur to the forms; and a series of landscapes in which the pyramidal mass of Mt. Ste. Victoire dominates the design. Even to the end of his life, Cézanne always cherished the hope of creating imaginative and "poetical" designs of nude figures in landscape, after the manner of some of Giorgione's and Titian's pictures. But in this he was hampered by his extreme reluctance to draw from the nude model, and most of these grandiose attempts remain failures.

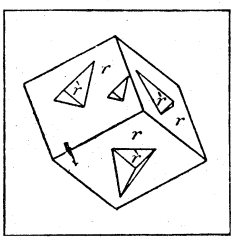
At the very end of his life there seems to have been a kind of recrudescence in Cézanne of the romantic tendencies of his youth. His paintings become richer, more intense and vivid in colour, more agitated in rhythm, more vehement in accent; they also depart more and more from the careful analysis of natural appearance of the middle period, as though his long apprenticeship to nature had ceased and he felt free to follow unhesitatingly his instinctive feeling. The middle and end of Cézanne's life was passed in great seclusion at Aix, with occasional visits to Paris. In the '80s and '90s his very name had become almost unknown in the larger art circles of Paris, though he never lacked a few enthusiastic admirers. Gradually his fame began to circulate among the more intelligent artists, and in 1904 a retrospective exhibition of his works in the Autumn Salon revealed to the public the existence of this almost unknown genius. It was the only foretaste of his posthumous fame which he experienced. He died Oct. 23, 1906.

BIBLIOGRAPHY.—G. Coquiot, *Cézanne* (1919); J. Gasquet, *Cézanne* (1921); G. Rivière, *Le Maître Paul Cézanne* (1923); A. Vollard, *Paul Cézanne,* trans. H. L. van Doren (1924); J. Meier-Graefe, *Cézanne,* trans. J. Holroyd-Reece (1927); R. Fry, *Cézanne* (1927).

(R. FR.)

C.G.S. SYSTEM, a system of units which takes as a basis the centimetre, the gram and the second. (*See* PHYSICAL UNITS and ABSOLUTE UNITS.)

CHABAZITE, a mineral species belonging to the group of zeolites. It occurs as white to flesh-red crystals which vary from transparent to translucent and have a vitreous lustre. The crystals are rhombohedral, and the predominating form is often a rhombohedron with interfacial angles of 85° 14′; they therefore closely resemble cubes in appearance, and the mineral was in fact early (in 1772) described as a cubic zeolite. A characteristic feature is the twinning, the crystals being in many cases interpenetration twins with the corners of small crystals in twinned position projecting from the faces of the main crystal. A flat lenticular form of crystal is also common, this variety being known as phacolite (from *φακός*, a lentil). The hardness is $4\frac{1}{2}$, and the specific gravity 2·08–2·16.



TWINNED CRYSTAL OF CHABAZITE
Interpenetrating rhombohedra (nearly cubic in form) are especially characteristic of this mineral

Chemically, chabazite is a complex hydrated calcium and sodium silicate. The composition is, however, variable, and is best expressed as an isomorphous mixture of the molecules $(Ca,Na_2)Al_2Si_4O_{12}+4H_2O$ and $(Ca,Na_2)Al_2(Si_3O_8)_2+8H_2O$, which are analogous to the felspars. Most analyses correspond with a formula midway between these extremes, namely $(Ca,Na_2)Al_2(SiO_3)_4+6H_2O$. Chabazite occurs with other zeolites in the amygdaloidal cavities of basaltic rocks; occasionally it has been found in gneisses and schists.

Gmelinite is another species of zeolite which may be mentioned here, since it is closely related to chabazite. It forms large flesh-red crystals usually of hexagonal habit, and was early known as soda-chabazite, it having the composition of chabazite, but with sodium predominating over calcium $(Na_2{\cdot}Ca)\ Al_2(SiO_3)_4+6H_2O$.

(L. J. S.)

CHABLIS, a town of north-central France, in the department of Yonne, on the left bank of the Serein, 14 m. E. of Auxerre by road. Pop. (1936) 1,821. Its church of St. Martin belongs to the end of the 12th century. The town gives its name to a well-known white wine (*see* BURGUNDY).

CHABOT, FRANÇOIS (1757–1794), French revolutionary, born at St. Geniez, near Aveyron, had been a Franciscan friar before the Revolution, and after the civil constitution of the clergy continued to act as "constitutional" priest. Then he was elected to the Legislative assembly, sitting at the extreme left, and forming with C. Bazire and Merlin de Thionville the "Cordelier trio." Re-elected to the convention he voted for the death of Louis XVI, and opposed the proposal to prosecute the authors of the massacre of September. Compromised in the falsification of a decree suppressing the India company and in a plot to bribe certain members of the convention, especially Fabre d'Eglantine and C. Bazire, he was made to appear before the Revolutionary tribunal, and was condemned and executed on April 5, 1794.

See *François Chabot . . . à ses concitoyens, . . . pluviose, an II. Mémoire apologetique, . . .* etc. ed. A. Mathiez (1914); J. M. J. A. de Bonald, *François Chabot, membre de la Convention* (1908).

CHABOT, PHILIPPE DE, SEIGNEUR DE BRION, COUNT OF CHARNY AND BUZANÇAIS (1492?–1543), admiral of France. The Chabot family was one of the oldest and most powerful in Poitou. Philippe was a cadet of the Jarnac branch. He was a companion of Francis I as a child, and on that king's accession was loaded with honours and estates. After the battle of Pavia he was made admiral of France and governor of Burgundy (1526), and shared with Anne de Montmorency the direction of affairs. He was at the height of his power in 1535, and commanded the army for the invasion of the states of the duke of Savoy; but in the campaigns of 1536 and 1537 he was eclipsed by Montmorency, and from that moment his influence began to wane. He was accused by his enemies of peculation, and condemned on Feb. 10, 1541, to a fine of 1,500,000 livres, to banishment, and to the confiscation of his estates. Through the good offices of Madam d'Étampes, however, he obtained the king's pardon (March 1541) and was reinstated, while Montmorency in his turn was disgraced. He died soon afterwards on June 1, 1543.

See the ms. correspondence of Chabot in the Bibliothèque Nationale, Paris and contemporary memoirs.

CHABRIAS (4th century B.C.), Athenian general. In 388 B.C. he defeated the Spartans at Aegina and commanded the fleet sent to assist Evagoras, king of Cyprus, against the Persians. In 378, when Athens joined Thebes against Sparta, he defeated Agesilaus near Thebes. On this occasion he invented a manoeuvre, which consisted in receiving a charge on the left knee, with shields resting on the ground and spears pointed against the enemy. In 376 he defeated the Spartan fleet off Naxos, but, when he might have destroyed the enemy, remembering Arginusae (*q.v.*), he delayed to pick up his dead. Later, when the Athenians joined the Spartans, he repulsed Epaminondas before Corinth. In 366, together with Callistratus, he was accused of treachery in advising the surrender of Oropus to the Thebans. He was acquitted, and soon after he accepted a command under Tachos, king of Egypt, who had revolted against Persia. On the outbreak of the Social War (357) he joined Chares in the command of the Athenian fleet. He lost his life in an attack on the island of Chios, probably in the same year.

See Cornelius Nepos, *Chabrias;* Xenophon, *Hellenica,* v. 1–4; Diod. Sic. xv. 29–34; *Cambridge Ancient History,* vol. vi. (1927) chapters iii., vi. and viii. (with useful bibliography). *See* also DELIAN LEAGUE.

CHABRIER, ALEXIS EMMANUEL (1841–1894), French composer, was born at Ambert, Puy de Dôme, on Jan. 18, 1841, and first attracted general attention in 1883 by his brilliant orchestral rhapsody entitled *España,* the themes of which he had jotted down when travelling in Spain. His opera *Gwendoline,* produced at Brussels on April 10, 1886, was successful too and still more so its successor, of a lighter type, *Le Roi malgré lui,* which was brought out in Paris at the Opéra Comique.

CHACMA, the Cape baboon, *Papio comatus,* inhabiting the mountains of South Africa as far north as the Zambezi. The size of an English mastiff, this powerful baboon is blackish-gray in colour with a tinge of green due to the yellow rings on the hairs. Unlike most of its tribe, it is a good climber. It is destructive to crops.

CHACO, a territory of northern Argentina, part of a large district known as the Gran Chaco, bounded north by the terri-

tory of Formosa, east by Paraguay and Corrientes, south by Santa Fé, and west by Santiago del Estero and Salta. The Bermejo river forms its northern boundary, and the Paraguay and Paraná rivers its eastern. Pop. (1942) 345,900; area, 38,468 sq. mi. Northern Chaco has long been the subject of dispute between Bolivia and Paraguay. Armed clashes over its possession began in 1928 and gradually developed into open war. All efforts of other states and the League of Nations to mediate were unavailing. And the belligerents continued their bloody struggle in spite of a seeming bankruptcy on both sides. Paraguay, on the whole, proved the more successful in arms. Finally a truce was arranged on June 14, 1935, followed by a formal peace agreement signed at Buenos Aires, Aug. 21, 1936.

CHACO CANYON, a tract of about 20,000 ac. in northwestern New Mexico, U.S.A., set apart in 1907 as a national monument. It contains the most remarkable architectural remains of prehistoric North America and has yielded a rich collection of objects illustrative of a vanished civilization. The buildings, which sometimes attained a height of at least four storeys, show a variety of methods in stone construction. Several are of enormous size, Pueblo Bonito, the largest, measuring 667 ft. by 315 ft.; a wall still standing rises to 48 feet. This building, like most of the others, constituted a veritable village and contained 800 rooms and 32 *kivas,* or large ceremonial halls. Chetro-Kettle and Peñasco Blanco are similar structures, while other ruins show that the private house also was in use.

CHACONNE, a slow dance, introduced into Spain by the Moors, now obsolete. It resembled the Passacaglia. The word is used also of the music composed for this dance—a slow, stately movement in $\frac{3}{4}$ time. Such a movement was often introduced into a sonata, and formed the conventional finale to an opera or ballet until the time of Gluck. The most famous of all chaconnes is that of Bach for violin unaccompanied—a colossal example which is generally played as an independent piece, though it is actually a movement in one of his violin sonatas (No. 4).

CHAD (CEADDA), **SAINT** (d. 672), brother of Cedd, whom he succeeded as abbot at Lastingham, was consecrated bishop of the Northumbrians by Wine, the West Saxon bishop, at the request of Oswy in 664. On the return of Wilfrid from France, where he had been sent to be consecrated to the same see, a dispute arose, which was settled by Theodore in favour of Wilfrid. Chad thereupon retired to Lastingham, whence with the permission of Oswy he was summoned by Wulfhere of Mercia to succeed his bishop Jaruman (d. 667). Chad built a monastery at Barrow in Lincolnshire and fixed his see at Lichfield.

See Bede's *Hist. Eccl.;* Eddius, *Vita Wilfridi,* xiv., xv., ed. J. Raine, Rolls series (1879).

CHAD, a lake of northern Central Africa lying between 12° 50′ and 14° 10′ N. and 13° and 15° E. It lies about 850ft. above the sea in the borderland between the Sudan and the Sahara. The lake has greatly shrunken since it was first seen by Europeans; this is attributed to the progressive desiccation of the region. Thus a town which in 1850 was on the southern margin of the lake was in 1905 over 20m. from it. But as the west shore is perfectly flat, a slight rise in the water causes the inundation of a considerable area, a fact to be remembered in considering the estimates made as to the size of the lake. In any case the Chad is but the remnant of what in recent geological times was a very much larger sheet of water spreading south, north east and east of its present limits. A considerable area lying to the north-east is below the level of the lake. Around the north-west and north shores is a continuous chain of gently sloping sand-hills covered with bush. In the east, the country of Kanem, the desiccation has been most marked. Along this coast is a continuous chain of islands running from north-west to south-east. They are generally low, being composed of sand and clay, and lie from 5 to 20m. from the shore, which throughout its eastern side nowhere faces open water. Two principal groups of islands are distinguished, the Kuri archipelago in the south, and the Buduma in the north. The inhabitants of Buduma were noted pirates until reduced to order by the French. The coastline is, in general, undefined and marshy, and broken into numerous bays and peninsulas. It is also, especially on the east, lined by lagoons which communicate with the lake by intricate channels, while across the middle of the lake are numerous mud-banks, marshes, islands and dense growths of aqueous plants. Another stretch of marsh usually cuts off the northernmost part of the lake from the central sections. The open water varies in depth from 3ft. in the north-west to over 20 in the south. Fed by the Shari and other rivers, the lake has no outlet. The flood water brought down by the Shari in December and January causes the lake to rise to a maximum of 24ft., the water spreading over low-lying ground, left dry again in May or June. But after several seasons of heavy rainfall the waters have remained for years beyond their low-water level. Nevertheless the loss by evaporation (estimated in the dry season to be 10in. a month) and percolation is believed to exceed the amount of water received.

The southern basin of Chad is described under the Shari, which empties its waters into the lake about the middle of the southern shore, forming a delta of considerable extent. Beyond the south-east corner of the lake is a channel or depression known as the Soro or Bahr-el-Ghazal (not to be confounded with the Bahr-el-Ghazal affluent of the Nile). This channel goes north-north-east and some 250m. from the lake reaches its lowest point, 500ft. below Chad, in what is known as the Kiri lake (now dry). The remarkable levels led to the supposition of a connection between the basins of the Chad and the Nile. The French explorer, Jean Tilho, in his 1912–17 expedition showed that this was not the case and that the Chad is a closed basin. The Soro depression continues north-east some distance beyond Kiri. Then in the valleys between the Tibesti and Ennedi mountains the ground gradually rises and forms the watershed between Nile and Chad. In this direction, however, Chad at one time extended to the foothills of Tibesti and Borku. Besides the Shari, the Yedseram and Ulge enter the Chad on the south. The only other important affluent of the Chad is the Waube or Yo (otherwise the Komadugu Yobe), which rises near Kano, and flowing eastward enters the lake on its western side 40m. N. of Kuka.

Lake Chad is supposed to have been known by report to Ptolemy, and is identified by some writers with the Kura lake of the middle ages. It was first seen by white men in 1823 when it was reached by way of Tripoli by Walter Oudney, Hugh Clapperton and Dixon Denham. By them the lake was named Waterloo. In 1850 James Richardson, accompanied by Heinrich Barth and Adolf Overweg, reached the lake, also via Tripoli, and Overweg was the first European to navigate its waters (1851). The lake was visited by Eduard Vogel (1855) and by Gustav Nachtigal (1870), the last-named investigating its hydrography in some detail. Owing to an exaggerated belief in its economic importance there was during the partition of Africa a "race" for Lake Chad; in 1890–93 its shores were divided by treaty between Great Britain, France and Germany. The first of these nations to make good its footing in the region was France. A small steamer, brought from the Congo by Emile Gentil, was in 1897 launched on the Shari, and, reaching the Chad, navigated the southern part of the lake. A British force under Col. T. L. N. Morland visited the western or Bornu side of the lake at the beginning of 1902, and in May of the same year the Germans reached Chad from the Cameroons. In 1902–03 French officers under Col. Destenave made detailed surveys of the south-eastern and eastern shores and the adjacent islands. In 1905 Boyd Alexander, a British officer, found that the lake then contained few stretches of open water. Later travellers found a good deal of open water; the extent of the water varying from year to year. One of the ancient trade routes across the Sahara from Tripoli to Kuka in Bornu strikes the lake at its north-west corner, but this has lost much of its former importance. As one of the results of the World War, that part of the lake region which was German passed (1919) under French mandate.

See the works of Denham, Clapperton, Barth and Nachtigal cited in the biographical notices: Jean Tilho in *La Géographie* (March, 1906); and the *Geog. Journal,* vol. lvi. (1920); Boyd Alexander, *From the Niger to the Nile,* vol. i. (1907); A. Chevalier, *Mission Chari-Lac Tchad 1902–1904* (1908); E. Lenfant, *La Grande Route du Tchad* (1905); H. Freydenberg, *Étude sur le Tchad et le bassin du Chari*

(1908); P. H. Lamb, "Notes on a visit to Lake Chad" in *Geog. Journal* (Dec. 1921).

CHADDERTON, an urban district of Lancashire, England, on the river Irk, 1 mi. W. of Oldham. Pop. (est. 1938), 30,270. Area, 4.71 sq.mi. It is a textile town, with some metalworking.

CHADERTON, LAURENCE (?1536–1640), Puritan divine, was born at Lees Hall, Oldham, Lancashire, was educated at Christ's college, Cambridge, and on the foundation of Emmanuel college in 1584, Sir Walter Mildmay, the founder, chose Chaderton for the first master. Chaderton was one of the four divines appointed to represent the Puritans at the Hampton Court conference; and he was also one of the translators of the Bible. He provided for 12 fellows and more than 40 scholars in Emmanuel college. Fearing that he might have a successor who held Arminian doctrines, he resigned the mastership in favour of John Preston. He died on Nov. 13, 1640, at the age of about 103, preserving his bodily and mental faculties to the end.

Chaderton published a sermon preached at St. Paul's Cross about 1580, and a treatise *On Justification* at Leyden. Other theological works remain in manuscript.

CHADRON, a city of north-western Nebraska, U.S.A., in the heart of the Pine Ridge country, at an altitude of 3,370 ft.; the county seat of Dawes county. It is on federal highway 20 and the Chicago and North Western railway. The population was 4,412 in 1920 (91% native white), and was 4,262 in 1940 by the federal census. Pine-clad buttes give the city a delightful setting, and the Black hills of South Dakota are visible in the distance. It is the trade centre of a fine cattle and farming region, a division point on the railway, which maintains a roundhouse and machine shops here, and the seat of a state normal college (established 1911), which has an enrolment of over 1,200. Four miles west is an emergency landing field and a weather station. The Pine Ridge Indian reservation (in South Dakota) is 35 mi. north, and 8 mi. south is a state park, which had 121,000 visitors in 1940. Chadron was settled in 1885 and incorporated in 1886.

CHADWICK, SIR EDWIN (1800–1890), English sanitary reformer, was born at Longsight, near Manchester, Jan. 24, 1800, and was educated for the bar. His essays in the *Westminster Review* (mainly on different methods of applying scientific knowledge to the business of government) introduced him to the notice of Jeremy Bentham, who engaged him as a literary assistant and left him a handsome legacy. In 1832 he was employed by the royal commission on the poor laws as an investigator, and in 1833 he was made a full member of that body. In conjunction with Nassau W. Senior he drafted the report of 1834 which procured the passing of the new poor law. His special contribution was the institution of the union as the area of administration. He favoured, however, a much more centralized system of administration than was adopted, and complained that the reform of 1834 was fatally marred by the rejection of his scheme for the management of poor law relief by salaried officers controlled from a central board, the boards of guardians acting merely as inspectors. In 1834 he was appointed secretary to the poor law commissioners. His relations with his official chiefs became much strained, and the disagreement led among other causes, to the dissolution of the poor law commission in 1846. Chadwick's chief contribution to political controversy was his constant advocacy of entrusting certain departments of local affairs to trained and selected experts, instead of to representatives elected on the principle of local self-government. While still officially connected with the poor law he had taken up the question of sanitation. His report on "The Sanitary Condition of the Labouring Population" (1842) is a valuable historical document. He was a commissioner of the Board of Health for improving the water supply, drainage and cleansing of great towns, from its establishment in 1848 to its abolition in 1854. He was made K.C.B. in 1889. He died at East Sheen, Surrey, on July 6, 1890.

See a volume on *The Evils of Disunity in Central and Local Administration . . . and the New Centralization for the People,* by Edwin Chadwick (1885); also B. W. Richardson, *The Health of Nations, a Review of the Works of Edwin Chadwick, with a Biographical Introduction* (1887). Many of his statistical papers are to be found in the *Journal* of the Royal Statistical Society.

CHAEREMON, Athenian dramatist of the first half of the 4th century B.C. Aristotle (*Rhetoric,* iii. 12) says his works were intended for reading, not for representation. According to Suidas, he wrote comedy as well as tragedy, and the title of his *Achilles, Slayer of Thersites* suggests that it was a satyric drama. His *Centaurus* is described by Aristotle (*Poet.* i. 12) as a rhapsody in all kinds of metres. The fragments of Chaeremon are correct in form and have an easy rhythm, but are marred by a florid style. It is not agreed whether he is the author of three epigrams in the Greek Anthology (Palatine vii. 469, 720, 721) which bear his name.

See H. Bartsch, *De Chaeremone Poëta tragico* (1843); fragments in A. Nauck, *Fragmenta Tragicorum Graecorum.*

CHAEREMON, of Alexandria (1st century A.D.) Stoic philosopher and grammarian. He was superintendent of part of the Alexandrian library and belonged to the higher ranks of the priesthood. In A.D. 49 he was summoned to Rome, with Alexander of Aegae, to become tutor to the youthful Nero. He was the author of a *History of Egypt;* of works on *Comets, Egyptian Astrology,* and *Hieroglyphics;* and of a treatise on *Expletive Conjunctions.* Chaeremon was the chief of the party which explained the Egyptian religious system as an allegory of the worship of nature. He can hardly be identical with the Chaeremon who accompanied (*c.* 26 B.C.; Strabo xvii. p. 806) Aelius Gallus, praefect of Egypt, on a journey into the interior.

Fragments in C. Müller, *Fragmenta Historicorum Graecorum,* iii. 495–499.

CHAERONEIA, an ancient town of Boeotia, about 7m. W. of Orchomenus. It may be the Homeric Arne. The site is partly occupied by the village of Kapraena; the ancient citadel was known as the Petrachus, and there is a theatre cut in the rock. Until the 4th century B.C. it was a dependency of Orchomenus. Its importance lay in its strategic position, the last serious obstacle to an invader of central Greece from the north. Two great battles were fought on this site in antiquity. In 338 B.C. Philip II. of Macedon defeated a confederation of Greek States (*see* below). In 86 B.C. the Roman general L. Cornelius Sulla defeated the army of Mithridates VI., king of Pontus, near Chaeroneia. Numerical superiority was neutralized by judicious choice of ground and the steadiness of the legionaries. Chaeroneia was the birthplace of Plutarch, who returned to his native town in old age, and was long held in honour. Pausanias (ix. 40) mentions the divine honours accorded at Chaeroneia to the sceptre of Agamemnon. (*Iliad,* ii. 101.) A colossal seated lion a little to the south-east of the site marks the grave of the Boeotians who fell fighting against Philip. This lion was found broken to pieces; the tradition that it was blown up by Odysseus Androutsos is incorrect (*see* Murray, *Handbook for Greece,* ed. 5. 1884, p. 409). It was re-erected in 1905.

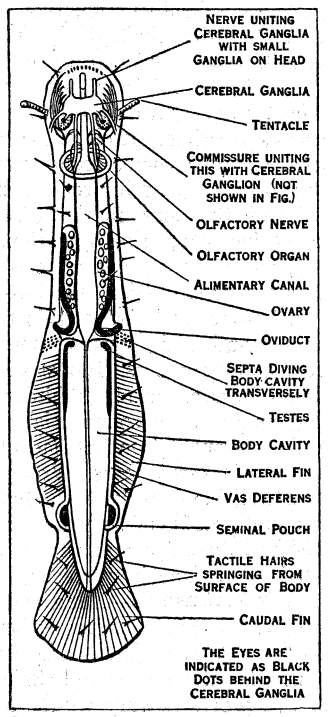
BIBLIOGRAPHY.—Thucydides iv. 76; Diodorus xvi. 85–86; Plutarch, *Alexander,* ch. 9; *Sulla,* chs. 16–19; Appian, *Mithridatica,* chs. 42–45; W. M. Leake, *Travels in Northern Greece* (London, 1835), ii. 112–117, 192–201; B. V. Head, *Historia Numorum* (Oxford, 1887), p. 292; J. Kromayer, *Antike Schlachtfelder in Griechenland* (Berlin, 1903), pp. 127–195; G. Sotiriades in *Athen. Mitteil.* 1903, pp. 301 ff.; 1905, p. 120; 1906, p. 396; Ἐφημ. Ἀρχαιολ., 1908, p. 65.

CHAERONEIA, BATTLE OF, 338 B.C. This is of great historial importance as the victory by which Philip II (*q.v.*) definitely established the Macedonian supremacy in Greece. In military history, however, too little is known of its details to give it marked significance. Philip's path into Boeotia was barred by the allied Athenians and Thebans both at the western route from Cytinium to Amphissa and the eastern pass of Parapotamii from Elateia to Chaeroneia. Philip first placed himself at Elateia; then, by a ruse of withdrawal, put the defenders of the western route still more off their guard and, moving from Cytinium by night, debouched into western Boeotia at Amphissa. He was thus on the rear of but at a distance from the defenders of the eastern pass, who thereupon fell back from Parapotamii. But instead of passing eastwards through hilly country which would have aided the resistance, he switched his army back to Elateia, moved unopposed through the pass of Parapotamii and descended upon the enemy's main army at Chaeroneia. Philip placed his 18-year old son, Alexander, in charge of the left wing, where his best troops

faced the redoubtable Thebans and after a bitter struggle gained the upper hand. Meanwhile he had retired his right wing elastically before the onset of the Athenians until he had drawn them on to low ground while he had retired on to a rising slope. Then, suddenly he launched a counterstroke and disrupted the Athenians. Both the victorious Macedonian wings now converged inwards upon the allied centre and crushed it between them. With the overthrow of the Theban army and the annihilation of the famous "Sacred Band" the sceptre of military as well as of political supremacy passed to the "new model" army of Macedonia that Philip had created. (*See* also MANTINEIA; GRANICUS, BATTLE OF THE; ALEXANDER III.)

CHAETOGNATHA, a small group of transparent and for the most part pelagic organisms, whose position is very isolated. There are eight genera and 38 species; the best-known genus is *Sagitta* with 27 species. These animals exist in extraordinary quantities, so that under certain conditions the surface of the sea seems almost stiff with the incredible multitude of organisms which pervade it. Rough seas cause them to drop into deeper water. Deep-sea forms also occur, but the group is essentially pelagic. The Chaetognatha form part of the diet of pelagic fishes. They are very voracious readily devouring herring fry as big as themselves.

As a rule the body is 1 to 3 cm. in length, though some species are larger, by 4 or 5 mm. in breadth, and is shaped something like a torpedo with side flanges and a slightly swollen, rounded head. It can be divided into three regions—(i.) head, (ii.) trunk, and (iii.) tail, separated from one another by two transverse septa. The almost spherical head is covered by a hood which can be retracted; it bears upon its side a number of sickle-shaped, chitinous hooks and rows of low spines. A pair of eyes lie dorsally. The trunk contains a spacious body-cavity filled during the breeding season by the swollen ovaries, and the same is true of the tail, substituting testes for ovaries.



CHAETOGNATHA, "ARROW-WORM," A GROUP OF TRANSPARENT ORGANISMS WHICH EXIST IN GREAT QUANTITIES NEAR THE SURFACE OF THE OPEN SEA

The skin consists of a transparent cuticle excreted by the underlying ectoderm; beneath this is a basement membrane; and then a layer of longitudinal muscle fibres which are limited inside by a layer of peritoneal cells. The muscles are striated and arranged in four quadrants. Along each side of the body stretches a horizontal fin and a similar flange surrounds the tail.

The mouth opens on to the ventral surface of the head. It leads into a straight alimentary canal whose walls consist of a layer of ciliated cells, ensheathed in a thin layer of peritoneal cells. There is no armature, and there are no glands, and the whole tract can be divided only into an oesophagus and an intestine. A median mesentery running dorsoventrally supports the alimentary canal and is continued behind it into the tail, thus dividing the body cavity into two lateral halves.

There are no specialized circulatory, respiratory or excretory organs. The nervous system consists of a cerebral ganglion in the head, and a ventral ganglion in the trunk, with lateral commissures uniting these ganglia on each side. There is a minute but extensive nervous plexus all over the body.

Chaetognatha are hermaphrodite. The ovaries are attached to the side walls of the trunk region; between them and the body wall lie the two oviducts whose inner and anterior end is closed, their outer ends opening one on each side of the anus, where the trunk joins the tail. This oviduct fits closely over a second duct, the receptaculum seminis, which the spermatozoa enter, passing through the walls and finally reaching the ripe ovum. Temporary oviducts are formed at each oviposition. A number of ova ripen simultaneously. The two testes lie in the tail and the spermatozoa pass out through short vasa deferentia with internal ciliated funnels.

With hardly an exception the transparent eggs are laid into the sea and float on its surface. The development is direct and there is no larval stage. As in some insects, the cells destined to form the reproductive organs are very early apparent.

The great bulk of the group is pelagic, as the transparent nature of all their tissues indicates. They move by flexing their bodies. The Chaetognatha appear to have no close relatives, and probably arose from the primitive *Procoelomate* stock in very ancient times. Recently Meek has attempted to show that they are related to the vertebrates.

(*See* also PLANKTON.)

See G. T. Burfield, "Sagitta" (*L.M.B.C Memoirs,* xxviii. (1927); Meek, *Proz. Zool. Soc.* (Lond. 1928).

CHAETOPODA, originally a zoological class, including all the Annelida (*q.v.*), except the Echiurida (*q.v.*). F. E. Beddard used the term to cover the classes Archiannelida, Polychaeta, Oligochaeta, Hirudinea (leeches) and Myzostomida. Parker and Haswell (*Textbook of Zoology*) use the term to include only the Polychaeta and Oligochaeta. The characteristic feature of Chaetopoda is the possession of bristles (*setae*). The term is now obsolete.

CHAFER, a word used in modern speech to distinguish the beetles of the family Scarabaeidae, and more especially those species which feed on leaves in the adult state. For the characters of the Scarabaeidae, *see* COLEOPTERA.

This family includes a large number of beetles, some of which feed on dung and others on vegetable tissues.

The cockchafers and their near allies belong to the subfamily Melolonthinae, and the rose-chafers to the Cetoniinae; in both the beetles eat leaves, and their grubs spend a long life underground devouring roots.

In Europe the Melolonthines that are usually noted as injurious are the two species of cockchafer (*Melolontha melolontha* and *M. hippocastani*), large heavy beetles with black pubescent prothorax, brown elytra and an elongated pointed tail-process; the summer-chafer (*Amphimallon solstitialis*), a smaller pale brown chafer.

In the United States, Melolonthines of the genus *Phyllophaga* (popularly known as "May beetles" or "June beetles") may do considerable damage to strawberries, corn (maize), wheat and grass crops.

The most important species is probably *Phyllophaga rugosa,* which frequently is very destructive to corn.

The larvae of the chafers are heavy, soft-skinned grubs, with hard brown heads provided with powerful mandibles, three pairs of well-developed legs, and a swollen abdomen. As they grow, they become strongly flexed towards the ventral surface, and lie curled up in their earthen cells, feeding on roots. The larval life lasts several years, and in hard frosts the grubs go deep down away from the surface.

Pupation takes place in the autumn, and though the perfect insect emerges from the cuticle very soon afterwards, it remains in its underground cell until the ensuing summer. After pairing, the female crawls down into the soil to lay her eggs. The grubs of chafers, when turned up by the plow, are greedily devoured by poultry, pigs and various wild birds.

CHAFF, the husks left after threshing grain (A.S. *ceaf,* allied to O.H.Ger. *cheva,* a husk or pod); also hay and straw chopped fine as food for cattle; hence, the worthless part of anything. The colloquial phrase, to chaff, meaning to make fun of a person, is derived from this word, or from "to chafe," meaning to irritate.

CHAFFARINAS or **ZAFFARINES,** a group of islands owned by Spain, 2½ mi. north of Cabo del Agua, in Morocco. Pop. *c.* 345, mainly soldiers of a garrison stationed there. The islands,

which were the *Tresinsulae* of the Romans and the *Zafrān* of the Arabs, were occupied by Spain in 1848. Construction of breakwaters between the islands of Isabella II and El Rey were undertaken; one dike was destroyed by storm in 1914. The largest island, Del Congreso, is rocky and hilly.

CHAFFCUTTER: *see* PROCESSING MACHINERY.

CHAFFEE, ADNA ROMANZA (1842–1914), United States soldier, born April 14, 1842, in Orwell, Ohio. He enlisted in the 6th cavalry regiment July 22, 1861, and was a member of that regiment for 25 years. The 6th cavalry was with the Army of the Potomac through most of the Civil War. Chaffee was commissioned 2nd lieutenant in May 1863, was wounded and taken prisoner at Gettysburg, refused to be paroled and was abandoned with other wounded. On Feb. 22, 1865, he was made 1st lieutenant. After the war the 6th cavalry was sent to Texas, and in 1867 Chaffee resigned, planning to enter private business. He was persuaded to change his mind, was restored to his rank, and served in the southwest until the Spanish-American War broke out, rising to the rank of lieutenant colonel. He served in the Spanish-American War, and at its conclusion was made chief of staff of the military governor of Cuba until May 1900. He became a colonel in May 1899. Chaffee commanded the U.S. troops in China during the Boxer uprising, and was military governor of the Philippine Islands July 1901–Sept. 1902. In 1904 he was promoted to lieutenant general and detailed as chief of staff. He retired Feb. 1, 1906, and died in Los Angeles, Calif., Nov. 1, 1914.

CHAFFINCH, a bird (*Fringilla coelebs*), belonging to the family Fringillidae (*see* FINCH), distinguished, in the male sex, by the deep grayish blue of its crown feathers, the yellowish green of its rump, two conspicuous bars of white on the wing coverts, and the reddish brown passing into vinous red of the throat and breast. The female is drab, but shows the same white markings as the male; the young males resemble the females until after the first autumn moult. The chaffinch breeds early, and its song may be heard in February. It builds its nest on trees and bushes, preferring those overgrown with lichens. The nest is composed of moss and wool, lined with grass and feathers. It lays four or five eggs of a pale bluish buff, streaked and spotted with purplish red. In spring the chaffinch is destructive to early flowers, and to young radishes and turnips; in summer it feeds on insects and their larvae, while in autumn and winter its food consists of grain and other seeds. On the continent of Europe the chaffinch is a favourite songbird. In winter chaffinches form small flocks, often composed solely of males. The continental chaffinch (*F. c. coelebs*) ranges generally over Europe to tree-limit in the north, wintering southward. The British chaffinch (*F. c. gengleri*) is a breeding resident. Allied races are found in northwest Africa, Canaries, Madeira and Azores. (G. F. Ss.)

CHAGRES, a village of the Republic of Panamá, on the Atlantic coast of the Isthmus, at the mouth of the Chagres river, and about 8 mi. W. of Colón. It has a harbour from 10 to 12 ft. deep, which is difficult to enter, however, on account of bars at its mouth. The port was discovered by Columbus in 1502, and was opened for traffic with Panamá, on the Pacific coast, by way of the Chagres river, in the 16th century. With the decline of Porto Bello in the 18th century Chagres became the chief Atlantic port of the Isthmus, and was at the height of its importance during the rush of gold-hunters across the Isthmus to California in 1849 and the years following. With the completion of the Panamá railway in 1855, however, travel was diverted to Colón, and Chagres soon became a village of miserable huts, with no evidence of its former importance. On a high rock at the mouth of the river stands the castle of Lorenzo, which was destroyed by Sir Henry Morgan when he captured the town in 1671, but was rebuilt soon afterwards by the Spaniards. Chagres was again captured in 1740 by British forces under Admiral Edward Vernon.

CHAIN-GANG, an American method of handling convicts, working principally on State road construction, stone quarrying and bridge building in the States of Virginia, North Carolina, Georgia, Florida and Alabama. The convicts are generally housed in temporary buildings of rough construction with inadequate sanitary arrangements, and are more or less isolated. In Virginia and Alabama the buildings are of a portable type, similar in construction to an army barrack. In some instances in Georgia a steel wagon cage is used. These cages are about 18 ft. long and 10 ft. wide and sometimes house as many as 18 men, sleeping in triple-decked bunks. The housing conditions differ in the several States, Alabama having by far the best conditions. In all of the camps except Alabama some method of chaining the men who are not trusties is in use. The most common method is the use of the "bull-chain," 4 ft. long, weighing about 3 lb., which is attached to a heavy iron cuff riveted around the right ankle. In going to and from work and during the time the convicts are confined in their quarters, the end of the bull-chain is attached to a long master chain which keeps all of the convicts leashed together. Sometimes, especially in the case of men who have attempted to or who have escaped and been returned, step-chains are used in addition to the bull-chain. These are attached by the use of leg irons, to both ankles, and are from 15 in. to 22 in. in length. Harsh methods of punishment prevail, ranging from solitary confinement on diminished rations to whipping, and, in Georgia, to the use of antiquated stocks and sweat-boxes. While, due to the long outdoor season, the labour of chain-gangs affords a great saving in the cost of road construction and is valuable in the prevention of idleness on the part of prisoners, the chaining of the men cannot help but have a definite demoralizing effect. In addition to the State chain-gangs there are in many localities similar county chain-gangs. (W. B. Co.)

CHAIN MANUFACTURE is the fabrication of a series of links, usually of metal, which are joined together by one of several methods. A chain provides a flexible loop or a connection between objects. The metal of the link is sometimes twisted to form a knot, or welded to strengthen the connection. Many methods of manufacturing chain by hand and machinery are now in vogue. Although a small quantity of chain is used for holding prisoners in check, the bulk of it serves man in various phases of his daily life. On the sea it is used for huge ship anchor chains, deck lashing chains, steering gear chains, buoy chains, etc. Railways use safety chains, brake chains, conductor's valve chains, etc. For motor travel on wet and icy roadways, anti-skid chains are used. Likewise on the farm, in the mine, the forest, the shop or on any extensive engineering operation, usage is found for chain.

There are three general classifications of chain: welded, weldless and transmission, the latter being literally a weldless style. Various materials are used in the manufacture of chain. Precious metals and semi-precious stones are formed into chains for jewellery and ornaments. Industrial chains are made from iron, steel, brass, bronze, nickel, aluminium and other metals or alloys. The large majority of commercial chain is made from wrought iron or steel. Wrought iron has had preference among fire-welded chain makers for many years. Wrought iron is generally regarded as the most reliable material in the manufacture of chains for uses where a failure would endanger life or property. It has considerable ductility, weldability and rust resistance. However, many reliable chains are made from steel.

Workmanship.—Hand and machine-made chain links usually go through several processes before they are ready for assembling into chains. Exceptions are in the instances of links used in cast chain, knotted chains and chain made directly from the solid bar. These processes vary widely in the different types of chain. In hand-made chain, the first operation consists of cutting the bar into short sections to a predetermined length, governed by the size of the link to be made. This short section is flattened, usually called "scarfed," at each end and then bent into a U shape. The scarfed ends are then brought to a welding temperature, threaded through the last finished link, and the weld completed by hammering. To give the welded end a finished appearance, concave tools, called "dollies," are sometimes placed over the weld and by additional hammering on the dollies, the weld is smoothed and shaped. The heating material for the chain maker's furnace is either coke, oil or gas.

By the use of machines some of these operations in this method are eliminated and others made easier. Bars or rods of metal are wound by machine into oval coils and single convolutions of the

coils are cut on an angle of about 45°, thus furnishing single-scarfed links ready for placing in the furnace to be heated. When the scarfed ends are at a welding temperature, the link is removed from the fire, threaded into the last completed link and the weld completed. Completion of the weld is accomplished with the aid of a hand hammer which is used to close the scarfed ends of the link together with a few blows. From this point the weld is completed in a power hammer, equipped with dies which fit over the welded end of the link. These hammers are operated by foot power, direct drive or indirect drive from some remote source of power. Chains made by this method have a slight twist in them. This twist is caused by the coiling operation. When the chain is for uses where this twist would be objectionable the twist is removed in a power hammer having especially designed dies, which straighten each link immediately after it is welded.

Electric Welded Chain.—This is the latest development in welded chain manufacture. A large part of the world's tonnage of small welded chain is now made by this method. Sizes up to $\frac{3}{4}$ in. diameter are commercially made in large quantities. Any of the larger sizes can be electrically welded but manufacturing costs in 1928 were too high. Three types of electric welds are in general use at the present time—the butt weld, the half-butt weld and the flash weld. All of these are of the resistance type, in which the electric current, passing through the material and across the butted ends of the link, produces sufficient heat to raise the metal to the welding or fusing temperature. A later development in electric chain welding is called "percussion welding," but it is not being used commercially. In this latter method, an electrically charged condenser is discharged across the butted ends of a chain link.

Links for electric welding are prepared differently than for fire welding. In the electric method, coils of wire or rods are passed through a chain-forming machine, which automatically straightens the wire, cuts the required length, threads the wire into the last completed link and forms the link, making a continuous chain ready for the welding machine. This butted chain is passed through a chain-welding machine which welds the links. Some welding machines weld alternate links and others consecutive links. They are automatic with one operator attending many machines, or semi-automatic, requiring the services of an operator for each machine. In the electric-weld process the weld is usually made at the side of the link. In the fire-weld process the weld is usually at the end of the link, the exception being certain very large sizes which are sometimes made with the weld at the side. Some electric-welded chain is made with weld at the end of the link, but this is the exception, rather than the rule. In the upset-welding method the links are welded at a relatively low temperature and the butted ends pressed together by a relatively low pressure. This type of weld is characterized by the extruded metal at the weld, forming a bulge which is seldom trimmed off. The semi-upset welding method is similar to the full-upset, with the exception that when the weld is about to be completed a die is placed over one-half the diameter of the material at the butted portion. This die prevents the metal from being forced to the outer side of the link.

Flash welding is also of the resistance type. It is distinguished by a small amount of metal extruded at the butted ends when the pressure is applied to form the weld. Because of the pressure and closeness of the electrodes, this excess metal, sometimes called the "flash," takes the shape of a flattened ring, differing in this respect from the bulge of the upset-weld. The "flash" is trimmed off close to the diameter of the material, leaving a smooth weld which, when polished, defies detection.

Welded chain is used largely in the straight link variety; however, some use is also made of twisted links. This type has the links twisted so that each link will be in approximately the same plane and therefore lie flat. In the fire-weld method each link is twisted as completed, but in the electric process the completed chain is passed through a machine which automatically twists the links. Other chains which have the same general shape as the welded chains, yet are not welded, include cast chains, which are made by casting metal in properly shaped molds, and solid link chains, made by stamping a solid cuneiform bar into the shape of stiff chain and twisting the individual links apart to make it flexible. The result is a solid, link chain having the appearance of a welded chain.

Anchor Chain.—For ship anchors is used a chain with links having a bar, called a stud, across the inside width of each link. This is called "stud-link" chain and in marine circles is referred to as a chain cable. Both the forming and welding operations are similar to the open link fire-welded chain. After the open link is completed, the stud, concave at each end, is inserted in the link and the sides pressed together. A relatively small amount of stud-link chain is made by a steam hammer process in which the link bars are upset; *i.e.*, balled on the end and scarfed by machines. The scarfed ends are heated and the weld completed on a steam hammer. In cast steel chain the stud is cast at the same time as the balance of the link and becomes a solid part of the link. Studs used in wrought iron chain are either castings or drop forgings. There are several reasons for putting the stud in this type of chain. It prevents the chain from fouling, adds weight to the link and prevents the link from deforming at a relatively low load. It does not increase the tensile strength of the chain, as is generally supposed.

Weldless Chain.—The term "weldless chain" covers a wide range of styles and broadly includes knotted chains, stamped link chains, transmission chains, bead chains, malleable chains, etc. Knotted chains bear a close relationship to the welded chain because they were developed, as a low-priced product, to replace small sizes of welded chain. They are practically all made upon automatic machines which fabricate the chain by straightening the wire, cutting, threading and tying, a single machine making the complete chain from the coil of wire to the finished product. There are about a dozen different styles of these chains in general use. Other forms of weldless wire chains contain no knot and consist simply of twisted wires hooked together—such as jack chain and ladder chain. Stamped link chain such as sash chain and transmission chain require at least two operations in their manufacture. The first operation blanks the links and the second, either automatic or by hand, assembles them. Bead or ball chain, commonly used in electric light fixtures, consists of a series of hollow balls joined by solid bars, the latter having a ball or cross-pipe formed at its ends. This chain is also made entirely by automatic machines. Jewellery chain in an almost endless variety is made from precious metals and used chiefly for ornament. Such chains are often made with oddly shaped links and with combinations of differently shaped links. Those made automatically bear somewhat of a uniform construction throughout their length, while other designs formed and ornamented by hand, vary in details with almost every link.

Finishes used on chain include practically every known finish for which there is a demand. Many chains are sold in their natural finish, as they come from the forge or machine. Some are polished highly by tumbling in sawdust, sand or leather scraps. Protective coatings, such as asphaltum, zinc, tin and lacquer are frequently used. Various colours of paints, powders and japans are used on chains for ornamental purposes, such as chandelier chain. Still others are plated with copper, brass, chromium, cadmium, nickel and other metals or alloys. At present, Cradley Heath, in the Black Country of England, is the centre of heavy-chain manufacture, while York, Pennsylvania, U.S.A., is the centre of small-chain manufacture. (H. M. B.)

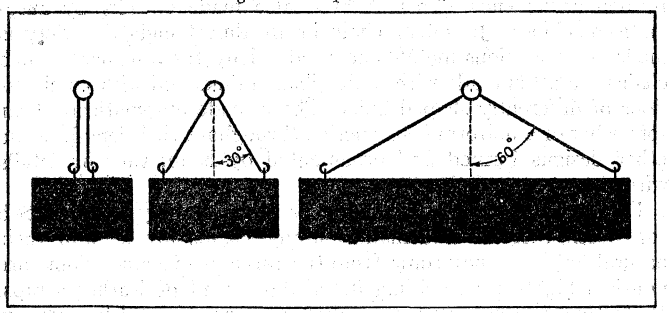
Testing.—After welded chain is made it should be given a "proof test" and each link examined for exterior defects. The purpose of this test is to determine if there are any hidden defects which would render the chain unsafe for its rated working load. Any load which is higher than the rated working load yet lower than the elastic limit of the chain link is suitable for this proof test. Railroads, testing bureaus, large users of chain, etc., have specifications giving definite loads to which the various sizes and grades of chain must be tested by the manufacturer. For many years it has been customary to proof test welded chain to a load equal to one-half of the average ultimate tensile strength. Many chain manufacturers continue to follow this practice. Some chain authorities feel that such a load is injurious to the chain links

especially when applied to iron chains. They recommend as a substitute a load about 25% higher than the working load. The statutory proof load required by the British board of trade applying to close-link chain for use on British ships is: proof load to be $12d^2$ tons, where d is the diameter in inches of the iron in the link. For stud-link chain the proof load is 50% higher than for the open-link chain although the tensile strength is practically the same. Knotted types of chain are not proof tested. There are no standard dimensions for chain links. Link dimensions vary with different manufacturers. Well proportioned links can be designed by making the outside dimensions $4\frac{1}{2}$ by $3\frac{1}{4}$ times the diameter of the material, for close-link chain and 6 by 3.6 times for stud-link chains. These dimensions can be varied.

Destruction Tests.—To determine what ultimate tensile strength may be expected from a finished chain a section several feet long should be tested to destruction. Toughness and ductility of the iron from which the links are made should be given greater consideration than merely high tensile strength when selecting a chain for use where a reliable chain is required. Chain with a high tensile strength is often brittle and will break without warning whereas a chain made from a ductile material will stretch considerably before breaking. Toughness and ductility can best be determined by observing the structure of the break and by the relative amount of reduction in area and the elongation at the point of fracture. These features should be determined in a straight bar of the material from which the links are to be made. Total stretch of a chain before breaking is of little value in determining the toughness and ductility of the material because the elongation of the chain is governed primarily by the shape of the links and not by the composition of the material.

Permissible Loading.—Maximum working loads for chains should be based upon the proof test and should never be higher than the rated working loads suggested by the manufacturer of the chain, individual specifications or testing bureau for the size and grade of chain being considered. Working loads are always given to be used when the chain is lifting in a vertical position. It should be noted (*see* table) that the working load of a chain

Working Loads of Sling Chains When Used at Angles
Wrought Iron Open Link Chain



Size chain, inches	Maximum working load for each branch of sling when used for vertical lift. In lbs.	Maximum working load for each branch of sling when used at angle of 30° from vertical. In lbs.	Maximum working load for each branch of sling when used at angle of 60° from vertical. In lbs.
$\frac{1}{4}$	1,100	950	550
$\frac{3}{8}$	2,700	2,350	1,350
$\frac{1}{2}$	4,500	3,900	2,250
$\frac{5}{8}$	6,900	6,000	3,450
$\frac{3}{4}$	10,100	8,750	5,050
$\frac{7}{8}$	14,000	12,000	7,000
1	18,600	16,000	9,300
$1\frac{1}{4}$	28,800	25,000	14,400
$1\frac{1}{2}$	40,800	35,000	20,400
$1\frac{3}{4}$	52,500	45,500	26,250
2	66,600	57,500	33,300

when lifting at any angle to the vertical line is always lower than for the vertical lift. When lifting at an angle of 60° to the direction of pull, as with a double sling chain, the working load is only one-half of the working load for the same chain when used for vertical lifting. (H. M. B.; W. L. Gn.)

CHAIN-SHOT, two large bullets or half-bullets fastened together by a chain; formerly used in naval engagements to cut rigging, etc., and sometimes in land battles as a short-range projectile.

CHAIN STORE. A chain store (known in Great Britain as "multiple shop") is a retail store that is one unit of an organized group of retail stores handling essentially the same type of merchandise, operating under a common ownership or ultimate capital control and under a central management that generally determines uniform methods of operation. Broadly speaking, any such ownership or operation of more than one retail store constitutes a chain store system. However, the Bureau of the Census classifies as chain store systems only those retail organizations that consist of four or more retail units. The Federal Trade Commission, in its Chain Store Inquiry, 1932, defined a chain store system as "an organization owning a controlling interest in two or more establishments which sell substantially similar merchandise at retail." The latter definition is followed by those States that have enacted chain store tax laws in that two units rather than four is the point of departure for such taxes. To date, no legal question with respect to the authority of the States on this point has been seriously raised.

The original purpose of chain store organization was to combine to a large extent the advantages of large and small scale retailing. A chain store system consolidates the ownership and management of many retail units within the same general line of merchandise but with decentralized locations. On the one hand, the chain store enjoys the economies of quantity purchasing, of advantageous discounts and allowances, of departmentalization, of skilful management, and of standard operating methods. On the other hand, it usually reaches out to the very door of the ultimate consumer and provides convenient availability of purchase in neighbourhood locations.

The first of the important existing chain store systems appears to have been The Great American Tea Company (now the Great Atlantic and Pacific Tea Company), founded by Gilman and Hartford in 1858 on a one-store basis, and which included three stores by the end of 1859 and 25 by 1865. The Jones Brothers Tea Company (now the Grand Union Company) was established in 1872; the F. W. Woolworth Company in 1879; the James Butler grocery chain in 1882; the J. G. McCrory chain in 1882, and S. S. Kresge chain in 1885. The United Cigar Stores Company came into existence in 1901; the J. C. Penney Company in 1902; the W. T. Grant Company in 1906, and the Louis K. Liggett chain in 1907.

Since 1919, the chain store idea in the United States has expanded with amazing rapidity and into many different fields.

The position of the chains in the United States can be seen from the following figures which are taken from census reports on retail distribution but which represent the Census Bureau's definition of a chain as consisting of four or more retail units.

Year	Number of Chains	Number of Retail Units	Retail Sales of Chains	% of All Retail Sales
1929	7,061	159,638	$10,740,385	21.9
1933	5,546	152,308	6,767,766	27.0
1935	6,079	139,810	8,460,611	25.0

The increase in the chain store's share of the nation's total retail trade from 1929 to 1933 and the decrease in the chain store's share of the total from 1933 to 1935 is explained by the fact that the chains are most important and prefer to operate in staple fields. Five chain store fields, grocery chains, department store chains, variety store chains, filling station chains, and drug store chains, account for about 60% of all the chain business. In a sharp depression, the dollar volume in such necessities as groceries (36% of all chain sales in 1933 were in the grocery trade) and other staple lines does not decline so rapidly as does the total retail business. In a recovery period the increase in chain store dollar volume (about 33% of all chain store sales in 1935 were in groceries) is likely to be smaller than the increase in

total retail business.

The fundamental merchandising policies of the typical chain store are: (1) a limitation of stocks handled to rapidly moving articles for which there is an established demand, (2) the purchase of merchandise on a quantity basis, (3) buying merchandise in the main direct from producers or manufacturers, (4) the elimination or limitation of such services as credit and delivery, (5) the use of frequently changed sales leaders, (6) price-tagging all merchandise plainly, and (7) featuring the price appeal in advertising.

The corporate chain store in the United States now faces a number of restrictive influences to which it must adjust its operating policies. Among these is the growing competition of: (1) the "voluntary chains" (groups of individual retailers—each of whom owns his own store—either associated with wholesalers or acting co-operatively, and organized to carry on joint merchandising activities), and (2) the severe price competition, particularly in the food field, of independent "super-markets."

There is, in addition, a growing amount of restrictive State and Federal legislation that results in higher tax and wage costs and in fewer special discounts for the chain. Many State legislatures and municipal governments have imposed special and graduated taxes upon the chain. A Federal "death sentence" chain store tax measure has been proposed and vigorously espoused by Representative Wright Patman and his supporters. The enforcement of the Robinson-Patman Act and its prohibitions on the division of "brokerage" and on "unfair" discounts and allowances has operated to spread out large-scale buying advantages more evenly among corporate chains and independents. The enactment of the Miller-Tydings resale price maintenance enabling amendment to the Sherman Anti-Trust Act has influenced many manufacturers to take advantage of the several State permissive fair trade acts to establish minimum resale prices.

Especially in the food field, the corporate chain store is attempting to meet these restrictive influences, in part, by limiting the number of new store locations established in neighbourhood locations, by weeding out unprofitable neighbourhood units, and by setting up self-service or semi-self-service "super-markets." In spite of the rapid push of the chain into the "super-market" field, the consumer's demand for "convenient availability" still exists. The independent neighbourhood store, in many instances, has sharply increased its volume when chain neighbourhood stores have been closed. (G. R. C.)

Great Britain.—The multiple shop system came into existence at the end of the 19th century, probably influenced by the "tied house" system of the brewers, and has had wide developments. Among the retail trades now organized in this way are chemists and druggists, oil and colour men, drapers, boot and shoe shops, clothiers, tea shops and cafés, milk retailers, grocers and furniture dealers, while in recent years there has been a large increase among the "variety" chain stores—typified by Messrs. Woolworth's —which sell a wide range of goods either at a single price or at a price not above a definite, and low, limit.

The economy of the multiple shop system is readily understood. A company owning branches has great capacity to buy, and by giving orders in large quantities can secure the most favourable terms and demand not only low prices but good design and quality.

Population movements and the creation of new housing estates have contributed to the expansion of the multiple shop system of trading, which also owes something to the incursion into this field of certain Football Pool organizations. Its growth has meant the elimination or suppression of a proportion of small trading units. A shop-keeper stands for independency; he is his own master and a definite social unit in civic life, and his replacement by a company-appointed manager amounts to a change of some importance from a social point of view. The manager may or may not be a local man; he may or may not be identified with the life of the town in which he draws his salary, and the profit made by the shop he manages leaves the society in which it is made and is distributed to absentee shareholders. The aggregate effect of these social and economic changes it is impossible to determine with accuracy, but it must be considerable.

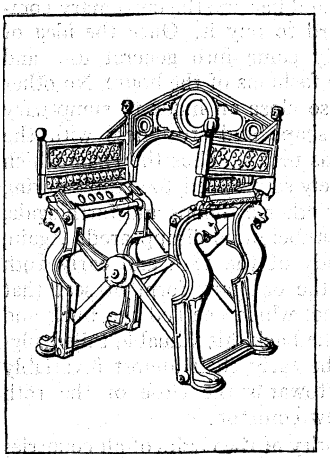
Chain stores in Great Britain are covered by the Shops Acts, and in 1938 agreements were concluded between the proprietors' associations regulating the grocery and footwear multiple firms and the Shop Assistants' Union with reference to minimum wages and conditions of labour.

In 1937 an unsuccessful attempt had been made to introduce a Bill limiting all such organizations to six branches, with other restrictions.

CHAIR, a movable seat, usually with four legs and for a single person, the most varied and familiar article of domestic furniture. (In Mid. Eng. *chaere,* through O.Fr. *chaëre* or *chaiere,* from Lat. *cathedra,* later *caledra,* Gr. *καθέδρα* seat, *cf.* "cathedral"; the modern Fr. form *chaise,* a chair, has been adopted in English with a particular meaning as a form of carriage; *chaire* in French is still used of a professorial or ecclesiastical "chair," or *cathedra.*) The chair is of extreme antiquity, although for many centuries and indeed for thousands of years it was an appanage of state and dignity rather than an article of ordinary use. "The chair" is still extensively used as an emblem of authority. It was not until the 16th century that it became common anywhere. The chest, the bench and the stool were until then the ordinary seats of everyday life, and the number of chairs which have survived from an earlier date is exceedingly limited; most of such examples are of ecclesiastical or seigneurial origin.

Ancient Chairs.—In ancient Egypt they were of great richness and splendour. Fashioned of ebony and ivory, or of carved and gilded wood, they were covered with costly stuffs and supported upon representations of the legs of beasts of the chase or the figures of captives. The earliest monuments of Nineveh represent a chair without a back but with carved legs ending in lions' claws or bulls' hoofs; others are supported by figures in the nature of caryatides or by animals. The earliest known form of Greek chair, going back to five or six centuries before Christ, had a back but stood straight up, front and back. On the frieze of the Parthenon Zeus occupies a square seat with a bar-back and thick turned legs; it is ornamented with winged sphinxes and the feet of beasts. The characteristic Roman chairs were of marble, also adorned with sphinxes; the curule chair was originally very similar in form to the modern folding chair, but eventually received a good deal of ornament.

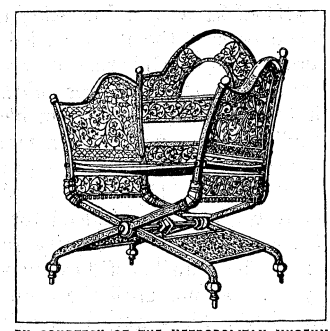
The most famous of the very few chairs which have come down from a remote antiquity is the reputed chair of St. Peter in St. Peter's at Rome. The wooden portions are much decayed, but it would appear to be Byzantine work of the 6th century, and to be really an ancient *sedia gestatoria.* It has ivory carvings representing the labours of Hercules. A few pieces of an earlier oaken chair have been let in; the existing one, Gregorovius says, is of acacia wood. The legend that this was the curule chair of the senator Pudens is necessarily apocryphal. It is not, as is popularly supposed, enclosed in Bernini's bronze chair, but is kept under triple lock and exhibited only once in a century.



"DAGOBERT CHAIR," OF CAST BRONZE AND PROBABLY MORE THAN 1,000 YEARS OLD

Byzantium, like Greece and Rome, affected the curule form of chair, and in addition to lions' heads and winged figures of Victory and dolphin-shaped arms used also the lyre-back which has been made familiar by the pseudo-classical revival of the end of the 18th century. The chair of Maximian in the cathedral of Ravenna is believed to date from the middle of the 6th century. It is of marble, round, with a high back, and is carved in high relief with figures of saints and scenes from the Gospels—the Annunciation, the Adoration of the Magi, the flight into Egypt, and the baptism of Christ. The smaller spaces are filled with carvings of animals,

birds, flowers and foliated ornament. Another very ancient seat is the so-called "Chair of Dagobert" in the Louvre. It is of cast bronze, sharpened with the chisel and partially gilt; it is of the curule or faldstool type and supported upon legs terminating in the heads and feet of animals. The seat, which was probably of leather, has disappeared. Its attribution depends entirely upon the statement of Suger, abbot of St. Denis in the 12th century, who added a back and arms. Its age has been much discussed, but Viollet-le-Duc dated it to early Merovingian times.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

SPANISH ARMCHAIR OF THE 17TH CENTURY, HEAVY IN CONSTRUCTION AND ELABORATELY CARVED

To the same generic type belongs the famous abbots' chair of Glastonbury; such chairs might readily be taken to pieces when their owners travelled. The *faldisternium* in time acquired arms and a back, while retaining its folding shape. The most famous, as well as the most ancient, English chair is that made at the end of the 13th century for Edward I., in which most subsequent monarchs have been crowned. It is of an architectural type and of oak, and was covered with gilded *gesso* which long since disappeared.

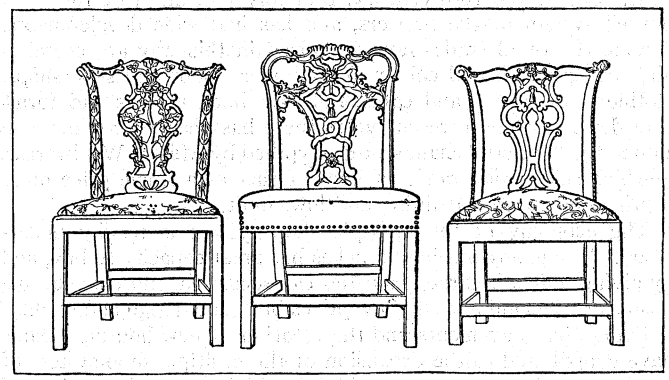
Transition.—Passing from these historic examples we find the chair monopolized by the ruler, lay or ecclesiastical, to a comparatively late date. As the seat of authority it stood at the head of the lord's table, on his dais, by the side of his bed. The seigneurial chair, commoner in France and the Netherlands than in England, is a very interesting type, approximating in many respects to the episcopal or abbatial throne or stall. It early acquired a very high back and sometimes had a canopy. Arms were invariable, and the lower part was closed in with panelled or carved front and sides—the seat, indeed, was often hinged and sometimes closed with a key. That we are still said to sit "in" an arm-chair and "on" other kinds of chairs is a reminiscence of the time when the lord or seigneur sat "in his chair." These throne-like seats were always architectural in character, and as Gothic feeling waned took the distinctive characteristics of Renaissance work. It was owing in great measure to the Renaissance that the chair ceased to be an appanage of state, and became the customary companion of whomsoever could afford to buy it. Once the idea of privilege faded the chair speedily came into general use, and almost at once began to reflect the fashions of the hour. No other piece of furniture has ever been so close an index to sumptuary changes. It has varied in size, shape and sturdiness with the fashion of women's dress as well as men's. Thus the chair which was not, even with its arms purposely suppressed, too ample during the several reigns of some form or other of hoops and farthingale, became monstrous when these protuberances disappeared. Again, the costly laced coats of the dandy of the 18th and early 19th centuries were so threatened by the ordinary form of seat that a "conversation chair" was devised, which enabled the buck and the ruffler to sit with his face to the back, his valuable tails hanging unimpeded over the front. The early chair almost invariably had arms, and it was not until towards the close of the 16th century that the smaller form grew common.

The 17th Century.—The majority of the chairs of all countries until the middle of the 17th century were of oak without upholstery, and when it became customary to cushion them, leather was sometimes employed; subsequently velvet and silk were extensively used, and at a later period cheaper and often more durable materials. Leather was not infrequently used even for the costly and elaborate chairs of the faldstool form—occasionally sheathed in thin plates of silver—which Venice sent all over Europe. To this day, indeed, leather is one of the most frequently employed materials for chair covering. The outstanding characteristic of most chairs until the middle of the 17th century was massiveness and solidity. Being usually made of oak, they were of considerable weight, and it was not until the introduction of the handsome Louis XIII. chairs with cane backs and seats that either weight or solidity was reduced. Although English furniture derives so extensively from foreign and especially French and Italian models, the earlier forms of English chairs owed but little to exotic influences.

This was especially the case down to the end of the Tudor period, after which France began to set her mark upon the British chair. The squat variety, with heavy and sombre back, carved like a piece of panelling, gave place to a taller, more slender, and more elegant form, in which the framework only was carved, and attempts were made at ornament in new directions. The stretcher especially offered opportunities which were not lost upon the cabinet-makers of the Restoration. From a mere uncompromising cross-bar intended to strengthen the construction, it blossomed into an elaborate scroll-work or an exceedingly graceful semi-circular ornament connecting all four legs, with a vase-shaped knob in the centre. The arms and legs of chairs of this period were scrolled, the splats of the back often showing a rich arrangement of spirals and scrolls. This most decorative of all types appears to have been popularized in England by the cavaliers who had been in exile with Charles II. and had become familiar with it in the north-western parts of the European Continent.

During the reign of William and Mary these charming forms degenerated into something much stiffer and more rectangular, with a solid, more or less fiddle-shaped splat and a cabriole leg with pad feet. The more ornamental examples had cane seats and ill-proportioned cane backs. From these forms was gradually developed the Chippendale chair, with its elaborately interlaced back, its graceful arms and square or cabriole legs, the latter terminating in the claw and ball or the pad foot. Hepplewhite, Sheraton and Adam all aimed at lightening the chair, which, even in the master hands of Chippendale, remained comparatively heavy. The endeavour succeeded, and the modern chair is everywhere comparatively slight. Chippendale and Hepplewhite between them determined what appears to be the final form of the chair, for since their time practically no new type has lasted, and in its main characteristics the chair of the 20th century is the direct derivative of that of the later 18th.

The 18th century was, indeed, the golden age of the chair, especially in France and England, between which there was considerable give and take of ideas. Diderot could not refrain from writing of them in his *Encyclopédie*. The typical Louis Seize chair, oval-backed and ample of seat, with descending arms and round-reeded legs, covered in Beauvais or some such gay tapestry woven with Boucher or Watteau-like scenes, is a very gracious



FROM ELLWOOD, "FURNITURE AND DECORATION"

CHIPPENDALE CHAIRS, WHICH IN THE 18TH CENTURY REPLACED THE HEAVIER MODELS OF TRADITION

object, in which the period reached its high-water mark. The Empire brought in squat and squabby shapes, comfortable enough no doubt, but entirely destitute of inspiration. English Empire chairs were often heavier and more sombre than those of French design. Thenceforward the chair in all countries ceased to attract the artist. The *art nouveau* school has occasionally produced something of not unpleasing simplicity; but more often its efforts have been frankly ugly or even grotesque. There have been practically no novelties. So much, indeed, is the present indebted to the past in this matter that even the revolving chair, now so


1


2


3


4


5


6


7


8


9

BY COURTESY OF THE METROPOLITAN MUSEUM OF ART, NEW YORK

CHAIRS OF THE 15TH TO THE 18TH CENTURY

1. Italian Renaissance armchair
2. Spanish Renaissance armchair
3. Italian "Dante" chair, 16th century
4. Italian Renaissance armchair
5. Louis XV. armchair. Gilded wood
6. Louis XVI. armchair
7. Chinese Chippendale, 1775–80
8. Hepplewhite chair, 1780–85
9. Chippendale ladder back, 1760–70

familiar in offices, has a pedigree of something like four centuries (*see* also INTERIOR DECORATION). (J. P.-B.)

CHAISE, a light two- or four-wheeled carriage with a movable hood or "calash" (the French for "chair," through a transference from a "sedan-chair" to a wheeled vehicle). The "post-chaise" was the fast-travelling carriage of the 18th and early 19th centuries. It was closed and four-wheeled for two or four horses and with the driver riding postillion.

CHAITANYA, Indian mystic, was born in 1485 at Navidvip, Bengal (died *c.* 1534). He was educated at the pathsala, or primary school of Navidvip and at eight years of age entered the Sanskrit tol. At an early age he became proficient in Sanskrit grammar and rhetoric. He initiated a popular religious movement within the Vaishnava faith (a cult of Vishnu). Chaitanya emphasized the path of bhakti (of devotion and direct relation to God) in contrast to the priestcraft and religious convention of the day. The Chaitanya Vaishnavas are a distinct religious sect in India to-day and the sankirton (chorus singing accompanied by drums and symbols), emphasized and developed by Chaitanya, still forms the centre of its religious rites.

CHAKMA, a tribe in India, of mixed origin, probably the descendants of prisoners taken by the Arakanese from the Mogul armies who were provided with Magh, Mon or Arakanese wives. It migrated from the southern portion of the Chittagong coastal plain towards the end of the 18th century and is now settled on the middle reaches of the Karnaphuli and its tributaries in the Chittagong Hills tracts. The language is a dialect of Bengali, but the old script, now falling into disuse, is closely allied to the ancient Khmer script. The men dress in Bengali style, but the women wear a distinctive long blue skirt with a red border, and after puberty a strip of silk over the breasts. The religion is Animism, with a thin veneer of Buddhism. The dead are burned on the banks of streams. The tribe is divided into patrilineal endogamous clans, but the power of the heads of the separate clans has in course of time been absorbed by one family, the head of whom is known as the Chakma chief. Despite strong and prolonged Bengali influence the underlying culture is Burmese or Mon. Only of recent years is shifting cultivation being gradually abandoned for plough cultivation. The houses are flimsily built on piles and the villages are invariably on the banks of streams.

See T. H. Lewin, *Hill Tracts of Chittagong and Dwellers Therein* (Calcutta, 1869); G. A. Grierson, *Linguistic Survey of India,* vol. v., part 9. (J. P. M.)

CHAKRATA, a small mountain cantonment in the Dehra Dun district of the United Provinces of India, on the range of hills overlooking the valleys of the Jumna and the Tons, at an elevation of 7,000 ft.

CHALCEDON, more correctly **CALCHEDON,** an ancient maritime town of Bithynia, in Asia Minor, almost directly opposite Byzantium, south of Scutari. It was a Megarian colony founded on a site so obviously inferior to that which was within view on the opposite shore, that it received from the oracle the name of "the City of the Blind." In its early history it shared the fortunes of Byzantium, vacillated long between the Lacedaemonian and the Athenian interests, and was at last bequeathed to the Romans by Attalus III. of Pergamum (133 B.C.). It was partly destroyed by Mithridates, but recovered during the Empire, and in A.D. 451 was the seat of the Fourth General Council. It fell under the repeated attacks of the barbarian hordes who crossed over after having ravaged Byzantium, and furnished an encampment to the Persians under Chosroes, *c.* 616–626. The Turks used it as a quarry for building materials for Constantinople. To the south are the ruins of Panteichion, where Belisarius is said to have lived in retirement.

See J. von Hammer, *Constantinopolis* (Pesth, 1822); Murray's *Handbook for Constantinople* (London, 1900).

CHALCEDON, COUNCIL OF, the fourth oecumenical council of the Catholic Church, was held in 451, its occasion being the Eutychian heresy and the notorious "Robber Synod" (*see* EUTYCHES and EPHESUS, COUNCILS OF), which called forth vigorous protests both in the East and West, and a loud demand for a new general council, a demand that was ignored by the Eutychian Theodosius II., but speedily granted by his successor, Marcian. In response to the imperial summons, 500 to 600 bishops, all Eastern, except the Roman legates and two Africans, assembled in Chalcedon on Oct. 8, 451. The bishop of Rome claimed for his legates the right to preside, and insisted that any act that failed to receive their approval would be invalid. The first session was tumultuous; party feeling ran high, and scurrilous epithets were bandied to and fro. The acts of the Robber Synod were examined; fraud, violence and coercion were charged against it; its entire proceedings were annulled, and, at the third session, its leader, Dioscurus, was deposed and degraded. The emperor requested a declaration of the true faith; but the sentiment of the council was opposed to a new symbol. It contented itself with reaffirming the Nicene and Constantinopolitan creeds and the Ephesine formula of 431, and accepting, only after examination, the Christological statement contained in the *Epistola Dogmatica* of Leo I. (*q.v.*) to Flavianus. Thus the council rejected both Nestorianism and Eutychianism, and stood upon the doctrine that Christ had two natures, each perfect in itself and each distinct from the other, yet perfectly united in one person, who was at once both God and man. With this statement, which was formally subscribed in the presence of the emperor, the development of the Christological doctrine was completed, but not in a manner to obviate further controversy (*see* MONOPHYSITES and MONOTHELITES).

The remaining sessions were occupied with matters of discipline, episcopal jurisdiction, organization of diocese and parish, occupations of the clergy and the like; and confirmed the third canon of the second oecumenical council, which accorded to Constantinople equal privileges (ἴσα πρεσβεῖα) with Rome, and the second rank among the patriarchates, and, in addition, granted to Constantinople patriarchal jurisdiction over Pontus, Asia and Thrace. The Roman legates, who were absent (designedly?) when this famous (xxviii.) canon was adopted, protested against it, but in vain, the imperial commissioners deciding in favour of its regularity and validity. Leo I., although he recognized the council as oecumenical and confirmed its doctrinal decrees, rejected canon xxviii. on the ground that it contravened the 6th canon of Nicaea and infringed the rights of Alexandria and Antioch. In what proportion zeal for the ancient canons and the rights of others, and jealous fear of encroachment upon his own jurisdiction, were mixed in the motives of Leo, it would be interesting to know. The canon was universally received in the East (*see* CONSTANTINOPLE, COUNCILS OF).

The emperor Marcian approved the doctrinal decrees of the council and enjoined silence in regard to theological questions. Eutyches and Dioscurus and their followers were deposed and banished.

See Hefele, *Church Councils* (2nd ed.) ii. pp. 394–578 (Eng. trans., iii. pp. 268–464); also bibliographies in Herzog-Hauck, *Realencyklopädie,* 3rd ed., *s.v.*, "Eutyches" (by Loofs) and *s.v.* "Nestorianer" (by Kessler); and the general histories of Christian Doctrine.

CHALCEDONY or **CALCEDONY,** a variety of native silica occurring in concretionary, mammillated or stalactitic forms of waxy lustre and a great variety of colours—though usually white, grey, yellow or brown. It has a compact fibrous structure and a fine splintery fracture. Its relation to quartz has been the subject of a long controversy; one theory supposed it to be a mixture of quartz and opal, whilst the other held that it was a mineral distinct from quartz. Chalcedony fibres are usually, though not invariably, uniaxial and positive, but differ from quartz in that the optic axis is perpendicular to the length. Further, the refractive indices, double refraction, specific gravity and hardness are all slightly less for chalcedony than for quartz. The fine-structure of the two minerals must, however, be very similar for their X-ray powder-photographs are identical. This result, which favours the view that chalcedony is a mixture of quartz and opal, is further supported by optical considerations; for by assigning reasonable values to the density, refractive index and amount of the opal supposed to be present, it is possible to account for all the characters of chalcedony.

Chalcedony occurs in veins and amygdales of volcanic rocks

together with zeolites and other hydrated silicates. It is deposited from residual magmatic solutions as well as being entirely secondary. In this mode of occurrence it is a common mineral in many volcanic fields, as in the basalts of northern Ireland, the Faroe islands, Iceland, the Deccan (India). Chalcedonic pseudomorphs after other minerals often give rise to very interesting specimens. The name "enhydro" is given to hollow nodules of chalcedony containing water and an air bubble which is visible through the semi-transparent wall. In all ages chalcedony has been the stone most used by the gem engraver, and many coloured varieties, described under special headings, are still cut and polished as ornamental stones. (*See* AGATE, BLOODSTONE, CARNELIAN, CHRYSOPRASE, HELIOTROPE, MOCHA STONE, ONYX, SARD AND SARDONYX.) (W. A. W.)

CHALCIS, the chief town of the island of Euboea in Greece, is situated on the strait of the Euripus at its narrowest point. Ancient Chalcis was peopled by Ionians, and early developed great industrial and colonizing activity. In the 7th and 8th centuries it founded thirty townships on the peninsula of Chalcidice, and several important cities in Sicily (*q.v.*). Its metal-work, purple and pottery found markets among these settlements, and were distributed widely in the ships of its allies Corinth and Samos. In the so-called Lelantine War, Chalcis won from its neighbour and rival Eretria the best agricultural district of Euboea and became the chief city of the island. But its prosperity was broken by disastrous wars with the Athenians, and it became a member of both the Delian Leagues. In the Hellenistic period it was one of the fortresses by which Macedon controlled Greece. Antiochus III. of Syria (192) and Mithradates VI. of Pontus (88) used it as a base for invading Greece. Under Roman rule Chalcis retained some commercial prosperity; after the 6th century A.D. it again served to protect central Greece against northern invaders. From 1209 it was under Venetian control; in 1470 it passed to the Ottoman Turks, who made it the seat of a pasha. In 1688 it was successfully held against Venetian attack. The modern town has considerable export trade and railway connection with Athens and Peiraeus (1904). The old walled Castro, towards the Euripus, is inhabited by Jewish and Turkish families; the modern suburb outside it, by Greeks. A part of the Castro was destroyed by the earthquake of 1894; part, the famous "Black Bridge," which gave its mediaeval name "Negroponte" to Euboea, has been replaced by a modern swing bridge in the widening of the Euripus. The church of St. Paraskeve, once the chief church of the Venetians, dates from the Byzantine period, though many of its details are Western. The Turkish mosque is now a guard-house. Chalcis was occupied by Germany in 1941.

BIBLIOGRAPHY.—Strabo vii. fr. II., x. p. 447; Herodotus v. 77; Thucydides i. 15; *Corpus Inscr. Atticarum,* iv. (1) 27a, iv. (2) 10, iv. (2) p. 22; W. M. Leake, *Travels in Northern Greece* (London, 1835), ii. 254–270; E. Curtius in *Hermes,* x. (1876), p. 220 *sqq.;* A. Holm, *Lange Fehde* (Berlin, 1884); H. Dondorff, *De Rebus Chalcidensium* (Göttingen, 1869); for coinage, B. V. Head, *Historia Numorum* (Oxford, 1887), pp. 303–305.

CHALCOCITE, a mineral consisting of cuprous sulphide (Cu_2S), crystallizing in the orthorhombic system. It is known also as copper-glance, redruthite and vitreous copper. The crystals have the form of six-sided tables or prisms which are usually twinned, with the result that they simulate hexagonal symmetry. The mineral more often occurs as compact masses, which are sometimes of considerable extent. The colour is dark lead-grey with a metallic lustre, but this is never very bright, since the material is readily altered, becoming black and dull on exposure to light. The mineral is soft (H. = 2½) and sectile and can be readily cut with a knife; specific gravity 5·7.

Next to chalcopyrite, chalcocite is the most important ore of copper, and is perhaps the most characteristic mineral of the zone of secondary enrichment. It seems probable however that at some localities, *e.g.*, Butte, Mont., it is of primary origin. The best crystals are from St. Just, St. Ives and Redruth in Cornwall, and from Bristol in Connecticut.

CHALCONDYLES (or CHALCOCONDYLAS), **LAONICUS,** the only Athenian Byzantine writer. He wrote a history, in ten books, of the period from 1298–1463, describing the fall of the Greek empire and the rise of the Ottoman Turks, down to the conquest of the Venetians and Mathias, king of Hungary, by Mohammed II. The capture of Constantinople he rightly regarded as an event of far-reaching importance. The work incidentally gives an interesting sketch of the civilization of England, France and Germany, whose assistance the Greeks sought against the Turks. Chalcondyles' chronology is defective, and his use of the old Greek place-names causes confusion.

Editio princeps, ed. J. B. Baumbach (1615); in Bonn *Corpus Scriptorum Hist. Byz.* ed. I. Bekker (1843); Migne, *Patrologia Graeca,* clix. There is a French translation by Blaise de Vigenère (1577, later ed. by Artus Thomas with valuable illustrations on Turkish matters); *see* also F. Gregorovius, *Geschichte der Stadt Athen im Mittelalter,* ii. (1889); Gibbon, *Decline and Fall,* ch. 66; C. Krumbacher, *Geschichte der byzantinischen Literatur* (1897). There is a biographical sketch of Laonicus and his brother in Greek by Antonius Calosynas, a physician of Toledo, who lived in the latter part of the 16th century (*see* C. Hopf, *Chroniques gréco-romanes,* 1873).

His brother, DEMETRIUS CHALCONDYLES (1424–1511), was born in Athens. In 1447 he went to Italy, where Cardinal Bessarion became his patron. He became famous as a teacher of Greek and the Platonic philosophy; in 1463 he was made professor at Padua, and in 1479 was summoned by Lorenzo de' Medici to Florence. In 1492 he removed to Milan, where he died in 1511. He was associated with Marsilius Ficinus, Angelus Politianus and Theodorus Gaza, in the revival of letters in the western world. One of his pupils at Florence was the famous John Reuchlin. Demetrius Chalcondyles published the editio princeps of Homer (1488), Isocrates (1493) and Suidas (1499), and a Greek grammar (*Erotemata*) in the form of question and answer.

BIBLIOGRAPHY.—*See* H. Hody, *De Graecis illustribus* (1742); C. Hopf, *Chroniques gréco-romanes* (1873); E. Legrand, *Bibliographie hellénique,* i. (1885).

CHALCOPYRITE or **COPPER-PYRITES,** a copper iron sulphide ($CuFeS_2$), an important ore of copper.

Chalcopyrite crystallizes in the tetragonal system with inclined hemihedrism, but the form is so nearly cubic that it was not recognized as tetragonal until accurate measurements were made in 1822. Crystals are usually tetrahedral in aspect but frequently twinned, and they are often complex and difficult to decipher. The fracture is conchoidal, and the material is brittle. Hardness 4; specific gravity 4·2. The colour is brass-yellow, and the lustre metallic; the streak, or colour of the powder, is greenish-black. The mineral is especially liable to surface alteration, tarnishing with beautiful iridescent colours; a blue colour usually predominates, owing probably to the alteration of the chalcopyrite to covellite (CuS).

Chalcopyrite may be readily distinguished from pyrite (or iron-pyrites), which it somewhat resembles in appearance, by its deeper colour and lower degree of hardness: the former is easily scratched by a knife, whilst the latter can only be scratched with difficulty or not at all. Chalcopyrite is decomposed by nitric acid with separation of sulphur and formation of a green solution; ammonia added in excess to this solution changes the green colour to deep blue and precipitates red ferric hydroxide.

The chemical formula $CuFeS_2$ corresponds with the percentage composition Cu = 34·5, Fe = 30·5, S = 35·0. Analyses usually, however, show the presence of more iron, owing to the intimate admixture of pyrite. Traces of gold, silver, selenium or thallium are sometimes present, and the mineral is sometimes worked as an ore of gold or silver, which are present in solid solution.

Chalcopyrite is of wide distribution and is the commonest of the ores of copper. Extensive deposits are mined in the United States, particularly at Butte in Montana, and in Namaqualand, South Africa. Well-crystallized specimens are met with at many localities; for example, formerly at Wheal Towan (hence the name towanite, which has been applied to the species) in the St. Agnes district of Cornwall, at Freiberg in Saxony, and Joplin, Missouri. (L. J. S.)

CHALDAEA (CHALDEA). "Chaldaea" and "Chaldaeans" are frequently used in the Old Testament as equivalents for "Babylonia" and "Babylonians." Chaldaea was really the name of a country, used in two senses. It was first applied to the extreme southern district, whose ancient capital was the city of *Bīt*

Yakīn, the chief seat of the renowned Chaldaean rebel Merodach-baladan, who harassed the Assyrian kings Sargon and Sennacherib. It is not as yet possible to fix the exact boundaries of the original home of the Chaldaeans, but it may be regarded as having been the long stretch of alluvial land situated at the then separate mouths of the Tigris and Euphrates, which rivers now combine to flow into the Persian Gulf in the waters of the majestic *Shatt el-'Arab.*

The name "Chaldaea," however, soon came to have a more extensive application. In the days of the Assyrian king Adad-nirāri III. (811–782 B.C.), the term *mat Kaldū* covered practically all Babylonia. Furthermore, Merodach-baladan was called by Sargon II. (722–705 B.C.) "king of the land of the Chaldaeans" and "king of the land of Bīt Yakīn" after the old capital city; but there is no satisfactory evidence that Merodach-baladan had the right to the title "Babylonian." The racial distinction between the Chaldaeans and the Babylonians proper seems to have existed until a much later date. That they differed from the Arabs and Aramaeans appears to follow from the distinction made by Sennacherib (705–681 B.C.) between the Chaldaeans and these races. Later, during the period covering the fall of Assyria and the rise of the Neo-Babylonian empire, the term *mat Kaldū* was not only applied to all Babylonia, but also embraced the territory of certain foreign nations who were later included by Ezekiel (xxiii. 23) under the expression "Chaldaeans."

The Chaldaeans probably first came from Arabia, the supposed original home of the Semitic races, at a very early date along the coast of the Persian Gulf and settled in the neighbourhood of Ur ("Ur of the Chaldees," Gen. xi. 28), whence they began a series of encroachments, partly by warfare and partly by immigration, against the other Semitic Babylonians. These aggressions after many centuries ended in the Chaldaean supremacy of Nabopolassar and his successors (from *c.* 625), although there is no positive proof that Nabopolassar was purely Chaldaean in blood. The sudden rise of the later Babylonian empire under Nebuchadnezzar, the son of Nabopolassar, must have tended to produce so thorough an amalgamation of the Chaldaeans and Babylonians, who had theretofore been considered as two kindred branches of the same original Semite stock, that in the course of time no perceptible differences existed between them. The language of these Chaldaeans differed in no way from the ordinary Semitic Babylonian idiom which was practically identical with that of Assyria. Consequently, the term "Chaldaean" came quite naturally to be used in later days as synonymous with "Babylonian," and through a misunderstanding the term *Chaldee* (*q.v.*) was subsequently applied to the Aramaic language.

The derivation of the name "Chaldaean" is uncertain. It is probably connected with the Semitic stem *kasādu* (conquer), in which case *Kaldi-Kašdi,* with the well-known interchange of *l* and *š,* would mean "conquerors." It is also possible that *Kašdu-Kaldū* is connected with the proper name Chesed, who is represented as having been the nephew of Abraham (Gen. xxii. 22). But there is no connection between the Black sea people called "Chaldaeans" by Xenophon (*Anab.* vii. 25) and the Chaldaeans of Babylonia. (For *Chaldians see* URARTU.)

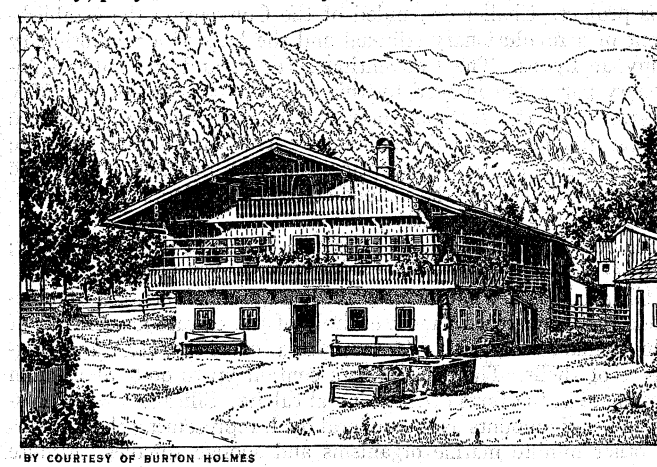
In Daniel, the term "Chaldaeans" commonly means "astrologers, astronomers," as it also does in the classical authors (Herodotus, Strabo, Diodorus, etc.). In Daniel i. 4, by the expression "tongue of the Chaldaeans," the writer evidently meant the language in which the celebrated Babylonian works on astrology and divination were composed. It is now known that the literary idiom of the Babylonian wise men was the non-Semitic Sumerian; but it is not probable that the late author of *Daniel* (*q.v.*) was aware of this fact. The word "Chaldaean" is applied as a race-name to the Babylonians (Dan. iii. 8, v. 30, ix. 1); but the expression is used oftener, either as a name for some special class of magicians, or as a term for magicians in general (ix. 1). The transfer of the name of the people to a special class can perhaps be explained. When in later times "Chaldaean" and "Babylonian" became practically synonymous, the term "Chaldaean" lived on in the secondary restricted sense of "wise men." The early *Kaldi* had seized and held from very ancient times the region of old Sumer, which was the centre of the primitive non-Semitic culture. It seems extremely probable that these Chaldaean Semites were so strongly influenced by the foreign civilization as to adopt it eventually as their own. Then, as the Chaldaeans soon became the dominant people, the priestly caste of that region developed into a Chaldaean institution. It is reasonable to conjecture that southern Babylonia, the home of the old culture, supplied Babylon and other important cities with priests, who from their descent were correctly called "Chaldaeans." This name in later times, owing to the racial amalgamation of the Chaldaeans and Babylonians, lost its former national force, and became, as it occurs in Daniel, a distinctive appellation of the Babylonian priestly class. *Kalū* (priest) in Babylonian, which has no etymological connection with *Kaldū,* may have contributed paronomastically towards the popular use of the term "Chaldaeans" for the Babylonian magi. (*See* also ASTROLOGY.)

See BABYLONIA AND ASSYRIA and the commentaries on the book of Daniel. (J. D. PR.)

CHALDEE, a term formerly applied to the Aramaic portions of the biblical books of Ezra and Daniel or to the vernacular paraphrases of the Old Testament (*see* TARGUM), on the assumption that the language was that of Chaldaea (*q.v.*). But the cuneiform inscriptions show that the language of the Chaldaeans was Assyrian; and it is now known that the substitution of Aramaic for Hebrew as the vernacular of Palestine took place very gradually. The dialect wrongly called "Chaldee" is really the language of the South-Western Arameans, who were the immediate neighbours of the Jews. *See* SEMITIC LANGUAGES.

CHALDER or **CHALDRON,** an old dry measure of capacity, usually called chalder in Scotland and chaldron in England. In Scotland the chalder was equivalent to 16 bolls (*q.v.*) of corn, and was used in computing the stipends of parish ministers, but, like the chaldron, it varied according to the locality and the commodity measured. As a measure for lime and coal, the chalder and the chaldron vary from 32 bushels upwards, and are in general equivalent in weight to about 25½ cwt.

CHALET, a term applied to the timber houses of Switzerland, the Bavarian Alps, Tirol and the French Alps. The chalet is distinguished above all by the frank and interesting manner in which it makes use of its material, wood. The timber used is generally in heavy planks, from 3 to 6in. thick, and carefully framed together somewhat in the manner of a log-house. Side walls, generally low, often project beyond the ends, forming porches or loggias, closed at the ends. Upper floors, almost universally, project over the storeys below, with all sorts of fantastic



BY COURTESY OF BURTON HOLMES

CHARACTERISTIC CHALET IN THE TIROL

and interesting bracket treatments. Balconies across the front are common and are frequently enriched with carved railings. Windows are small and hung as casements. In general, roofs are of low pitch and project enormously, both at the eaves and at the gable ends, which are occasionally snubbed with a small triangle of sloping roof at the top. The roof surfaces are covered with large wood shingles, slabs of slate or stone; in the wilder districts planks are often laid over the roof covering and weighted with

boulders to prevent damage from heavy gales. In plan, the chalet tends towards the square; frequently, not only the house proper, but stables and storage barns are included under one enormous roof. Many local peculiarities of detail exist. (*See* HOUSE.)

CHALIAPIN, FYODOR IVANOVICH (1873–1938), (shạhl-yah′pēn) Russian bass singer, born at Kazan, on Feb. 1, 1873. His early career was a varied and adventurous one; he was by turns porter, shoemaker, hunter and street sweeper. He received his first musical training as a choirboy at Kazan, but his serious studies as a singer were made under Oussatov at Tiflis, where he made his first appearance in opera in 1892 in *A Life for the Tsar*. He then sang in 1894 at the Summer theatre, St. Petersburg (Leningrad), and later at the Imperial opera house. After visiting Milan he took important parts in the Mamantoff opera company, and at a private opera house in Moscow in 1896. In 1913, during the Russian opera season organized by Sir Thomas Beecham at Drury Lane, London, he appeared in *Boris Godunov, Ivan the Terrible,* and *La Khovantchina*. His superb bass voice and remarkable dramatic powers took his audience by storm, and he had a similar success in *Prince Igor*. During the World War and afterwards, until 1921, he remained in Russia. His first appearance outside Russia after the war was at the Albert Hall, London, in 1921. He visited America in 1908; his second tour there was in 1922–23. Among his most famous parts may be named those of Ivan the Terrible in Rimsky-Korsakov's *Maid of Pskof*; Salieri in *Mozart and Salieri;* Leporello in *Don Giovanni;* Don Basilio in the *Barber of Seville;* and Mephisto in *Mefistofele*.

See his *Pages from my Life* (1927).

CHALICE, the cup used in the celebration of the Eucharist (*q.v.*). For the various forms which the chalice so used has taken, *see* DRINKING VESSELS. The ancient custom of mixing water with wine in the Eucharistic service, practised from early times in both Eastern (except the Armenian) and Western Churches, is known as that of the "mixed chalice." The practice has been generally discontinued since the Reformation in the English Church, but is not illegal if it is not done ceremonially (*Martin* v. *Mackonochie,* 1868, L.R. 2 P.C. 365; *Read* v. *Bp. of Lincoln,* 1892, A.C. 664).

CHALIER, MARIE JOSEPH (1747–1793), French revolutionary, became a partner in a business firm at Lyons for which he travelled in the Levant, in Italy, Spain and Portugal. He became the orator and leader of the Jacobins of Lyons, and induced the other revolutionary clubs and the commune of the city to arrest a great number of Royalists in the night of Feb. 5, 1793. The mayor, supported by the national guard, opposed this project. Chalier demanded of the Convention the establishment of a revolutionary tribunal and the levy of a revolutionary army at Lyons. The Convention refused, and the anti-revolutionary party, encouraged by this refusal, took action. On May 29–30, 1793, the sections rose; the Jacobins were dispossessed of the municipality and Chalier arrested. On July 15, in spite of the order of the Convention, he was brought before the criminal tribunal of the Rhone-et-Loire, condemned to death, and guillotined the next day.

See N. Wahl, "Étude sur Chalier," in *Revue historique,* t. xxxiv.; and *Les Premières Années de la Révolution à Lyon* (1894).

CHALK is a white or greyish, loosely coherent kind of limestone rock, composed almost entirely of the calcareous remains of minute marine organisms (foraminifera, cocoliths, etc.) and fragments of shells. The purest kinds contain up to 99% of calcium carbonate in the form of the mineral calcite. Silica is always present in small amounts as the mineral opal, representing the remains of other minute marine organisms and sponge spicules. Minute grains of quartz, felspar, zircon, rutile and other minerals are also present. With the admixture of clayey material there may be an insensible gradation from pure chalk to chalk-marl. Not only may there be considerable variation in the composition of chalk (phosphatic, glauconitic, etc.) but there may also be wide variations in the colour (snow-white, grey, etc.) and the texture of the material. It may be soft, incoherent and porous or quite hard and crystalline.

The uses of chalk are numerous; for example, as a writing material in the form of white and coloured crayons, for the manufacture of quicklime, mortar, Portland cement (*see* CEMENT), plaster and as a fertilizer. Whiting is prepared by grinding chalk and collecting the finer sediments from water; this is used for polishing, making putty and many other purposes. Under the name of "Paris White," chalk is used in the manufacture of india-rubber goods, oil-cloth, wall-paper, etc. The harder kinds are extensively used as a building stone.

Large quantities of chalk are quarried in England in Kent, Surrey, Sussex, Cambridgeshire, Lincolnshire and Hampshire, Kent being by far the most important. The production of English chalk is not far short of five million tons annually. A certain amount of this is exported to the United States, though there are extensive beds of chalk in Kansas, Arkansas and Texas.

CHALKHILL, JOHN (fl. 1600?), English poet. Two songs by him are included in Izaak Walton's *Compleat Angler,* and in 1683 appeared "Thealma and Clearchus. A Pastoral History in smooth and easie Verse. Written long since by John Chalkhill, Esq., an Acquaintant and Friend of Edmund Spencer," together with a preface written five years earlier by Walton. Another poem, "Alcilia, Philoparthens Loving Follie" (1595, reprinted in vol. x. of the *Jahrbuch des deutschen Shakespeare-Vereins*), was at one time attributed to him. Nothing further is known of the poet, but a person of his name occurs as one of the coroners for Middlesex in the later years of Queen Elizabeth's reign. Professor Saintsbury, who included *Thealma and Clearchus* in vol. ii. of his *Minor Poets of the Caroline Period* (Oxford, 1906), points out a marked resemblance between his work and that of William Chamberlayne.

CHALKING THE DOOR, a former Scottish custom of tenant eviction within burgh. The law was that "a burgh officer, in presence of witnesses, chalks the most patent door 40 days before Whit Sunday, having made out an execution of 'chalking,' in which his name must be inserted, and which must be subscribed by himself and two witnesses." This ceremony proceeded simply on the verbal order of the proprietor. The Removal Terms (Scotland) Act 1886 introduced, as optional to "chalking," the procedure of giving notice to remove by registered letter posted to the last known address of the tenant. The Sheriff Courts (Scotland) Act 1907 requires written notice of removal to be given to the tenant as a prerequisite of ejection, and "chalking the door" is now an obsolete practice.

CHALLEMEL-LACOUR, PAUL AMAND (1827–1896), French statesman, was born at Avranches on May 19, 1827. Educated at the École Normale Supérieure, he became professor of philosophy at Pau and at Limoges, but was obliged to leave France after the coup d'état of 1851. He settled in Zürich, where he became professor of French literature in 1856. Three years later the amnesty permitted his return to France. Appointed by the government of national defence prefect of the Rhone in 1870, he suppressed the communard rising at Lyons directed by Bakunin. He became a deputy to the National Assembly in 1872, and in 1876 a member of the Senate. Though Challemel-Lacour sat at first on the extreme Left, he modified his opinions as time went on, and towards the close of his career was a foremost representative of moderate republicanism. He was French ambassador at Berne (1879), London (1880), minister of foreign affairs in the Jules Ferry cabinet (for some months in 1883), vice-president of the Senate (1890), president of the Senate (1893). His close and reasoned eloquence made him one of the most conspicuous members of the Senate. He died in Paris on Oct. 26, 1896.

See *Oeuvres oratoires de Challemel-Lacour* (1897) and *Études et réflexions d'un Pessimiste* (1901), edited by J. Reinach. *See* also H. Defasse, *Challemel-Lacour*.

CHALLENGE: *see* DUEL.

"CHALLENGER" EXPEDITION. The scientific results of several short expeditions between 1860 and 1870 encouraged the commissioning of a vessel for a prolonged cruise for oceanic exploration. H.M.S. "Challenger," a wooden corvette of 2,306 tons, under Captain (afterwards Sir) George Nares with a scientific staff under Prof. (afterwards Sir) C. Wyville Thomson as director, was sent out in Dec. 1872. The staff included John

Murray (afterwards Sir) and H. N. Moseley, biologists; Dr. von Willemoes-Suhm, Commander Tizard and J. Y. Buchanan, chemist and geologist. The Atlantic was crossed several times. From Cape Town south-east and east the ship visited the various islands between 45° and 50° S., reached Kerguelen island in Jan. 1874, and proceeded south about the meridian of 80° east. She was the first steamship to cross the Antarctic Circle; early in March she made for Melbourne. Thence the route led by New Zealand, the Fiji islands, Torres strait, the Banda sea, and the China sea to Hongkong. The western Pacific was then explored northward to Yokohama, after which the "Challenger" struck across the ocean by Honolulu and Tahiti to Valparaiso. She then coasted south, penetrated the Straits of Magellan, touched at Montevideo, recrossed the Atlantic by Ascension and the Azores, and reached Sheerness in May 1876. The *"Challenger" Report* was issued in 50 volumes (London, 1880–95), mainly under Sir John Murray, who succeeded Wyville Thomson in 1882.

See also Lord G. Campbell, *Log Letters from the "Challenger"* (1876); W. J. J. Spry, *Cruise of H. M. S. "Challenger"* (1876); Sir C. Wyville Thomson, *Voyage of the "Challenger," The Atlantic, Preliminary Account of General Results* (1877); J. J. Wild, *At Anchor; Narrative of Experiences afloat and ashore during the Voyage of H.M.S. "Challenger"* (1878); H. N. Moseley, *Notes by a Naturalist on the "Challenger"* (1879).

CHALLIS, a light, all-wool fabric of almost gossamer texture used for women's dressing gowns and children's suits and dresses. Challis is distinguished from all the other muslin-delaine weaves, of which class it is a member, by the tiny romantic designs in which it is printed. These designs are mostly of 18th and 19th century inspiration and show conventionalized versions of dots, rose-buds, violets and other flowers.

CHALLONER, RICHARD (1691–1781), English Roman Catholic prelate, was born at Lewes, Sussex, on Sept. 29, 1691, and educated at the English college at Douai, where he was ordained a priest in 1716, took his degrees in divinity, and was appointed professor in that faculty. In 1730 he was sent to London. The controversial treatises which he published in rapid succession attracted much attention, particularly his *Catholic Christian Instructed* (1737), with its witty reply to Dr. Conyers Middleton's *Letters from Rome, showing an Exact Conformity between Popery and Paganism.* In 1741 Challoner was raised to the episcopal dignity at Hammersmith and nominated coadjutor with right of succession to Bishop Benjamin Petre, vicar-apostolic of the London district, whom he succeeded in 1758. He died on Jan. 12, 1781. Bishop Challoner was the author of numerous controversial and devotional works, including the *Garden of the Soul* (1740?), one of the most popular manuals of devotion. He re-edited the Douai Bible (1749–1750), correcting the obsolete language and orthography. Of his historical works the most valuable is his *Memoirs of Missionary Priests and other Catholicks of both Sexes who suffered Death or Imprisonment in England on account of their Religion, from the year 1577 till the end of the reign of Charles II.* (1741, latest ed., 1924) intended as an antidote to Foxe's martyrology. He also published anonymously, in 1745 *Britannia Sancta,* or lives of the British saints, now superseded by that of Alban Butler.

See E. H. Burton, *Life and Times of Bishop Challoner* (1909).

CHALMERS, ALEXANDER (1759–1834), Scottish writer, was born in Aberdeen on March 29, 1759, and died in London on Dec. 19, 1834. He was educated as a doctor, but gave up this profession for journalism, and he was for some time editor of the *Morning Herald.* Besides editions of the works of Shakespeare, Beattie, Fielding, Johnson, Warton, Pope, Gibbon and Bolingbroke, he published *A General Biographical Dictionary* in 32 vols. (1812–17); a *Glossary to Shakespeare* (1797); an edition of Steeven's *Shakespeare* (1809); and the *British Essayists,* beginning with the *Tatler* and ending with the *Observer,* with biographical and historical prefaces and a general index.

CHALMERS, GEORGE (1742–1825), Scottish antiquarian and political writer, was born at Fochabers, Moray, and emigrated to Maryland in 1763, where he practised as a lawyer until the outbreak of the war of American Independence, when he returned to England. In 1786 he was appointed chief clerk to the privy council, an office which he held until his death in London May 31 1825.

Of some 30 works which he wrote the most important are *Political Annals of the present United Colonies from their Settlement to the Peace of 1763* (1780), drawn from the American State papers, and *Caledonia, An Account, Historical and Topographical, of North Britain* (1807–24). Neither of these is complete. Of the *Political Annals* only one volume was published, bringing the history down to 1688; and *Caledonia* covers only the southern counties of Scotland.

Chalmers wrote biographical sketches of Defoe, Allan Ramsay, Sir David Lyndsay, and others, prefixed to their collected works, and a *Life of Mary Queen of Scots* (1818). He engaged in many literary and historical controversies with Malone, Steevens, Dr. Jamieson, and others.

CHALMERS, GEORGE PAUL (1836–1878), Scottish portrait and landscape painter, was born at Montrose and studied at Edinburgh. The best of his works are "The End of the Harvest" (1873), "Running Water" (1875), and "The Legend" (in the National Gallery, Edinburgh). He became an associate (1867) and a full member (1871) of the Royal Scottish Academy.

CHALMERS, JAMES (1841–1901), Scottish missionary to New Guinea, was born at Ardrishaig in Argyll. He was appointed to Rarotonga in the South Pacific in 1866. After ten years' service he was transferred to New Guinea. Chalmers did much to open up the island, and, with his colleague W. G. Lawes, gave valuable aid in the British annexation of the south-east coast of the island. On April 8, 1901, in company with a brother missionary, Oliver Tomkins, he was killed by cannibals at Goaribari island. R. L. Stevenson has left on record his high appreciation of Chalmers's character and work.

See his *Autobiography and Letters* (1902).

CHALMERS, THOMAS (1780–1847), Scottish divine, was born at Anstruther, Fifeshire, on March 17, 1780. In 1799 he was licensed by the St. Andrews presbytery. After further study at Edinburgh he became assistant to the professor of mathematics at St. Andrews, and was ordained as minister of Kilmany, Fifeshire. In 1808 he published an *Inquiry into the Extent and Stability of National Resources,* a contribution to the discussion created by Bonaparte's commercial policy. His article on "Christianity" in the *Edinburgh Encyclopaedia* enhanced his reputation as an author. In 1815 he became minister of the Tron church, Glasgow, and his repute as a preacher spread throughout the United Kingdom. A series of sermons on the relation between discoveries of astronomy and the Christian revelation was published in Jan. 1817, and within a year nine editions and 20,000 copies were in circulation. When he visited London Wilberforce wrote, "all the world is wild about Dr. Chalmers."

In Sept. 1819 he became minister of the church and parish of St. John where he was singularly successful in dealing with the problem of poverty. When he undertook the management of the parish its poor cost the city £1,400 per annum, and in four years, the expenditure was reduced to £280 per annum. In 1823, after eight years of work at high pressure he was glad to accept the chair of moral philosophy at St. Andrews, the seventh academic offer made to him during the eight years spent in Glasgow. In Nov. 1828 he was transferred to the chair of theology in Edinburgh.

In 1826 he published a third volume of the *Christian and Civic Economy of Large Towns,* a continuation of work begun at St. John's, Glasgow. In 1832 he published a *Political Economy,* and in 1833 appeared his Bridgwater treatise on *The Adaptation of External Nature to the Moral and Intellectual Constitution of Man.* In 1834 he became leader of the evangelical section of the Scottish Church in the general assembly. In 1841 the movement which ended in the Disruption was rapidly culminating, and Dr. Chalmers found himself at the head of the party which stood for the principle that "no minister shall be intruded into any parish contrary to the will of the congregation." Cases of conflict between the Church and the civil power arose in Auchterarder, Dunkeld and Marnoch; and when the courts made it clear that the Church, in their opinion, held its temporalities on condition of

rendering such obedience as the courts required, the Church appealed to the Government for relief. In Jan. 1843 the Government put a final and peremptory negative on the Church's claims for spiritual independence. On May 18, 1843, 470 clergymen withdrew from the general assembly and constituted themselves the Free Church of Scotland, with Dr. Chalmers as moderator. He had prepared a sustentation fund scheme for the support of the seceding ministers, and this was at once put into successful operation. He himself became principal of the newly founded Free Church college, Edinburgh. On May 30, 1847 immediately after his return from the House of Commons, where he had given evidence as to the refusal of sites for Free Churches, by Scottish landowners, he was found dead in bed.

Dr. Chalmers' writings are a valuable source for argument and illustration on the question of Establishment. They run to 38 volumes concerned with theology, devotional practice and social economy. The most important of them is his *Institutes of Theology* written in his later years at the Free Church college.

BIBLIOGRAPHY.—W. Hanna *Memoirs* (Edinburgh, 1849–52); *Correspondence* (1853); and *Lives* by E. B. Ramsay (3rd ed. 1867); D. Fraser (1881); Mrs. Oliphant (1893) and W. G. Blaikie (1896).

CHALONER, SIR THOMAS, the elder (1521–1565), English diplomatist and poet, the son of Roger Chaloner, a mercer of London, was educated at Oxford and Cambridge. In 1540 he went as secretary to Sir Henry Knyvett, to the court of Charles V., whom he accompanied in his expedition to Algiers in 1541. In 1547 Chaloner served in the expedition to Scotland, and was knighted after the battle of Pinckie, by the protector Somerset. He was a witness against Bishop Bonner, in 1549, and against Stephen Gardiner, Bishop of Winchester, in 1551. Sent as a commissioner to Scotland three times (1551, 1552 and 1555–56), he was also employed both by Queen Mary and Elizabeth, as ambassador to France, Belgium and Spain. He returned home in 1564, and died at Clerkenwell on Oct. 14, 1565.

Chaloner's most important works are "Howe the Lorde Mowbray . . . was . . . banyshed the Realme," printed in the 1559 edition of William Baldwin's *Mirror for Magistrates* (repr. in vol. ii., pt. 1 of J. Haslewood's ed., 1815); *De Rep. Anglorum instauranda libri decem*, published by W. Mallim (1579, 3 pts.); and *The praise of folie, Moriae encomium . . . by Erasmus . . . Englished by Sir Thomas Chaloner, Knight* (1549, ed. Janet E. Ashbee, 1901).

CHÂLONS-SUR-MARNE, a town of north-eastern France, capital of the department of Marne, 107 m. E. of Paris on the main line of the Eastern railway to Nancy, and 25 m. S.E. of Reims. Pop. (1936) 35,530. The town proper is bordered on the west by the lateral canal of the Marne and is traversed by branches of the canal and by small streams.

Châlons-sur-Marne occupies the site of the chief town of the Catalauni and, on the plain between it and Troyes, Attila was defeated by the Romans in 451. In the 10th and following centuries it attained great prosperity under its bishops, who were ecclesiastical peers of France. In 1214 the militia of Châlons served at the battle of Bouvines; and in the 15th century the citizens twice repulsed the English from their walls. In the 16th century the town sided with Henry IV., king of France, who in 1589 transferred thither the parliament of Paris, which shortly afterwards burnt the bulls of Gregory XIV. and Clement VIII. The camp of Châlons, about 16 m. N. of the town, was established in 1856 by Napoleon III. and is a training-centre for troops. Châlons was occupied by the Germans in August, 1914, and was retaken by Foch in September, 1914. The cathedral of St. Étienne (chiefly 13th century) has a 17th century west façade. There are stained-glass windows of the 13th century in the north transept. Notre-Dame, of the 12th and 13th centuries, is conspicuous for its four Romanesque towers, two flanking the apse, two flanking the principal façade. The churches of St. Alpin, St. Jean and St. Loup date from various periods between the 11th and 17th centuries. The hôtel-de-ville (1771), the prefecture (1759–1764), the college, once a Jesuit establishment, and a training college which occupies the Augustinian abbey of Toussaints (16th and 17th centuries), are noteworthy civil buildings. The houses are generally ill-built, but some old mansions remain. The town is the seat of a bishop and a prefect, has tribunals of first instance and of commerce, a chamber of commerce, a board of trade-arbitrators, a museum and a library. The principal industry is brewing, which is carried on in the suburb of Marne. Galleries hewn in a limestone hill are used as store-houses for beer. The preparation of champagne, the manufacture of boots, brushes, wire-goods and wall-paper also occupy many hands. There is trade in cereals. (X.)

Battle of Châlons.—The battle of the Catalaunian Plains, "fierce, manifold, huge, stubborn, without its like in the history of times past" (Priscus), was fought between Attila and the Roman Aëtius in 451 A.D.

The Huns had crossed the Danube in the first quarter of the fifth century. Uldin, their leader was driven back by the soldiers of Byzantium; but by 424 the Byzantine court was paying the Huns a tribute of 350lb. of gold. Some ten years later Attila, nephew of a king who had brought the Huns to some rough unity of predatory purpose, became joint ruler with his brother. Attila, a typical Kalmuck in appearance, thereupon began a career of plunder. In another ten years he had forced the eastern empire to multiply sixfold the annual tribute. In six more years he had become lord of the lands north of the middle and lower Danube, and wasted the northern Balkan country. He forbade his Huns and Germans subject to him to take service in the imperial armies. The western Roman armies had long ceased to find their soldiers from within the frontiers; therefore Attila could cut off one of the main supplies of men.

Aëtius had been no enemy of the Huns, and had used them to make an end of the Burgundian kingdom about Worms (whence the Nibelungenlied). In 450 a good soldier, Marcian, became emperor of the East, and refused to pay the Hunnic tribute. A few months earlier a discontented Roman princess had given Attila a pretext for turning to that quarter of the world which he had not yet plundered. Justa Gratia Honoria, sister of the emperor Valentinian III. had plotted with a lover to take the throne. The plot was discovered; Honoria was married to a respectable and harmless senator. Honoria boldly sent to Attila for help, with her ring to show from what quarter the message came. Attila took the ring to mean that Honoria would be his wife. The time was good for using this claim; Gaiseric, king of the Vandals, fearing an attack from the Visigoths in southwest Gaul, had asked for Attila's alliance.

In 451 Attila led into Gaul a host of Huns, Alans and tributary Germans. Two parties were disputing the kingship of the Franks on the Rhine; one group joined the Huns, and thereby decided Attila's route. On April 7 this host plundered Metz, and thence moved slowly towards Orleans. Aëtius had not crossed the Alps in time to hold the Rhine; nor could he do much without Visigothic help. The fall of Orleans would leave the way open across the Loire to the Visigothic lands; therefore the Visigoths listened to Aëtius' messengers. An army of Romans (that is, of Romanized Germans) and Visigoths marched to save Orleans. Legends of the prowess of a Christian bishop (the legend of St. Geneviève is of the same time) have clouded over the history of the attack upon Orleans. But the town was on the point of falling when Aëtius and Theodoric, the Visigothic king, forced the Huns to retire.

Attila took the road northwards to Troyes and collected his forces on the plains well fitted for his cavalry. Chalons has been named as the chosen battlefield; but the *campi Catalaunici* include most of Champagne. The best chroniclers speak of a certain "Mauriac place." There was a Moirey west of Troyes, and there is a Méry-sur-Seine where bones, weapons and gold ornaments have been found. Here, about sixteen miles north-west of Troyes, some scholars think must be the "Mauriac place" and the tomb of Theodoric. On the night before the battle those Franks who favoured Aëtius broke through to him after a slaughter of 15,000 men. Before the day began Attila took the voice of his augurs; the Huns would be beaten (a likely prophecy about a retreating tribal host), but the enemy leader would fall. Attila could get another army; the empire had not another Aëtius, nor would anyone else be likely to keep together the Visigoths and Romans. By delaying until 3 P.M. Attila planned to secure

his retreat in the darkness. The chroniclers say that on one side the field sloped towards a slight hill; for this hill the armies fought. In the place of honour on the Roman right were the Visigoths; on the left Aëtius, and with him as a hostage, Thorismund son of Theodoric; in the centre, enclosed by more trusted troops were the Alan auxiliaries of the Romans. Aëtius hoped that the Huns might try to drive in this centre, for Attila kept in the midst of his Huns, and set the Ostrogoths and Gepidae on the left, and on his right the lesser German allies. Here was the decision. Aëtius seized the hill; his Alans were forced back, but now he could take the Huns on one flank, while on the other the Visigoths attacked. Thus the victory in this last great battle of western Roman power was won by the tactics which Hannibal had used at Cannae.

The Huns expected another attack, since in the immense slaughter Theodoric had been killed but Aëtius was alive. Attila, within his ring of wagons, prepared for death; but Aëtius feared a camp of desperate men whose strength was in their archery. Nor was he willing to secure in Gaul a Visigothic predominance against which the Huns might yet be his allies. He persuaded Thorismund to hasten to Toulouse, lest his brothers should take his inheritance. Attila escaped to ravage Italy in 452, and to die, or be murdered in a drunken sleep in 453. Was this battle of the "Mauriac place," one of the world's decisive battles? The Huns showed nothing of the fruitfulness of the Germanic peoples who came within the Empire, and their power could scarcely have survived for long the death of a king who was as rare as a Saladin among the Kurds. A son of Attila and Honoria might have been another Aëtius, if Attila's other sons had not put him to death; but the coming of the Huns was only an episode before the greater confusion of the dark ages, before the victory of Charles Martel, and the splendour and dominion of Charlemagne.

(E. L. W.)

CHALON-SUR-SAÔNE, an industrial town of east-central France, capital of an arrondissement in the department of Saône-et-Loire, 81 mi. N. of Lyons by the P.L.M. railway. Pop. (1936) 29,445. It is a well-built town, with fine quays, situated on the right bank of the Saône at its junction with the Canal du Centre. A 15th century bridge with 18th century obelisks, leads to the suburb of St. Laurent on an island in the river. Chalon-sur-Saône is identified with the ancient *Cabillonum,* an important town of the Aedui. It was chosen in the 6th century by Gontram, king of Burgundy, as his capital. The bishopric, founded in the 4th century, was suppressed at the Revolution. In feudal times Chalon was the capital of a countship. In 1237 it was given in exchange for other fiefs in the Jura by Jean le Sage, whose descendants nevertheless retained the title. Hugh IV, duke of Burgundy, the other party to the exchange, gave the citizens a communal charter in 1256. The town resisted a division of the Austrian army in 1814.

The church of St. Vincent, once the cathedral, dates mainly from the 12th to the 15th centuries, and has a choir in the 13th century Burgundian style. The old bishop's palace dates from the 15th century. The church of St. Pierre, with two lofty steeples, is late 17th century. Chalon preserves remains of its ancient ramparts and a number of old houses. It is the seat of a sub-prefect and a court of assizes, and has tribunals of first instance and commerce and a chamber of commerce. Chalon ranks next to Le Creusot among the manufacturing towns of Burgundy. Its position at the junction of the Canal du Centre and the Saône, and as a railway centre for Lyons, Paris, Dole, Lons-le-Saunier and Roanne, brings it a large transit trade. The founding and working of copper and iron are its main industries; the large engineering works of Petite-Creusot, a branch of those of Le Creusot, construct bridges, tug-boats etc., and there are chemical works, straw-hat factories, oil-works and tile-works. It is a busy corn-market and trades widely in wine, grain and timber.

CHALUKYA, the name of an Indian dynasty which ruled in the Deccan from A.D. 550 to 750, and again from 973 to 1190. The Chalukyas claimed to be Rajputs from the north. The dynasty was founded by a chief named Pulakesin I, who mastered the town of Vatapi (now Bādāmī, in the Bijapur district) about 550. His sons extended their principality east and west; but the founder of the Chalukya greatness was his grandson Pulakesin II., who succeeded in 608 and (609), established as his viceroy in Vengi his brother Kubja Vishnuvardhana, who in 615 declared his independence and established the dynasty of Eastern Chalukyas, which lasted till 1070. In 620 Pulakesin defeated Harsha (*q.v.*), the powerful overlord of northern India, and established the Nerbudda as the boundary between the South and North. He also defeated in turn the Chola, Pandya and Kerala kings, and by 630 was beyond dispute the most powerful sovereign in the Deccan. In 655 the Chalukya power was restored by Pulakesin's son Vikramaditya I.; but the struggle with the Pallavas continued until, in 740, Vikramaditya II. destroyed the Pallava capital. In 750 Vikramaditya's son, Kirtivarman Chalukya, was overthrown by the Rashtrakutas.

In 973, Taila or Tailapa II. (d. 995), a scion of the royal Chalukya race, succeeded in overthrowing the Rashtrakuta king Kakka II. He was the founder of the dynasty known as the Chalukyas of Kalyani. About A.D. 1000 a formidable invasion by the Chola king Rajaraja the Great was defeated, and in 1052 Somesvara I., or Ahamavalla (d. 1068), the founder of Kalyani, defeated and slew the Chola Rajadhiraja. The reign of Vikramaditya VI., or Vikramanka, which lasted from 1076 to 1126, formed another period of Chalukya greatness. In 1156 the commander-in-chief Bijjala (or Vijjana) Kalachurya revolted, and he and his sons held the kingdom till 1183. In this year Somesvara IV. Chalukya recovered part of his patrimony, only to succumb, about 1190, to the Yadavas of Devagiri and the Hoysalas of Dorasamudra. Henceforth the Chalukya rajas ranked only as petty chiefs.

See J. F. Fleet, *Dynasties of the Kanarese Districts;* Prof. R. G. Bhandarker, "Early History of the Deccan," in the *Bombay Gazetteer* (1896), vol. i. part ii.; Vincent A. Smith, *Early Hist. of India* (revised J. M. Edwardes, 1924).

CHALUMEAU is a word having several different musical meanings (from Lat. *calamus,* a reed). Thus it is the name of an obsolete wind instrument, with a single beating reed, of the clarinet type; and also of a later instrument, with a double reed, which developed into the oboe. It is used also for the deepest notes of the clarinet and further, in its German form of Schalmey or Schalmei, for the chanter of the bag-pipe and for an old kind of organ stop of chalumeau-like quality.

CHALYBÄUS, HEINRICH MORITZ (1796–1862), German philosopher, was born at Pfaffroda in Saxony. He lectured at Dresden on the history of German philosophy, and in 1839 became professor in Kiel university. His first published work *Historische Entwickelung der spekulativen Philosophie von Kant bis Hegel* (1837, Eng. tr. 1854), still ranks among the best expositions of 19th century German thought. His chief works are *Entwurf eines Systems der Wissenschaftslehre* (Kiel, 1846) and *System der spekulativen Ethik* (1850).

See Überweg, *Grundriss der Gesch. der Philosophie,* Bd. iv. (1923).

CHALYBITE: *see* SIDERITE.

CHAM, a Muslim tribe of Indo-China, rather dark skinned with Oceanic affinities (*see* ASIA), practising circumcision but with strong traces of Hinduism, phallic worship and animism surviving in their beliefs and customs. Thus they believe in a plurality of souls, eighteen of which are mortal, attached to each individual, and associate the departure of the soul at death with the flight of a bird. They bury their dead close to their best rice fields, and have a series of ceremonies depending on the operations of the agricultural year; the reaping of the rice crop must be initiated by a woman. In the family the matrilineal system is still followed. Children are given opprobrious names, probably to obviate the malice of the spirits. Speech is tabu when collecting the valuable "eagle wood" (*aquilaria agallocha*), and invulnerability is procured by anointing the body with human bile. The Cham are fond of regattas and boat races, and play chess using canoes instead of bishops. The language of the tribe is connected with Cambodian and with Oceanic tongues and, like the dolichocephaly of its speakers, and their customs, suggests an Indonesian basis for the tribe.

See Baudesson, *Indo-China and its Primitive People* (1919); Leuba, *Les Chams et leur Art* (1923).

CHAMBA, an Indian State in the Punjab, amid the Himalayas, on the south border of Kashmir. Area, 3,127 sq.mi. Pop. (1941), 168,908. Revenue, £60,000. The sanatorium of Dalhousie, though within the state, is attached to the district of Gurdaspur. Chamba is entirely mountainous; in the east, north and centre are snowy ranges. The chief rivers are the Chandra and Ravi. The principal crops are rice, maize and millet. Mineral ores are known but unworked. Trade is chiefly in forest produce. The capital of the state is Chamba (pop. [1941] 6,597) picturesquely situated above the Ravi gorge. Founded in the 6th century, sometimes nominally subject to Kashmir and afterwards tributary to the Mogul empire, it was always practically autonomous. Its chronicles are preserved in inscriptions, mostly engraved on copper.

It first came under British influence in 1846, when it was declared independent of Kashmir.

CHAMBER, THE KING'S, the *camera regis,* was, in the later middle ages, an important financial office. In origin it was the king's bedroom, with cupboards and chests for clothes and valuables. The servants in charge of this room, the king's chamberlains as they were called (*see* CHAMBERLAIN), were in such close touch with the king that they were often consulted and employed by him on matters not strictly within their province. Thus, the king's chamber was, from the beginning, something more than mere sleeping-quarters. It was an office where the king attended to private and public business alike, the greater part of which related to finance, and a storehouse for jewels, money and archives. From it, the first department to grow up within the royal household (*q.v.*), there sprang many mediaeval and modern ministries of State. Not only in England but throughout western Europe kings and magnates had their chamber, the *chambre des comptes* of the kings of France and the *camera apostolica* of the Popes being cases in point.

In England the reconstruction following on the Norman Conquest provided the monarchy with a regular income from taxation, the collection and administration of which threw upon the chamber so much extra work that it became concerned primarily with finance. A hierarchy of clerical and lay officials came into being to assist the original staff. But, whereas in Europe generally, for example in the papacy and in France, the *camera curiae,* the chamber of the court, was the sole treasury of the State, in England by the 12th century, the king's chamber had developed a branch to deal with the finances of the kingdom as opposed to the more personal finances of the king. This was the exchequer (*q.v.*), the first department of the household to become a public office. It soon superseded the chamber, which then found itself once more a simple domestic and court office, although certain moneys continued to be paid to it rather than to the exchequer. The activities of the chamber were curtailed still further in the 13th century by the growth of a second off-shoot, the king's wardrobe (*see* WARDROBES), by which it was ultimately replaced as the chief financial and administrative office of the household. Yet the chamber persisted, responsible to the king alone and overlapping the jurisdiction of both exchequer and wardrobe. Though its former power had been whittled down to authority over only the intimate financial needs of the king, there were several attempts to give it a foremost position in administration. Some of them, especially those of Edward II., Edward III. and Henry VII., achieved considerable success.

Faced by a hostile baronage which sometimes dominated the chief public offices and interfered in the government of the royal household, Edward II. turned to the chamber to secure independence of aristocracy, parliament and exchequer. To finance it adequately he allotted to it the management and income of certain lands which fell into his hands. The forfeited estates of the Templars (*q.v.*) were the first large block of lands to be brought under the authority of the chamber (1309). In 1322 the confiscation of the possessions of certain rebellious magnates, known as the "contrariants," put into Edward's power many more lands, which were soon reserved to the chamber, although only for a few months. The chamber staff was increased to discharge the duties involved in the care of an estate, and the secret seal fostered by Edward II. in opposition to the privy seal (*see* SEALS: *Small*), which the barons strove to control, was entrusted to it. In the schemes of the younger Hugh Despenser, made king's chamberlain in 1322, the chamber played a leading part, but its progress was checked by Edward II.'s deposition, and its lands transferred to the exchequer.

In 1332 Edward III. revived the chamber on the lines indicated by Despenser, and gradually placed a large number of lands at its disposal. A special seal, the griffin (*see* SEALS: *Small*), was set up for their service and the regular staff was again augmented. Edward III.'s need, however, differed from that of his father. Instead of an alienated baronage to contend with, Edward III. had a foreign enemy, France, against whom all parties were united. Consequently he had less inducement to cultivate the chamber for purely prerogative purposes. His chamber seems to have met little unfriendly criticism, and, in the first phase of the Hundred Years' War, had a fair opportunity of proving its worth. During the early campaigns, its chief officers took a conspicuous share in administration at home as well as with the armies abroad. But the estate upon which it largely relied disappointed expectations, most of the proceeds being swallowed up by the costs of its administration. Without considerable funds the chamber was crippled. In 1355–56, therefore, the estate was given up, and for it an annual sum of 10,000 marks (£6,666. 13s.4d.) payable by the exchequer, was substituted. This, the *certum* (fixed amount), was supplemented, as before the estate revenue had been, by casual receipts from the exchequer and elsewhere. Although the chamber was still answerable only to the king, its utility as an instrument of prerogative was diminished by this close dependence upon the exchequer. A further limitation was its total lack of skilfully devised, well-tried machinery to enforce its authority, for the griffin seal and the organization set up to administer the lands disappeared along with the estate. If, for the rest of Edward III.'s reign, the chamber occupied a recognized, amply endowed place in the administration, it was definitely subordinated to the exchequer. It was the royal privy purse, and a means whereby the king's will could be communicated to other departments, but little more.

On the accession of Richard II., a child with few personal expenses, the king's chamber suffered a natural relapse. When, in 1380, it was restored to something of its old dignity, the policy of 1355–56 was adopted, and a yearly allowance was granted to it, first from the customs, then, two years later, from the exchequer. On this *certum,* at most not more than two-thirds of that enjoyed under Edward III., the chamber was mainly dependent to the end of the 14th century, though in some years large casual payments were received. Such an office was valueless to a despotically minded king, and Richard II. seems never to have thought of making it a chief instrument of his prerogative. Yet chamber officials figured prominently among his confidants, and it was in his reign that the office of king's secretary (*see* SECRETARY OF STATE) assumed definite shape, the final result being the withdrawal from the chamber of the secretary and his seal, the signet (*see* SEALS: *Small*), the successor to the secret seal.

Of chamber history in the greater part of the 15th century little is known, but the office lived on. Then, in the restoration of financial stability after the Wars of the Roses (*q.v.*), Henry VII. advanced it to a position of supreme importance. Although he began to put the exchequer into working order, he wanted some less rigid, less elaborate machinery to supply him at once with the steady income necessary to strengthen Government and throne. Like Edward II. and Edward III. he had recourse to the chamber as the most suitable instrument and one that was, besides, entirely in his control. Forfeited estates and Crown lands were once again reserved to it, and other moneys were paid to it instead of to the exchequer. A new staff grew up, and to the daily labours of the regenerated office the king gave constant oversight. Unlike the Edwards, Henry was able to make the chamber effective, for, although he too diverted to the chamber revenues ordinarily paid and accounted for to the exchequer, and imposed

upon it functions technically belonging to the exchequer, the exchequer's extreme weakness, due to civil war, prevented remonstrance from that quarter.

Soon after the death of Henry VII., however, the exchequer, grown stronger, tried to insist that issues formerly paid to it, and accounts customarily rendered to it for audit, should still follow those rules, and not go to the chamber. In reply to this claim Henry VIII. induced parliament to recognize his father's system. Thus the chamber, already possessing wider influence than in the 14th century, seemed well on the way to recapturing its original position in the State. But Henry VIII., hard-working as he was, attended less to the routine of government than Henry VII., and the exchequer slowly deprived the chamber of all its newly given power. When the exchequer had recovered from the effects of the Wars of the Roses, not even Henry VIII. himself could maintain for the chamber the supremacy won under the guidance of Henry VII. Yet it was not until Mary's reign that the exchequer regained its traditional status, and then it was an exchequer changed at heart. From the end of the 13th century the chamber's rise and fall was chiefly determined by the weakness or strength of the exchequer. By taking over the best the chamber had to offer, the exchequer rendered it harmless for all time. There was no subsequent attempt to revive the work of that department, and only a memory of past glory is preserved in the office of the modern lord chamberlain (*q.v.*).

BIBLIOGRAPHY.—T. F. Tout, *The Place of the Reign of Edward II. in English History* (1914, bibl.); A. P. Newton, "The King's Chamber, under the Early Tudors," *English Historical Review*, xxxii (1917); T. F. Tout, *Chapters in the Administrative History of Mediaeval England* (vols.i–vi, 1920–33). (D. M. B.)

CHAMBERLAIN, ARTHUR NEVILLE (1869–1940), British politician, was born March 18, 1869, the son of Joseph Chamberlain by his second wife. Educated at Rugby and Mason college, Birmingham, he was successful in business in Birmingham and was lord mayor in 1915–16.

After serving on the central board of control of the liquor traffic and as director of national service during World War I., he became M.P. for the Ladywood division of Birmingham in 1918, was postmaster general from Oct. 1922 to March 1923, and then minister of health.

In Aug. 1923 he was made chancellor of the exchequer, but the government fell before he could present a budget. Again health minister in 1924, he carried out useful pension, housing and pure-food reforms. In 1931 he again became chancellor of the exchequer, retaining office until he succeeded Baldwin as prime minister in May 1937.

During his premiership, Chamberlain had to face a profound crisis in Europe, and to meet the growing might of nazi Germany. His aim was to ward off the danger of war by acquiescing in what he considered to be reasonable German demands, and this policy of appeasement reached its climax in the Munich agreement of Sept. 30, 1938, and the joint Anglo-German declaration of intention not to war on each other.

Chamberlain held that "peace in our time" was assured by this agreement, and as such augury it was hailed by his country. But Hitler's abrogation of the Munich agreement six months later with the complete absorption of Czechoslovakia proved these hopes to be illusory. Chamberlain then declared that Britain would oppose further nazi aggression by force and gave a guarantee of assistance to Poland (March 31, 1939). It was never clear how this guarantee could be made effective, however, for during the summer of 1939 the government failed to come to an agreement with Russia, the only power which could materially have helped Poland. After the Russo-German agreement of Aug. 1939, the German attack on Poland forced Chamberlain to declare war on Germany on Sept. 3, 1939.

Though essentially a peacetime leader, Chamberlain remained prime minister during the period of the "phoney" war, but the military debacle in Norway and the German attack on the Low Countries and France forced him to resign on May 10, 1940, in favour of Winston Churchill (*q.v.*). He was appointed lord president of the council and remained in the cabinet until Oct. 3, when he resigned this office and the leadership of the Conservative party because of ill-health. On Nov. 9, 1940, he died, a disillusioned man who had seen destroyed all his hopes of maintaining peace in Europe. (C. M. CL.)

CHAMBERLAIN, SIR (JOSEPH) AUSTEN (1863–1937), the eldest son of Joseph Chamberlain (*q.v.*) and of his first wife, Harriet Kenrick, was born at Birmingham on Oct. 16, 1863. He was educated at Rugby and Trinity College, Cambridge, and afterwards studied in Paris and Berlin. During the early stages of the Home Rule controversy he acted as his father's private secretary, and in 1892 was returned unopposed as M.P. for East Worcestershire. This seat he held until 1914, when, on his father's death, he succeeded him as a member for West Birmingham. "I was born in Birmingham," he said when he was given the freedom of that city in 1926. "I was bred in Birmingham; Birmingham is in my blood and in my bones, and wherever I go and whatever I am, I shall remain a Birmingham man."

His maiden speech drew from Gladstone the famous compliment, uttered in his father's presence, that it was one which must have been "dear and refreshing to a father's heart." After a short apprenticeship as a private member, he was a civil lord of the Admiralty (1895–1900), financial secretary to the Treasury (1900–2) and postmaster-general (1902). This rapid promotion was not due merely to the towering influence of his father, during the days of his great colonial secretaryship. Though the son's powers were of a solid rather than of a showy order, his administrative ability and his cogency in debate steadily developed with opportunity. His command of clear statement was exceptional; and he could be unexpectedly formidable in defence. In 1903 he was promoted to the chancellorship of the Exchequer. He ardently espoused his father's fiscal policy of tariff reform, nor did he slacken in its advocacy when Joseph Chamberlain left the Balfour administration in order to prosecute, with less embarrassment to the prime minister, his unofficial campaign. Unfriendly critics suggested at the time that the son's promotion to the second post in the Government was made in the hope of continuing his father's activities within reasonable bounds and preventing the threatened rupture in the party. This is not an adequate view. The father outside the Cabinet, like the son inside it, wished not to rupture their party but to convert it as a whole to the new doctrine of closer Imperial economic union and tariff-defence at home against foreign protection. Austen Chamberlain remained at the exchequer till the Unionist *débâcle* at the polls in 1906 and there acquired the reputation of being a departmentalist of the best Victorian type—safe, cautious, hard-working, and signally loyal to his associates. This loyalty was unflinching and more than once self-sacrificial.

During the long Liberal domination from 1906 to the World War Austen Chamberlain consolidated his position as a Unionist leader and gained the high esteem of all parties. He suffered, however, a great disappointment when Balfour, faced by the discontent and revolt of the rank and file, resigned his leadership of the Unionist party in 1911. Austen Chamberlain's claims to the succession were well supported. But a slightly stronger section favoured the claims of Walter Long, and as neither would yield to the other, both honourably agreed to the election of Bonar Law.

When the first Coalition Government was formed, in 1915, Austen Chamberlain entered Asquith's Cabinet as secretary of state for India, and held this post until 1917, when he resigned in consequence of the Government's decision to submit to a judicial investigation the charges and criticisms embodied in the report of the Mesopotamia commission. In his view the public interest and his personal honour alike required his resignation, though not one of the charges referred to him. The official responsibilities for the "horrible break-down" of the hospital arrangements during the first advance on Baghdad were incurred without his personal knowledge. His insistence on resignation was over-scrupulous, but showed that his views of what principle and loyalty demand were stricter than the normal. He did not long remain out of office. In April 1918 he became a member of the War Cabinet and after the Armistice returned to the chancellorship of the Exchequer in succession to Bonar Law. His guiding principle during the next two years was to strengthen British credit and pay off debt,

and to that end he called upon the taxpayer to make unprecedentedly heavy sacrifices, especially in respect of income tax, super-tax and excess profits duty. At the Treasury in a very British way he preserved an iron tradition of fiscal integrity.

In 1921 Bonar Law's failing health caused his withdrawal from active politics. Austen Chamberlain stepped into the vacant leadership of the House of Commons amid general acclamation. The post carried with it the virtual promise of the leadership of the Conservative party, ten years after the frustration of that chance in 1911. But the restraints and compromises of coalition had already begun to be irksome to many Conservatives, who distrusted the direction in which the Liberal prime minister of the Coalition was leading them. Austen Chamberlain, as lord privy seal and leader of the House, found that his staunch loyalty to his chief was bringing him into disfavour with many of the Conservative rank and file. The complaint was that he did not stand up to Lloyd George with sufficient firmness and that he sacrificed too many Conservative principles. This feeling was sharply intensified when Austen Chamberlain took a leading part at the end of 1921 in the startling settlement with Sinn Fein and the establishment of the Irish Free State. He pleaded boldly and eloquently for this "act of faith." He had been, indeed, the first to suggest to the prime minister that a choice had to be made between negotiations with the rebels and a thorough reconquest of Ireland.

Most of the Conservative party accepted the treaty with reluctance and with forebodings. Party confidence in Austen Chamberlain was further weakened by his steady refusal to listen to suggestions that fidelity to Conservative principles required him to lead his party out of Coalition bondage into party independence and freedom. His view, shared by his principal Conservative colleagues in the Lloyd George administration, was that Coalition was still necessary to deal with the difficult problems of the post-War period and not less to obviate the dangers of a socialist government, which, without co-operation between the two older parties, could not in their view long be averted. When, therefore, the discontented Conservative Diehards carried their revolt to success, and at the Carlton Club meeting on Oct. 19, 1922, offered the leadership to Bonar Law—who accepted it—Austen Chamberlain once more saw the ruin of his highest chances in politics. He and those of his colleagues who shared his views and quitted office with Lloyd George, naturally had no place in Bonar Law's Cabinet. He remained a private member during Baldwin's first administration and during the short period of the succeeding Labour Government. The dissensions in the Conservative party were gradually healed. When Baldwin formed his second administration, at the end of 1924, the post of foreign secretary was accepted by Austen Chamberlain. Then began a new stage of his career. Thirteen days after he entered on his duties at the Foreign Office (*i.e.*, on Nov. 20, 1924) Sir Lee Stack, governor general of the Sudan and Sirdar of the Egyptian army, was murdered in Cairo. The resultant situation was handled by Austen Chamberlain with a promptness and firmness that prevented further trouble, and at once established his own prestige as foreign secretary. Without delay he applied himself, at the beginning of 1925, to the remarkable diplomacy which produced the Locarno treaties. That diplomacy was pursued throughout the year, and it was mainly due to his moral earnestness and determination (for the sceptics abounded) that the treaties were initialled at Locarno on Oct. 16, 1925, Austen Chamberlain's birthday. For the nature of those treaties *see* LOCARNO, PACT OF. For the part he had played in this big step towards post-War reconciliation in Europe, Chamberlain received the Garter on Nov. 30, 1925 and the Nobel prize for peace in the same year (jointly with Charles G. Dawes). He increased the general pacific tendency in Europe by making the League of Nations a first consideration of his policy, himself attending all the meetings of the Council and Assembly. Germany's entry into the League in September 1926 was an event for which he personally was entitled to much credit. In 1927 his policy in the Chinese crisis was both conciliatory and strong. A military force was sent out to safeguard against possible attack and anarchy the great commercial community of Shanghai, but Great Britain also was the first in the field with proposals for large and increasing concessions to Chinese nationalism.

In May 1927 he reluctantly broke off relations with Russia after the Arcos raid, when it became clear that Bolshevism was violating normal diplomatic rules both in China and Britain. In the summer he initiated discussions with Sarwat Pasha for an Anglo-Egyptian treaty of alliance. A nine months' effort was thwarted early in 1928 by Cairo's repudiation of Sarwat and the emergence of Nahas Pasha as his successor. The failure of the three-Power naval conference at Geneva in July was not directly his responsibility. During the winter of 1927–28 and up to the summer of 1928 his general policy was concerned with a consideration of Kellogg's proposal for a Peace Pact, which he supported with some reserves as to interpretation, though wholly endorsing its principle. The Pact was duly signed in August. In the autumn of 1928 illness forced him to take a long sea voyage through the Panama Canal to California and thence through Canada homewards. His health had been rapidly restored, but in his absence the Foreign Office was widely attacked for its effort—wrapped in needless mystery—to concert with France joint suggestions to America on the subject of naval limitation. Public criticism made an end of this method, for which the Admiralty and the Cabinet generally were mainly responsible. Sir Austen died Mar. 16, 1937.

BIBLIOGRAPHY.—George Glasgow, *From Dawes to Locarno* (1925); A. J. Toynbee, C. A. Macartney and others, *Survey of International Affairs* (1926); Sir A. Chamberlain, *Peace in Our Time:* addresses on Europe and the Empire (1928).

CHAMBERLAIN, CHARLES JOSEPH (1863–1943), U.S. plant morphologist and cytologist, was born near Sullivan, Ohio on Feb. 23, 1863 and educated at Oberlin college, graduating in 1888. Most of his life he was connected with the University of Chicago, from which he obtained the degree of Ph.D. in 1897 and Sci.D. in 1923. He became instructor in 1901, spent one year in Bonn, Germany where he worked in the laboratory of Prof. Eduard Strasburger, and after his return, was appointed assistant professor in 1907, associate professor in 1911 and was professor of plant morphology and cytology from 1915 until his retirement in 1931. He was fundamental in organizing botanical laboratories and was in charge of them from the beginning. His interest in morphology and life history of cycads caused him to make many exploring trips which resulted in the assembling of the most extensive and complete collection of living cycads in the greenhouses of the university. He visited Mexico in 1904, 1906, 1908 and 1910 and made a long journey in 1911–12 to New Zealand and Australia, returning through South Africa. In 1914 and 1922 he collected in Cuba. He died on Feb. 5, 1943.

His publications include *Morphology of Spermatophytes* (1901); *Morphology of Angiosperms* (1903) *and Morphology of Gymnosperms* (1910, ed. 2, 1917) all in collaboration with J. M. Coulter; among his other works are *Methods in Plant Histology* (1901, ed. 5, 1932) and *Gymnosperms, Structure and Evolution* (1935).

See *Bot. Gaz.*, vol. civ (1943) and *Chronica Botanica,* vol. vii (1943).

CHAMBERLAIN, JOSEPH (1836–1914), British statesman, third son of Joseph Chamberlain, master of the Cordwainers' Company, was born at Camberwell Grove, London, on July 8, 1836. His father carried on the family business of boot and shoe manufacture, and was a Unitarian in religion and a Liberal in politics. Young Joseph Chamberlain was educated at Canonbury (1845–50), and at University college school, London (1850–52). After two years in his father's office in London, he was sent to Birmingham to represent his father's interest in the firm of Nettlefold, screw manufacturers. Nettlefold and Chamberlain employed new inventions and new methods of attracting customers. After years of success Chamberlain himself, with daring but sure ability amalgamated rival firms so as to reduce competition. In 1874 he was able to retire with an ample fortune. Taking a more and more important part in the municipal and political life of Birmingham, in 1868 when the Birmingham Liberal Association was reorganized, he became one of its leading members. In 1869 he was elected chairman of the executive council of the new National Education League. He took an active part in education, started classes for his workmen, and himself taught history, French and arithmetic in a Unitarian Sunday school. In 1869 he was elected a member of the town council. He married in 1868 his first wife's cousin, Florence Kendrick (d. 1875).

In 1870 he was elected a member of the first school board for Birmingham; and for the next six years, and especially after 1873, when he became leader of a majority and chairman, he actively championed the Nonconformist opposition to denominationalism. He was then regarded as a republican—the term signifying rather that he held advanced Radical opinions, which were construed by average men in the light of the current political

developments in France, than that he really favoured republican institutions for Britain. His programme was "free Church, free land, free schools, free labour." At the general election of 1874 he stood as a parliamentary candidate for Sheffield, but without success. Between 1869 and 1873 he worked in the Birmingham town council for the realization of the projects of municipal reform preached by Dawson, Dr. Dale and Bunce (of the "Birmingham Post"). In 1873 his party obtained a majority, and he was elected mayor, an office he retained by re-election until June 1876. As mayor he had to receive the prince and princess of Wales on their visit in June 1874, an occasion which excited some curiosity because of his reputation as a republican; but the behaviour of the Radical mayor satisfied the requirements alike of *The Times* and of *Punch*.

Birmingham.—The period of his mayoralty was important for Birmingham itself, and the stupendous energy which Chamberlain brought to bear on evil conditions in Birmingham had repercussions in every municipality in the country. The conference of local sanitary authorities summoned by him in 1874 and held in Jan. 1875 was the beginning of the modern movement for better and healthier organization of town life. In Birmingham he carried through the municipalization of the supply of gas and water, and the improvement scheme by which slums were cleared away and 40 acres laid out in new streets and open spaces. New municipal buildings were erected, Highgate park was opened for recreation, and the free library and art gallery were developed. The prosperity of modern Birmingham dates from 1875 and 1876, when these admirably administered reforms were initiated, and by his share in them Chamberlain became not only one of its most popular citizens but also a man of mark outside. An orator of a practical but consummate type, cool and hard-hitting, his spare figure, incisive features and single eye-glass soon made him a favourite subject for the caricaturist; and in later life his aggressiveness made his actions and speeches the object of more controversy than was the lot of any other politician of his time. In private life his loyalty to his friends, and his "genius for friendship" (as John Morley said) made a curious contrast to his capacity for arousing the bitterest political hostility. It may be added here that the interest taken by him in Birmingham remained undiminished during his life, and he was the founder of Birmingham university (1900), of which he became chancellor.

In 1876 Dixon resigned his seat in parliament, and Chamberlain was returned for Birmingham in his place unopposed, as John Bright's colleague. He made his maiden speech in the House of Commons on Aug. 4, 1876, on Lord Sandon's education bill. At this period, too, he paid much attention to the question of licensing reform, and in 1876 he examined the Gothenburg system in Sweden, and advocated a solution of the problem in England on similar lines. During 1877 the new federation of Liberal associations, which became known as the "Caucus," was started under Chamberlain's influence in Birmingham, the results of which were clearly shown in the general election of 1880.

After the general election of 1880 the Liberal party numbered 349 against 243 Conservatives and 60 Irish Nationalists. Gladstone was compelled to recognize the services of the Radicals in the election by the inclusion of Dilke and Chamberlain, who were sworn allies, in the new ministry. They had resolved together that one of them must be in the cabinet. The prime minister had not contemplated the admission of either, and was determined not to have both. Chamberlain, willing to give the preference to Dilke, was himself chosen as president of the Board of Trade. Dilke became under-secretary for foreign affairs but, at the end of 1882, he too entered the cabinet as president of the Local Government Board, and the alliance between the two rising ministers was more powerful than ever. The position of the Radicals in the 1880–85 Government was extremely difficult. Gladstone naturally turned rather to his old friends, Granville and Spencer, and had little personal sympathy with the new men. Dilke and Chamberlain stood for more far-reaching social reforms at home than their elder colleagues, and on foreign affairs there were many difficulties. In Egypt Chamberlain demanded more vigorous measures after the massacre at Alexandria (1882), yet insisted that the Government must not be tied to the bondholders' interest, but must give legitimate effect to Egyptian nationalist aspirations. Again in Feb. 1884 he would have given instructions to Baring to arrange for the relief of the Sudan garrisons, but no steps were taken, and, when at last a much more elaborate expedition than that at first urged by Chamberlain was sent, it was too late to avoid the tragedy of Gordon.

Irish Policy.—But the deepest fissure was on Irish policy. Chamberlain hated coercion, and held a positive view of Irish affairs. He made a personal effort in 1882 to heal the Irish sore. On the understanding that he would be disavowed if he failed, he was authorized to negotiate with Parnell and succeeded. The result was the "Kilmainham treaty." Parnell, on May 2, 1882, was released from Kilmainham gaol, having agreed to advise the cessation of outrages and the payment of rent, while Gladstone's ministry was to relax its coercive administration. Thereupon, W. E. Forster, the Irish secretary, resigned. His successor, the blameless Lord Frederick Cavendish, was immediately murdered in Phoenix park. This tragedy darkened the whole aspect of Irish affairs. Chamberlain, conspicuously marked out for the post of danger, was prepared to face the risk, but was not appointed. He refused to allow the tragedy to divert him from a definitely remedial policy. Eventually in 1885, after indirect negotiation through Capt. O'Shea with Parnell, he placed before the cabinet a scheme for Irish government on lines of semi-Home Rule without weakening, however, the imperial connection. A "central council," or national elective board was to be set up in Dublin, and Parnell was to forego obstruction to a bill which would reduce coercion to a minimum. The Irish bishops were thought to favour the plan. When these proposals for devolution came before the cabinet (May 9) all the peers, except Granville, voted against them; of the commoners only Hartington opposed them. Proposals for a Coercion bill and a land purchase bill were then put forward. Dilke and Chamberlain resigned, the latter being definitely opposed to land purchase unaccompanied by local autonomy. But the resignations did not take effect before the Government was defeated on the budget (June 8).

Both before and after the defeat Chamberlain associated himself with what was known as the "unauthorized programme," *i.e.*, free education, small holdings for agricultural labourers, graduated taxation and local government. In June 1885 he made a speech at Birmingham, treating the reforms just mentioned as the "ransom" that property must pay to society for the security it enjoys. In October Chamberlain defined his ideas to Gladstone. They were that local authorities must have the right of appropriation for public purposes, that a radical readjustment of taxation was necessary, and that ministers must be free to advocate free education, even if some of their colleagues opposed it. At the general election of Nov. 1885 Chamberlain was returned for West Birmingham. The Liberal strength in the nation generally was, however, reduced to 335 members, though the Radical section held their own; and the Irish vote became necessary to Gladstone if he was to command a majority. Chamberlain still had an open mind on the Irish question. He foresaw that between Home Rule and separation there was but a step, and in a letter written on Dec. 26 he went so far as to discuss a federalist scheme for the British Isles with five separate parliaments. In December it was stated that Gladstone intended to propose Home Rule for Ireland, and when the new parliament met in Jan. 1886 Lord Salisbury's ministry was defeated on the address, on an amendment moved by Chamberlain's Birmingham henchman, Jesse Collings, embodying the "three acres and a cow" of the Radical programme. Lord Hartington (afterwards duke of Devonshire) and some other Liberals, declined to join Gladstone in view of the altered attitude he was adopting towards Ireland. But Chamberlain—stipulating for liberty of judgment on the prime minister's Irish policy when embodied in definite legislative shape—entered the cabinet as president of the Local Government Board (with Jesse Collings as parliamentary secretary). On March 15, 1886, he resigned, explaining in the House of Commons (April 8), that while he had always been in favour of the largest extension of local government to Ireland consistent

with the integrity of the empire and the supremacy of the imperial parliament, and had therefore joined Gladstone when he believed that agreement might be possible, he was unable to recognize that the scheme communicated by Gladstone to his colleagues maintained those conditions. At the same time he was not irreconcilable, and invited Gladstone even then to modify the bill so as to remove the objections of Radical dissentients. This indecisive attitude did not last long, and the split in the party rapidly widened. At Birmingham Chamberlain was supported by the local "Two Thousand," but deserted by the national "Caucus" of the Liberal party and by its organizer, his own former lieutenant, Schnadhorst. In May the Radicals who followed Bright and Chamberlain, and the Whigs who took their cue from Lord Hartington, decided to vote against the second reading of the Home Rule bill, instead of allowing it to be taken and then pressing for modifications in committee, and on June 7 the bill was defeated by 343 to 313, 94 Liberal Unionists—as they were generally called—voting against the Government. Chamberlain was the object of the bitterest attacks from the Gladstonians for his share in this result; and open war was proclaimed by the Home Rulers against the "dissentient Liberals"—the description used by Gladstone. The general election, however, returned to Parliament 316 Conservatives, 78 Liberal Unionists, and only 276 Gladstonians and Nationalists, Birmingham returning seven Unionist members. When the House met in August, it was decided by the Liberal Unionists, under Hartington's leadership, that their policy henceforth was essentially to put in the Tories and to keep Gladstone out. The old Liberal feeling still prevailing among them was too strong, however, for their leaders to take office in a coalition ministry. For them as a whole it was enough to be able to tie down the Conservative Government to such measures as were not offensive to Liberal Unionist principles; but Chamberlain from the first was determined to impose on that Government a progressive policy in British social questions as the price of his indispensable support on the Irish question. It still seemed possible, moreover, that the Gladstonians might be brought to modify their Home Rule proposals, and in Jan. 1887 a Round Table conference, suggested by Chamberlain, was held between him and Sir G. Trevelyan for the Liberal Unionists, with Sir William Harcourt, John Morley and Lord Herschell for the Gladstonians, but no *rapprochement* was effected.

Reform.—The influence of his views upon the domestic legislation of the Government was bringing about a more complete union in the Unionist party, and destroying the old lines of political cleavage. Before 1892 Chamberlain had the satisfaction of seeing Lord Salisbury's ministry pass such important acts, from a progressive standpoint, as those dealing with coal mines regulation, allotments, county councils, housing of the working classes, free education and agricultural holdings, besides Irish legislation like the Ashbourne Act, the Land Act of 1891, and the Light Railways and Congested District acts.

In Oct. 1887, Chamberlain, Sir L. Sackville West and Sir Charles Tupper were selected by the Government as British plenipotentiaries to discuss with the United States the Canadian fisheries dispute, and a treaty was signed by them at Washington on February 15, 1888. The Senate, however, refused to ratify it; but a protocol provided for a *modus vivendi* giving American fishing vessels similar advantages to those contemplated in the treaty. This arrangement, prolonged from year to year, proved to be a real settlement. Chamberlain returned home in March, his already strong feelings of friendliness to the United States much strengthened. This sentiment was reinforced in Nov. 1888, by his marriage with his third wife, Miss Endicott, daughter of the United States secretary of war in President Cleveland's first administration.

At the general election of 1892 Chamberlain was again returned, with an increased majority, for West Birmingham, but the Unionist party as a whole was narrowly defeated; the Irish Nationalist vote again held the balance in the House of Commons and, with a small and precarious majority, Gladstone returned to office, pledged to Home Rule for Ireland. On Feb. 13, 1893, that wonderful veteran, now in his 84th year, introduced his second Home Rule bill, which was read a third time on Sept. 1. During the 82 days' discussion in the House of Commons Chamberlain was its most acute, ceaseless, unsparing critic, and he moved public opinion outside the House. His chief contribution to the discussions during the later stages of the Gladstone and Rosebery ministries was in connection with Asquith's abortive Employers' Liability bill, when he foreshadowed the broader method of "compensation for accidents," afterwards carried out, in favour of the working classes by the act of 1897. Outside parliament he was busy formulating proposals for old age pensions, which had a prominent place in the Unionist programme of 1895. After his visit to America in 1889 he was developing the imperialist outlook which profoundly modified his future activity.

South Africa.—In 1895 he became secretary of State for the colonies in Lord Salisbury's ministry. His influence in the Unionist cabinet was soon visible in the Workmen's Compensation act and other measures. This act, though in formal charge of the home secretary, was universally and rightly associated with Chamberlain. Another less important "social" measure, which formed part of the Chamberlain programme, was the Small Houses Acquisition Act of 1899; but the problem of old age pensions was less easily solved. This subject had been handed over in 1893 to a royal commission, and further discussed by a select committee in 1899 and a departmental committee in 1900, but both of these threw cold water on the schemes laid before them.

From New Year 1896 (the date of the Jameson Raid) onwards South Africa demanded the chief attention of the colonial secretary (*see* SOUTH AFRICA, and for details TRANSVAAL). In his negotiations with President Kruger one masterful temperament was pitted against another. Chamberlain had a very difficult part to play in a situation dominated by suspicion on both sides. While he firmly insisted on the rights of Great Britain and of British subjects in the Transvaal, he was the continual object of Radical criticism at home. Attempts were even made to ascribe financial motives to Chamberlain's actions, and the political atmosphere was thick with suspicion and scandal. The report of the Commons committee (July 1897) definitely acquitted both Chamberlain and the Colonial Office of any privity in the Jameson Raid, but Chamberlain's detractors continued to assert the contrary. Opposition hostility reached such a pitch that in 1899 there was hardly an act of the cabinet during the negotiations with President Kruger which was not attributed to the personal malignity and unscrupulousness of the colonial secretary. In fact he gave ample scope to the man on the spot, Sir Alfred (Lord) Milner, whom he had sent out as high commissioner in 1897. The Bloemfontein Conference of 1899 was a serious attempt to secure amicable agreement; but its failure did not deter Chamberlain from making repeated efforts to ensure peace. In the Transvaal the original Boer burghers had become an armed minority, determined at all costs to maintain its racial ascendancy. Since the opening of the gold mines, the unenfranchised outlanders, chiefly British, had become the majority of the adult inhabitants and supplied most of the revenue. Their plight was one of "taxation without representation." Chamberlain offered as part of a general settlement of the franchise and other outstanding questions, to give complete guarantees against any attack on the independence of the republic. But President Kruger's ultimatum demanded, in effect, the military withdrawal and political abdication of Britain in South Africa, and the Boer War began. It lasted for over $2\frac{1}{2}$ years before the two Dutch republics formally surrendered. Throughout this period, Chamberlain was the mainstay of British public opinion when nearly all the world was hostile. The elections of 1900 (when he was again returned, unopposed, for West Birmingham) turned upon the individuality of a single minister more than any since the days of Gladstone's ascendancy, and Chamberlain, never conspicuous for inclination to turn his other cheek to the smiter, was not slow to return the blows with interest.

Apart from South Africa, his most important work at this time was the successful passing of the Australian Commonwealth Act (1900), when both tact and firmness were needed to settle certain differences between the imperial Government and the colonial

delegates.

Chamberlain's tenure of the office of colonial secretary between 1895 and 1900 must always be regarded as a turning-point in the history of the relations between the British colonies and the mother country. In spirit he was an imperial federationist even before his separation from Gladstone. From 1887 onwards he worked for a *rapprochement* of the different parts of the empire for purposes of defence and commerce. In 1895 he struck a new note of constructive statesmanship, basing itself on the economic necessities of a world-wide empire. Not the least of the anxieties of the Colonial Office during this period was the situation in the West Indies, where the cane-sugar industry was being steadily undermined by the European bounties given to exports of Continental beet, and though the Government restricted themselves to attempts at removing the bounties by negotiation and to measures for palliating the worst effects in the West Indies, Chamberlain made no secret of his repudiation of the Cobden club view that retaliation would be contrary to the doctrines of free trade. He set to work to educate public opinion at home into understanding that the responsibilities of the mother country are not merely to be construed according to the selfish interests of a nation of consumers. As regards foreign affairs, Chamberlain more than once (particularly at Birmingham, May 13, 1898, and at Leicester, Nov. 30, 1899) indicated his leanings towards a closer understanding between the British empire, the United States and Germany. The unusually outspoken and pointed expression, however, of his disinclination to submit to Muscovite duplicity or to "pin-pricks" or "unmannerliness" from France was widely criticized. For three years from the spring of 1898 to 1901 he worked strenuously in secret for an Anglo-German alliance. He was convinced that this project was the chief key to the peace of the world. The Kaiser and Bülow hoped rather by keeping free hands to become arbiters of the world.

Boer War.—During the progress of the Boer War from 1899 to 1902, Chamberlain, as colonial secretary, naturally played only a subordinate part during the carrying out of the military operations. But in parliament and on the platform he was more than ever supreme—the chief animating influence of the British empire. He was the hero of the one side, just as he was the bugbear of the other. On Feb. 13, 1902, he was presented with an address in a gold casket by the corporation of the city of London, and entertained at luncheon at the Mansion House, an honour not unconnected with the strong feeling recently aroused by his firm reply (at Birmingham, Jan. 11) to disparaging remarks made by the German chancellor in the Reichstag (Jan. 8). Against offensive allegations abroad Chamberlain had defended the British army in South Africa, and declared its conduct to be as good as that of the Germans in 1870–71. The way in which England's difficulties called forth colonial assistance intensified his imperialism. More and more the problems of empire engrossed him, and a new enthusiasm for imperial projects arose in the Unionist party under his inspiration. No English statesman probably—except Peel—has ever been, at different times in his career, so able an advocate of apparently contradictory policies, and his opponents baited him with quotations from his earlier speeches. He replied in effect that to flinch from adopting new methods and even new opinions in face of totally changed circumstances, is either practical folly or moral cowardice.

The settlement after the war was full of difficulties, financial and others, in South Africa. When Arthur Balfour succeeded Lord Salisbury as prime minister in July 1902, Chamberlain agreed to serve loyally under him, and the friendship between the two leaders was indeed one of the most marked features of the political situation. In Nov. 1902 Chamberlain, bent upon a conciliatory settlement with the Boers, went out to South Africa. He travelled from place to place (Dec. 26–Feb. 25), arranged with the leading Transvaal financiers that in return for support from the British Government in raising a Transvaal loan they would guarantee a large proportion of a Transvaal debt of £30,000,000 which, by so much, should repay the British Treasury the cost of the war, and when he returned in March 1903, satisfaction was general in the country over the success of his mission. But meantime two things had happened. He desired above all things imperial union. At the Imperial Conference of 1902 the attitude of the overseas premiers had shown that the only way to the beginnings of a closer political union of the whole empire was on lines of mutually preferential commerce, deviating from the strict traditional doctrines of "free trade"—that is of equally free imports for all products, whether of foreign or British—imperial origin. But at home—while he was still in South Africa—some of his colleagues had gone a long way, behind the scenes, to destroy one of the very factors on which the practical scheme for imperial commercial federation seemed to hinge. In the budget of 1902 a duty of a shilling a quarter on imported corn had been reintroduced. This small tax was regarded as only a registration duty. Even by free-trade ministers like Gladstone it had been left up to 1869 untouched, and its removal by Robert Lowe (Lord Sherbrooke) had since then been widely regarded as a piece of economic pedantry. The more advanced imperialists, as well as the more old-fashioned protectionists (like Lord Chaplin) who formed a small but integral part of the Conservative body, had looked forward to this tax being converted into a differential one between foreign and colonial corn, so as to introduce a scheme of colonial preference. The latter principle would be introduced even by a remission of sixpence in favour of grain grown "under the flag" overseas. Ritchie, the chancellor of the exchequer, having a surplus in prospect and taxation to take off, persuaded the cabinet to abolish the corn-duty altogether. Chamberlain himself had proposed only to take it off as regards colonial, but not foreign corn—thus inaugurating a preferential system—and when he left for South Africa he did not imagine that this principle was in danger. But in his absence, a majority of the cabinet supported Ritchie. To those who had hoped so to handle the tax as to make it a lever for a gradual change in the established fiscal system, the total abolition was a bitter blow. At once there began, though not at first openly, a split between the more rigid free-traders—advocates of cheap food and free imports—and those who desired to use the opportunities of a tariff, of however moderate a kind, for attaining national and imperial and not merely revenue advantages. This idea had for some time been forming in Chamberlain's mind, and now took full possession of it. For the moment he remained in the cabinet, but the seed of dissension was sown. The first public intimation of his views was given in an epoch-marking speech to his constituents at Birmingham (May 15, 1903), when he outlined a plan for raising more money by a rearranged tariff, partly to obtain a preferential system for the empire and partly to produce funds for social reform at home. On May 28 in the House of Commons he spoke on the same subject, and declared "if you are to give a preference to the colonies, you must put a tax on food." Putting the necessity of food-taxes in the forefront was injudicious; but imperialist conviction and enthusiasm were more conspicuous than electioneering prudence in the launching of Chamberlain's new scheme. His courage was heroic; his tactics fell short of the old unfailing mastery of manoeuvre.

Tariff Reform.—Chamberlain argued that since 1870 certain other countries (Germany and the United States), with protective tariffs, had increased their trade in much larger proportion, while English trade had been chiefly maintained by the increased business done with British colonies. A scientific enquiry into the facts was needed. For a time the demand merely for enquiry, and the production of figures, gave no sufficient occasion for dissension among Unionists, even when, like Sir M. Hicks Beach, they were convinced free-importers on purely economic as well as political grounds. Balfour, as premier, managed to hold his colleagues and party together by taking the line that particular opinions on economic subjects should not be made a test of party loyalty. The Tariff Reform League was founded in order to further Chamberlain's policy, holding its inaugural meeting on July 21; and it began to take an active part in issuing leaflets and in work at by-elections.

Meanwhile, the death of Lord Salisbury (Aug. 22) removed a weighty figure from the councils of the Unionist party. The cabinet met several times at the beginning of September, and the

question of their attitude towards the fiscal problem became acute. The public had its first intimation of impending events in the appearance on Sept. 16 of Balfour's *Economic Notes on Insular Free Trade,* which had been previously circulated as a cabinet memorandum. The next day appeared the Board of Trade Fiscal Blue-Book, and on the 18th conflicting resignations were announced—not only of the more rigid free-traders in the cabinet, Ritchie and Lord George Hamilton, but also of Chamberlain himself for the opposite reason. His exit from the British Government after eight years of office was an event discussed with interest throughout the world.

Letters in cordial terms were published, which had passed between Chamberlain (Sept. 9) and Balfour (Sept. 16). Chamberlain pointed out that he was committed to a preferential scheme involving new duties on food, and could not remain in the Government without prejudice while it was excluded from the party programme; remaining loyal to Balfour and his general objects, he could best promote this course from outside, and he suggested that the Government might confine its policy to the "assertion of our freedom in the caste of all commercial relations with foreign countries." Balfour, while reluctantly admitting the necessity of Chamberlain's taking a freer hand, expressed his agreement in the desirability of a closer fiscal union with the colonies, but questioned the immediate practicability of any scheme; he was willing to adopt fiscal reform so far as it covered retaliatory duties, but thought that the exclusion of taxation of food from the party programme was in existing circumstances necessary, so long as public opinion was not ripe.

The tariff reform movement itself was now outside the purely official programme, and Chamberlain (backed by a majority of the Unionist members) threw himself with impetuous ardour into a crusade on its behalf, while at the same time supporting Balfour in parliament, and leaving it to him to decide as to the policy of going to the country when the time should be ripe. On Oct. 6 he opened his campaign with a speech at Glasgow. Analysing the trade statistics as between 1872 and 1902, he insisted that British progress involved a relative decline compared with that of protectionist foreign countries like Germany and the United States; Great Britain exported less and less of manufactured goods, and imported more and more; the exports to foreign countries had decreased, and it was only the increased exports to the colonies that maintained the British position. This was the outcome of the working of a one-sided free-trade system. Now was the time for consolidating British trade relations with the colonies. A further increase of £26,000,000 a year in the trade with the colonies might be obtained by a preferential tariff, and this meant additional employment at home for 166,000 workmen, or subsistence for a population of a far larger number. His positive proposals were: (1) no tax on raw materials; (2) a small tax on food other than colonial, *e.g.,* two shillings a quarter on foreign corn but excepting maize, and 5% on meat and dairy produce excluding bacon; (3) a 10% general tariff on imported manufactured goods. To meet any increased cost of living, he proposed to reduce the duties on tea, sugar and other articles of general consumption.

Colonial Preference.—"The colonies," he said, "are prepared to meet us; in return for a very moderate preference, they will give us a substantial advantage in their markets." This speech was the type of others which followed quickly during the year. At Greenock next day he emphasized the necessity of retaliating against foreign tariffs. The practice of "dumping" must be met; if foreign goods were brought into England to undersell British manufacturers, either the Fair Wages clause and the Factory Acts and the Compensation Act would have to be repealed, or the workmen would have to take lower wages, or lose their work, "Agriculture has been practically destroyed, sugar has gone, silk has gone, iron is threatened, wool is threatened, cotton will go! How long are you going to stand it?" In all his speeches he managed to point his argument by application to local industries. On Jan. 18, 1904, Chamberlain ended his series of speeches by a meeting at the Guildhall, in the city of London, the key-note being his exhortation to his audience to "think imperially."

Chamberlain needed a rest, and was away in Italy and Egypt from March to May, 1904, and again in November. He made three important speeches at Welbeck (Aug. 4), at Luton (Oct. 5), and at Limehouse (Dec. 15), but he had nothing substantial to add to his case. The Russo-Japanese War in Manchuria distracted popular attention from his campaign.

In Jan. 1905 some correspondence was published between Chamberlain and the duke of Devonshire, dating from the previous October, as to difficulties arising from the central Liberal-Unionist organization subsidizing local associations which had adopted the programme of tariff reform. The duke objected to this departure from neutrality, and suggested that it was becoming "impossible with any advantage to maintain under existing circumstances the existence of the Liberal-Unionist organization." Chamberlain retorted that this was a matter for a general meeting of delegates to decide; if the duke was out-voted he might resign his presidency; for his own part he was prepared to allow the local associations to be subsidized impartially, so long as they supported the Government, but he was not prepared for the violent disruption, which the duke apparently contemplated, of an association so necessary to the success of the Unionist cause. The duke was in a difficult position as president of the organization, since most of the local associations supported Chamberlain; and he replied that the differences between them were vital, and he would not be responsible for dividing the association into sections, but would rather resign. Chamberlain then called a general meeting on his own responsibility in February, when a new constitution was proposed; and in May, at the annual meeting of the Liberal-Unionist council, the free-food Unionists, being in a minority, retired, and the association was reorganized under Chamberlain's auspices, Lord Lansdowne and Lord Selborne (both of them cabinet ministers) becoming vice-presidents. On July 14 the reconstituted Liberal-Unionist organization held a great demonstration in the Albert hall, and Chamberlain's success in ousting the duke of Devonshire and the other free-trade members of the old Liberal-Unionist party, and imposing his own fiscal policy upon the Liberal-Unionist caucus, was now complete.

In reply to Balfour's appeal for the sinking of differences (Newcastle, Nov. 14), Chamberlain insisted at Bristol (Nov. 21) on the adoption of his fiscal policy; and Balfour resigned on Dec. 4 on the ground that he no longer retained the confidence of the party. At the crushing Unionist defeat in the general election which followed in Jan. 1906, Chamberlain was triumphantly returned for West Birmingham, and all the divisions of Birmingham returned Chamberlainite members. This, by contrast with the national disaster to the Unionist party as a whole, was one of the astonishing features of all British electoral history.

But he had no desire to set himself up as leader in Balfour's place, and after private negotiations with the ex-prime minister, a common platform was arranged between them, on which Balfour—for whom a seat was found in the City of London—should continue to lead the remnant of the party. The "Valentine's Day" formula was given in a letter from Balfour of Feb. 14 which admitted the necessity of making fiscal reform the first plank in the Unionist platform, and accepted a general tariff on manufactured goods and a small duty on foreign corn as "not in principle objectionable."

It may be left to future historians to attempt a considered judgment on the English tariff reform movement, and on Chamberlain's responsibility for the Unionist *débâcle* of 1906. But while his enemies taunted him with having twice wrecked his party—first the Radical party under Gladstone, and secondly the Unionist party under Balfour—no well-informed critic doubted his sincerity, or failed to recognize that in leaving the cabinet and embarking on his fiscal campaign he showed real devotion to an idea. In championing the cause of imperial fiscal union, by means involving the abandonment of a system of taxation which had become part of British orthodoxy, he followed the guidance of a profound conviction that the stability of the empire and the very existence of the hegemony of the United Kingdom depended upon the conversion of public opinion to a revision of the current economic doctrine. For the second time he had staked an already

established position on his refusal to compromise with his convictions on a question which appeared to him of vital and immediate importance.

Mr. Chamberlain's own activity in the political field was cut short in the middle of the session of 1906. His 70th birthday was celebrated in Birmingham with immense enthusiasm shared in spirit by the bulk of the Unionist party in Great Britain and by idealists of imperialism throughout the British dominions. His fatigue before this apotheosis was extreme. Immediately afterwards he had a stroke of paralysis. He never spoke in public again. Though, for some time, his adherents hoped that he might return to the House of Commons, he was quite incapacitated for any public work. At the general election of Jan. 1910 Chamberlain was returned unopposed for West Birmingham again. His last sad appearance in the House was in the February following when, while few members were present, the formality of signing the roll was performed for him by his eldest son.

He died at his house, Highbury, Birmingham, on July 2, 1914. His last speech had been made on July 9, 1906. In that speech he uttered words which may fairly be given as his political testament: "The union of the Empire," he said, "must be preceded and accompanied by a better understanding, by a better sympathy. To secure that is the highest object of statesmanship now at the beginning of the 20th century; and if these were the last words that I were permitted to utter to you, I would rejoice to utter them in your presence, and with your approval. I know that the fruition of our hopes is certain. I hope I may live to congratulate you upon our common triumph; but in any case I have faith in the people. I trust in the good sense, the intelligence and the patriotism of the majority, the vast majority, of my countrymen."

Joseph Chamberlain had a singularly happy home life, and during his long illness had the devoted attention of Mrs. Chamberlain. Both his sons, Joseph Austen and Arthur Neville, rose to high position amongst statesmen, and are separately noticed.

See H. W. Lucy, *Speeches of Joseph Chamberlain, with a sketch of his life* (1885); *Speeches on Home Rule and the Irish Question 1881–87* (1887); *Foreign and Colonial Speeches* (1897); *Imperial Union and Tariff Reform, 15 May–Nov. 4, 1903* (2nd ed. 1910); C. W. Boyd, *Mr. Chamberlain's Speeches* (2 vols., 1914). The authorized *Life* of Chamberlain, by J. L. Garvin, is in preparation. The existing biographies were written during Chamberlain's lifetime by N. M. Marris (1900), S. H. Jeyes (1903), Louis Creswick (4 vols., 1904), Alexander Mackintosh (1906) and by Viscount Milner, J. Spender, Sir Henry Lucy and others (pub. 1912). Much information, including letters and reports of conversations, is to be found in biographies of his contemporaries, notably in those of Gladstone, the duke of Devonshire, Granville, Goschen and Harcourt, which will be found noted under those heads. For the South African period *see* the despatches published in the parliamentary papers series, Accounts and Papers (Colonies and British Possessions, South Africa), for the years in question, and *The "Times" History of the War in South Africa* (edit. L. C. S. Amery, vol. i. and vi. 1900–09); and for the suggested *rapprochement* with Germany at the turn of the century, E. Fischer, *Holstein's grosses Nein; Die deutschenglischen Bündnisverhandlungen von, 1898–1901* (1925); H. von Eckhardstein, *Lebens erinnerungen und politische Denkwürdigkeiten* (Leipzig, 1919, etc.); Erich Brandenburg, *Von Bismarck zum Weltkriege* (1924, trans. by A. E. Adams, 1927); *Die Grossepolitik der Europäischen Kabinette, 1871–1914;* and F. Meinecke, *Geschichte des Deutsch Englischen Bündnissproblems, 1890–1901* (1927).

CHAMBERLAIN, SIR NEVILLE BOWLES (1820–1902), British field-marshal, was born at Rio de Janeiro Jan. 10, 1820, the son of Henry Chamberlain, consul-general and chargé d'affaires in Brazil. He entered the East India Company's army in 1837 and served in the first Afghan war (1839–42), in the Gwalior campaign of 1843, and in the Punjab campaign of 1848–49. After that date, promotion was rapid, and he commanded several expeditions on the north-east frontier of the Punjab Frontier Force. During the Mutiny he became adjutant-general of the Indian Army, and for his services at the siege of Delhi and elsewhere was rewarded with a series of honours. He gained more honours after the Umbeyla campaign in 1863. Chamberlain was promoted to lieut.-general in 1872, made G.C.S.I. in 1873, and G.C.B. in 1875. From 1876–81 he was commander-in-chief of the Madras army, and in 1879 was sent on a mission to Shere Ali, whose refusal to allow him to enter Afghanistan precipitated the outbreak of the second Afghan war. Chamberlain agreed with Lord Lytton that the British Government should take steps to show its resentment at a "gross and unprovoked insult," but he did not approve of the policy of disintegration of Afghanistan adopted by Lytton after the second occupation of Kabul. He disapproved of the retention of Kandahar in 1880 on the ground of his knowledge of the increased difficulty involved in additional outposts. Chamberlain returned to England in 1881, and received the rank of field-marshal in 1900. He died at Lordswood, near Southampton, Feb. 18, 1902.

See W. H. Paget, *Record of the Expeditions against the North-West Frontier Tribes* (1884); G. W. Forrest, *Life of Chamberlain* (1909).

CHAMBERLAIN, etymologically, and also to a large extent historically, an officer charged with the superintendence of domestic affairs. Such were the chamberlains of monasteries or cathedrals, who had charge of the finances, gave notice of chapter meetings, and provided the materials necessary for the services. In these cases, as in that of the apostolic chamberlain of the Roman see, the title was borrowed from the usage of the courts of the western secular princes. A royal chamberlain is now a court official whose function is in general to attend on the person of the sovereign and to regulate the etiquette of the palace. He is the representative of the mediaeval *camberlanus, cambellanus* or *cubicularius,* whose office was modelled on that of the *praefectus sacri cubiculi* or *cubicularius* of the Roman emperors. But at the outset there was another class of chamberlains, the *camerarii, i.e.,* high officials charged with the administration of the royal treasury (*camera*). The *camerarius* of the Carolingian emperors was the equivalent of the *hordere* or *thesaurarius* (treasurer) of the Anglo-Saxon kings; he develops into the *Erzkämmerer* (*archicamerarius*) of the Holy Roman Empire, an office held by the margraves of Brandenburg, and the *grand chambrier* of France, who held his *chamberie* as a fief. Similarly in England after the Norman conquest the *hordere* becomes the chamberlain. This office was of great importance. Before the Conquest the *hordere* had been, with the marshal, the principal officer of the king's court; and under the Norman sovereigns his functions were manifold. As he had charge of the administration of the royal household, his office was of financial importance, for a portion of the royal revenue was paid, not into the exchequer, but in *camera regis.* In time the office became hereditary and titular, but the complexity of the duties necessitated a division of the work, and the office was split up into three: the hereditary and sinecure office of *magister camerarius* or lord great chamberlain (*q.v.*) the more important domestic office of *camerarius regis,* king's chamberlain or lord chamberlain (*q.v.*) and the chamberlains (*camerarii*) of the exchequer, two in number, who were originally representatives of the chamberlain at the exchequer, and afterwards in conjunction with the treasurer presided over that department. In 1826 the last of these officials died, when by an act passed 44 years earlier they disappeared.

In France the office of *grand chambrier* was early overshadowed by the *chamberlains* (*cubicularii, cambellani,* but sometimes also *camerarii*), officials in close personal attendance on the king, men at first of low rank, but of great and ever-increasing influence. As the office of *grand chambrier,* held by great feudal nobles seldom at court, became more and more honorary, the chamberlains grew in power, in numbers, and in rank, until, in the 13th century, one of them emerges as a great officer of State, the *chambellan de France* or *grand chambellan* (also *magister cambellanorum, mestre chamberlenc*), who at times shares with the *grand chambrier* the revenues derived from certain trades in the city of Paris. The honorary office of *grand chambrier* survived till the time of Henry II., who was himself the last to hold it before his accession; that of *grand chambellan,* which in its turn soon became purely honorary, survived till the Revolution. Among the prerogatives of the *grand chambellan,* which survived to the last, was the right to hand the king his shirt at the ceremonial levee. The offices of *grand chambellan, premier chambellan,* and *chambellan* were revived by Napoleon, continued under the Restoration, abolished by Louis Philippe, and again restored by Napoleon III.

In the papal Curia the apostolic chamberlain (*camerarius*) is at the head of the treasury (*camera thesauraria*) and, in the days of the temporal power, not only administered the papal finances but possessed an extensive civil and criminal jurisdiction. During a vacancy of the Holy See he is at the head of the administration of the Roman Church. The office dates from the 11th century, when it superseded that of archdeacon of the Roman Church, and the close personal relations of the *camerarius* with the pope, together with the fact that he is the official guardian of the ceremonial vestments and treasures, point to the fact that he is also the representative of the former *vestararius* and *vice-dominus*, whose functions were merged in the new office.

In England the modern representatives of the *cubicularii* are the gentlemen and grooms of the bed-chamber; in Germany were the *Kammerherr* (*Kämmerer*, from *camerarius*, in Bavaria and Austria) and *Kammerjunker*. The insignia of their office is a gold key attached to their coats behind.

Many corporations appoint a chamberlain. The chamberlain of the corporation of the city of London, who is treasurer of the corporation, admits persons to the freedom of the city, and, in the chamberlain's court, of which he and the vice-chamberlain are judges, exercises concurrent jurisdiction with the police court in determining disputes between masters and apprentices. Formerly nominated by the crown, since 1688 he has been elected annually by the liverymen. He has a salary of £2,000 a year. Similarly in Germany the administration of the finances of a city is called the *Kämmerei* and the official in charge of it the *Kämmerer*.

See Lord Chamberlain; Lord Great Chamberlain; Household, Royal; Du Cange, *Glossarium*, s. "Camerarius" and "Cambellanus"; Père Anselme, *Hist. généalogique et chronologique de la maison royale de France, etc.* (3rd ed. 1726–33); A. Luchaire, *Manuel des institutions françaises* (1892); W. R. Anson, *Law and Custom of the Constitution* (1896); Hinschius, *Kirchenrecht*, i. 405 (1869).

CHAMBERLAYNE, WILLIAM (1619–1679), English poet, died on July 11, 1679. Nothing is known of his history except that he practised as a physician at Shaftesbury in Dorsetshire, and fought on the Royalist side at the second battle of Newbury. His works are: *Pharonnida* (1659), a verse romance in five books; *Love's Victory* (1658), a tragi-comedy, acted under another title in 1678 at the Theatre Royal; *England's Jubilee* (1660), a poem in honour of the Restoration. A prose version of *Pharonnida*, entitled *Eromena* or *The Noble Stranger*, appeared in 1683. Southey speaks of him as "a poet to whom I am indebted for many hours of delight." *Pharonnida* was reprinted by S. W. Singer in 1820, and again in 1905 by Prof. G. Saintsbury in *Minor Poets of the Caroline Period* (vol. i.). The poem is loose in construction, but contains some passages of great beauty.

CHAMBERLIN, THOMAS CHROWDER (1843–1928), American educator and geologist, was born at Mattoon, Ill., on Sept. 25, 1843. He graduated at Beloit college in 1866 (A.B.) and returned to the college in 1873 as professor of geology, serving also as assistant State geologist of Wisconsin until 1876, when he was made chief geologist of the Wisconsin Geological Survey (1876–82). From 1882 to 1887 he served as U.S. geologist in charge of the glacial division; from 1887 to 1892, as president of the University of Wisconsin; from 1892 to 1919, as head of the geological department of the University of Chicago, retiring as professor emeritus in 1919. He studied glaciers in Switzerland in 1878 and in Greenland in 1894, as geologist to the Peary relief expedition. His principal scientific work in later years has been the study of fundamental problems in geology particularly as related to the origin and growth of the earth, the developing of the planetesimal hypothesis of the planets, planetoids and satellites; and the chondrulitic hypothesis of the origin of chondrulites, comets and meteorites. He died in Chicago, Nov. 15, 1928.

His chief publications are *Geology of Wisconsin* (1879–82); *Reports of the Glacial division U.S. Geol. Survey* (1882–87); a three-volume treatise on geology (with R. D. Salisbury, 1906); reports on researches on certain fundamental problems in geology to the Carnegie Institution of Washington, *Year Books* 2 to 27; *The Tidal and Other Problems* (1909), "Diastrophism and the Formative Processes," numerous articles in the *Journal of Geology*, vol. xxi. (1913–21); *The Origin of the Earth* (1916); *The Two Solar Families, The Sun's Children* (1928).

CHAMBER MUSIC, a term obviously denoting music for performance in a room of a private house, has acquired the special meaning of large works in the sonata style for a group of individual instruments; although it may be borne in mind that in the early 18th century vocal cantatas for solo voices were at least as important as purely instrumental compositions.

One feature of immaturity is common to all the chamber music, vocal and instrumental, between and including Corelli and Bach; namely, that the harmonic background is left to the harpsichord player to extemporize from the indications given by a figured bass (*q.v.*). Even works with elaborate obligato harpsichord parts, have passages which presuppose this extempore element. Only the concerted music of the French clavecinists Couperin and Rameau consistently leaves nothing undetermined.

Works with Continuo.—The forms of chamber music are those of music at large, and it has no independent history. But it is very definite in the principles which determine its texture; and the element of the figured bass or continuo puts the earlier chamber music into an altogether different category from the art which arose with Haydn. As is shown in the articles Instrumentation, Music and Sonata Forms, the sonata-style of Haydn and Mozart irrevocably brought the dramatic element into music; but in addition to this, it brought alike into chamber music and orchestral music a fundamental principle that all players in an instrumental combination should between them provide their own harmonic background without the aid of a continuo part.

The disappearance of the continuo in later chamber music marks the realization of the central classical idea of the style, according to which there is no part in the ensemble left either indeterminate or in permanent subordination.

With its disappearance must also disappear the conception of the ensemble as a group of treble instruments over a firm bass, requiring a middle mass of harmony on an altogether remoter plane to hold them together. The middle part must be on the same plane as the others, and all must be as ready to provide the background as to carry on the main lines. There were no string quartets in the continuo period; and, what is more significant, the viola parts in the orchestra of Bach and Handel are, except when accompanying a choral fugue, neither interesting in themselves nor sufficient to fill up the gap between violins and bass. Their function is to reinforce the continuo without going a step out of their way to make the harmony always complete.

Haydn's first Quartets.—Rightly understood and performed, the result is perfectly mature; but it is worlds away from the crudest of Haydn's first quartets which, written before the death of Handel, show the criterion of self-sufficiency firmly established, so that there is no room for a continuo. The first string quartets are not clearly distinguished from orchestral music; wind parts have been discovered for Haydn's op. 1, No. 5 and op. 2, No. 3, and Haydn throughout his life remained capable of occasionally forgetting that his quartet-violoncello was not supported by a double-bass. But few processes in the history of music are more fascinating than the steady emergence of Haydn's quartet-style from the matrix of orchestral habit. In the quartets of op. 9 which he afterwards wished to regard as the beginning of his work, the four string parts are equally necessary and equally alive. They are not equally prominent; because the criterion is not polyphony but self-sufficiency for the purposes of this kind of music; and in this kind of music the normal place for melody is on the top.

In the very important six quartets, op. 20, Haydn discovers the character of the violoncello as something more than a bass to the violins—you can hear him discover it in the fourth bar of op. 20, No. 1; and with this discovery all possibility of the use of a double-bass vanishes, though miscalculations occur in the latest quartets. Had Haydn been a great violoncellist his first quartets might have been as luxurious as the quintets of Boccherini (*q.v.*), and he might have dallied longer in the bypaths of a style which tries to give each instrument in turn its display

of solo-work. But Haydn's line of progress is steady and direct, and no document in the history of music is more important than his op. 20, with its three fugues (which secure autonomy and equality of parts by a return to the old polyphony), its passages of turn-about solo, its experiments in rich and special effects, and, most important of all, its achievements in quite normal quartet-writing such as pervades the remaining forty-odd quartets which end with his pathetic last fragment, op. 103.

Haydn's pianoforte trios also cover his whole career but they show, from first to last, no effort to achieve more than pianoforte sonatas with string accompaniment.

Mozart.—Mozart was an inveterate polyphonist by the time he was 12 years old, and the character of the viola, unnoticed by Haydn in his ripest quartets, is imaginatively realized in quartets written by Mozart at the age of 17. The point is not that the viola takes part in a more polyphonic style (though Mozart's early quartets are full of contrapuntal and canonic forms) but that the composer's imagination is attentive to the tone of the instrument in every note he writes for it.

Mozart's pianoforte trios, which are very insufficiently appreciated by historians and players, are perfect examples of independence of parts, no less than the two great pianoforte quartets (which should have been six but that the publisher cried off his bargain because of their difficulty) and the quintet for pianoforte and wind instruments. The set of six great string quartets (avowedly inspired by and affectionately dedicated to Haydn) contains some of the profoundest music outside Beethoven; and of the four remaining quartets, the last three, written for the King of Prussia, who was a good violoncellist, gave his majesty a grateful and prominent part and showed that Mozart's wit was able to maintain the full greatness of his style even when he was restricted to a lighter vein of sentiment.

His string quintets are as great as the quartets. Mozart prefers a second viola as the fifth member; and the only case where he suggested a second violoncello was by way of substitute for the horn in a little quintet for the curious combination of one violin, two violas, violoncello and horn. The combination of wind instruments with strings is a special problem the mention of which brings us back to reconsider the central idea of chamber music as now realized by Haydn and Mozart.

Vocal music has here dropped below the horizon. The human voice inevitably thrusts all instruments into the background; and we are now at the stage where the forces engaged in chamber music must be on planes sufficiently near to combine in one mental focus. A slight divergence of plane will give the mind pleasures analogous to those of stereoscopic vision. For example, the greatest masters of chamber music with pianoforte take pleasure in supporting heavy but incomplete pianoforte chords by the low notes of the violoncello: a procedure puzzling to self-centred pianoforte virtuosos, and never risked by composers who have not attained a pure style. Again, the clarinet, in the wonderful quintets by Mozart (A major) and Brahms (B minor) does not and is not intended to blend with the strings, but it nowhere gives a more intense pleasure than where it behaves as an inner part exactly like the others. These works belong to the highest regions of the art.

Wind and Other Combinations.—The flute blends with nothing; even among other wind instruments it is like water-colour among oils. It accordingly plays a part in witty little works, such as Beethoven's serenade for flute, violin and viola (twice imitated by Reger), and Mozart's two quartets with strings. The oboe, once not much less important in continuo chamber music than the flute (Handel confessed to "writing like a devil for it" when he was a boy) requires other wind instruments to relieve the ear of its plaintive tone, though Mozart wrote a pretty little quartet for it with strings, and Beethoven achieved a remarkable *tour-de-force* in an early trio for two oboes and cor anglais. But the further consideration of wind instruments brings us again to the borderland regions of chamber music. What are the smallest forces that can make a coherent combination for chamber music; and at what point do the forces become too large to cohere?

The pianoforte, even when treated in Mozart's hard-pencil line-drawing style, provides a central mass of complete harmony that can absorb shocks and combine (*pace* the virtuoso player) with anything. The question begins to be interesting when we deal with the strings alone. Duets for two violins are obviously a *tour-de-force*, since their bass can never go below a contralto G. This *tour-de-force* is executed on a large scale with a mastery and euphony beyond praise by Spohr. Mozart, coming to the rescue of Michael Haydn, who was prevented by illness from completing a set of six commissioned by the archbishop of Salzburg, wrote two for violin and viola, which profit greatly by the extra lower fifth and which are written with great zest and a reckless disregard (justified by personal knowledge) of the chance that the archbishop might detect their difference from the dutiful efforts of brother Michael.

Trios for two violins and any kind of bass but the viola, are ominously suggestive of a return to, or non-emergence from, the continuo method; and indeed it may be doubted whether any Italian composer before Cherubini (*q.v.*) ever did quite emerge therefrom. Trios for violin, viola and violoncello are a very different matter. They represent the problem of the string quartet intensified into a *tour-de-force*. Mozart's great example, the divertimento in E flat, is in all its six movements on a scale and a plane of thought that its title vainly belies. It inspired Beethoven to one of his biggest early works, the Trio op. 3; and the success of this encouraged Beethoven to write the three string Trios op. 9, of which the first, in G major, and the third, in C minor, are bolder in conception and execution than even the largest of the six string quartets, op. 18, and not less sonorous than any string quartet written before or since.

The string quartet represents the normal apparatus for a chamber music work of homogeneous tone. String quintets are usually produced in Mozart's way by doubling the viola. Doubling the violoncello, as in Schubert's great C major quintet, produces a very rich tone and sets the first violoncello free to soar into the cantabile region without (as in other quintets and in quartets) depriving the ensemble of a deep bass. Sextets, for two violins, two violas and two violoncellos, are represented in the two great works of Brahms. Octets for strings show signs of clotting into an orchestral style. Spohr hit upon the device of dividing the eight into antiphonal quartets; and his four double quartets are much nearer to the true style of chamber music than his string quartets, where his lower parts have the simplicity of early Haydn while the first violin plays a concerto above them. Mendelssohn in the wonderful octet which he wrote at the age of 16, does not find Spohr's simple antiphonal scheme worth the trouble of specially grouping the players when he can use 255 different combinations of the eight without enquiring how they are seated.

As for the semi-orchestral borderland of septets and octets in which several wind instruments join and a double-bass adds depth without any normal capacity to rise into cantabile or solo work, this borderland (inhabited by Beethoven's septet, Schubert's octet and many glorious serenades and divertimenti of Mozart) has a fascinating aesthetic of its own. Wind instruments by themselves are happiest in pairs, as their tones contrast too sharply otherwise to blend at all, though Reicha, who composed regularly for two hours before breakfast every morning, ground out over 100 quintets for flute, oboe, clarinet, horn and bassoon, all admirably euphonious, if they are up to the sample passages quoted by him in his treatise on composition. It is unreasonable to blame Mozart's glorious serenade for 13 wind instruments for sounding like a military band; we ought rather to wish that a military band could sound like a Mozart serenade.

Modern Tendencies.—Nothing remains to be said about chamber music, classical or modern, apart from the general tendencies of the art. The exclusive prevalence of sonata form in the classics is a result of the fact that when several persons assemble to play together they prefer to make the most of their opportunity. Smaller works are liable to be overlooked; how otherwise can we account for the fact that most musicians do not realize the existence of three quiet minutes of the most delicate writing in Beethoven's third manner, the quintet-fugue op. 137? A spirited

capriccio and a pretty fugue by Mendelssohn have dropped out of sight for no other reason, while the andante and scherzo published with them and Schubert's allegro in C minor have roused interest as fragments of full-sized works.

In modern times the sonata form no longer obstructs the view of other possibilities. Mr. W. W. Cobbett's prize competitions stimulated English composers to the production of fantasies in terse continuous-movement forms. Less important are the numerous experiments in the use of the human voice without words in an otherwise instrumental scheme. Nature responds cattishly to the pitchfork. Saint-Saëns has a charming manner which puts the trumpet on its best behaviour in his amusing septet. The trombone and side-drums in the chamber music of Stravinsky will do well enough in a very smart house-party where all the conversation is carried on in an esoteric family slang and the guests are expected to enjoy booby-traps. Very different is the outlook of some of our younger masters such as Hindemith, Jarnach, and others whose renunciation of beauty is in itself a youthfully romantic gesture, and is accompanied by endless pains in securing adequate performance. The work of masterly performers can indeed alone save the new ideas from being swamped in a universal dullness which no external smartness can long distinguish from that commemorated in the Dunciad.

(D. F. T.)

CHAMBER ORCHESTRA, a small orchestra of some 20 or 30 players suited to the performance of works of the smaller and lighter order.

CHAMBERS, EPHRAIM (d. 1740), English encyclopaedist, was born at Kendal, Westmorland, and apprenticed to a globe-maker in London. The first edition of his *Universal Dictionary of Arts and Sciences* appeared by subscription in 1728, in two vols., fol., dedicated to the king. The *Encyclopédie* of Diderot and d'Alembert owed its inception to a French translation of Chambers's work. In addition to the *Cyclopaedia,* Chambers wrote for the *Literary Magazine* (1735–36), and translated the *History and Memoirs of the Royal Academy of Sciences at Paris* (1742), and the *Practice of Perspective* from the French of Jean Dubreuil. He died on May 15, 1740.

CHAMBERS, GEORGE (1803–1840), English marine painter, born at Whitby, Yorkshire, was the son of a seaman, and for several years he pursued his father's calling. He then took lessons from a drawing-master, and found a ready sale for small and cheap pictures of shipping. Coming to London, he was employed by Thomas Horner to assist in painting the great panorama of London for the Colosseum (the exhibition building in Regent's park, demolished *c.* 1860). His best works represent naval battles. Two of these—the "Bombardment of Algiers in 1816," and the "Capture of Porto Bello"—are in Greenwich hospital. He died on Oct. 28, 1840.

A *Life,* by John Watkins, was published in 1841.

CHAMBERS, ROBERT (1802–1871), Scottish author and publisher, was born at Peebles on July 10, 1802. A small circulating library in the town, and a copy of the *Encyclopædia Britannica* which his father had purchased, furnished the boy with stores of reading of which he eagerly availed himself. Long afterwards he wrote of his early years—"Books, not playthings, filled my hands in childhood. At 12 I was deep, not only in poetry and fiction, but in encyclopaedias." The family removed to Edinburgh in 1813, and in 1818 Robert began business at 16 as a bookstall-keeper in Leith Walk. In 1819 his elder brother William had begun a similar business, and the two eventually united as partners in the publishing firm of W. and R. Chambers. Robert Chambers was an enthusiast for the history and antiquities of Edinburgh, and his *Traditions of Edinburgh* (1824), secured for him the personal friendship of Sir Walter Scott. A *History of the Rebellions in Scotland from 1638 to 1745* (1828), and numerous other works followed.

At the beginning of 1832 William Chambers started a weekly publication under the title of *Chambers's Edinburgh Journal* (known since 1854 as *Chambers's Journal of Literature, Science and Arts*), which speedily attained a large circulation.

Among the numerous works of which Robert was in whole or in part the author, the *Biographical Dictionary of Eminent Scotsmen* (Glasgow, 1832–35), the *Cyclopaedia of English Literature* (1844), the *Life and Works of Robert Burns* (1851), *Ancient Sea Margins* (1848), the *Domestic Annals of Scotland* (1859–61) and the *Book of Days* (1862–64) were the most important. *Chambers's Encyclopaedia* (1859–68), with Dr. Andrew Findlater as editor, was carried out under the superintendence of the brothers (*see* ENCYCLOPAEDIA).

As a geologist, Robert Chambers published *Tracings of the North of Europe* (1851) and *Tracings in Iceland and the Faröe Islands* (1856). His knowledge of geology was one of the principal grounds on which the authorship of the *Vestiges of the Natural History of Creation* (1843–46) was eventually assigned to him. The *Book of Days,* a miscellany of popular antiquities, was his last publication. He died at St. Andrews on March 17, 1871.

His brother, WILLIAM CHAMBERS (1800–83), the financial genius of the publishing firm, was born at Peebles, on April 16, 1800. He laid the city of Edinburgh under the greatest obligations by his public spirit and munificence. As lord provost he procured the passing in 1867 of the Improvement Act, which led to the reconstruction of a great part of the Old Town, and at a later date he proposed and carried out, largely at his own expense, the restoration of the noble and then neglected church of St. Giles, making it in a sense "the Westminster Abbey of Scotland." This service was fitly acknowledged by the offer of a baronetcy, which he did not live to receive, dying on May 20, 1883, three days before the reopening of the church. He was the author of a history of St. Giles, of a memoir of himself and his brother (1872), and of many other useful publications. On his death in 1883 Robert Chambers (1832–88), son of Robert Chambers, succeeded as head of the firm, and edited the *Journal* until his death. His eldest son, Charles Edward Stuart Chambers (b. 1859), became editor of the *Journal* and chairman of W. & R. Chambers, Ltd.

See also *Memoir of Robert Chambers, with Autobiographic Reminiscences of William Chambers* (1872), the 13th ed. of which (1884) has a supplementary chapter; Alexander Ireland's preface to the 12th ed. (1884) of the *Vestiges of Creation;* the *Story of a Long and Busy Life* (1884), by William Chambers; and some discriminating appreciation in James Payn's *Some Literary Recollections* (1884), chapter v. The *Select Writings of Robert Chambers* were published in seven vols. in 1847, and a complete list of the works of the brothers is added to *A Catalogue of Some of the Rarer Books . . . in the Collection of C. E. S. Chambers* (Edinburgh, 1891).

CHAMBERS, SIR WILLIAM (1726–1796), British architect, was the grandson of a rich merchant who had financed the armies of Charles XII., but was paid in base money, and whose son remained in Sweden many years endeavouring to obtain redress. In 1728 the latter returned to England and settled at Ripon, where William, who was born in Stockholm, was educated. At the age of 16 he became supercargo to the Swedish East India Company, and, voyaging to Canton, made drawings of Chinese architecture, furniture and costume which served as basis for his *Designs for Chinese Buildings,* etc. (1757). Two years later he quitted the sea to study architecture seriously, and spent a long time in Italy, devoting special attention to the buildings of classical and Renaissance architects. He also studied under Clérisseau in Paris, with whom, and with the sculptor Wilton, he lived at Rome. In 1755 he returned to England where his first important commission was a villa for Lord Bessborough at Roehampton, but he made his reputation by the grounds he laid out and the buildings he designed at Kew, among them being the pagoda in the gardens, between 1757 and 1762 for Augusta, princess dowager of Wales. He published (1759) a *Treatise on Civil Architecture* and in 1772 a *Dissertation on Oriental Gardening,* which attempted to prove the inferiority of European to Chinese landscape gardening. As a furniture designer and internal decorator he is credited with the creation of that "Chinese Style" which was for a time furiously popular, although Thomas Chippendale (*q.v.*) had published designs in that manner at a somewhat earlier date. He became architect to the king and queen, comptroller of his majesty's works, and afterwards surveyor-general. In 1775 he was appointed architect of Somerset House, his greatest monument, at a salary of £2,000 a year. He

also designed town mansions for Earl Gower at Whitehall and Lord Melbourne in Piccadilly, built Charlemont House, Dublin, and Duddingston House, near Edinburgh. He designed the market house at Worcester, was employed by the earl of Pembroke at Wilton, by the duke of Marlborough at Blenheim, and by the duke of Bedford in Bloomsbury. Although his practice was mainly classic, he made Gothic additions to Milton Abbey in Dorset. Sir William numbered among his friends Dr. Johnson, Goldsmith, Sir Joshua Reynolds, David Garrick and Dr. Burney.

CHAMBERS, in law, the rooms of counsel or of judges or judicial officers who deal with questions of practice and other matters not of sufficient importance to be dealt with in court. It is doubtful at what period the practice of exercising jurisdiction "in chambers" commenced in England; there is no statutory sanction before 1821, though the custom can be traced back to the 17th century. An Act of 1821 provided for sittings in chambers in vacation, and an Act of 1822 empowered the sovereign to call upon the judges by warrant to sit in chambers on as many days in vacation as should seem fit, while the Law Terms Act, 1830, defined the jurisdiction to be exercised at chambers. The Judges' Chambers Act, 1867, was the first Act, however, to lay down proper regulations for chamber work, and the Judicature Act, 1873, preserved that jurisdiction and gave power to increase it as might be directed or authorized by rules of court to be thereafter made. (*See* PRACTICE AND PROCEDURE.)

CHAMBERSBURG, a borough of Franklin county, Pennsylvania, U.S.A., on an elevated site in the broad and fertile Cumberland valley, 52 mi. S.W. of Harrisburg; it is on federal highways 11 and 30, and is served by the Pennsylvania and the Western Maryland railways. The population in 1930 was 13,788; in 1940 it was 14,852. It is the county seat, and has large grain elevators and various factories.

Wilson college, a Presbyterian institution for women, chartered in 1869, is there. Chambersburg was founded in 1730 by Benjamin Chambers. He built a stone fort after Gen. Braddock's defeat (1755) and surrounded it with a stockade as a defence against the Indians. At Chambersburg Gen. Lee massed his troops for his attack on Gettysburg. On July 30, 1864, a large part of the borough was burned by Confederates. The birthplace of President Buchanan is near by, and 10 mi. E. is Caledonia park, a state forest preserve of 260 acres.

CHAMBERS OF COMMERCE: *see* TRADE ORGANIZATION.

CHAMBER SYMPHONY, a musical composition written for a small orchestra exceeding in numbers the largest of the ordinary chamber music combinations (octet or nonet) but not approaching those of a full orchestra, and confined usually to a single instrument in each class. Such a work is Franz Schreker's Kammersymphonie for 23 solo instruments; another has been written by Schönberg.

CHAMBÉRY, a city of France, capital of the department of Savoie, pleasantly situated on the Leisse, in a fertile valley among the Alps, 79 mi. by rail S.S.W. of Geneva. Pop. (1936) 26,647. It was formerly capital of the duchy of Savoy, and remains, with its quiet narrow streets and its girdle of boulevards, a typical old provincial capital of France. The neighbouring country is dotted with summer resorts, and the town is a favourite centre for excursions. Chambéry grew up around a castle of the counts of Savoy, who resided there in the 13th, 14th and 15th centuries. A Roman station (Lemincum) in the vicinity has given its name to the rock of Lémenc, which overlooks the town on the north. Between 1536 and 1713 Chambéry was several times occupied by the French; in 1742 it was captured by a Franco-Spanish army; and in 1792 it was occupied by the Republican forces, and became the capital of the department of Mont Blanc. Restored to the house of Savoy by the treaties of Vienna and Paris, it was again surrendered to France in 1860.

The principal buildings are the cathedral, dating from the 14th and 15th centuries; the Hôtel-Dieu, founded in 1647, and the castle, a modern building serving as the prefecture, with only a great square tower belonging to the original structure; Chambéry is the seat of an archbishop (raised from a bishopric in 1817) and of a superior tribunal. It has long been famous as a regional culture-centre, and possesses an academy (1819) and several learned societies. Local benefactions have profited greatly from the fortune of General Boigne (1751–1830), amassed in India. Among the manufactures are silk-gauze, lace, leather and hats; there are also aluminium-works.

CHAMBORD, HENRI CHARLES FERDINAND MARIE DIEUDONNÉ, COMTE DE (1820–1883), the "King Henry V." of the French legitimists, was born in Paris on Sept. 29, 1820, son of the duc de Berry, the elder son of the comte d'Artois (afterwards Charles X.), and princess Caroline Ferdinande Louise of Naples. Born seven months after the assassination of his father, he was hailed as the "enfant du miracle," and was made the subject of one of Lamartine's most famous poems. He was created duc de Bordeaux, and in 1821, as the result of a subscription organized by the Government, received the château of Chambord. His education was inspired by detestation of the French Revolution and its principles. After the revolution of July, Charles X. vainly endeavoured to save the Bourbon cause by abdicating in his favour and proclaiming him king under the title of Henry V. (Aug. 2, 1830). The comte de Chambord accompanied his grandfather into exile, and resided successively at Holyrood, Prague and Görz. The death of his grandfather, Charles X., in 1836, and of his uncle, the duc d'Angoulême, in 1844, left him the last male representative of the elder branch of the Bourbon family; and his marriage with the archduchess Maria Theresa, eldest daughter of the duke of Modena (Nov. 7, 1846), remained without issue. The title to the throne thus passed to the comte de Paris, as representative of the Orleans branch of the house of Bourbon, and the history of the comte de Chambord's life is largely an account of the efforts made to unite the Royalist party by effecting a reconciliation between the two princes.

Though he continued to hold an informal court, both on his travels and at his castle of Frohsdorf, near Vienna, yet he allowed the revolution of 1848 and the *coup d'état* of 1851 to pass without any decisive assertion of his claims. It was the Italian war of 1859, with its menace to the pope's independence, that roused him at last to activity, thus making common cause with the Church. The Royalists now began an active campaign against the Empire. On Dec. 9, 1866, Chambord addressed a manifesto to Gen. Saint-Priest, in which he declared the cause of the pope to be that of society and liberty, and held out promises of retrenchment, civil and religious liberty "and above all honesty." Again, on Sept. 4, 1870, after the fall of the Empire, he invited Frenchmen to accept a Government "whose basis was right and whose principle was honesty," and promised to drive the enemy from French soil. Fortune favoured him. The elections placed the Republican party in a minority in the National Assembly; the abrogation of the law of exile against the royal family permitted him to return to his castle of Chambord; and it was thence that on July 5, 1871, he issued a proclamation, in which for the first time he publicly posed as king, and declared that he would never abandon the white standard of the Bourbons, "the flag of Henry IV., Francis I., and Joan of Arc," for the tricolour of the Revolution. He again quitted France, and answered the attempts to make him renounce his claims in favour of the comte de Paris by the declaration (Jan. 25, 1872) that he would never abdicate. A constitutional programme, signed by some 280 members of the National Assembly was presented for his acceptance, but without result. The fall of Thiers in May 1873, however, offered an opportunity to the Royalists by which they hastened to profit. The comte de Paris and the prince de Joinville journeyed to Frohsdorf, and were formally reconciled with the head of the family (Aug. 5). The Royalists were united, the premier (the duc de Broglie) an open adherent, the president (MacMahon) a benevolent neutral. MM. Lucien Brun and Chesnelong were sent to interview the comte de Chambord at Salzburg, and obtain the definite assurances that alone were wanting. They returned with the news that he accepted the principles of the French Revolution and the tricolour flag. But a letter to Chesnelong, dated Salzburg, Oct. 27, declared that he had been misunderstood: he

would give no guarantees; he would not inaugurate his reign by an act of weakness, nor become "le roi légitime de la Révolution." "Je suis le pilote nécessaire," he added, "le seul capable de conduire le navire au port, parce que j'ai mission et autorité pour cela." A last effort was made in the national assembly in June 1874 by the duc de la Rochefoucauld-Bisaccia, who formally moved the restoration of the monarchy. The comte de Chambord on July 2 issued a fresh manifesto, which added nothing to his former declarations. The motion was rejected by 272 to 79, and on Feb. 25, 1875, the assembly definitely adopted the republic as the national form of government. The count died at Frohsdorf on Aug. 24, 1883.

See *Manifestes et programmes politiques de M. le comte de Chambord, 1848–73* (1873), and *Correspondance de la famille royale et principalement de Mgr. le comte de Chambord avec le comte de Bouillé* (1884). Of the literature relating to him, mention may be made of *Henri V. et la monarchie traditionnelle* (1871); *Le Comte de Chambord étudié dans ses voyages et sa correspondance* (1880); H. de Pène, *Henri de France* (1885).

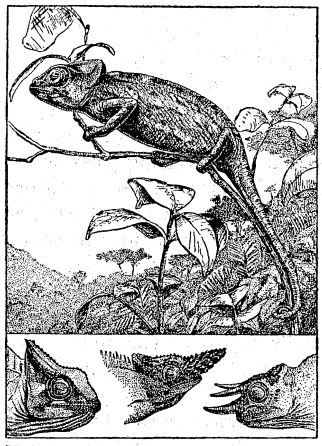
CHAMBORD, a village of central France, in the department of Loir-et-Cher, on the left bank of the Cosson, 10 mi. E. by N. of Blois. Pop. (1936) 165. The village stands in the park of Chambord, which is enclosed by a wall 22 mi. in circumference. The celebrated château (*see* ARCHITECTURE) forms a parallelogram flanked at the angles by round towers and enclosing a square block of buildings, the façade of which forms the centre of the main front. There is a chapel of the 16th century and a famous double staircase. The château was originally a hunting-lodge of the counts of Blois, the rebuilding of which was begun by Francis I in 1526, and completed under Henry II. It was the residence of several succeeding monarchs, and under Louis XIV considerable alterations were made. In the same reign Molière's *Monsieur de Pourceaugnac* and *Le Bourgeois gentilhomme* were performed here for the first time. Stanislas of Poland lived at Chambord, which was bestowed by his son-in-law, Louis XV, upon Marshal Saxe. It was given by Napoleon to Marshal Berthier, from whose widow it was purchased by subscription in 1821, and presented to the duc de Bordeaux, who assumed the title of comte de Chambord. On his death it came by bequest to the family of Parma. The estate was sequestrated in 1914.

CHAMBRE ARDENTE, the term for an extraordinary court of justice in France, mainly held for the trials of heretics (Fr. "burning chamber"). These courts were originated by the Cardinal of Lorraine, the first of them meeting in 1535 under Francis I. The *Chambre Ardente* co-operated with an inquisitorial tribunal also established by Francis I, the duty of which was to discover cases of heresy and hand them over for final judgment to the *Chambre Ardente*. The court was abolished in 1682.

See N. Weiss, *La Chambre Ardente* (Paris, 1889).

CHAMELEON, the common name of members of one of the most remarkable of the families of lizards, Chameleontidae. Because of the similar ability to change colour, the same name is misapplied to American lizards of the genus *Anolis* (Iguanidae). The great majority of chameleons are referable to the genus *Chamaeleo* (containing about 70 species), the remaining genera, *Rhampholeon, Leandria* and *Brookesia,* containing only a few dwarfed forms. The group is found in Africa and Madagascar, Arabia, southern India and Ceylon. The grasping feet are formed by the fusion of the digits into two opposable bundles, the two outer digits being opposed to the three inner on the forelimb and vice versa on the hindlimb, and, like the prehensile tail, are correlated with climbing habits. The eyes are large and independently movable, but the eyelids are fused into one circular fold which leaves only the pupil visible; the eyes can also, unlike those of other reptiles, be focussed upon one spot, giving the binocular vision necessary for the nice appreciation of distances required in the use of the tongue. This organ is very large, club-shaped and provided with a sticky secretion at its tip; the basal portion is narrow and composed of very elastic fibres, which, when the tongue is not in use, are telescoped over the elongated copular piece of the hyoid, which acts as a support. By means of its muscular mechanism the tongue can be shot out to a remarkable distance, somewhat exceeding the length of the body; the elasticity of the basal fibres assists in its rapid withdrawal. It is by means of this extraordinary mechanism that the chameleon secures its prey; flies and other insects are deliberately stalked until within range, then out shoots the tongue and the victim is withdrawn adhering to its sticky tip.

The ability of chameleons to change colour is proverbial, but their powers are usually exaggerated and are quite equalled by those of some other lizards. Change of colour is partly reflex in response to emotional stimuli and partly controlled through the eye; changes in the intensity of light, change of temperature and emotion produce marked and characteristic changes, but there is little direct response to the colour of the environment. The normal colour of the common chameleon may be gray-green with innumerable small dark specks and with rows of pale-brown patches on the sides of the body; in the dark at normal temperatures the colour fades to a cream-colour with irregular yellow spots, but exposure to hot sunlight causes the whole animal to darken until it may be uniformly dull black. High temperatures without direct sunlight usually produce greens and low temperatures dull grays; excitement and fright bring paler shades with brown patches and yellow spots, while anger causes the lighter areas to darken.



THE TRUE CHAMELEONS. ABOVE: THE COMMON CHAMELEON OF THE MEDITERRANEAN REGION. BELOW: THREE DIVERSE TYPES OF AFRICAN CHAMELEONS

Propagation is in most cases by means of eggs; these are small, oval, white in colour and provided with a tough parchmentlike shell. They are buried by the mother and left to be incubated by the heat of the sun. A few species, *e.g.,* the dwarf chameleon of South Africa (*C. pumilus*), retain the eggs within the body until they hatch, so that the young are born alive.

An extraordinary feature of the group is a tendency toward the production of excrescences on the head. Many species have the occiput produced backwards into a pointed casque and this may assume extraordinary dimensions; but the most remarkable developments are the horns of some of the tropical African and Malagasy species. In different forms there may be one, two, three or four horns or a single, flexible, dermal flap on the tip of the snout; in some species these appendages occur only on the male but in others they are present on both sexes.

(D. M. S. W.; X.)

CHAMFER, CHAMPFER or **CHAUMFER,** an architectural term for the cutting off of the edges of the corners of a beam, post or other similar form, and also the slanting surface so produced. Chamfers are frequently hollowed or moulded. When the chamfer does not run the full length of the member that it decorates, the shoulder, diagonal cut or moulding against which it stops is known as a stop chamfer.

CHAMFORT, SEBASTIEN ROCH NICOLAS (1741–1794), French wit and man of letters, was born at a little village near Clermont in Auvergne, the son of a grocer named Nicolas. Educated as a free scholar at the Collège des Grassins, he lived from hand to mouth in Paris mainly on the hospitality of people who were only too glad to give him board and lodging in exchange for the pleasure of the conversation for which he was famous. Thus Mme. Helvétius entertained him at Sèvres for some years. He had a great success with his comedies *La Jeune Indienne* (1764) and *Le Marchand de Smyrne* (1770). In 1775, while taking the waters at Barèges, he met the duchesse de Grammont, sister of Choiseul, through whose influence he was introduced at court. In 1776 his poor tragedy *Mustapha et Zeangir* was played at Fontainebleau before Louis XVI and Marie Antoinette; the king gave him a further pension of 1,200 livres, and the prince de Condé made him his secretary. But he was a Bohemian naturally

and by habit, and the restraints of the court irked him. In 1781 he was elected to the Academy; in 1784, through the influence of Calonne, he became secretary to the king's sister, Mme. Elizabeth, and in 1786 he received a pension of 2,000 livres from the royal treasury. He was thus once more attached to the court, and made himself friends in spite of the reach and tendency of his unalterable irony; but he quitted it for ever after an unfortunate and mysterious love affair, and was received into the house of M. de Vaudreuil. Here in 1783 he had met Mirabeau, with whom he remained to the last on terms of intimate friendship.

The outbreak of the Revolution made a profound change in Chamfort's life. Theoretically he had long been a republican, and he now devoted all his small fortune to the revolutionary propaganda. Until Aug. 31, 1791, he was secretary of the Jacobin club; he entered the Bastille among the first of the storming party. He worked for the *Mercure de France,* collaborated with Ginguené in the *Feuille villageoise,* and drew up for Talleyrand his *Adresse au peuple français.*

With the reign of Marat and Robespierre, however, his uncompromising Jacobinism grew critical, and with the fall of the Girondins his political life came to an end. But he could not restrain the tongue that had made him famous; he no more spared the Convention than he had spared the court. He was imprisoned for a short time, and released; but he had determined to prefer death to a repetition of confinement, and when he was again threatened with arrest he attempted suicide with pistol and with poniard, dictating to those who came to arrest him the well-known declaration: *"Moi, Sebastien-Roch-Nicolas Chamfort, déclare avoir voulu mourir en homme libre plutôt que d'être reconduit en esclave dans une maison d'arrêt,"* which he signed in a firm hand and in his own blood. He lingered on until April 13, 1794 in charge of a gendarme. To the Abbé Sieyès Chamfort had given fortune in the title of a pamphlet (*"Qu'est-ce que le Tiers-État? Tout. Qu'a-t-il? Rien"*), and to Sieyès did Chamfort retail his supreme sarcasm, the famous *"Je m'en vais enfin de ce monde où il faut que le coeur se brise ou se bronze."* The maker of constitutions followed the dead wit to the grave.

The writings of Chamfort, which include comedies, political articles, literary criticisms, portraits, letters and verses, are colourless and uninteresting. His genius was in conversation. His *Maximes et Pensées* are, after those of La Rochefoucauld, the most brilliant and suggestive sayings of the 18th century. The aphorisms of Chamfort, less systematic and psychologically less important than those of La Rochefoucauld, are as significant in their violence and iconoclastic spirit of the period of storm and preparation that gave them birth as the *Réflexions* in their exquisite restraint and elaborate subtlety are characteristic of the tranquil elegance of their epoch; and they have the advantage in richness of colour, in picturesqueness of phrase, in passion, in audacity. Sainte-Beuve compares them to "well-minted coins that retain their value," and to keen arrows that *arrivent brusquement et sifflent encore.*

The *Oeuvres complètes de Nicolas Chamfort* appeared at Paris, 5 vols. (1824–25), selections one vol. (1852), with a biographical and critical preface by Arsène Houssaye and *Oeuvres choisies,* with a preface and notes by M. de Lescure (1879). *See* also Sainte-Beuve, *Causeries du Lundi;* M. Pellisson, *Chamfort, étude sur sa vie* (1895).

CHAMFRON or **CHANFRIN.** A horse's forehead, more particularly the piece of armour which covered the front of a barded horse.

CHAMIER, FREDERICK (1796–1870), English novelist, was the son of an Anglo-Indian official, and served in the navy from 1809 to 1856. Captain Chamier wrote several popular sea-stories, including *The Life of a Sailor* (1832), *Ben Brace* (1836), *The Arethusa* (1837), *Jack Adams* (1838), *Tom Bowling* (1841), and *Jack Malcolm's Log* (1846). He also edited and brought down to 1827 James's *Naval History* (1837).

CHAMILLART, MICHEL (1652–1721), French statesman, minister of Louis XIV. In 1690 he was made intendant of finances, and on Sept. 5, 1699, the king appointed him controller-general of finances, and on Jan. 7, 1700, minister of war. From the first Chamillart's position was a difficult one. The deficit amounted to more than 53 million livres, and the credit of the state was almost exhausted. In Oct. 1706 he showed the king that the debts immediately due amounted to 288 millions, and that the deficit already foreseen for 1707 was 160 millions. In Oct. 1707 he saw with consternation that the revenue for 1708 was already entirely eaten up by anticipation, so that neither money nor credit remained for 1708. In these conditions Chamillart resigned his office of controller-general. Public opinion attributed to him the ruin of the country, though he had tried in 1700 to improve the condition of commerce by the creation of a council of commerce. As secretary of state for war he had to place in the field the army for the War of the Spanish Succession, and to reorganize it three times, after the great defeats of 1704, 1706 and 1708. With an empty treasury he succeeded only in part, and he frankly warned the king that the enemy would soon be able to dictate the terms of peace. He resigned office in 1709, and died on April 14, 1721.

See G. Esnault, *Michel Chamillart, contrôleur général et secrétaire d'état de la guerre, correspondance et papiers inédits* (1885); A. de Boislisle *Correspondance des contrôleurs généraux* (vol. ii., 1883); M. Langlois, *Louis XIV. et la cour. D'après trois témoins nouveaux: Bélise Beauvillier, Chamillart.* (1926).

CHAMINADE, CÉCILE (1861–1944), French composer, was born in Paris on Aug. 8, 1861. She studied in Paris, her musical talent being shown at the age of eight by the writing of some church music which attracted Bizet's attention; and at eighteen she came out in public as a pianist. Her own compositions, both songs (in large numbers) and instrumental pieces, are melodious and effective and have enjoyed great popularity.

CHAMISE (*Adenostoma fasciculatum*). A North American shrub of the rose family (Rosaceae), called also chamiso, found in the chaparral belt on foothills and mountain slopes in California, ranging up to 5,000 ft. altitude. It grows from 2 ft. to 10 ft. high, with shreddy brown bark; slender twiggy branches; resinous, narrow leaves in bundles or fascicles, and small white flowers in panicled clusters. Chamise is the most abundant and characteristic small shrub of the higher foothills west of the Sierra Nevada, where, between the lower foothills and the yellow pine belt, it often forms a distinct zone called chamisal. (*See* CHAPARRAL.)

CHAMISSO, ADELBERT VON (LOUIS CHARLES ADELAIDE DE) (1781–1838), German poet and botanist, was born at the château of Boncourt in Champagne, the ancestral seat of his family. Driven from France by the revolution, his parents settled in Berlin, where in 1796 young Chamisso obtained the post of page-in-waiting to the queen, and in 1798 entered a Prussian infantry regiment as ensign. In close collaboration with Varnhagen von Ense, he founded in 1803 the *Berliner Musenalmanach,* in which his first verses appeared. Although the enterprise was a failure, it brought him to the notice of literary celebrities. He left the army in 1808, and in 1810 joined the charmed circle of Mme. de Staël, following her in her exile to Coppet in Switzerland. In 1813 he wrote the prose narrative *Peter Schlemihl,* the man who sold his shadow. The most famous of all his works, it has been translated into most European languages (English by W. Howitt). In 1815 Chamisso was appointed botanist to the Russian ship "Rurik," which Otto von Kotzebue commanded on a scientific voyage round the world. He published his diary (*Tagebuch*) of this expedition in 1821. In 1818 he became custodian of the botanical gardens in Berlin. From 1829 he brought out the *Deutsche Musenalmanach,* in which his later poems were mainly published. He died on Aug. 21, 1838.

As a scientist Chamisso wrote *Bemerkungen und Ansichten,* and *Übersicht der nutzbarsten und schädlichsten Gewächse in Norddeutschland* (1829). His *Frauenliebe und -leben* (1830), a cycle of lyrical poems, which was set to music by Schumann, were particularly famous. Noteworthy are also *Schloss Boncourt* and *Salas y Gomez.* In the lyrical expression of the domestic emotions he displays a fine felicity, and he knew how to treat with true feeling a tale of love or vengeance. *Die Löwenbraut* may be taken as a sample of his weird and powerful simplicity; and *Vergeltung* is remarkable for a pitiless precision of treatment.

The first collected edition of Chamisso's works was edited by J. E. Hitzig (6 vols., 1836; 6th ed., 1874); there are also excellent editions

by M. Koch (1883) and O. F. Walzel (1892). On Chamisso's life *see* J. E. Hitzig, "Leben und Briefe von Adelbert von Chamisso" (in the *Gesammelte Werke*); K. Fulda, *Chamisso und seine Zeit* (1881); G. Hofmeister, *Adelbert von Chamisso* (1884); and E. du Bois-Reymond, *Adelbert von Chamisso als Naturforscher* (1889).

CHAMKANNI, a small tribe of Ghoria Khel Pathans in Kurram, Afghanistan.

CHAMOIS, the Franco-Swiss name of a hollow-horned ruminant known in German as *Gemse* or *Gemsbok;* scientifically, *Rupicapra rupicapra.* It is the only species in the genus, though every European range possesses a local race. It is the type of the tribe *Rupicaprini* which includes several goatlike genera (*see* ANTELOPE; BOVIDAE). About the size of a roebuck, with a short tail, it is distinguished by the vertical, backwardly-directed horns in both sexes, though these are larger in the male. Though differing in the shade of their hair, all the various races have black and white face markings and a black tail and dorsal stripe. The alpine race is chestnut brown in summer, lighter and grayer in winter. A thick under-fur is developed in the cold weather. Chamois live in small herds, but the old males only join these during the rutting season (October), when they engage in fierce contests with each other. The period of gestation is 20 weeks, and the usual number of offspring is one. In summer, the animals ascend to the snow-line, being only exceeded in the loftiness of their haunts by the ibex. In winter they descend to wooded regions. Chamois-hunting is a favourite sport of the Swiss and Tirolese, and of amateurs from all countries. As a result of this, the chamois has become rare in many of its old haunts, but it is now preserved in the Swiss National Park in the Engadine. Exceedingly wary and astonishingly agile, the animal is very difficult of approach. It feeds in summer on mountain herbs and flowers, in winter on the young shoots of the pine. The skin is very soft and is made into the original "shammy" leather, though this is now also made from the skins of other animals. The flesh is prized as venison. During the present century the chamois has been successfully introduced from Austria into New Zealand.



BY COURTESY OF E. L. SANBORN AND THE NEW YORK ZOOLOGICAL SOCIETY

CHAMOIS, A GOAT ANTELOPE

CHAMOMILE or **CAMOMILE FLOWERS,** the *flores anthemidis* of the British Pharmacopoeia, the flower-heads of *Anthemis nobilis* (family Compositae), a herb indigenous to western Europe. It is cultivated for medicinal purposes in Surrey, at several places in Saxony, and in France and Belgium—that grown in England being much more valuable than any of the foreign chamomiles. In the wild plant the florets of the ray are ligulate and white, and contain pistils only, those of the disk being tubular and yellow; but under cultivation the whole of the florets tend to become ligulate and white, in which state the flower-heads are said to be double. The flower-heads have a warm aromatic odour, which is characteristic of the entire plant, and a very bitter taste. In addition to a bitter extractive principle, they yield a volatile liquid, which on its first extraction is of a pale blue colour, but becomes a yellowish brown on exposure to light. It has the characteristic odour of the flowers, and consists of a mixture of butyl and amyl angelates and valerates. Chamomile is used in medicine in the form of its volatile oil.

Wild chamomile is *Matricaria Chamomilla,* a weed common in waste and cultivated ground especially in the southern counties of England. It has somewhat the appearance of true chamomile, but a fainter scent.

CHAMONIX-MONT-BLANC, a well-known Alpine tourist resort, in the department of Haute-Savoie, south-east France. Pop. (1936) 1,858. The valley of Chamonix runs from north-east to south-west, and is watered by the Arve, which rises in the Mer de Glace. On the south-east towers the snowclad chain of Mont Blanc, and on the north-west the rugged chain of the Brévent and of the Aiguilles Rouges. Chamonix (3,416 ft.) is the best starting-point for the exploration of the glaciers of the Mont Blanc chain, as well as for the ascent of Mont Blanc itself. It is connected with Geneva by a railway (55 miles).

The valley is first heard of about 1091, when it was granted by the count of the Genevois to the great Benedictine house of St. Michel de la Cluse, near Turin, which, by the early 13th century, had established a priory there. In 1786 the inhabitants bought their freedom from the canons of Sallanches, to whom the priory had been transferred in 1519. In 1530 the count of the Genevois granted the privilege of holding two fairs a year. The tourist industry dates from the 18th century, but its development is modern. The first party to publish (1744) an account of their visit was that of Dr. R. Pococke, W. Windham and other Englishmen who visited the Mer de Glace in 1741.

CHAMPAGNE, an ancient province of France, bounded north by Liége and Luxemburg; east by Lorraine; south by Burgundy; and west by Picardy and Isle de France. It now forms the departments of Ardennes, Marne, Aube and Haute Marne, with part of Aisne, Seine-et-Marne, Yonne and Meuse. Its name is derived from the immense plains near Reims, Châlons and Troyes. The province was constituted by joining to the countship of Champagne the ecclesiastical duchies of Reims and Langres and the ecclesiastical countship of Châlons. From 1152 to 1234 the countship of Champagne reckoned among its dependencies the countship of Blois and Chartres, of which Touraine was a fief, the countship of Sancerre and various scattered fiefs in the Bourbonnais and in Burgundy. The countships of Troyes and Meaux were also absorbed into this amalgamation of territories which became known as the "countship of Champagne and Brie." (*See* TROYES.)

About 1020, Odo I. (Odo II., count of Blois, *q.v.*) became count of Champagne. In 1037 he was succeeded by his younger son, Stephen II. About 1050, Odo II., son of Stephen II., became count and was followed about 1063 by Theobald I., count of Blois and Meaux, eldest son of Odo I. In 1077 he seized the countships of Vitry and Bar-sur-Aube, left vacant by Simon of Valois, who had retired to a monastery. In 1089 Odo III., second son of Theobald II., became count, and was succeeded about 1093 by his younger brother, Hugh, who became a templar in 1125, and gave up the countship to his suzerain, the count of Blois. In 1125 the countship of Champagne passed to Theobald II. the Great, already count of Blois and Meaux, and one of the most powerful French barons of his time. After him the countship of Blois became the appanage of a younger branch of his house. In 1152 Henry the Liberal, eldest son of Theobald II., became count of Champagne; he married Mary, daughter of Louis VII. of France, and went to the crusade in 1178. He was taken prisoner by the Turks, recovered his liberty through the good offices of the emperor of the East, and died a few days after his return to Champagne. In 1181 his eldest son, Henry II., succeeded him under the tutelage of Mary of France. In 1190, he went to the Holy Land and became king of Jerusalem in 1192 through his marriage with Isabelle, widow of the marquis of Montferrat. He died in 1197 in his town of Acre. In 1197 Theobald III., younger son of Henry I., became count, and was succeeded in 1201 by Theobald IV., "le Chansonnier," the son of Theobald III. and Blanche of Navarre. His reign was singularly eventful. In 1226 he followed King Louis VII. to the siege of Avignon, and after the death of that monarch played a prominent part during the reign of St. Louis. He became king of Navarre in 1234 by the death of his maternal uncle, Sancho VII., but as a result of the onerous treaty which he concluded in that year with the queen of Cyprus he was compelled to cede to the king, in return for a large sum of money, the overlordship of the countships of Blois, Chartres and Sancerre, and the viscounty of Châteaudun. In 1239–40 he took part in an expedition to the Holy Land, and died on July 14, 1254 at Pampeluna. The witty and courtly songs he composed place him in the front rank of the poets of that class, in which he showed somewhat more originality than his rivals. In 1254 Theobald V., his eldest son and, like him, king of Navarre, became count of Champagne. He married Isabelle of France, daughter of St. Louis, and followed his father-in-

law to Tunis to the crusade, dying on his return. In 1270 he was succeeded by Henry III. the Fat, king of Navarre. Henry was succeeded in 1274 by his only daughter, Joan of Navarre, who married in 1284 the heir-presumptive to the throne of France, Philip the Fair. She became queen of France in 1285, and died on April 4, 1305, when her eldest son by King Philip, Louis Hutin, became count of Champagne, which was attached to the French crown on his accession as king in 1314.

The celebrated fairs of Champagne, which flourished in the 12th and 13th centuries, were attended by merchants from all parts of civilized Europe. They were six in number; two at Troyes, two at Provins, one at Lagny-sur-Marne and one at Bar-sur-Aube. They formed a kind of continuous market, divided into six periods, and passed in turn from Lagny to Bar, from Bar to Provins, from Provins to Troyes, from Troyes to Provins and from Provins to Troyes, to complete the year. It was, in fact, a perpetual fair, which had at once unity and variety, offering to the different parts of the countship the means of selling successively the special productions of their soil or their industry, and of procuring in exchange riches and comforts. These fairs had special legislation; and special magistrates, called "masters of the fairs," had control of the police. For the wine *see* CHAMPAGNE WINES.

BIBLIOGRAPHY.—H. d'Arbois de Jubainville, *Histoire des ducs et des comtes de Champagne* (1859–66); A. Longnon, *Documents relatifs au comté de Champagne et de Brie*, vol. i. with map (1901 *seq.*); F. Bourquelot, *Études sur les foires de Champagne* (1865). (A. Lo.)

CHAMPAGNE, BATTLES IN. This was the name commonly if vaguely given to a number of long drawn-out offensives on the western front in World War I. Among the principal ones the first was the French attack east of Reims on Sept. 25, 1915, an outline of which will be found in the article on WORLD WAR I. The simultaneous British offensive at Loos (*q.v.*), north of Lens, was intended to be subsidiary to this, as was also a lesser French offensive south of Lens. Still more important in scale and design was the French offensive west of Reims in April 1917, frequently called the Nivelle offensive. The failure of this ambitious plan for a swift and decisive break-through culminated in mutinies which seriously endangered the fighting efficiency of the French army; only after some months was its morale restored by the sympathetic and prudent leadership of Gen. Pétain.

The Autumn Offensive, 1915.—During the summer of 1915 local attacks had been carried out in the Vosges and Argonne, while preparations were being made for operations on a large scale in Champagne and for a powerful diversion in Artois. The objective in Champagne was the rupture of the German front from Bazancourt to Challerange, so as to outflank their positions to the north of Reims and in the Argonne. It was hoped thus to roll up the eastern part of the German front. Under the direction of Gen. de Castelnau the attack was made by the II. Army (Pétain) with the right of the IV. Army (de Langle de Cary) and the left of the III. Army (Humbert), a total of 35 divisions, or at least 420 battalions, against the German III. Army (Einem), which had at first only 70 battalions, later reinforced to 192. However, the secret of the future offensive was so badly kept that as early as Aug. 15 a German order had foreseen it. The artillery preparation began on Sept. 22, and at 9:15 A.M. on Sept. 25 the assault was launched and penetrated along almost the whole front to a depth of from 2,000 to 4,000yd. reaching even the second position in one sector. But the German command, foreshadowing the method of elastic defence which became famous in 1918, had withdrawn the guns and allowed the lightly held first position to act as a shock-absorber. Progress then became slow and costly.

On Sept. 28 and 29 a part of the second position was carried to the west of Le Mesnil and Navarin farm and a break through was made in a narrow section, but the Germans quickly closed the gap. The French cavalry corps had to retire on the 28th to the rear lines without having been engaged. On the 30th a general order announced the end of the operations with the capture of 25,000 prisoners and 150 guns. Nevertheless, abortive attacks continued until Oct. 8. The Champagne offensive cost the French 80,000 killed and missing and 100,000 sick and wounded. The results were not in due proportion to this sacrifice, mainly because the attacks had lacked the characteristics of surprise, rapidity and continuity, and had been continued too long.

French Offensive on the Aisne, 1917.—The strategical and political controversies which preceded the opening of the allies' offensive campaign of 1917 are dealt with in the article on WORLD WAR I. On the Aisne, the French offensive was to extend from Vailly to Reims. Gen. Pétain, consulted by Nivelle on the proposed action, criticized it freely and refused the leadership, which was entrusted to Gen. Michelet. The V. Army (Masel), which had held this front since 1914, closed on its right to make room for the VI. Army (Mangin), while the X. Army (Duchêne) was in reserve. Nivelle had decided on a rapid attack which aimed at carrying the positions and all the artillery zone at the first assault. This resembled the method twice employed at Verdun. No one raised any serious objection, but Nivelle foretold an immediate exploitation of the success by the X. Army, which should carry it as far to the north as possible. Michelet estimated that the whole operation might be accomplished the first day, or at latest on the morning of the second. He indicated as objectives the foot of the heights to the north of the Ailette, the plain of Laon, and the east of Brimont fort. The only objection was raised by Mangin, who called attention particularly to the importance of good atmospheric conditions. This did not modify Nivelle's wishes, and Michelet exaggerated them by giving such detailed orders that no initiative was left to the army commanders.

The preparation for the offensive was in full swing when the German retreat to the Hindenburg line began. Nivelle's plan had to be modified, the Oise-Somme attack lost all interest and that upon the Aisne alone remained. Mangin called attention to the fact that the retirement had left a right-angled salient about the Laffaux mill and that an attack to the north would be able to take the Chemin des Dames in reverse. The commander-in-chief admitted this and two divisions were devoted to this local operation. In addition it was decided that the IV. Army (Anthoine) should attack the Massif de Moronvilliers, east of Reims. On top of this a political incident led to the retirement of Gen. Lyautey, Minister of War. He was replaced by M. Painlevé, who was hostile to Nivelle's plans. This weakened the confidence of the commander-in-chief's subordinates, and Nivelle went so far as to offer his resignation, which was refused.

The British share of the offensive began on April 9 before Arras. The operations on the Aisne should have begun on April 12, but were put off, first to the 14th, then to the 16th on account of the bad weather. The front of attack measured 25 miles. The VI. Army (Mangin) operated on nearly 10m. with 17 divisions plus a cavalry division and a territorial division, 1,669 guns, of which 823 were heavy or large; the V. Army (Masel) had a nearly similar strength but with 1,967 guns (1,107 heavy or large). The artillery preparation commenced on April 5 and continued until the 15th on account of the postponement of the attack. It sufficed, but its duration permitted the Germans to make suitable dispositions and there was no surprise. On the morning of April 16 the Allies carried the first German line on the whole front. The right and centre of the V. Army gained a depth of $1\frac{1}{2}$ to 2m., but on the left a tank attack, badly conducted, failed with heavy losses and the infantry rapidly came to a standstill on the plateau of Craonne. The right of the VI. Army took the position of Hurtebise and pushed as far as the Ailette, but further east the fighting was desperate and the gain insignificant. In the centre progress was more satisfactory, though difficult. On the left, the commencement was good, but the advance quickly became wild, and at certain points it was practically negligible.

To sum up, although some good results had been obtained the hoped for success had not been won. Badly informed, Nivelle imagined that on the 17th he ought to stop the northern advance of the VI. Army and push the V. Army towards the north-east. This order became delayed, so on the 17th Mangin continued his attacks, notably in the centre, where he made a marked advance on the front Braye en Laonnois-Ostel. The situation having changed Mangin ordered a vigorous pursuit, in spite of the

stopping order. Slow progress was made towards the Chemin des Dames. On the same date (17th) the IV. Army (Anthoine) had made good progress in the Massif de Moronvilliers. Between the 16th and 20th the French captured 21,000 prisoners and 183 guns, and advanced some 5m. on the Aisne front of 7½m. width. Of the 52 German divisions in reserve available on April 1 only 16 remained unengaged. This result was less than had been hoped, but it was nevertheless appreciable and certainly superior to those of preceding offensives.

Unhappily the morale behind the front line was rapidly declining, the losses being greatly exaggerated. Nevertheless, Nivelle continued his operations. The X. Army took up its position on the plateau de Craonne, between the V. and VI. Armies, but on April 27 Michelet wrote that he had not strength enough for a general offensive toward the north and that he proposed to limit himself to local attacks. Nivelle accepted this solution. These operations, rendered more difficult by the unfortunate intervention of politicians, produced very poor results. The IV. Army on May 4 captured the Craonne plateau, and Laffaux mill was carried on the 5th. For several months, however, the X. Army could only with difficulty hold on to the crest of the Chemin des Dames. The French had lost from April 16 to 25, 15,000 dead, 60,000 wounded and 20,500 missing. Nevertheless, all the 52 reserve German divisions of April 1 had been employed by May 4, and quiet sectors had been robbed to reinforce the Aisne line. Up to May 25, 99 German divisions had already appeared on the front attacked, of which 11 had appeared twice. This expenditure was triple that before Verdun in ten months.

(B. E. P.; C. M. E. M.)

CHAMPAGNE WINES. Champagne is a pale gold or straw-coloured table wine which has been made naturally effervescent through a second fermentation in a bottle or other closed container. It is the best-known of all sparkling wines (*see* WINE), having been developed to perfection through centuries in the former province in France from which it gets its name.

In France, but not normally elsewhere, the name Champagne is restricted to wine obtained from grapes grown in hillside vineyards within a rough triangle connecting Reims, Epernay and Châlons-sur-Marne. White table wines of a number of these vineyards, usually from Pinot noir, Chardonnay and Pinot blanc grape varieties, are blended together to combine their differing characteristics. To the blend are added a special Champagne yeast, and some sugar, either alone or in a syrup with aged wine. In the resulting fermentation carbon dioxide gas seeks to escape; but, blocked by the closed container, it becomes fixed in the wine, to reveal itself in the form of tiny, pungent bubbles, when the bottle is opened for use.

Either of two types of closed containers may be used to encase the fermenting Champagne. In the older, classic method, bottles able to withstand pressures of as much as 100 lb. per sq.in. are employed. Thick corks, held by steel clamps called agraffes, block the necks. The filled bottles are stacked horizontally in tiers and left so for a period of months, until the second fermentation completes itself.

Unwanted sediment is created during the fermentation, and, to remove this, workers place the bottles in racks, necks downward. Each day for months they lift each bottle slightly, twist and partly turn it. The repeated action, called "riddling," shifts the sediment along the glass until it comes to rest on the cork. At this point the bottle's neck is immersed in a freezing solution; the clamp is then released and the gas pressure forces out the cork and a small quantity of frozen wine, containing the sediment. This process is known as "disgorging."

Quickly, before much of the Champagne can be lost, a little sweet liqueur is added, the bottle is strongly corked, the cork is wired on, and, except for final aging, the effervescent wine is ready for use. The amount of liqueur added determines the degree of sweetness of the Champagne. A Champagne may be almost completely dry of sugar ("brut"), semi-dry (usually labelled "extra-dry," "dry" or "sec") or sweet ("doux").

The second, and faster and less expensive, way of producing Champagne is by the "bulk" process. In this, the wine has its second fermentation in large glass-lined tanks which may hold 50 or even 1,000 gallons. From these, after fermentation, the wine is transferred, under pressure, directly into bottles; the sediment is left behind in the tank or removed by a filter.

Outside of France, wines produced in the manner and possessed of the characteristics of Champagne may be sold under that label qualified with the name of the place of origin. When the "bulk" process has been used the governments of some countries, including the U.S., require that fact to be stated. (*See* WINE.)

BIBLIOGRAPHY.—André L. Simon, *The Supply, the Care and the Sale of Wine* (1923), *Champagne* (1934); H. Warner Allen, *The Wines of France* (1924); C. Moreau-Bérillon, *Au pays du Champagne, Le vignoble, Le vin* (1913); Frank Schoonmaker and Tom Marvel, *The Complete Wine Book* (1934); Wine Advisory Board, San Francisco, *Wine Handbook Series,* vol. ii (1943). (H. A. Cw.)

CHAMPAGNY, JEAN BAPTISTE NOMPERE DE, DUC DE CADORE (1756–1834), French politician, was born at Roanne on Aug. 4, 1756, and entered the navy in 1774. He fought through the war in America and resigned in 1787. Elected deputy by the *noblesse* of Forez to the states-general in 1789, he went over to the third estate on June 21 and collaborated in the work of the Constituent Assembly, especially occupying himself with the reorganization of the navy. He remained in private life from 1791–99, when Napoleon named him member of the council of state. From July 1801 to Aug. 1804 he was ambassador of France at Vienna and directed the incessant negotiations between the two courts. As minister of the interior (1804–7) he proved an administrator of the first order. In Aug. 1807 he succeeded Talleyrand as minister for foreign affairs. He directed the annexation of the Papal states in April 1808, worked to secure the abdication of Charles IV. of Spain in May 1808, negotiated the peace of Vienna (1809) and the marriage of Napoleon. In April 1811 a quarrel with the emperor led to his retirement. In 1814, after the abdication, the empress sent him on a fruitless mission to the emperor of Austria. Then he went over to the Bourbons. During the Hundred Days he again joined Napoleon. This led to his exclusion by Louis XVIII., but in 1819 he recovered his dignity of peer. He died in Paris on July 3, 1834. Three of his sons achieved distinction. François (1804–1882) wrote a history of the Roman empire, in three parts—(1) *Les Césars* (1841–43, 4 vols.); (2) *Les Antonins* (1863, 3 vols.); (3) *Les Césars du III siècle* (1870, 3 vols.). Napoleon (1806–1872) published a *Traité de la police municipale* in 4 vols. (1844–61), and was a deputy in the Corps Législatif from 1852–70. Jérome Paul (1809–86) was also deputy in the Corps Législatif from 1853–70, and was made honorary chamberlain in 1859. He worked on the official publication of the correspondence of Napoleon I.

CHAMPAIGN, a city of Champaign county, Illinois, U.S.A., in a rich agricultural region, 125m. S. by W. of Chicago. It is on federal highways 45 and 150; is served by the Big Four, the Illinois Central, the Wabash and the Illinois Traction railways; and has a commercial airport. The population in 1940 was 23,302. Champaign and Urbana, adjoining it on the east, form practically one city, with common public utilities and civic enterprises. The only separate institutions are the post offices and the city governments. Champaign has the greater part of the business and industrial activities, which include railroad repair shops and manufactures of heavy castings, soybean oil and feed, bleachers, gloves, concrete measuring devices, impact registers, caps and gowns. Its total factory production in 1939 was valued at $3,604,996. The campus of the University of Illinois (*q.v.*) lies partly in Champaign. At Rantoul, 14 mi. N., is Chanute field, a flying field of the U.S. army air corps, with 16,000 students. Champaign was founded in 1855 and incorporated as a city in 1860.

CHAMPAIGNE, PHILIPPE DE (1602–1674), Belgian painter of the French school, was born at Brussels of a poor family. He was a pupil of J. Fouquières; and, going to Paris in 1621, was employed by N. Du Chesne to paint with Nicholas Poussin in the palace of the Luxembourg. His best works are to be found at Vincennes, and in the church of the Carmelites at Paris, where is his celebrated Crucifix, a signal perspective success, on one of the vaultings. After the death of Du Chesne, Philippe became first painter to the Queen of France, and ulti-

mately rector of the Academy of Paris. As his age advanced and his health failed, he retired to Port Royal, where he had a daughter cloistered as a nun, of whom (along with Catherine Agnès Arnauld) he painted a picture, now in the Louvre, highly remarkable for its solid unaffected truth. This, indeed, is the general character of his work,—grave reality, without special elevation or depth of character, or charm of warm or stately colour. He produced an immense number of paintings, religious and other subjects as well as portraits, dispersed over various parts of France, and now over the galleries of Europe. Philippe died on Aug. 12, 1674.

CHAMPARAN, a district of British India, in the Tirhut division of Bihar, occupying the northwest corner of Bihar, between the two rivers Gandak and Baghmati and the Nepal hills. It has an area of 3,553 sq.mi., and a population (1941) of 2,397,569. The district is a vast level, except in the north and northwest, where outliers of the Himalayas, known as the Sumeswar and Dun ranges, extend for some 15 miles into the alluvial plain. The former hills rise to a height of 2,884 feet at Fort Sumeswar; at their eastern extremity is the Bhikna Thori pass into Nepal. The two ranges, which have an area of about 364 sq.mi., contain stretches of forest and jungle. Elsewhere the land is closely cultivated, and teems with an active agricultural population. The principal rivers are the Gandak, navigable all the year round, the Burh Gandak, Lelbagi, Dhanauti and Baghmati. Old beds of rivers intersect Champaran, and one of these forms a chain of lakes which occupies an area of 139 sq.mi. in the centre of the district.

Champaran was the chief seat of indigo planting in Bihar before the decline of that industry. There are about 40 saltpetre refineries. The district suffered severely from drought in 1866 and 1874, and again in 1897. As a protection against crop failures the Tribini and Dhaka canals have been constructed. The former derives its supply from the Gandak river at Tribini immediately below the Nepal frontier and irrigates a tract in the north of the district. The latter is a minor work taking off from the river Lalbukaya and irrigating 13,000 acres in the east. The district is traversed by the Bengal and North-Western railway. A considerable trade is conducted with Nepal.

The administrative headquarters are at Motihari (pop., 1941, 20,717); and Bettia (pop., 1941, 30,309), a subdivisional town, is the headquarters of the large estate known as the Bettia Raj and of a Roman Catholic mission founded in 1748; Sugauli, a small military station, was the scene of a massacre during the Mutiny; it was here that the Nepalese treaty of 1815 was signed. Three of the sandstone pillars with pillar edicts which Asoka erected to mark the stages of his journey into Nepal are found in this district at the following places: Lauriya Nandangarh, Lauriya Araraj and Rampurisa.

CHAMPEAUX, WILLIAM OF (*c.* 1070–1121), French Scholastic, was born at Champeaux near Melun. After studying under Anselm of Laon and Roscelin, he taught in the cathedral school of Paris, where he opposed Roscelin and had Abélard as a pupil. In 1103 he became a canon of Notre Dame, but in 1108 retired to the abbey of St. Victor, where he resumed his lectures. He afterwards became bishop of Châlons-sur-Marne, and took part in the dispute concerning investitures as a supporter of Calixtus II. His theological works are the *De Eucharistia* (inserted by Jean Mabillon in his edition of the works of St. Bernard), and the *De Origine Animae* (in E. Martène's *Anecd. nov.* 1717 vol. v.) in which he upholds the theory of Creatianism (that a soul is specially created for each human being). In his *De Generibus et Speciebus* (printed by V. Cousin in *Ouvrages inédits d'Abélard,* 1836), William shows himself an excessive realist by declaring that the universal is the whole reality of the individual, but in his later *Sententiae* (extracts published in G. Lefèvre: *Les variations de G. de Champeaux,* Lille, 1898), he adopts a moderate realism.

For his views and controversies with Abélard *see* SCHOLASTICISM and ABÉLARD.

See Lefèvre: *op. cit.;* Hurtault: "Théologie de G. de Champeaux" in *Rev. de sc. eccl. et sc. cath.* 1908–09; E. Michaud: *G. de Champeaux et les écoles de Paris au XIIe siècle* (2nd ed. Paris, 1868), and Uberweg: *Grundriss der Gesch. der Phil.* teil ii. (Berlin, 1928).

CHAMPERICO, a Pacific port of Guatemala, Central America, 28m. by the International Railways of Central America from Retalhuleu. Pop. (1940) 894. Exports, chiefly coffee. The harbour is an open roadstead, ships being served by lighter.

CHAMPERTY, in common law, a bargain between a plaintiff or defendant in a cause and another person, to divide the land (*campum partiri*) or other subject-matter of the action in the event of success, in consideration of that person carrying on or defending the suit partly or wholly at his own expense. It is a misdemeanour punishable by fine or imprisonment. It differs only from maintenance, in that the recompense for the service which has been given is always part of the matter in action, or some profit growing out of it. Such an agreement is illegal and void. It is not, however, illegal to charge the subject-matter of an action in order to obtain the means of prosecuting or defending it.

See *Fifth Report of the Criminal Law Commissioners,* pp. 34–39.

CHAMPION, in the judicial combats of the middle ages the substitute for a party to the suit disabled from bearing arms or specially exempt from the duty to do so. Hence the word has come to be applied to any one who "champions," or contends on behalf of, any person or cause. In the laws of the Lombards (lib. ii. tit. 56, sections 38, 39), those who by reason of youth, age or infirmity could not bear arms were allowed to nominate champions, and the same provision was made in the case of women (lib. i. tit. 3, section 6, tit. 16, section 2). This was practically the rule laid down in all subsequent legislation on the subject. The clergy, as individuals or corporations, were represented by champions; in the case of bishops and abbots this function was part of the duties of the *advocatus* (*see* ADVOCATE). Du Cange gives instances of mercenary champions who were regarded as "infamous persons," and sometimes, in case of defeat, were condemned to lose hand or foot. Sometimes championships were "serjeanties"; *i.e.,* rendered service to lords, churches or cities in consideration of the grant of certain fiefs, or annual money payments.

The office of "King's champion" (*campio regis*) is peculiar to England. His function was to ride, clad in complete armour, on his right the high constable, on his left the earl marshal, into Westminster Hall during the coronation banquet, and challenge to single combat anyone who should dispute the King's right to reign. The challenge was thrice repeated by the herald, at the entrance to the hall, in the centre, and at the foot of the dais. On picking up his gauntlet for the third time, the champion was pledged by the King in a gilt-covered cup, which was then presented to him as his fee by the King. If he had had occasion to fight, and had been victorious, his fee would have been the armour he wore and the horse he rode, the second best in the royal stables; but no such occasion ever arose. This ceremonial was last performed at the coronation of George IV. The office of King's champion is of great antiquity, but of the actual exercise of the office the earliest record dates from the coronation of Richard II. On this occasion the champion, Sir John Dymoke, appeared at the door of the Abbey immediately after the coronation mass, but was peremptorily told to go away and return later; moreover, in his bill presented to the court of claims, he stated that the champion was to ride in the procession before the service, and make his challenge to all the world. This seems to show that the ceremony, as might be expected, was originally performed before the King's coronation, when it would have had some significance. The manor of Scrivelsby is held in grand serjeanty by the service of acting as the king's champion, although the service has become obsolete with the coronation banquet; it is still held by a Dymoke.

See Du Cange, *Glossarium, s.v.* "Campio"; L. G. Wickham Legg, *English Coronation Records* (1901); J. H. T. Perkins, *The Coronation Book* (1902).

CHAMPIONNET, JEAN ÉTIENNE (1762–1800), French general, born at Valence, enlisted in the army at an early age and served in the great siege of Gibraltar. In May 1793 he was charged with the suppression of the disturbances in the Jura, which he quelled without bloodshed. Under Pichegru he took part in the Rhine campaign of that year as a brigade commander and

at Weissenburg and in the Palatinate won the warm commendation of Hoche. He commanded the left wing of the French armies on the Rhine, between Neuwied and Düsseldorf, and took part in the expeditions to the Lahn and the Main. In 1798 Championnet was named commander-in-chief of the "army of Rome," which was protecting the infant Roman republic against the Neapolitan court and the British fleet. The Austrian general Mack had a tenfold superiority in numbers, but Championnet captured Naples itself and there set up the Parthenopean republic. But his intense earnestness and intolerance of opposition soon embroiled him with the civilians, and the general was recalled in disgrace. The following year, however, saw him again in the field as commander-in-chief of the "army of the Alps." The campaign which followed was uniformly unsuccessful, and, worn out by the unequal struggle, Championnet died at Antibes, on Jan. 9, 1800.

See A.R.C. de St. Albin, *Championnet, ou les Campagnes de Hollande, de Rome et de Naples* (1860); M. Faure, *Souvenirs du Général Championnet* (1904).

CHAMPLAIN, SAMUEL DE (1567–1635), French explorer, colonial pioneer and first governor of French Canada, was born at Brouage on the Bay of Biscay. His father was a sea captain, and the boy was early skilled in seamanship and navigation. He entered the army of Henry IV., and served in Brittany. When the army of the League was disbanded he accompanied his uncle, who had charge of the ships in which the Spanish allies were conveyed home, and on reaching Cadiz secured (1599) the command of one of the vessels about to make an expedition to the West Indies. He was gone over two years, visiting all the principal ports and pushing inland from Vera Cruz to the city of Mexico. The ms. account of his adventures, *Bref Discours des Choses plus remarquables que Samuel Champlain de Brouage a recognues aux Indes Occidentales,* is in the library at Dieppe. It was not published in French until 1870, although an English translation was printed by the Hakluyt Society in 1859. It contains a suggestion of a Panama canal, "by which the voyage to the south sea would be shortened by more than 1,500 leagues." In 1603 Champlain made his first voyage to Canada, being sent out by Aymar de Clermont, on whom the king had bestowed a patent. Champlain at once established friendly relations with the Indians and explored the St. Lawrence to the rapids above Montreal. On his return he published *Des sauvages, ou voyage de Samuel Champlain de Brouage fait en la France Nouvelle.* During his absence de Clermont had died, and his privileges and fur trade monopolies were conferred upon Pierre du Guast, Sieur de Monts (1560–*c.* 1630). With him, in 1604, Champlain was engaged in exploring the coast as far south as Cape Cod, in seeking a site for a new settlement, and in making surveys and charts. They first settled on an island near the mouth of the St. Croix river, and then at Port Royal—now Annapolis, Nova Scotia.

Meanwhile the Basques and Bretons got de Monts' patent revoked, and Champlain returned to Europe. When, however, in modified form, the patent was re-granted to his patron, Champlain induced him to abandon Acadia and establish a settlement on the St. Lawrence. Champlain was placed in command of one of the two vessels sent out. He was to explore and colonize, while the other vessel traded, to pay for the expedition. Champlain fixed on the site of Quebec and founded the first white settlement there in July 1608, giving it its present name. In the spring he joined a war party of Algonquins and Hurons, discovered the great lake that bears his name, and, near the present Ticonderoga, took part in the victory which they obtained over the Iroquois. The Iroquois naturally turned first to the Dutch and then to the English for allies. Champlain then returned to France, but in 1611 was back in Canada, and established a trading post at Mont Royal. He was subsequently appointed lieutenant-general in New France.

In 1613 Champlain again crossed the Atlantic and endeavoured to confirm Nicolas de Vignau's alleged discovery of a short route to the ocean by the Ottawa river, a great lake at its source, and another river flowing north therefrom. That year he got as far as Allumette Island in the Ottawa, but two years later, with a "Great War Party" of Indians, he crossed Lake Nipissing and the eastern ends of Lakes Huron and Ontario, and attacked an Onondaga fortified town a few miles south of Lake Oneida. This was the end of his wanderings. He now devoted himself to the growth and strengthening of Quebec. Every year he went to France with this end in view. He was one of the 100 associates of the Company of New France, created by Richelieu to reform abuses and take over all his country's interests in the new world. But in 1629 Quebec was forced to surrender to the English. Champlain was taken to England a prisoner, but when Canada was restored to the French he returned (1633) to his post, where he died. He had married in 1610, Hélène Boullé, then but 12 years old. She did not leave France for Canada, however, until ten years later. After his death she became a nun.

Champlain's works in six vols. were published under the patronage of the University of Laval in 1870. There is a careful trans. of *Champlain's Voyages,* by A. N. and E. G. Bourne (1906) in the "Trailmaker" series ed. by Prof. J. B. McMaster. *See* F. Parkman, *Pioneers of France in the New World* (1865); J. Winsor, *Cartier to Frontenac* (1894); G. Gravier, *Vie de S. Champlain* (1900); N. E. Dionne, *Champlain* (1905); R. Flenly, *S. Champlain* (Toronto, 1924).

CHAMPLAIN, LAKE. This lake is chiefly in the United States, between the States of New York and Vermont, but extends about 6m. into the Province of Quebec, Canada. It is about 125m. long, covers an area of about 600sq.m., varies in width from ¼m. to 12m. and in depth from 100ft. to a maximum of about 400 feet. It drains into the St. Lawrence through the Richelieu river. Lake Champlain receives the waters of Lake George through a small stream containing rapids and falls. It receives the drainage from many other streams, all of them small. The most important ports on the lake are Burlington, Vt., Rouses Point, Plattsburg and Port Henry, New York. Plattsburg Barracks, a beautiful army post, is located on its shores at the city of the same name. It was at this post that the first experiment in training young men for the citizens army was tried out by Gen. Leonard Wood in 1915. The experience here gained was of great value during the World War when speed and efficiency were so essential. Since the World War, many young men of New York and other nearby States have been trained here in the Citizens Military Training Camps and in the Reserve Officers Training Corps.

Lake Champlain is a link in the international water line of communication between the Hudson river and the lower St. Lawrence. The total commerce passing the narrows of the lower end of the lake in 1926 was 115,000 tons. The through traffic consists principally of southbound lumber and pulp-wood and northbound coal. Local traffic is comparatively unimportant. The route from the St. Lawrence south is via the Richelieu river, with the St. Ours lock and dam in its lower course and the Chambly canal in its upper reach. This canal has 9 locks with total lift of 74 feet. The locks have the following dimensions: length, 118ft. (110ft. available); width, 22½ft.; depth on sills, 7ft. (reduced at low water to 6½ft.). The width of the canal is 36ft. at the bottom and 60ft. at the water surface. The "Champlain canal" connects Lake Champlain, at Whitehall, with the Hudson river at Waterford, New York. There are 12 locks with total lockage of 182 feet. The summit level is at elevation 140 and is supplied with water from the headwaters of the Hudson.

With the Green mountains on the east and the Adirondacks on the west, the scenery is rugged and beautiful. Many islands dot the northern portion of the lake. It was discovered in 1609 by the French explorer and soldier Samuel de Champlain, from whom the lake takes its name. During the early period of settlement of the North American continent Lake Champlain was the gateway between French Canada and the English colonies. It played an important part in all the wars in which the people to the north and south of it were on opposite sides. It is rich in the history and traditions of these early days. Champlain, with an expedition of about 80 friendly Montagues Indians, defeated the Iroquois on its shores in 1609. Thus began the long struggle between the French and the Five Nations.

In 1731 the French built a fort at Crown Point and in 1755 another at Ticonderoga; both were important strategic points in the French and Indian War as well as in the American Revolution. They controlled the easiest and most natural route between

Canada and New York. During the Seven Years' War (French and Indian) English and colonial expeditions twice failed to capture Crown Point. It was finally occupied by Amherst in 1759. Early in the American Revolution it was captured by a detachment of Ethan Allen's Green Mountain Boys. Ft. Ticonderoga was the scene of the severe repulse administered to Gen. Abercrombie by Gen. Montcalm in 1758. Later on it was captured by Amherst. At the beginning of the Revolution it was captured in a surprise attack by Capt. Ethan Allen. When asked by the British commander, Capt. La Place, by what authority the surrender of the fort was demanded, Capt. Allen made his historic reply, "In the name of the great Jehovah and the continental congress." During the subsequent years of the war the fort changed hands several times. On Oct. 11, 1776, the first battle between an American and a British fleet, the battle of Valcour island, was fought on the lake. Benedict Arnold, the American commander, with a decidedly inferior force, inflicted severe damage on the enemy and then during the night escaped. Although overtaken two days later he again, after a fight of a few hours, made a successful retreat saving all his men.

At the beginning of the War of 1812 the American naval force on the lake, though very small, was superior to that of the British, but on June 3, 1813, the British captured two American sloops in the narrow channel at the northern end and gained supremacy. Both sides now began to build and equip vessels for a decisive contest. By May, 1814, the Americans had regained supremacy, and four months later a British land force of 11,000 men under Sir George Prevost and a naval force of 16 vessels of about 2,402 tons with 937 men and 92 guns under Capt. George Downie confronted an American land force of 1,500 men under Brigadier General Alexander Macomb, strongly entrenched at Plattsburg, and an American naval force in Plattsburg bay of 14 vessels of about 2,244 tons with 882 men and 86 guns under Commodore Thomas MacDonough (1783–1825). The naval battle occurred on the morning of Sept. 11, 1814. Although the weight of the metal thrown by the guns of MacDonough's American fleet was greater than that of the British fleet, the latter had more guns of long range. Knowing that in a battle in the open lake he would be at a disadvantage, MacDonough anchored his fleet in such a way as to force Downie to pass between him and the land and to prevent him from anchoring his fleet out of range of the American guns. Downie was killed early in the fight, and the British fleet was soon driven out of action or surrendered. The American loss was 52 killed and 58 wounded, and the British loss was 57 killed and 92 wounded. The land forces engaged in desultory fighting but no decisive action occurred. As the lake was entirely in the control of the Americans, Prevost was forced to retreat during the night of Sept. 12–13, leaving his sick and wounded behind. The British gave up further efforts to invade New York.

See B. C. Butler, *Lake George and Lake Champlain* (Albany, N.Y., 1868); Francis Parkman, *Montcalm and Wolfe* (Boston, 1884) and *Historic Handbook of the Northern Tour* (Boston, 1885); F. W. Halsey, "The Historical Significance of the Hudson and Champlain Valley," *N.Y. State Hist. Assoc. Proc.*, vol. ix., pp. 227–236 (Albany, 1910); and E. T. Gillispie, "The War Path," ib., vol. x., pp. 139–155 (Albany, 1911). (E. Ja.)

CHAMPLAIN CANAL: *see* New York State Barge Canal System.

CHAMPMESLÉ, MARIE (1642–1698), née Desmares, French actress, was born in Rouen and made her first appearance on the stage at Rouen with Charles Chevillet (1645–1701), who called himself sieur de Champmeslé, and they were married in 1666. By 1669 they were playing in Paris at the Théâtre du Marais. The next year, as Hermione in Racine's *Andromaque*, she had a great success at the Hôtel de Bourgogne. Her intimacy with Racine dates from then. Some of his finest tragedies were written for her, but her repertoire was not confined to them, and many an indifferent play—like Thomas Corpeille's *Ariane* and *Comte d'Essex*—owed its success to "her natural manner of acting and her pathetic rendering of the hapless heroine." *Phèdre* was the climax of her triumphs, and when she and her husband deserted the Hôtel de Bourgogne (*see* Béjart *ad fin.*), it was selected to open the Comédie Française on Aug. 26, 1680. There, with Mme. Guérin as the leading comedy actress, she played the great tragic love parts for more than 30 years, dying on May 15, 1698. La Fontaine dedicated to her his novel *Belphégor*, and Boileau immortalized her in verse.

Her brother, the actor Nicolas Desmares (*c.* 1650–1714), began as a member of a subsidized company at Copenhagen. After 1685 he played peasant parts with great success at the Comédie Française. His daughter, to whom Christian V. and his queen stood sponsors, Christine Antoinette Charlotte Desmares (1682–1753), was a fine actress in both tragedy and soubrette parts. She made her début at the Comédie Française in 1699, in La Grange Chancel's *Oreste et Pylade*, and was at once received as *sociétaire*. She retired in 1721.

CHAMPOLLION, JEAN FRANÇOIS (1790–1832), French Egyptologist, called Le Jeune to distinguish him from Champollion-Figeac (*q.v.*), his elder brother, was born at Figeac, in the department of Lot, on Dec. 23, 1790. At the age of 16 he read before the academy of Grenoble a paper in which he maintained that the Coptic was the ancient language of Egypt. He soon after removed to Paris. In 1809 he was made professor of history in the Lyceum of Grenoble. His first decipherment of hieroglyphics dates from 1821. In 1824 he was sent by Charles X. to visit the Egyptian antiquities in the museums of Italy; and on his return was appointed director of the Egyptian museum at the Louvre. In 1828 he was commissioned to conduct a scientific expedition to Egypt in company with Rosellini. In March 1831 he received the chair of Egyptian antiquities, which had been created specially for him, in the Collège de France. He was engaged with Rosellini in publishing the results of their Egyptian researches when he died at Paris (1832). Champollion is now universally acknowledged to have been the founder of Egyptology.

He wrote *L'Égypte, sous les Pharaons* (2 vols. 8vo. 1814); *Sur l'écriture hiératique* (1821); *Sur l'écriture démotique; Précis du système hiéroglyphique, etc.* (1824); *Panthéon égyptien, ou collection des personnages mythologiques de l'ancienne Égypte* (incomplete); *Monumens de l'Égypte et de la Nubie considérés par rapport à l'histoire, la religion, etc.; Grammaire égyptienne* (1836), and *Dictionnaire égyptienne* (1841), edited by his brother; *Analyse méthodique du texte démotique de Rosette; Aperçu des résultats historiques de la découverte de l'alphabet hiéroglyphique* (1827); *Mémoires sur les signes employés par les Égyptiens dans leurs trois systèmes graphiques à la notation des principales divisions du temps; Lettres écrites d'Égypte et de Nubie* (1833); and also several letters on Egyptian subjects, addressed at different periods to the duc de Blacas and others.

See H. Hartleben, *Champollion, sein Leben und sein Werk* (2 vols., 1906); *Lettres de Champollion le Jeune* (1909); also Egyptian Language.

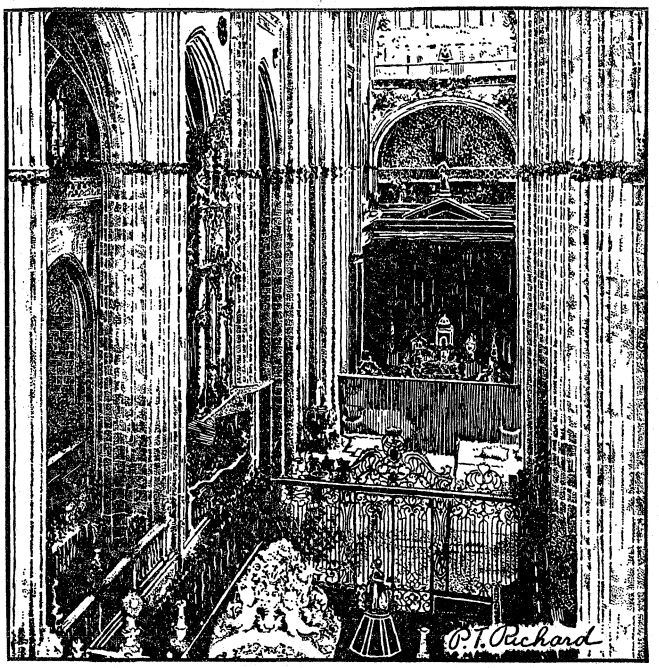
CHAMPOLLION-FIGEAC, JACQUES JOSEPH (1778–1867), French archaeologist, elder brother of Jean François Champollion, was born at Figeac in the department of Lot, on Oct. 5, 1778. He became keeper of manuscripts at the Bibliothèque Nationale in Paris, and professor of palaeography at the École des Chartes. In 1849 he became librarian of the palace of Fontainebleau. His works include, *Nouvelles recherches sur les patois ou idiomes vulgaires de la France* (1809), *Annales de Lagides* (1819) and *Chartes latines sur papyrus du VIe siècle de l'ère chrétienne*. His son Aimé (1812–1894) became his assistant at the Bibliothèque Nationale, and in addition to a number of historical works wrote a biographical and bibliographical study of his family in *Les Deux Champollion* (Grenoble, 1887).

CHANCE, an accident or event, a phenomenon which has no apparent or discoverable cause; hence an event which has not been expected, a piece of good or bad fortune. From the popular idea that anything of which no assignable cause is known has therefore no cause, chance was regarded as having a substantial objective existence, being itself the source of such uncaused phenomena. For the philosophic theories relating to this subject *see* Accidentalism.

"Chance," in the theory of probability, is used in two ways. In the stricter or mathematical usage, it is synonymous with probability, *i.e.*, if a particular event may occur in n ways in an aggregate of p events, then the "chance" of the particular event occurring is given by the fraction n/p. In the second usage, the

"chance" is regarded as the ratio of the number of ways which a particular event may occur to the number of ways in which it may not occur; mathematically expressed, this chance is $n/(p-n)$. This is more usually called Odds (*see* PROBABILITY). In the English law relating to gaming and wagering a distinction is drawn between games of chance and games of skill (*see* GAMING AND WAGERING).

CHANCEL, strictly, that part of a church close to the altar and separated from the nave (*q.v.*) by cancelli or screens. This



LOOKING DOWN OVER THE CHOIR INTO THE CHANCEL OF THE SALAMANCA CATHEDRAL, SPAIN. THE ALTAR IS SEEN IN THE CENTRE BACKGROUND

space, originally known as the space *inter cancellos,* or *locus altaris cancellis septus,* came itself to be called the chancel. Later the word came to include the whole of that part of the church occupied by altars, communion tables and all the officiating clergy and singers, *i.e.,* the presbytery (*q.v.*), the chancel proper and the choir (*q.v.*). In some cases the word is used synonymously with choir.

In basilican churches, the chancel is set apart only by a low railing; *e.g.,* S. Clemente, Rome. Such divisions correspond more to the altar, communion or sanctuary rail of a modern church than to the developed mediaeval chancel screen. In the highly organized mediaeval church, the chancel is clearly differentiated from the nave by the raising of the floor level, and by the chancel or rood screen (*see* JUBÉ). This screen is frequently continued on each side, behind the choir stalls, and around the east end of the cathedrals of sanctuary, as in Paris, Bourges and Amiens. At the side, such screens form the back of the choir stalls. The chancel screen in front of the altar is sometimes only a low parapet, sometimes a light, openwork structure of wood or metal, but often, especially in the large cathedrals and abbeys of England, a massive and solid stone structure, frequently carrying the organ. In collegiate and monastic churches, these screens thus completely separated the spaces reserved for services for the members of the clerical community from the spaces for popular services, for which a second altar was usually set up to the west of the screen, as formerly in Westminster Abbey.

Chancel sizes vary enormously. On the European continent they usually extend from the east end to the crossing, as in many modern churches, but in abbey churches, and generally in English mediaeval churches, they comprise also several bays of the nave. In the churches of Paris the chancel is relatively small. The chancel screen becomes more open and its main function is to support a crucifixion group; it is, therefore, primarily a rood screen. In small churches the chancel is sometimes lower and narrower than the nave.

CHANCELLOR, RICHARD (d. 1556), English seaman, is said to have been brought up by the father of Sir Philip Sidney. Nothing is known of his own family except that he had two sons. In 1553 Sir Hugh Willoughby fitted out an expedition in search of the North-West passage to India, of which Chancellor was appointed "pilot-general." It was arranged that the expedition should meet at Vardohuus, but owing to unfavourable weather, Chancellor's was the only one of the original seven ships which arrived at the rendezvous. He therefore went on alone into the White Sea, and thence overland to Moscow. The emperor showed him great hospitality in Moscow, and gave him a letter for the king of England giving very favourable conditions for English trade. Chancellor rejoined his ship in the summer of 1554, and came back to England, after having, by his successful negotiations, laid the foundations of English trade with Russia. The Muscovy Company was established as a result of this voyage. In 1555 Chancellor left England again for Moscow, which he reached in November. He lost his life on the return voyage, on Nov. 10, off Pitsligo on the coast of Aberdeenshire.

See Hakluyt's *Principal Navigations,* etc., vol. i.

CHANCELLOR, an official title used by most of the peoples whose civilization has arisen directly or indirectly out of the Roman empire. It stands for very various duties, and is borne by officers of various degrees of dignity. The original chancellors were the *cancellarii* of Roman courts of justice, ushers who sat at the *cancelli* or lattice work screens of a "basilica" or law court, which separated the judge and counsel from the audience (*see* CHANCEL). In the later Eastern empire the *cancellarii* were promoted at first to notarial duties. The barbarian kingdoms which arose on the ruin of the empire in the West copied more or less intelligently the Roman model in all their judicial and financial administration. Under the Frankish kings of the Merovingian dynasty the *cancellarii* were subordinates of the great officer of state called the *referendarius,* the predecessor of the modern chancellor. The office became established under the form *archi-cancellarius,* or chief of the *cancellarii.* Stubbs says that the Carolingian chancellor was the royal notary and the arch-chancellor keeper of the royal seal. His functions would naturally be discharged by a cleric in times when book learning was mainly confined to the clergy. From the reign of Louis the Pious the post was held by a bishop. By an equally natural process he became the chief secretary of the king and of the queen, who also had her chancellor. Such an office would develop on the judicial as well as the administrative side. Appeals and petitions of aggrieved persons would pass through the chancellor's hands, as well as the political correspondence of the king. Great officers and corporations also had occasion to employ an agent to do secretarial, notarial and judicial work for them, and called him by the convenient name of chancellor.

The Chancellor in England.—The model of the Carolingian court was followed by the mediaeval states of Western Europe. In England the office of chancellor dates back to the reign of Edward the Confessor, the first English king to use the Norman practice of sealing instead of signing documents. The chancellor was originally, and long continued to be, an ecclesiastic, who combined the functions of the most dignified of the royal chaplains, the king's secretary in secular matters, and keeper of the royal seal. From the first, then, though at the outset overshadowed by that of the justiciar, the office of chancellor was one of great influence. As chaplain the chancellor was keeper of the king's conscience; as secretary he enjoyed the royal confidence in secular affairs; as keeper of the seal he was necessary to all formal expressions of the royal will. By him and his staff of chaplains the whole secretarial work of the royal household was conducted, the accounts were kept under the justiciar and treasurer, writs were drawn up and sealed, and the royal correspondence was carried on. He was, in fact, as Stubbs put it, a sort of secretary of state for all departments. "This is he," wrote John of Salisbury (d. 1180), "who cancels (*cancellat*) the evil laws of the realm, and makes equitable (*aequa*) the commands of a pious prince," a curious anticipation of the chancellor's later equitable jurisdiction. Under Henry II., indeed, the chancellor was already

employed in judicial work, either in attendance on the king or in provincial visitations; though the peculiar jurisdiction of the chancery was of later growth. By this time, however, the chancellor was "great alike in Curia and Exchequer"; he was *secundus a rege, i.e.,* took precedence immediately after the justiciar, and nothing was done either in the Curia or the exchequer without his consent. So great was his office that William Fitz Stephen, the biographer of Becket, tells us that it was not purchasable (*emenda non est*), a statement which requires modification, since it was in fact more than once sold under Henry I., Stephen, Richard and John (Stubbs, *Const. Hist.* i. pp. 384–497; Gneist, *Const. Hist. of England,* p. 219), an evil precedent which was, however, not long followed.

The judicial duties of the chancellor grew out of the fact that all petitions addressed to the king passed through his hands. The number and variety of these became so great that in 1280, under Edward I., an ordinance was issued directing the chancellor and the justices to deal with the greater number of them; those which involved the use of the great seal being specially referred to the chancellor. The chancellor and justices were to determine which of them were "so great, and of grace, that the chancellor and others would not despatch them without the king," and these the chancellor and other chief ministers were to carry in person to the king (Stubbs ii. 263, and note, and p. 268). At this period the chancellor, though employed in equity, had ministerial functions only; but when, in the reign of Edward III., the chancellor ceased to follow the court his tribunal acquired a more definite character, and petitions for grace and favour began to be addressed primarily to him, instead of being merely examined and passed on by him to the king; and in the 22nd year of this reign matters which were of grace were definitely committed to the chancellor for decision. This is the starting-point of the equitable jurisdiction of the chancellor, whence developed that immense body of rules, supplementing the deficiencies or modifying the harshness of the common law, which is known as Equity (*q.v.*).

The Chancellor in Parliament.—The position of the chancellor as speaker or prolocutor of the House of Lords dates from the time when the ministers of the royal Curia formed *ex officio* a part of the *commune concilium* and parliament. The chancellor originally attended with the other officials, and he continued to attend *ex officio* after they had ceased to do so. If he chanced to be a bishop, he was summoned regularly *qua* bishop; otherwise he attended without summons. When not a peer the chancellor had no place in parliament except as chancellor, and the act of 31 Henry VIII. cap. 10 (1539) laid down that, if not a peer, he had "no interest to give any assent or dissent in the House." Yet Sir Robert Bourchier (d. 1349), the first lay chancellor, had protested in 1341 against the first statute of 15 Edward III. (on trial by peers, etc.), on the ground that it had not received his assent and was contrary to the laws of the realm. From the time, however, of William, Lord Cowper (first lord high chancellor of Great Britain in 1705, created Baron Cowper in 1706), all chancellors have been made peers on their elevation to the woolsack. Sometimes the custody of the great seal has been transferred from the chancellor to a special official, the lord keeper of the great seal (*see* LORD KEEPER OF THE GREAT SEAL); this was notably the case under Queen Elizabeth (*cf.* the French *garde des sceaux,* below). Sometimes it is put into commission, being affixed by lords commissioners of the great seal. By the Catholic Emancipation Act of 1829 it was enacted that none of these offices could be held by a Roman Catholic (*see* further under LORD HIGH CHANCELLOR). The office of lord chancellor of Ireland and that of chancellor of Scotland (who ceased to be appointed after the Act of Union 1707) followed the same lines.

Chancellor of the Exchequer.—The title of chancellor, without the predicates "high" or "lord," is also applied in Great Britain to a number of other officials and functionaries. Of these the most important is the chancellor of the Exchequer, an office which originated in the separation of the chancery from the Exchequer in the reign of Henry III. (1216–72). His duties consisted originally in the custody and employment of the seal of the Exchequer, in the keeping of a counter-roll to check the roll kept by the treasurer, and in the discharge of certain judicial functions in the exchequer of account. So long as the treasury board was in active working the chancellorship of the Exchequer was an office of small importance, and even during a great part of the 19th century was not necessarily a cabinet office, unless held in conjunction with that of first lord of the Treasury. At the present time the chancellor of the Exchequer is minister of finance, and therefore always of cabinet rank (*see* EXCHEQUER).

Chancellor of the Duchy.—The chancellor of the duchy of Lancaster is the representative of the crown in the management of its lands and the control of its courts in the duchy of Lancaster, the property of which is scattered over several counties. These lands and privileges, though their inheritance has always been vested in the king and his heirs, have always been kept distinct from the hereditary revenues of the sovereign, whose palatine rights as duke of Lancaster were distinct from his rights as king. The Judicature Act of 1873 left only the chancery court of the duchy, but the chancellor can appoint and dismiss the county court judges within the limits of the duchy; he is responsible also for the land revenues of the duchy, which are the private property of the sovereign, and keeps the seal of the duchy. As the judicial and estate work is done by subordinate officials, the office is usually given to a minister whose assistance is necessary to a government, but who for one reason or another cannot undertake the duties of an important department. John Bright described him as the maid-of-all-work of the cabinet.

Ecclesiastical Chancellors.—The chancellor of a diocese is the official who presides over the bishop's court and exercises jurisdiction in his name. This use of the word is comparatively modern, and, though employed in acts of parliament, is not mentioned in the commission, having apparently been adopted on the analogy of the like title in the State. The chancellor was originally the keeper of the archbishop's or bishop's seals; but the office, as now understood, includes two other offices distinguished in the commission by the titles of vicar-general and official principal (*see* ECCLESIASTICAL JURISDICTION). The chancellor of a diocese must be distinguished from the chancellor of a cathedral, whose office is the same as that of the ancient *scholasticus* (*see* CATHEDRAL).

Academic, etc.—The chancellor of an order of knighthood discharges notarial duties and keeps the seal. The chancellor of a university is an official of mediaeval origin. The appointment was originally made by the popes, and the office from the first was one of great dignity and originally of great power. The chancellor was, as he remains, the head of the university; he had the general superintendence of its studies and of its discipline, could make and unmake laws, try and punish offences, appoint to professorial chairs and admit students to the various degrees. In England the chancellorship of the universities is conferred on noblemen or statesmen of distinction, whose principal function is to look after the general interests of the university, especially in its relations with the government. The chancellor is represented in the university by a vice-chancellor, who performs the administrative and judicial functions of the office. In the United States the heads of certain educational establishments have the title of chancellor. In Scotland, the foreman of a jury is called its chancellor. In the United States the chancellors are judges of the chancery courts of the states, *e.g.,* Delaware and New Jersey, where these courts are still maintained as distinct from the courts of common law. In other states, *e.g.,* New York since 1847, the title has been abolished, and there is no federal chancellor.

In diplomacy generally the chancellor of an embassy or legation is an official attached to the suite of an ambassador or minister. He performs the functions of a secretary, archivist, notary and the like, and is at the head of the chancery, or chancellery, of the mission. The functions of this office are the transcribing and registering of official despatches and other documents, and generally the transaction of all the minor business, *e.g.,* marriages, passports and the like, connected with the duties of a diplomatic agent towards his nationals in a foreign country.

France.—The country in which the office of chancellor followed most closely the same lines as in England is France. He

had become a great officer under the Carolingians, and he grew still greater under the Capetian sovereigns. The great chancellor, *summus cancellarius* or *archi-cancellarius*, was a dignitary who had indeed little real power. The post was commonly filled by the archbishop of Reims, or the bishop of Paris. The *cancellarius*, who formed part of the royal court and administration, was officially known as the *sub-cancellarius* in relation to the *summus cancellarius*, but as *proto-cancellarius* in regard to his subordinate *cancellarii*. He was a very great officer, an ecclesiastic who was the chief of the king's chaplains or king's clerks, who administered all ecclesiastical affairs; he had judicial powers, and from the 12th century had the general control of foreign affairs. The chancellor in fact became so great that the Capetian kings, who did not forget the mayor of the palace, grew afraid of him. Few of the early ecclesiastical chancellors failed to come into collision with the king, or parted with him on good terms. Philip Augustus suspended the chancellorship throughout the whole of his reign, and appointed a keeper of the seals (*garde les sceaux*). The office was revived under Louis VIII., but the ecclesiastical chancellorship was finally suppressed in 1227. The kings of the 13th century employed only keepers of the seal. Under the reign of Philip IV. le Bel, lay chancellors were first appointed. From the reign of Charles V. to that of Louis XI. the French *chancelier* was elected by the royal council. In the 16th century he became irremovable, a distinction more honourable than effective, for though the king could not dismiss him from office he could, and on some occasions did, deprive him of the right to exercise his functions, and entrusted them to a keeper of the seal. The *chancelier* from the 13th century downwards was the head of the law, and performed the duties which are now entrusted to the minister of justice. His office was abolished by the Revolution. The smaller *chanceliers* of the provincial *parlements* and royal courts disappeared at the same time. But when Napoleon was organizing the empire he created an arch-chancellor, an office which was imitated rather from the *Erz-Kanzler* of the Holy Roman empire than from the old French *chancelier*. At the Restoration the office of chancellor of France was restored, the chancellor being president of the House of Peers, but it was finally abolished at the revolution of 1848. The administration of the Legion of Honour is presided over by a *grand chancelier*, who is a grand cross of the order, and who advises the head of the state in matters concerning the order. The title of *chancelier* continues also to be used in France for the large class of officials who discharge notarial duties in some public offices, in embassies and consulates. They draw up diplomas and prepare all formal documents, and have charge of the registration and preservation of the archives.

Spain.—In Spain the office of chancellor, *canciller*, was introduced by Alphonso VII. (1126–57), who adopted it from the court of his cousins of the Capetian dynasty of France. The *canciller* did not in Spain go beyond the king's notary. The chancellor of the privy seal, *canciller del sello de la puridad* (literally the secret seal), was the king's secretary, and sealed all papers other than diplomas and charters. The office was abolished in 1496, and its functions were transferred to the royal secretaries. The *cancelario* was the chancellor of a university. *The canciller* succeeded the *maesescuela* or *scholasticus* of a church or monastery. *Canciller mayor de Castilla* is an honorary title of the archbishops of Toledo. The *gran canciller de las Indias*, high chancellor of the Indies, held the seal used for the American dominions of Spain, and presided at the council in the absence of the president. The office disappeared with the loss of Spain's empire in America.

Italy, Germany, etc.—In central and northern Europe, and in Italy, the office had different fortunes. In southern Italy, where Naples and Sicily were feudally organized, the chancellors of the Norman kings, who followed Anglo-Norman precedents very closely, and, at least in Sicily, employed Englishmen, were such officers as were known in the West. The similarity is somewhat concealed by the fact that these sovereigns also adopted names and offices from the imperial court at Constantinople. Their chancellor was officially known as Protonotary and Logothete, and their example was followed by the German princes of the Hohenstaufen family, who acquired the kingdoms of Naples and Sicily. The papal or apostolic chancery is dealt with in the article on the Curia Romana (q.v.).

The title of arch-chancellor (*Erz-Kanzler*) was borne by three great ecclesiastical dignitaries of the Holy Roman empire. The archbishop of Mainz was arch-chancellor for Germany. The archbishop of Cologne held the dignity for Italy, and the archbishop of Trier for Gaul and the kingdom of Arles. The second and third of these dignities became purely formal with the decline of the empire in the 13th century. But the arch-chancellorship of Germany remained to some extent a reality till the empire was finally dissolved in 1806. The office continued to be attached to the archbishopric of Mainz, which was an electorate. Karl von Dalberg, the last holder of the office, and the first prince primate of the Confederation of the Rhine, continued to act in show at least as chancellor of that body, and was after a fashion the predecessor of the *Bundeskanzler*, or chancellor of the North German Confederation. The duties imposed on the imperial chancery by the very complicated constitution of the empire were, however, discharged by a vice-chancellor attached to the court of the emperor. The abbot of Fulda was chancellor to the empress.

The house of Austria in their hereditary dominions, and in those of their possessions which they treated as hereditary, even where the sovereignty was in theory elective, made a large and peculiar use of the title chancellor. The officers so called were of course distinct from the arch-chancellor and vice-chancellor of the empire, although the imperial crown became in practice hereditary in the house of Habsburg. In the family states their administration was, to use a phrase familiar to the French, "polysynodic." As it was when fully developed, and as it remained until the March revolution of 1848, it was conducted through boards presided over by a chancellor. There were three aulic chancellorships for the internal affairs of their dominions, "a united aulic chancellorship for all parts of the empire (*i.e.*, of Austria, not the Holy Roman) not belonging to Hungary or Transylvania, and a separate chancellorship for each of those last-mentioned provinces" (Hartig, *Genesis of the Revolution in Austria*). There were also a house, a court, and a state chancellor for the business of the imperial household and foreign affairs, who were not, however, the presidents of a board. These "aulic" (*i.e.*, court) officers were in fact secretaries of the sovereign, and administrative or political rather than judicial in character, though the boards over which they presided controlled judicial as well as administrative affairs. In the case of such statesmen as Kaunitz and Metternich, who were house, court and state chancellors as well as "united aulic" chancellors, the combination of offices made them in practice prime ministers, or rather lieutenants-general, of the sovereign.

In the modern German empire the *Reichskanzler* was the immediate successor of the *Bundeskanzler*, or chancellor of the North German Confederation (*Bund*). But the *Bundeskanzler*, who bore no sort of resemblance save in name to the *Erz-Kanzler* of the old empire, was in a position not perhaps actually like that of Prince Kaunitz, but capable of becoming much the same thing. When the German empire was established in 1871 Prince Bismarck, who was *Bundeskanzler* and became *Reichskanzler*, took care that his position should be as like as possible to that of Prince Kaunitz or Prince Metternich. The constitution of the German empire is separately dealt with, but it may be pointed out here that the *Reichskanzler* was the federal minister of the empire, the chief of the federal officials, and a great political officer, who directed the foreign affairs, and superintended the internal affairs, of the empire.

In these German states the title of chancellor is also given as in France to government and diplomatic officials who do notarial duties and have charge of archives. The title of chancellor has naturally been widely used in the German and Scandinavian States, and in Russia since the reign of Peter the Great. It has there, as elsewhere, wavered between being a political and a judicial office. Frederick the Great of Prussia created a *Gross-Kanzler* for judicial duties in 1746. But there was in Prussia a state chancellorship on the Austrian model. It was allowed to lapse on the death of Hardenberg in 1822. The Prussian chancellor after his

time was one of the four court ministries (*Hofämter*) of the Prussian monarchy.

BIBLIOGRAPHY.—K. F. Stumpf, *Die Reichs Kanzler* (Innsbruck, 1865–73); P. Hinschius, *Kirchenrecht* (1869); Du Cange, *Glossarium, s.v.* "Cancellarius"; W. Stubbs, *Const. Hist. of England* (1874–78); G. Seeliger, *Erzkanzler und Reichskanzleien* (*ib.*, 1889); Rudolph Gneist, *Hist. of the English Constitution* (Eng. trans., 1891); A. Luchaire, *Manuel des institutions françaises* (1892); L. O. Pike, *Const. Hist. of the House of Lords* (1894); Sir R. J. Phillimore, *Eccles. Law* (1895); P. Pradier-Fodéré, *Cours de droit diplomatique*, ii. 542 (1899); Sir W. R. Anson, *The Law and Custom of the Constitution*, vol. ii. part i. (1907).

CHANCELLORSVILLE, a village of Spottsylvania county, Virginia, U.S.A., situated almost midway between Washington and Richmond. It was the central point of one of the greatest battles of the Civil War, fought on May 2 and 3, 1863, between the Union army of the Potomac under Maj.-gen. Hooker, and the Confederate army of Northern Virginia under Gen. Lee. (*See* AMERICAN CIVIL WAR, and WILDERNESS.) Gen. "Stonewall" Jackson was mortally wounded in this battle.

CHANCE-MEDLEY, an accident of a mixed character, an old term in English law for a form of homicide arising out of a sudden affray or quarrel. This term is not in use in the United States. Manslaughter in one of its various degrees would embrace such a homicide, under U.S. law.

CHANCERY, in English law, the court of the lord chancellor of England, consolidated in 1873 along with the other superior courts in the Supreme Court of Judicature. Its origin is noticed under the head of CHANCELLOR.

It has been customary to say that the court of chancery consists of two distinct tribunals—one a court of common law, the other a court of equity. From the former have issued all the original writs passing under the great seal, all commissions of sewers, lunacy, and the like—some of these writs being originally kept in a *hanaper* or hamper (whence the "hanaper office"), and others in a little sack or bag (whence the "petty-bag office"). The court had likewise power to hold pleas upon *scire facias* (*q.v.*) for repeal of letters patent, etc. "So little," says Blackstone, "is commonly done on the common law side of the court that I have met with no traces of any writ of error being actually brought since the 14th year of Queen Elizabeth."

The equitable jurisdiction of the court of chancery was founded on the supposed superiority of conscience and equity over the strict law. The appearance of equity in England is in harmony with the general course of legal history in progressive societies. What is remarkable is that, instead of being incorporated with or superseding the common law, it gave rise to a wholly independent set of tribunals. The claims of equity in its earlier stages are well expressed in the little treatise called *Doctor and Student,* published in the reign of Henry VIII.:—"Conscience never resisteth the law nor addeth to it, but only when the law is directly in itself against the *law of God,* or *law of reason.*" So also King James, speaking in the Star Chamber, says: "Where the rigour of the law in many cases will undo a subject, then the chancery tempers the law with equity, and so mixes mercy with justice, as it preserves a man from destruction." By the time of Lord Eldon equity had become fixed, and the judges, like their brethren in the common law courts, strictly followed the precedents. Henceforward chancery and common law courts have exhibited the anomaly of two co-ordinate sets of tribunals, empowered to deal with the same matters, and compelled to proceed in many cases on wholly different principles. The court of chancery could in most cases prevent a person from taking advantage of a common law right, not approved of by its own system. But if a suitor chose to go to a court of common law, he might claim such unjust rights, and it required the special intervention of the court of equity to prevent his enforcing them. In many cases also a special application had to be made to chancery for facilities which were absolutely necessary to the successful conduct of a case at common law. Another source of difficulty and annoyance was the uncertainty in many cases whether the chancery or common law courts were the proper tribunal, so that a suitor often found at the close of an expensive and protracted suit that he had mistaken his court and must go elsewhere for relief. "If this be equity, give me law," was said to be the cry of the disappointed suitor in chancery, while the unsuccessful defendant in the King's Bench was heard to exclaim "If this be law, give me equity!" Attempts more or less successful were made to lessen those evils by giving the powers to both sets of courts; but down to the consolidation effected by the Judicature Act, the English judicial system justified the sarcasm of Lord Westbury, that one tribunal was set up to do injustice and another to stop it.

The equitable jurisdiction of chancery was commonly divided into *exclusive, concurrent* and *auxiliary.* Chancery had exclusive jurisdiction when there were no forms of action by which relief could be obtained at law, in respect of rights which ought to be enforced. Trusts were the most conspicuous example of this class. It also included certain rights of married women, infants and lunatics. Chancery had concurrent jurisdiction when the common law did not give *adequate* relief, *e.g.,* in cases of fraud, accident, mistake, specific performance of contracts, etc. It had auxiliary jurisdiction when the administrative machinery of the law courts was unable to procure the necessary evidence.

The Judicature Act 1873, s. 24 (now repealed and replaced by the Judicature Act 1925, s. 37 [1]), enacts that in every civil cause or matter commenced in the High Court of Justice, law and equity shall be administered by the High Court of Justice and the court of appeal respectively, according to the rules therein contained, which provide for giving effect in all cases to "equitable rights and other matters of equity." The 44th section of the act of 1925 declares the law to be administered in England on certain points, and ordains that "generally in all matters not hereinbefore particularly mentioned in which there is any conflict or variance between the rules of equity and the rules of the common law with reference to the same matter, the rules of equity shall prevail." The 56th section specifically assigns certain matters to the chancery division.

The chancery division originally consisted of the lord chancellor as president and the master of the rolls and the vice-chancellors. The master of the rolls was also a member of the new court of appeal, but Sir George Jessel, who held that office when the new system came into force, regularly sat as a judge of first instance until 1881, when, by the act of that year (s. 2), the master of the rolls became a member of the court of appeal only. The chancery division now consists of the lord chancellor and six puisne judges, who are divided into groups of three. The judge may either hear an application in chambers, or may direct any matter which he thinks of sufficient importance to be argued before him in court, or a party may move in court to discharge an order made in chambers with a view to an appeal, but this is not required if the judge certifies that the matter was sufficiently discussed before him in chambers. Under the existing rules of court many orders can now be made on summons in chambers which used formerly to require a suit or petition in court. Bankruptcy and winding up business is now dealt with by a judge or judges of the chancery division.

In the United States "chancery" is generally used as the synonym of "equity." Chancery courts are equity courts in the few jurisdictions where such courts are maintained separately. (*See* EQUITY.) For the diplomatic sense of chancery (chancellery) *see* CHANCELLOR; and DIPLOMATIC. (X.; W. V. B.)

CHAN CHAN or GRAN CHIMU, a ruined and deserted pre-Inca city on the coast of Peru, situated some 300 mi. north of Lima and approximately 2 mi. north of Trujillo, in the department of La Libertad. It was once the capital of a populous, powerful and relatively advanced civilization variously known as the Chimu, Yunga or Mochica, whose influence extended from the department of Lambeyeque southward to Ancón, not far from Lima.

The city itself covers a considerable area, and from a careful survey and estimate must have had a population of at least 250,000 at the height of its glory. It consists of a group of separate walled cities, each surrounded by massive walls from 30 to 40 ft. high, from 8 to 12 ft. in thickness at the base and from 1 to 3 ft. at the top; the walls, as well as the houses, so-called palaces, temples and other structures are constructed of adobe bricks, plastered over in most cases with a smooth coat of adobe. No stone and apparently little or no wood entered into the buildings.

Owing to a dry and comparatively rainless climate with no great extremes of temperature the ruins, which under other conditions would surely have disappeared, are in a remarkable state of preservation.

The Chimu.—Whence the population came no one can say. We do know, however, from skeletal remains that are found in great abundance in the burying-grounds about and in the ruins, that they were totally unlike any of the other pre-Columbian peoples of South America, the characteristic that distinguished them being that they were a broad-skulled or brachycephalic race while the Quichuas and Aymaras, Andean tribes who formed the Inca confederation, were respectively a mesaticephalic (or normal) and a dolichocephalic (or long-skulled) people. In this peculiarity the Chimu were more closely allied to the Mayas of the Yucatan peninsula, Southern Mexico, Guatemala and Honduras than any other people of the Western Hemisphere. This lends colour to the theory that they were an off-shoot of the Mayas that broke away from the original stock in remote times and made their way to the coast of Peru where they established and built up the civilization of which we are here treating.

When they settled on these shores is equally hazy. Certain it is that if they drifted here by sea they must have come in comparatively small numbers. On the other hand, if they migrated by land—which seems less probable—they must, at the rate primitive people and people without any fixed objective migrate, have been centuries in building up the civilization of which we find remains to-day, so that it is quite probable that their advent on the coast of Peru may have been about the time of the beginning of the Christian era.

We know their fate somewhat more definitely from legends and accounts related by the Incas upon the arrival of the Spaniards. From these we learn that for a century, more or less, a bitter war was waged between the Inca confederation or Andean tribes and the coastal peoples, the Chimu in the north and the Nazca in the south. Many and fierce are the struggles recorded and the Incas eventually defeated the coastal tribes at their great fortress of Paramonga, near Supe, not far from Huacho on the Peruvian coast north of Lima. This fortress remains to this day and is in a remarkable state of preservation. Having been defeated at Paramonga the Chimu retired behind the walls of their capital, Chan Chan, and were here starved into submission by the besieging Incas. Whether the Chimu were wholly exterminated by their enemies or whether, as was the Inca custom with conquered tribes, they were broken up and distributed in small numbers throughout the empire, we do not know. Certain it is, however, that when the Spaniards came there were no evident remains of the Chimu save their ruined and deserted cities, remains of their irrigation systems and other like traces. This extermination of the coastal peoples has been reckoned to have taken place some 130 or 140 years before the coming of the Spaniards, which would put it in the neighbourhood of the year A.D. 1400.

Remains.—From a study of the ruins we know that Chan Chan was the seat of a great empire whose extent was the entire coast from Lambeyeque on the north to about Ancón on the south. We also know that these were a people who lived mainly by agricultural pursuits. In the vicinity of Chan Chan itself, in the valley of the Chicama, Moche, Viru and other Andean streams, there are evidences of truly remarkable systems of irrigation and certain signs that agriculture was carried on to a considerably greater extent in those ancient times than it is to-day. Fishing also formed an important part of their life and conventionalized figures of fishes and maritime birds form the principal motifs in their mural and other decorations.

That they were highly developed in the arts is likewise patent. They knew the art of mining, smelting and working such metals as gold, silver and copper, though none of the other metals have been found in the ruins. Metal utensils, ornaments and other objects are still found in and about Chan Chan, as are also the remains of an ancient smelter, with considerable quantities of slag. The Chimu were also expert potters; examples of their work are to be found in many museums. Strange to note, there are three known strata of pottery, that in the lowest being of the finest quality, while the top stratum is the poorest, indicating that the art degenerated. From their pottery much of their life and habits may be reconstructed. Wood, as has been noted, appears to play very little part in their arts. This is probably because of the indigenous trees, the willow was too soft and perishable for practical use and the algarroba too hard to be worked. Hence wood was used but little, if at all, except in the making of idols, musical instruments and small objects.

Save for a few small settlements, notably at Huanchaco and at Moche, in the vicinity of Trujillo, where the inhabitants show traces of brachycephalism, the ruined cities, irrigation works, fortresses and the like, as well as all traces of these peoples, have disappeared. (O. Ho.)

CHANCRE is a term formerly used loosely, to designate any sore or ulcer, especially one of a corroding nature or venereal origin. It is now applied almost exclusively to the primary lesion of syphilis, which used to be called a hard, indurated or Hunterian chancre. It appears at the site of inoculation in from one to seven weeks after exposure, and is most commonly found on the external genitals, but sometimes on the lip, tongue and other parts. A small, hard, translucent swelling appears at the infected spot, becomes gradually larger (up to one inch), and often breaks in the centre leaving a shallow ulcer. This lesion is the chancre and represents the first reaction of body tissues to the causative agent, *Treponema pallidum*. Diagnosis is established by finding the organism in scrapings from the ulcer. (*See* VENEREAL DISEASES.)

CHANDA. The southernmost District of the Central Provinces of British India.

Chanda Town is the old capital of an ancient Gond dynasty, situated near the confluence of the Erai and Wardha rivers. It once had a much larger population for there are now waste and cultivated fields inside the stone walls, which have a circumference of five and a half miles, whilst the modern suburbs of the town have grown up outside the city walls, and in the jungles which hem in the city on two sides there are many traces of old habitations. The town is noted for its silk woven fabrics, ornamental slippers and other minor industries of the same kind. Outside one of the gates is held an annual fair attended by 100,000 people. After a great decline from its ancient status as a Gond capital, it has begun to revive with the construction of roads and railway communications, and its population was (1941) 35,730 as compared with 16,000 in 1872.

District of Chanda.—The District of Chanda is one of the largest districts in the Central Provinces, having an area of 9,205 sq.mi., but the twenty Zamindari estates which it contains account for 4,000 sq.mi. of wild and thinly populated country, while government forest reserves cover no less than 2,700 sq.mi., and include valuable teak and other timber, and large bamboo jungles. Coal of a poor quality is found in the extreme west at Ballarpur and Ghugus, while iron ore of high grade is found in the eastern part of the District.

Except in the north-west and on the borders of the Wardha and Nagpur Districts, where cotton and wheat are both grown and there are large areas under juar (sorghum), rice and the small millets are the principal crops. Numbers of irrigation tanks have been constructed by the people to water rice and sugar-cane, to which the Government has added a number of storage reservoirs of some magnitude.

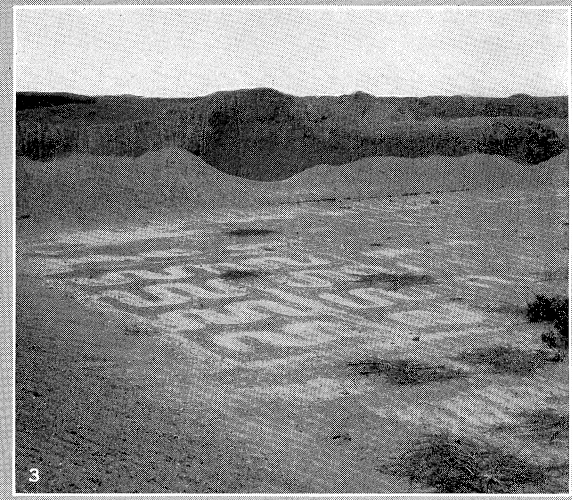
Many useful roads have been made since the great famines, and Chanda town is now connected with Wardha on the G.I.P. railway via Warora (where the colliery is now worked out), and by narrow gauge lines with Nagpur and Gondia in the Bhandara district.

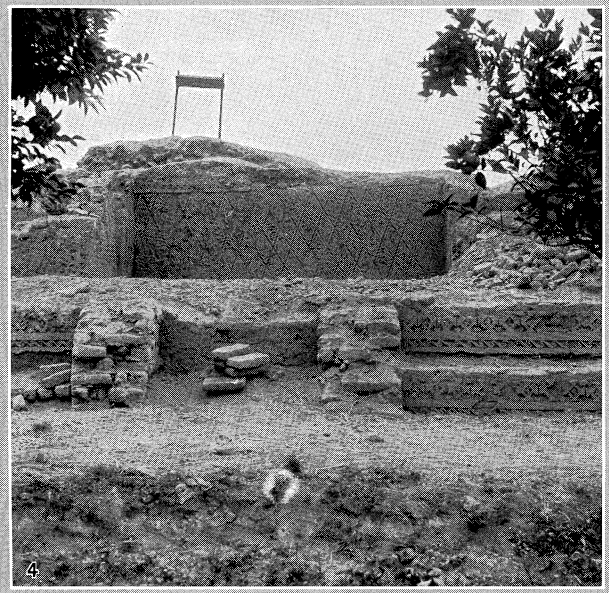
It is a most picturesque part of the country, with varied scenery, wooded hills and interesting archaeological remains, old temples and forts, notably at Chanda itself, Bhandak, Markandi and Wairagarh, but the climate is unpleasantly hot, the forests malarious, and the people unprogressive. Several languages are spoken.

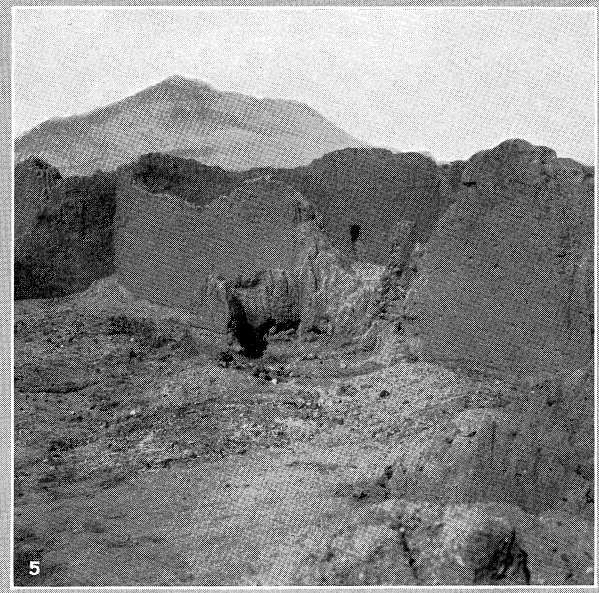
The Marathi of the north-west gives way to Telugu in the south and to Hindi (Chhattisgarhi) in the north-east. In all the wilder tracts aboriginal races predominate, and Gondi and other













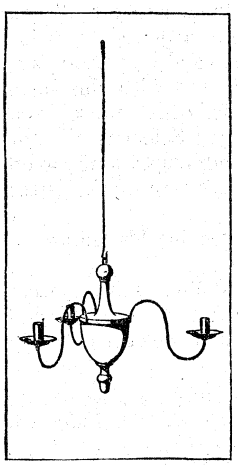
BY COURTESY OF OTTO HOLSTEIN

RUINS OF AN ANCIENT CIVILIZATION

1. Huaca, or Temple, of the Moon, about 10 miles outside of Chan Chan proper, showing mural paintings in black, red, orange, blues and yellows, against a ground of white
2. Aerial view of the fortress of Paramonga. Here, *c.* 1400, the Incas defeated the Chimu, practically exterminating them
3. Remains of a garden, showing fanciful patterns formed probably by incrustation of mineral salts in irrigation ditches
4. Decorated walls of palace within grounds of the Esmeralda group. The reduplicated figures are in low relief
5. Characteristic group of ruins, the back wall showing relief decorations formed in the plaster, which covered adobe blocks
6. Presumably an altar of sacrifice, S.E. of the Palace of the Arabesques, a palace 52½ ft. wide and of unknown length

tribal dialects are common, as in the neighbouring Bastar State. The total population of the district in 1941 was 873,284. In the famine decade (1891–1901) there was a sharp decrease, and a set-back in the decade 1911–1921 due to influenza, but in the last fifty years the growth of population has, nevertheless, been 30%.

CHANDAUSI, a town of British India in the Moradabad district of the United Provinces; an important junction (for Aligarh) on the Oudh and Rohilkand railway. Pop. *c.* 27,000. It exports cotton, hemp, sugar and stone.



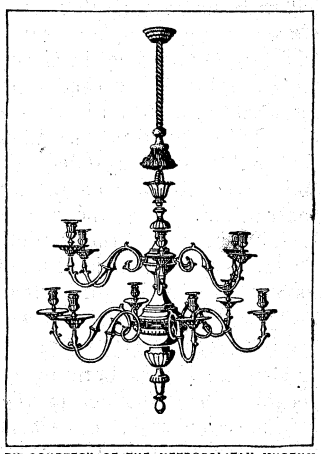
BY COURTESY OF THE PENNSYLVANIA MUSEUM

AMERICAN BRASS CHANDELIER, 18TH CENTURY

CHAND BARDAI (*c.* A.D. 1200), Hindu poet, a native of Lahore, who lived at the court of Prithiraj, the last Hindu sovereign of Delhi. His *Prithiraj Rasau,* a poem of some 100,000 stanzas, chronicling his master's deeds and the contemporary history of his part of India, is valuable as the earliest monument of the Western Hindi language, and the first of the long series of bardic chronicles for which Rajputana is celebrated. It is written in ballad form, and portions of it are still sung by itinerant bards throughout north-western India and Rajputana.

See J. Tod, *Annals and Antiquities of Rajast'han* (2 vols., 1829–1832).

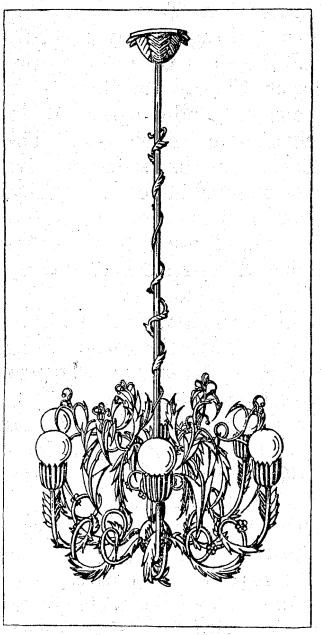
CHANDELIER, a frame of metal, wood, crystal, glass or china, suspended from the roof or ceiling for the purpose of holding lights. The word is French, but the appliance has lost its original significance of a candle-holder, the chandelier being now chiefly used for gas and electric lighting. Clusters of hanging lights were in use as early as the 14th century, and appear originally to have been almost invariably of wood. They were, however, so speedily ruined by grease that metal was gradually substituted, and fine and comparatively early examples in beaten iron, brass, copper and even silver are still extant. Throughout the 17th century the hanging candle-holder of brass or bronze was common throughout northern Europe, as innumerable pictures and engravings testify. In the great periods of the art of decoration in France many magnificent chandeliers were made by Boulle, and at a later date by Gouthière and Thomire and others among the extraordinarily clever *fondeurs-ciseleurs* of the second half of the 18th century. The chandelier in rock crystal and its imitations had come in at least a hundred years before their day, and continued in favour to the middle of the 19th century, or even somewhat later. It reached at last the most extreme elaboration of banality, with ropes of pendants and hanging faceted drops often called lustres. When many lights were burning in one of these chandeliers an effect of splendour was produced that was not out of place in a ballroom, but the ordinary household varieties were extremely ugly and inartistic. The more purely domestic chandelier usually carries from two to six lights. The present use of electricity and the modern ideas of interior lighting have pushed into the background the elaborate specimens of the past few centuries and substituted the simpler designs with smaller clusters of lights. (*See* also LIGHTING AND ARTIFICIAL ILLUMINATION; INTERIOR DECORATION.)



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

ENGLISH CHANDELIER BY ADAMS, ILLUSTRATIVE OF THE MORE ELABORATE MODELS OF THE LATTER PART OF THE 18TH CENTURY

CHANDERNAGORE or **CHANDARNAGAR,** a French settlement in India, with a small adjoining territory, situated on the right bank of the river Hugli, 20m. above Calcutta. Area 3 sq.m.; pop. (1941) 38,284. Chandernagore has played an important part in the European history of Bengal. It became a permanent French settlement in 1688, but did not rise to any importance till the time of Dupleix, during whose administration the town was transformed and became the focus for a considerable maritime trade. In 1757 Chandernagore was bombarded by an English fleet under Admiral Watson and captured. On peace being established the town was restored to the French in 1763. When hostilities afterwards broke out in 1794, the English again took possession of it and held it till 1816, when it was a second time given up to the French; it has ever since remained in their possession; it is now little more than a quiet riverside town. The authorities of Chandernagore are subject to the jurisdiction of the governor-general of Pondicherry, to whom is confided the general government of all the French possessions in India.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

MODERN ELECTRIC CHANDELIER WITH FROSTED GLOBES AND SILVERED METAL

CHANDLER, RICHARD (1738–1810), British antiquary, was born at Elson in Hampshire. In 1759 he published fragments from the Greek minor poets, with notes (*Elegiaca Graeca*); and in 1763 a fine edition of the Arundelian marbles, *Marmora Oxoniensia,* with a Latin translation, and suggestions for supplying the lacunae. He was sent by the Dilettanti Society with Revett, an architect, and Pars, a painter, to explore the antiquities of Ionia and Greece (1763–66); and the result of their work was the two magnificent folios of Ionian antiquities published in 1769. Other works by Chandler were *Inscriptiones Antiquae pleraeque nondum editae* (1774); *Travels in Asia Minor* (1775); *Travels in Greece* (1776); *History of Ilium* (1803); in which he asserted the accuracy of Homer's geography. His *Life of Bishop Waynflete,* lord high chancellor to Henry VI., appeared in 1811.

A complete edition (with notes by Revett) of the *Travels in Asia Minor and Greece* was published by R. Churton (1825), with an "Account of the Author."

CHANDLER, SAMUEL (1693–1766), English Nonconformist divine, was born in 1693 at Hungerford, Berkshire. He took a leading part in the deist controversies of the time, and discussed with some of the bishops the possibility of an act of comprehension. From 1716–26 he preached at Peckham, and for 40 years he was pastor of a meeting-house in Old Jewry. He died on May 8, 1766, leaving four vols. of sermons (1768), and a paraphrase of the Epistles to the Galatians and Ephesians (1777), several works on the evidence of Christianity, and various pamphlets against Roman Catholicism.

CHANDLER, ZACHARIAH (1813–1879), American politician, was born at Bedford, N.H., on Dec. 10, 1813. In 1833 he removed to Detroit, Mich., where he became a prosperous dry-goods merchant. He took a prominent part as a Whig in politics, and, impelled by his strong anti-slavery views, actively furthered the work of the "underground railroad," of which Detroit was one of the principal "transfer" points. He was one of the organizers in Michigan of the Republican Party, and in 1857 succeeded Lewis Cass in the U.S. Senate, serving until 1875. Throughout the Civil War he allied himself with the most radical of the Republican faction in opposition to President Lincoln's policy, and subsequently became one of the bitterest opponents of President Johnson's plan of reconstruction. From Oct. 1875, to March 1877, he was secretary of the interior in the cabinet of President Grant. In Feb. 1879, he was re-elected to the Senate.

He died at Chicago, Ill., on Nov. 1, 1879. By his extraordinary force of character he exercised a wide personal influence during his lifetime, but failed to stamp his personality upon any measure or policy of lasting importance.

CHANDOS, BARONS AND DUKES OF. The English title of Chandos began as a barony in 1554, and was continued in the family of Brydges (becoming a dukedom in 1719) till 1789. In 1822 the dukedom was revived in connection with that of Buckingham.

JOHN BRYDGES, 1st Baron Chandos (*c.* 1490–1557), a son of Sir Giles Brydges, or Bruges (d. 1511), was a prominent figure at the English court during the reigns of Henry VIII., Edward VI. and Mary. He took part in suppressing the rebellion of Sir Thomas Wyat in 1554, and as lieutenant of the Tower of London during the earlier part of Mary's reign, had the custody, not only of Lady Jane Grey and of Wyat, but for a short time of the princess Elizabeth. He was created Baron Chandos of Sudeley in 1554, one of his ancestors, Alice, being a grand-daughter of Sir Thomas Chandos (d. 1375), and he died in March 1557. The three succeeding barons, direct descendants of the 1st baron, were all members of parliament and persons of some importance. Grey, 5th Baron Chandos (*c.* 1580–1621), lord-lieutenant of Gloucestershire, was called the "king of the Cotswolds," owing to his generosity and his magnificent style of living at his residence, Sudeley Castle. His elder son George, 6th Baron Chandos (1620–1655), was a supporter of Charles I. during his struggle with Parliament. After the death of his brother William in 1676 the barony came to a kinsman, Sir James Brydges, Bart. (1642–1714), who was English ambassador to Constantinople from 1680–1685.

JAMES BRYDGES, 1st duke of Chandos (1673–1744), son and heir of the last-named, had been member of parliament for Hereford from 1698 to 1714, and, three days after his father's death, was created Viscount Wilton and earl of Carnarvon. For eight years, from 1705 to 1713, during the War of the Spanish Succession, he was paymaster-general of the forces abroad, and in this capacity he amassed great wealth. In 1719 he was created marquess of Carnarvon and duke of Chandos. The duke is chiefly remembered on account of his connection with Handel and with Pope. He built a magnificent house at Canons near Edgware in Middlesex. For over two years Handel, employed by Chandos, lived at Canons, where he composed his oratorio *Esther*. Pope, who in his *Moral Essays (Epistle to the Earl of Burlington)* doubtless described Canons under the guise of "Timon's Villa," referred to the duke in the line, "Thus gracious Chandos is belov'd at sight"; but Swift, less complimentary, called him "a great complier with every court." After his death on Aug. 9, 1744, Canons was pulled down. He was succeeded by his son Henry, 2nd duke (1708–1771), and grandson James, 3rd duke (1731–1789). The third duke's only daughter, Anna Elizabeth, who became Baroness Kinloss on her father's death, was married in 1796 to Richard Grenville, afterwards marquess of Buckingham; and in 1822 this nobleman was created duke of Buckingham and Chandos (*see* BUCKINGHAM, EARLS, MARQUESSES AND DUKES OF).

See G. E. C(okayne), *Complete Peerage* (1887–98); and J. R. Robinson, *The Princely Chandos, i.e.,* the 1st duke (1893).

CHANDOS, SIR JOHN (d. 1370), English soldier, fought at the siege of Cambrai (1337), at Crécy in 1346, and at Poitiers, where he saved the life of the Black Prince. For these services Edward III. gave him the lands of the viscount of Saint Sauveur in Cotentin, and appointed him lieutenant in France, and vice-chamberlain of the royal household in 1360. In 1362 he was made constable of Guienne, and defeated Charles de Blois at Auray in 1364. Chandos accompanied the Black Prince on his expedition in 1367, to restore Pedro the Cruel to the throne of Castile, and won the victory of Navaret over Bertrand du Guesclin. Appointed seneschal of Poitou in 1369, he was mortally wounded in an encounter with the French at the bridge of Lussac near Poitiers, and died on the day after the battle, Jan. 1, 1370.

CHANDRAGUPTA MAURYA (reigned 321–296 B.C.), known to the Greeks as Sandracottus, founder of the Maurya empire and first paramount ruler of India, was the son of a king of Magadha by a woman of humble origin, whose caste he took and whose name, Mura, is said to have been the origin of that of Maurya assumed by his dynasty. As a youth he was driven into exile by his kinsman, the reigning king of Magadha. In the course of his wanderings he met Alexander the Great, and, according to Plutarch (*Alexander,* cap. 62), encouraged him to invade the Ganges kingdom. On the death of Alexander he attacked the Macedonian garrisons and conquered the Punjab. He next attacked Magadha, dethroned and slew the king, and established himself on the throne (321). The great army acquired from his predecessor he increased until it reached the total of 30,000 cavalry, 9,000 elephants and 600,000 infantry; and with this huge force he overran all northern India, establishing his empire from the Arabian sea to the Bay of Bengal. In 305 Seleucus Nicator crossed the Indus, but was defeated by Chandragupta and forced to a humiliating peace (303), by which the empire of the latter was still farther extended in the north.

About six years later Chandragupta died, leaving his empire to his son Bindusura.

An excellent account of the court and administrative system of Chandragupta has been preserved in the fragments of Megasthenes, who came to Pataliputra as the envoy of Seleucus shortly after 303.

See J. W. MacCrindle, *Ancient India as described by Megasthenes and Arrian* (Calcutta, 1877); V. A. Smith, *Early Hist. of India,* ed. S. M. Edwardes (1924); also the article INDIA: *History.*

CHANGARNIER, NICOLAS ANNE THÉODULE (1793–1877), French general, was born at Autun on April 26, 1793. Educated at St. Cyr, he served for a short time in the bodyguard of Louis XVIII., and entered the line as a lieutenant in January 1815. In 1830 he entered the Royal Guard and was sent to Algeria, where he served with great distinction until 1848, and had just succeeded Gen. Cavaignac as governor of the colony when he was recalled to command the National Guard. An avowed enemy of republican institutions, he at first upheld the power of the president; but in January 1851 he opposed Louis Napoleon's policy, was deprived of his double command, and at the *coup d'état* in December was arrested and sent to Mazas until his banishment from France by the decree of Jan. 9, 1852. He returned to France after the general amnesty. In 1870 he was present with the headquarters, and afterwards with Bazaine in Metz. He was employed on an unsuccessful mission to Prince Frederick Charles, commanding the German army which besieged Metz, and on the capitulation became a prisoner of war. At the armistice he returned to Paris, and in 1871 was elected to the National Assembly by four departments, and sat for the Somme. He took an active part in politics, defended the conduct of Marshal Bazaine, and served on the committee which elaborated the monarchical constitution. When the comte de Chambord refused the compromise, he moved the resolution to extend the executive power for ten years to Marshal MacMahon. He was elected a life senator in 1875. He died in Paris on Feb. 14, 1877.

See Comte d'Antioche, *Changarnier* (1891).

CHANG CHUN, KIU (1148–1227), Chinese Taoist sage and traveller, was born in 1148. In 1219 he was invited by Jenghiz Khan, founder of the Mongol empire and greatest of Asiatic conquerors, to visit him. Jenghiz' letter of invitation, dated May 15, 1219 (by present reckoning), has been preserved, and is among the curiosities of history; here the terrible warrior appears as a meek disciple of wisdom, modest and simple, almost Socratic in his self-examination, alive to many of the deepest truths of life and government. Chang Chun obeyed this summons; and leaving his home in Shantung (Feb. 1220), journeyed first to Peking. Learning that Jenghiz had gone far west upon fresh conquests, the sage stayed the winter in Peking. In February 1221 he started again and crossed eastern Mongolia to the camp of Jenghiz' brother Ujughen, near Lake Bör or Buyur in the upper basin of the Kerulun-Amur. Thence he travelled south-westward up the Kerulun, crossed the Karakorum region in north-central Mongolia, and so came to the Chinese Altai, probably passing near the present Uliassutai. After traversing the Altai he visited Bishbalig (modern Urumtsi), and moved along the north side of the Tian Shan range to lake Sairam, Almalig (or Kulja), and the

rich valley of the Ili. We then trace him to the Chu, over this river to Talas and the Tashkent region, and over the Jaxartes (or Syr Daria) to Samarkand, where he halted for some months. Finally, through the "Iron Gates" of Termit, over the Oxus, and by way of Balkh and northern Afghanistan, Chang Chun reached Jenghiz' camp near the Hindu Kush. Returning home he followed much the same course as on his outward route: certain deviations, however, occur, such as a visit to Kuku-khoto. He was back in Peking by the end of January 1224. From the narrative of his expedition (the *Si yu ki,* written by his pupil and companion Li Chi Chang) we derive some of the most faithful and vivid pictures ever drawn of nature and man between the Great Wall of China and Kabul, between the Aral and the Yellow Sea. We may particularly notice the sketches of the Mongols, and of the people of Samarkand and its neighbourhood; the account of the fertility and products of the latter region, as of the Ili valley, at or near Almalig-Kulja; and the description of various great mountain ranges, peaks and defiles, such as the Chinese Altai, the Tian Shan, Mt. Bogdo-ola (?), and the Iron Gates of Termit. There is, moreover, a noteworthy reference to a land apparently identical with the uppermost valley of the Yenisei. After his return Chang Chun lived at Peking till his death on July 23, 1227. By order of Jenghiz some of the former imperial garden grounds were made over to him, for the foundation of a Taoist monastery.

BIBLIOGRAPHY.—*See* E. Tretschneider, *Mediaeval Researches from Eastern Asiatic Sources,* vol. i. pp. 35–108, where a complete translation of the narrative is given, with a valuable commentary; C. R. Beazley, *Dawn of Modern Geography,* iii. 539. (C. R. B.)

CHANGE, the substitution of one thing for another, hence any alteration or variation, so applied to the moon's passing from one phase to another. The use of the word for a place of commercial business has usually been taken to be a shortened form of Exchange (*see* EXCHANGE, FOREIGN) and so is often written 'Change. "Change" is particularly used of coins of lower denomination given in substitution for those of larger denomination or for a note, cheque, etc., and also for the balance of a sum paid larger than that which is due. A further application is that in bell-ringing, of the variations in order in which a peal of bells may be rung (*see* BELL).

CHANGELING, the term used of a child substituted or changed for another. It was formerly believed that infants were sometimes stolen from their cradles by the fairies before christening, so that in the Highlands of Scotland babies were strictly watched till then.

Any specially peevish or weakly baby was regarded as a changeling.

The belief is referred to by Shakespeare, Spenser and other authors.

See Pennant, *Tour in Scotland* (1796), p. 257, and W. Wirt Sikes, *British Goblins* (1880).

CHANGE OF LIFE: *see* MENOPAUSE.

CHANGOAN, a tribe or small group of tribes of South American Indians, forming an independent linguistic stock. The Changos occupied the arid coast of the desert of Atacama in northern Chile. They are an almost dwarfish, fisher folk of very simple culture, and are now nearly extinct, except in the vicinity of Cobija. The Changos depended largely on shell-fish for food, and had balsas or rafts of poles and inflated seal-skins from which they fished along the shore. They wore little clothing, and had small crude huts of poles and thatch. Unlike the population of the coast farther north, the dead were buried at length, instead of flexed.

See E. Boman, *Antiquités de la Région Andéenne de la République Argentine et du Désert d'Atacama* (Paris, 1908).

CHANGRA or CANKIRI (anc. *Gangra;* called also till the time of Caracalla, *Germanicopolis,* after the emperor Claudius), the chief town of a vilayet of the same name in Turkey, situated in a rich, well-watered valley; altitude 2,500 ft. The ground is impregnated with salt and the town is unhealthy. Pop (1940) 10,235. Gangra, the capital of Paphlagonian kingdom of Deiotarus Philadelphus, son of Castor, was taken into the Roman province of Galatia on his death in 6–5 B.C. The earlier town was built on the hill behind the modern city, on which are the ruins of a late fortress; while the Roman city occupied the site of the modern. In Christian times Gangra was the metropolitan see of Paphlagonia.

Synod of Gangra.—Conjectures as to the date of this synod vary from 341 to 376. The synodal letter states that 21 bishops assembled to take action concerning Eustathius (of Sebaste?) and his followers, who contemned marriage, disparaged the offices of the church, held conventicles of their own, wore a peculiar dress, denounced riches, and affected especial sanctity. The synod condemned the Eustathian practices. The 20 canons of Gangra were declared ecumenical by the Council of Chalcedon, 451.

See Mansi ii. pp. 1095–1122; Hardouin i. pp. 530–540; Hefele 2nd ed., i. pp. 777 *sqq.* (Eng. trans. ii. pp. 325 *sqq.*).

CHANG TSO-LIN (1873–1928), Chinese military leader, born in the Province of Fengtien. Of humble origin and without education, he was successively a swineherd, a menial in the Catholic Mission at Newchang and a labourer on the Peking–Mukden Railway. Later he abandoned regular employment and rose to prominence in 1904 as a leader of *Hunghutse,* or Manchurian brigands, when he and his band became irregular allies of Japan during the Russo–Japanese War. After the Treaty of Portsmouth, under Japanese advice, he submitted to the Chinese Government, and he and his following were incorporated in the Chinese army. He received quick promotion, and attained command of a Division. In 1913 he was appointed *Tutuh,* later *Tuchun,* both terms denoting Military Governor, of Fengtien.

Chang Tso-lin faithfully served the young republic of China, and opposed both Yuan Shi-k'ai's monarchical aspirations in 1916 and Chang Hsün's attempted restoration of the Imperial dynasty in 1917. In 1918 he was appointed Inspector-General of the Three Eastern Provinces, *i.e.,* of Manchuria, and, while civil government slowly weakened, his military control became absolute. He adopted the course, unusual in China, of punctually paying, feeding and disciplining his troops, and by this means he became a dominant factor in the unstable politics of the country. In civil life his activities were boundless: mining, farming, stock-breeding, banking, railway construction, in these and many other forms of industrial enterprise, his hand was felt.

During the concluding twelve years of his life, while maintaining autocratic control of Manchuria, he made four descents upon Peking, actuated on each occasion by the desire to set up a stable form of government for the country. In 1920, when, during the halting and incapable Presidency of Hsu Shi-chang, the Government fell under the control of the reactionary militarists known as the Anfu Party, he drove their leaders into retirement, and, in co-operation with Tsao Kun, the Tuchun of Chihli, made an attempt to form an administration. Their efforts were fruitless, and in 1921 he again came to Peking and installed a Cabinet under Liang Shih-yi. Upon this occasion he was defeated by General Wu Pei-fu and driven back to Manchuria, whereupon he declared the independence of the Three Eastern Provinces. His third incursion took place in 1924, when large forces under Wu Pei-fu assembled near the Great Wall to repel the Manchurian invasion. Owing to the treacherous defection of Fêng Yu-hsiang, who withdrew to Peking and "declared for peace," Wu Pei-fu's forces collapsed, and Chang's army pressed forward, eventually occupying Shantung, Anhui and Kiangsu. In the latter part of this year he was occupied in suppressing the revolt of one of his lieutenants, by name Kuo Sung-ling, whom he defeated outside Mukden and executed. His final coming to Peking was in December, 1926, when he once more announced his intention to reorganize the Government. In June, 1927, he formed a Cabinet consisting entirely of his own adherents, with Pan Fu as Premier, he himself, under the title of Generalissimo, becoming President. He watched from Peking the victorious Southern Nationalist army reach the Yangtse, and their further advance in 1928 to Peking. His troops, after some show of defending the capital, received orders to stop further opposition, and Chang himself left for Mukden by train on June 3. Before he reached his destination the train was bombed and he succumbed to injuries received.

Soft-voiced and of delicate constitution, suave yet resolute, Chang Tso-lin would have been an admirable viceroy under the

Empress Dowager's régime. It was the only system of government he understood, and his failure to bring about union and a stable government is evidence of how far removed he was *au fond* from realizing the strides which the country had made in acquiring race-consciousness and a political sense. His administrative achievements in Manchuria, and his friendliness towards foreigners, are among his claims to be styled a Chinese patriot.

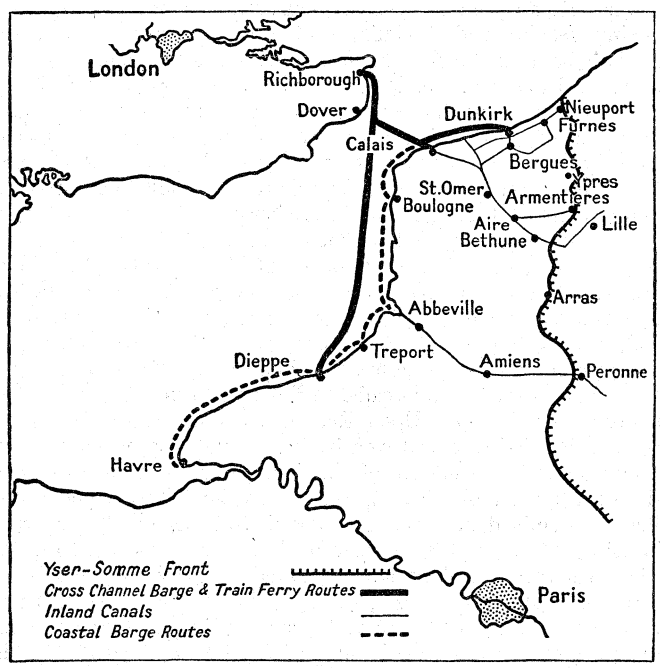
(W. E. L.)

CHANNEL FERRY. In the World War the necessity of utilizing the canals and waterways of France and Belgium for transport in order to relieve the pressure on the railways was early recognized, and to take over and develop this work behind the British lines the Inland Water Transport Section of the Royal Engineers was formed in 1914.

The activities of this new organization became so great that a similar organization (later the Directorate of Inland Waterways and Docks, Royal Engineers) was set up in England. The functions of this directorate expanded until it took in other branches of transport besides canal traffic, and included the supply and equipment for docks and harbours, and constructional work at various ports which formed bases for transport of munitions and materials for the British armies in all theatres of war.

To meet the growing demands from France for suitable craft, personnel, plant and stores in an efficient and economical manner, it was decided to establish a cross-channel barge port and stores depot, from which barges capable of navigating the French canals could be sent across loaded. Richborough in Kent was chosen.

The site had many advantages. It was:—(*a*) directly opposite the ports and canals of northern France (*see* Map); (*b*) within easy access of a main railway system; (*c*) a flat, low-lying, unoccupied ground of over 2,000 acres, capable of being developed without interfering with any vested interests, or existing traffic



MAP SHOWING THE CROSS-CHANNEL BARGE AND TRAIN FERRY ROUTES ESTABLISHED BY THE BRITISH GOVERNMENT DURING THE WORLD WAR TO TRANSPORT MUNITIONS AND STORES TO THE WESTERN FRONT

or other port facilities; (*d*) situated on a tidal river with a sheltered entrance; (*e*) comparatively inaccessible to enemy naval raids.

The development of Richborough was remarkably rapid and by 1917—although the primary object of its existence was the cross-channel barge traffic—it had grown into a large and well equipped seaport and workshop base with three-quarters of a mile of wharves and 7om. of railway sidings capable of dealing with 30,000 tons of traffic per week; with extensive engineering workshops and foundries where urgent repair work which could not be carried out in the war areas was done; a spacious salvage transit yard where the sorting, storage and dispatch of salvage was carried on by female labour; large store warehouses from which consumable stores, plant, and other material were dispatched overseas at a moment's notice; camp accommodation for 15,000 troops and a regimental depot for the reception, equipment, training and disposal of all personnel recruited for the Inland Waterways and Docks for service at home and in the various theatres of war.

These works were constructed by military labour, especially recruited from skilled trades and working under the supervision of technical officers. The recruits, large numbers of whom were of low medical category, after being given a short military training at the regimental depot were passed on for duty and intensive training to one or other of the formations, *e.g.*, construction, workshops, railway traffic, marine or stores, from which they were drafted overseas for similar service as and when required, 1,200 officers and 51,000 other ranks passing through in this way.

Cross-Channel Barge Service.—The expansion of Richborough into a transportation base and the establishment of the channel barge service—carried on without a break day or night until the Armistice with barges specially designed for the crossing and for navigating the French waterways—was an enormous relief to ordinary shipping and the following advantages were also obtained:—(*a*) Relief of congestion at French ports as barges passed straight through to inland depots with consequent avoidance of double handling; (*b*) return of barges from war zone loaded with salvage; (*c*) saving of railway carriage in France; (*d*) relief to English ports; (*e*) disposal of both marine and war risks into smaller units; (*f*) no naval patrol necessary.

The total exports by barge up to the armistice exceeded $3\frac{1}{4}$ million tons and the total imports of salvage half a million.

A fleet of 386 craft was controlled from Richborough including 67 sea-going tugs and 255 200-ton barges. Over 20,000 cross-channel trips were made and it is interesting to note that no craft was lost as the result of enemy action, though some sustained casualties when in canals close up behind the British lines.

Train Ferry Service.—Late in 1916, the serious shipping position, the increasing demand from France for supplies, and the delays in the channel ports owing to inadequate appliances for handling heavy cargo, led to the decision to establish a train ferry service on the Richborough cross-channel route to enable heavy war material to be run direct on rail from factories to war areas.

In Jan. 1917 orders were placed for three train ferry vessels capable of carrying 54 fully loaded ten-ton trucks or as many guns, tanks, locomotives, or other vehicles as could be arranged on the four deck-tracks, or a total load of 960 tons.

Terminals and berths for these vessels were built at Richborough, Southampton, Dunkirk, Calais and Dieppe; the method of communication between ship and shore being a double track self-adjusting bridge hinged at the shore end.

The service from Richborough to Calais began in February 1918 and was carried on without mishap and without convoy. The vessels were good seaboats and crossed in all but the most severe weather. As a transport unit they were of immense value. Their first cargoes were heavy wagons, 340 of which were taken across in seven trips (averaging 12 hours each). Previously it had taken a 3,600-ton steamer one month to convey 300 wagons. It is estimated that the three ferry boats released six 8,000 ton ocean-going steamers, whilst an enormous economy was effected in the avoidance of double transhipment. One of the outstanding features of the service was the ease and rapidity with which the vessels were loaded and unloaded—the time averaging less than 25 minutes per trip. After the disaster of March 21, 1918, when some 600 British guns were lost, over 700 guns were shipped by train ferry within 48 hours to replace them. In May 1918 two 14-inch guns on railway mountings, each weighing 302 tons and measuring 87ft. overall, were taken over safely and run up to the front without the necessity of dismantling in England and re-erecting in France. In his dispatch of Jan. 7, 1919, F.M. Sir Douglas Haig said, "During the period following the great defensive battles, up to the final triumph of the Allied cause the channel ferry has proved of inestimable value."

After the war the port at Richborough was acquired by an

industrial group with interests in the Kent coalfields. In Oct. 1936 a passenger train ferry service was opened between Dover and Dunkirk. (A. J. A. W.; X.)

CHANNEL ISLANDS, a group of islands in the English channel (French, *Îles Normandes*), belonging (except the Îles Chausey) to Great Britain. They lie across the shallow rectangular bay formed by the west coast of the department of Manche (France) and the north coast of Brittany. This bay is strewn with numerous small islands and rocks and, owing to the concentration of the tidal wave in it, has dangerous tidal races. The total land area of the islands is about 75 sq.mi. and the population (1931) 93,205. There are four principal islands:—Jersey (area 44.87 sq.mi., pop. 49,127), Guernsey (area 24.46 sq.mi., pop., with associated islands, 42,138), Alderney (area 3.06 sq.mi.), Sark (area *c.* 2 sq.mi.). The population figures exclude visitors. St. Helier is the chief town of Jersey, St. Peter Port of Guernsey and St. Anne of Alderney: the first two are ports. Normally there is communication by steamer on alternate days in winter, and daily in summer from Southampton and Weymouth with Guernsey and Jersey, and on certain days from French ports, especially from St. Malo with Jersey and Guernsey, and from Cherbourg with Alderney and Guernsey. Communications are maintained between the larger islands. A daily air service between Jersey and Southampton and London was opened in 1933.

Structurally, the islands are a partially submerged portion of the Armorican massif and fall into four groups related to old fold lines running west from the Cotentin peninsula. The most northerly group, comprising Alderney, Burhou, Ortac, the Casquets and numerous other islets, lies due west of Cap de la Hague. The Casquets, on which has been built a powerful lighthouse, were formerly dangerous to ships, notable wrecks being that of the "White Ship" (according to tradition) in 1120, the "Victory" in 1744 and the "Stella" in 1899. The second and most westerly group includes Guernsey, with a few islets to the west, and to the east, Sark, Herm, Jethou (inhabited islands) and others. The straits of Little Russel and Great Russel separate Guernsey and Herm, and Herm and Sark respectively. Sark is famous for its cliffs and caves. Herm has a remarkable shell beach, half a mile long, formed in a tidal eddy north of the island. The third group, southeast of the second, and separated from it by La Déroute strait, includes Jersey and a few small islets, of which Les Écréhou to the northeast are the chief. The fourth group consists of the Minquiers, lying almost 12 mi. S. of Jersey, and the Îles Chausey, lying almost 9 mi. N.W. of Granville, in which commune they are included. Maîtresse Île, the largest of the Minquiers, provides landing and shelter to fishermen. Of the Chausey islands Grande Île is permanently inhabited by farmer-fishermen, and the other islets temporarily by fishermen. Sea-weed burning and granite-quarrying also occupy some of the inhabitants. The dominant east-west structural lines of Armorica are broken by north to south lines, a net-work only partially obscuring certain northeast to southwest lines, and in the fine coastal scenery of the islands and in their vertical cliffs, rectangular bays and intervening channels is repeated the structural "pattern" of the whole massif. When the coast stood at the 30-fathom line, the islands formed a projection of the French coast, but before the 20-fathom line had become the coast line the Alderney group had become separate from the continent. Before the 10-fathom line had become the coast the Guernsey group had also been separated. There is only shallow water between the Jersey and Chausey groups and the mainland, and legend ascribes invasions of the sea to Post-Roman times, though this is considered doubtful. Raised beaches of uncertain date are evidence of downward movements beyond the present levels, while there are evidences of submerged forests at St. Ouen's Bay (West Jersey) and Vazon Bay (West Guernsey).

Geology.—Geologically the Channel islands are closely related to the neighbouring mainland of Normandy. With a few exceptions all the rocks are pre-Cambrian. They consist of massive granites, gneisses, diorites, porphyrites, schists and phyllites; dykes and veins are abundant. In Jersey there is in the northwest corner a granitic tract extending from Grosnez to St. Mary and St. John, beyond which it passes into a small granulitic patch. South of the granites is a schistose area, by St. Ouen and St. Lawrence, and reaching to St. Aubin's Bay. Granitic masses again appear round St. Brelade's bay. The eastern half of the island is largely occupied by porphyrites and similar rocks with rhyolites and devitrified obsidians; a complex igneous and intrusive series of rocks lies around St. Helier. In the northeast corner of the island a conglomerate, possibly of Cambrian age, occurs between Bouley bay and St. Catherine's bay. Tracts of blown-sand cover the ground for some distance north of St. Clement's bay and again east of St. Ouen's bay. The northern half of Guernsey is mainly dioritic; the southern half, from St. Peter, is occupied by gneisses. Several patches of granite and granulite fringe the western coast; the largest of these is a hornblende granite around Rocquaine bay. Hornblende gneiss from St. Sampson and quartz diorite from Capelles, Corvée and elsewhere have long been transported to England for road metal. Sark is composed almost wholly of hornblende-schists and gneisses, with hornblende granite in North Sark and middle Brechou and diorite in Little Sark and west Brechou. In Alderney we have Cambrian grits stretching from Corblets bay (northeast) to l'Étac à la Quoiré (east) overlain by modern sands at Longy, with a small outlier opposite Coque Lihou. The island, west of the main area of grits, is diorite with granite round the coast (hornblendic at Crabby and Tourgis, inclining to gabbro at Rozelle, where it is quarried, and fine-grained with rare hornblende and biotite at Bibette head, Saye bay and Corblets bay). The island south and west of a line from Tourgis point to Noir Roque is granite-porphyry faulted against diorite round the coast.

Flora and Fauna.—The flora of the islands is rich, producing more than 2,000 different species of plants. Timber is scarce, but the evergreen oak, the elm and the beech are common. Root crops are more important than grain. The tomato is a field crop in Jersey and a greenhouse crop in Guernsey. Grapes and peaches ripen in greenhouses without artificial heat and figs out of doors. Such plants as arbutus, camellia, myrtle and magnolia flourish. The Guernsey lily with its rich red petals is said to have come from Japan.

The distribution of animals in the islands illustrates the later separation of Jersey from the continent, and points also to the northward advance of animals following the retreat of the ice. Thus Jersey has the toad, the grass snake, the green lizard, the newt and the mole. The mole has reached Alderney and Sark, but not Guernsey. Squirrels, hares and foxes formerly inhabited Jersey, but never Guernsey; Guernsey, in common with the other islands, has the frog, the slowworm and the rabbit. The red deer was once indigenous, and the black rat is still found in Alderney, Sark and Herm. The birds number more than 200 species, the variety of fish is very great and crustacea, molluscs, including *Haliotis,* and zoophytes abound round the coasts.

Government.—For purposes of government the Channel islands (excluding the Chauseys) are divided into two divisions:—(1) Jersey, and (2) the bailiwick of Guernsey, which includes Alderney, Sark, Herm and Jethou. The constitution of each division is broadly the same. Until 1854 governors were appointed by the crown; now a separate military lieutenant-governor is appointed for each division on the recommendation of the British war office after consultation with the home office. The other crown officials are the bailiff (*bailli*) or chief magistrate, the *procureur du roi,* representing the attorney-general, and the *avocat du roi,* or in Guernsey the *contrôlleur,* representing the solicitor-general. In Jersey the *vicomte* is also appointed by the crown, in the position of a high sheriff (and coroner); but his counterpart in Guernsey, the *prévôt,* is not so appointed. The bailiff in each island is president of the royal court, which is composed of twelve jurats, elected for life, in Jersey by the ratepayers of each parish, in Guernsey by the elective states, a body which also elects the *prévôt,* who, with the jurats, serves upon it. The rest of the body is made up of the rectors of the parishes, the *douzaines,* or elected parish councils ("dozens," from the original number of their members) of the town parish of St. Peter Port, and of its four cantons, and the country parishes, and certain other officials. The royal court administers justice (but in Jersey there is a trial

by jury for criminal cases) and in Guernsey can pass temporary ordinances subject to no higher body. It also puts forward *projets de loi* for the approval of the Deliberative States. Jersey and Guernsey have stipendiary magistrates for police matters. Alderney and Sark have a separate legal existence with courts dependent on the royal court of Guernsey. In both Jersey and Guernsey the chief administrative body is the Deliberative States. The Jersey States is composed of the lieutenant-governor (with right of veto, but no vote), the bailiff, jurats, parish rectors, parish *connétables* and deputies, the *procureur* and *avocat* (with right to speak but no vote) and the *vicomte* (with right of attendance only). If the bailiff dissents from any measure, it is referred to the privy council. In Guernsey the States consists of the bailiff, jurats, eight out of ten rectors, the *procureur* and deputies; the lieutenant-governor is invited and may speak. Both States administer local affairs; relations with the British parliament are maintained through the privy council. Acts of parliament are transmitted to the islands by an order in council to be registered in the rolls of the royal court and are not binding until this is done; registration may be held over pending discussion by the States if any act is considered to menace the privileges of the islands. The right of the crown to legislate by order in council is limited in the same way. In cases of encroachment on property, an ancient form of appeal called *Clameur de Haro* survives (*see* HARO, CLAMEUR DE). The islands are in the diocese of Winchester, and there are deans in both Jersey and Guernsey, also rectors of a parish.

These peculiar constitutions are of local development and represent adaptations of Norman feudal schemes to remote communities under lords who in many cases were absentees; views as to the origin of the jurats differ but they are an ancient institution; the practice of summoning the States to assist in the passing of ordinances was established later by the bailiff and jurats, and at last the States claimed the absolute right (confirmed 1771) of being consulted. Compulsory service in the militia was established and garrisons of regular troops maintained. Taxation is light in the islands, and pauperism is practically unknown.

For the year ended Jan. 31, 1939 the revenue of Jersey was £520,022, and its expenditure £533,873; the revenue of Guernsey for the previous year was £433,659 and the expenditure £425,242. The public debt in the respective islands and years was £1,271,190 and £1,514,514. Crown revenues from Jersey include seigneurial dues and revenues from houses, lands and tithes. For Guernsey there are seigneurial dues and in some cases dues paid on transference of property. From Alderney the crown receives chiefly harbour dues. These revenues are all small. English coinage is current, but Jersey has a local copper coinage and local one-pound notes. Guernsey also has such notes, and its copper coinage consists of pence, half-pence, two-double and one-double (one-eighth of a penny) pieces. During World War I the islands provided a large contingent of men, and in 1917 the imperial government temporarily relieved insular funds of the cost of the local militia. Jersey subsequently contributed £400,000 and Guernsey £350,000 to the expenses of the war.

Industry.—The Norman system of land tenure, which still survives in the islands, seems to have been superimposed upon a primitive open-field system of cultivation. Traces of the original system are to be found in Alderney. The soil is extremely fertile. "Vraic" (sea weed), either green or in the form of ash, has been used as a fertilizer from time immemorial. The cutting of the Vraic became a ceremonial occasion, taking place at times fixed by the government and connected with popular festivities. Small holdings with intensive cultivation are characteristic of all the islands. Jersey specializes in early potatoes, Guernsey in vegetables grown under glass and in bulbs and flowers. Other important industries are stock-raising (Jersey and Guernsey each has a special breed of horned cattle and its own herd book), fishing and quarrying. Cattle from abroad are not admitted alive, nor Jersey cattle in Guernsey nor Guernsey cattle in Jersey. Total exports from Jersey, mainly potatoes, granite, tomatoes and cattle, were valued at £2,138,000 in 1938. In the same year exports from Guernsey were mainly tomatoes (34,964 tons), cut flowers (3,721 tons) and vegetables (1,856 tons). Jersey imports were valued at £3,329,000 and consisted mostly of coal, paraffin and fuel, and alcoholic beverages, followed by manures and cement. Imports of Guernsey were mainly timber, cement, lime, etc., metals and machinery and manure. The two main sources of income are agriculture and the tourist trade. There is some commerce with France in farm produce and fruit.

Language.—The old Norman French *patois* is dying out. Modern French is the official language, but English is the main language of business and religion and is familiar to all. Each island has its own *patois;* local differences are also observable as between north and south Guernsey. None of the dialects has received much literary cultivation. Jersey was the birthplace of the Norman poet Wace (12th century).

History.—Mousterian man is known to have occupied caves in Jersey, then a part of the mainland. Of early inhabitants abundant proof is afforded by the numerous megalithic monuments, dolmens, kistvaens and menhirs still extant. Some of these are of great importance and have been scientifically studied; the local museums are of great value. Little trace has been left of Roman occupation, and such remains as have been discovered are mainly of the portable description that affords little proof of actual settlement. The constant recurrence of the names of saints in the place-names of the islands, and the fact that pre-Christian names do not occur, leads to the inference that when Christianity was introduced the population was scanty. Christianity may have been introduced in the 5th century. Guernsey is said to have been visited in the 6th century by St. Sampson of Dol (whose name is given to a small town and harbour in the island), St. Marcou or Marculfus and St. Magloire, a friend and fellow-evangelist of St. Sampson, who founded monasteries at Sark and at Jersey and died in Jersey in 575. Another evangelist of this period was St. Helerius, whose name is borne by the chief town of Jersey, St. Helier. In his life it is stated that the population of the island when he reached it was only 30. In 933 the islands were made over to William, duke of Normandy (d. 943). Modern research shows that by 1177 (how long previously is not known) Guernsey and Jersey formed one administrative unit, and were identical with the rest of Normandy. Herm (belonging to the Abbey of Notre Dame du Voeu, Cherbourg) and Jethou (belonging to Mt. St. Michel) may have been under the jurisdiction of Guernsey. Alderney and Sark were separate units, each with its own overlord. After the conquest of England by Normandy it was the policy of the islands to play off one country against the other, meanwhile developing their own independence.

In the reign of John of England the future of the islands was decided by their attachment to the English crown, in spite of the separation of the duchy of Normandy. To John it has been usual to ascribe a document at one time regarded by the islanders as their Magna Carta, but modern criticism leaves little doubt that it is not genuine. An unauthenticated "copy" of uncertain origin alone has been discovered, and there is little proof of there ever having been an original. The reign of Edward I was full of disturbance; and in 1279 Jersey and Guernsey received from the king, by letters patent, a public seal as a remedy for the dangers and losses which they had incurred by lack of such a certificate. Edward II found it necessary to instruct his collectors not to treat the islanders as foreigners: his successor, Edward III, fully confirmed their privileges, immunities and customs in 1341; and his charter was recognized by Richard II in 1378. In 1343 there was a descent of the French on Guernsey; the governor was defeated and Castle Cornet besieged. In 1372 there was another attack on Guernsey, and in 1374 and 1404 the French descended on Jersey. None of these attempts, however, resulted in permanent occupation. Henry V confiscated the alien priories which had kept up the same connection with Normandy as before the conquest and conferred them along with the regalities of the islands on his brother, the duke of Bedford. During the Wars of the Roses, Queen Margaret, the consort of Henry VI, made an agreement with Pierre de Brézé, comte de Maulevrier, the seneschal of Normandy, that if he afforded assistance to the king, he should hold the islands independently of the crown. A force was accordingly sent to take possession of Mont Orgueil. It was

captured and a small part of the island subjugated, and here Maulevrier remained as governor from 1460 to 1465; but the rest held out under Sir Philip de Carteret, seigneur of St. Ouen, and in 1467 the vice-admiral of England, Sir Richard Harliston, recaptured the castle and brought the foreign occupation to an end. In 1482–1483 Pope Sixtus IV, at the instance of King Edward IV, issued a bull of anathema against all who molested the islands; it was formally registered in Brittany in 1484 and in France in 1486; and in this way the islands acquired the right of neutrality, which they retained till 1689. In the same reign (Edward IV) Sark is said to have been taken by the French, and only recovered in the reign of Mary. By a charter of 1494 the duties of the governors of Jersey were defined. Religious houses were dissolved, as in England, in the reign of Henry VIII. The Reformation was welcomed in the islands, and the English liturgy was translated into French for their use. There was much religious persecution in the reigns of Mary and Elizabeth. In 1568 the islands were transferred from the see of Coutances to that of Winchester, being finally separated from that of Coutances, with which they had long been connected.

The Presbyterian form of church government was adopted under the influence of refugees from the persecution of Protestantism on the continent. It was formally sanctioned in St. Helier and St. Peter Port by Queen Elizabeth; and in 1603 King James enacted that the whole of the islands "should quietly enjoy their said liberty." During his reign, however, disputes arose. An episcopal party had been formed in Jersey, and in 1619 David Bandinel was declared dean of the island. A body of canons which he drew up agreeable to the discipline of the Church of England was accepted after modification by the people of his charge; but the inhabitants of Guernsey maintained their Presbyterian practices. Of the hold which this form of Protestantism had got on the minds of the people even in Jersey, abundant proof is afforded by the general character of the worship.

In the great struggle between king and parliament, Presbyterian Guernsey supported the parliament; in Jersey, however, there were at first parliamentarian and royalist factions. Sir Philip de Carteret, lieutenant-governor, declared for the king, but Dean Bandinel and Michael Lemprière headed the parliamentary party. They received a commission for the apprehension of Carteret, who established himself in Elizabeth Castle; but after some fighting he died in the castle (1643). Meanwhile in Guernsey Sir Peter Osborne, the governor, was defying the whole island and maintaining himself in Castle Cornet. A parliamentarian governor, Leonard Lydcott, arrived in Jersey immediately after Sir Philip de Carteret's death. But the dowager Lady Carteret was holding Mont Orgueil; George Carteret, Sir Philip's nephew, arrived from St. Malo to support the royalist cause, and Lydcott and Lemprière fled to England. George Carteret established himself as lieutenant-governor and bailiff.

Bandinel was imprisoned in Mont Orgueil and killed himself in trying to escape. Jersey was now completely royalist. In 1646 the prince of Wales, afterward Charles II, arrived secretly at Jersey and remained more than two months at Elizabeth Castle. He went on to France, but returned in 1649, having been proclaimed king by George Carteret, and at Elizabeth Castle he signed the declaration of his claims to the throne on Oct. 29. In 1651, when Charles had fled to France again after the battle of Worcester, parliamentarian vessels of war appeared at Jersey. On Dec. 15 the royalist remnant yielded up Elizabeth Castle; and at the same time Castle Cornet, Guernsey, which had been steadily held by Osborne, capitulated. Both islands had suffered severely, and the people of Guernsey, appealing to Cromwell on the ground of their support of his cause, complained that two-thirds of the land was out of cultivation and that they had lost "their ships, their traffic and their trading." In the reign of James II the islanders got a grant of wool for the manufacture of stockings—4,000 tods of wool being annually allowed to Jersey, 2,000 to Guernsey, 400 to Alderney and 200 to Sark. Alderney, which had been parliamentarian, was granted after the Restoration to the Carteret family; and it continued to be governed independently till 1825.

William of Orange abolished the neutrality of the islands in 1689, and during the war of 1778–1783 there were two unsuccessful attacks on Jersey, in 1779 and 1781, the second, under Baron de Rullecourt, being famous for the victory over the invaders due to the bravery of the young Major Peirson, who fell when the French were on the point of surrender. During the revolutionary period in France the islands were the home of many refugees. In the 18th century various attempts were made to introduce the English custom house system but proved practically a failure, and the islands throve on smuggling and privateering down to the Napoleonic wars, Jersey being also interested in the Newfoundland fisheries, as place names in that region testify. The 19th century brought some prosperity from maritime commerce so long as wooden sailing ships were in general use. Later, intensive cultivation for export to English markets caused unprecedented development. The encouragement of the tourist traffic, with the establishment of airports on the three main islands, was a contributing factor.

During World War II, following the fall of France, the islands were occupied by Germany—Guernsey on June 30, 1940, and Jersey on July 1. Shortly before, large parts of the civilian population and the military garrison were evacuated, and in 1942 it was estimated that there were 30,000 island refugees in Britain. Those who remained were subject to considerable hardships through lack of salt, soap, food of various kinds, clothing, shoe leather, etc. The government continued to function but only under German authority. Labour had to be provided free to Germans, according to their requirements. Many residents, not native-born islanders, were deported to Germany and interned, the number involved being estimated at about 2,000.

BIBLIOGRAPHY.—P. Falle, *Account of the Island of Jersey* (1694; notes, etc. by E. Durell, Jersey, 1837); J. Duncan, *History of Guernsey* (1841); F. B. Tupper, *History of Guernsey and its Bailiwick* (2nd ed., Guernsey, 1876); S. E. Hoskins, *Charles II in the Channel Islands* (1854), and other works; C. LeQuesne, *A Constitutional History of Jersey* (London, 1856); Delacroix, *Jersey, ses antiquités*, etc. (Jersey, 1859); G. Dupont, *Le Cotentin et ses îles* (Caen, 1870–1885); J. P. E. Havet, *Les Cours royales des Îles Normandes* (1878); E. Pégot-Ogier, *Histoire des Îles de la Manche* (1881); C. Noury, *Géologie de Jersey* (Paris and Jersey, 1886); Laurent-Carey, *Essai sur les Institutions, Lois et Coûtumes de l'Île de Guernesey* (Guernsey, 1889); D. T. Ansted and R. G. Latham, *Channel Islands* (1865; 3rd ed., rev. by E. T. Nicolle, 1893); Sir E. MacCulloch, *Guernsey Folklore* (ed. Edith F. Carey, 1903); Société Jersiaise, Rolls of the Assizes, 1304; Louis Selosse, *L'île de Serk* (Lille, 1928); J. Sinel, *Geology of Jersey* (Jersey, 1929); E. F. Carey, *Channel Islands* (1924); R. Besnier, *La Coûtume de Normandie: histoire externe* (Paris, 1935, pp. 250–70); J. H. LePatourel, *Mediaeval Administration of the Channel Islands, 1199–1399* (Oxford, 1937); Société Jersiaise, Bulletin Annual; Société Guernesiaise, Report and Transactions.

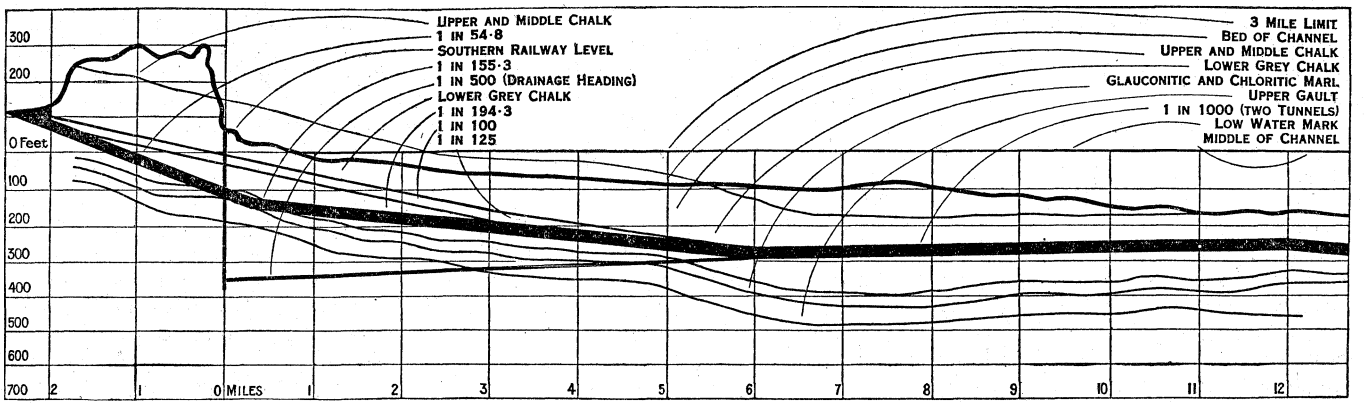
CHANNEL TUNNEL. A tunnel under the English channel would be one of the engineering wonders of the world, and the longest ever made. The Simplon tunnel through the Alps is 12 miles long; the channel tunnel would be over 30 miles long, of which more than 20 would be under the open sea. The authors of the channel tunnel scheme are confident that it could be made successfully, and their proposals may be thus summarized:—

Construction.—The tunnel would consist of two tubes or tunnels of about 20 ft. diameter, driven about 50 ft. apart and connected by frequent cross galleries. The tunnel would start in France near Wissant, between Boulogne and Calais, and in England behind the Shakespeare cliffs between Dover and Folkestone. The total length would be 31 miles.

The trains would be worked by electricity, and the power station would be situated in Kent at some miles distance from the sea.

The train time in such a tunnel would be about three-quarters of an hour and if luggage were examined on trains the 30 or 40 minutes wasted in embarking and disembarking would be saved and the journey to Paris shortened by an hour and a half.

A tube of about 10 ft. diameter would first be driven from shore to shore to serve as a drainage tunnel and to take a light railway. Chambers would be excavated near the middle, and by this means additional facings would be provided for driving the two railway tunnels and the time of construction would thus be greatly shortened.

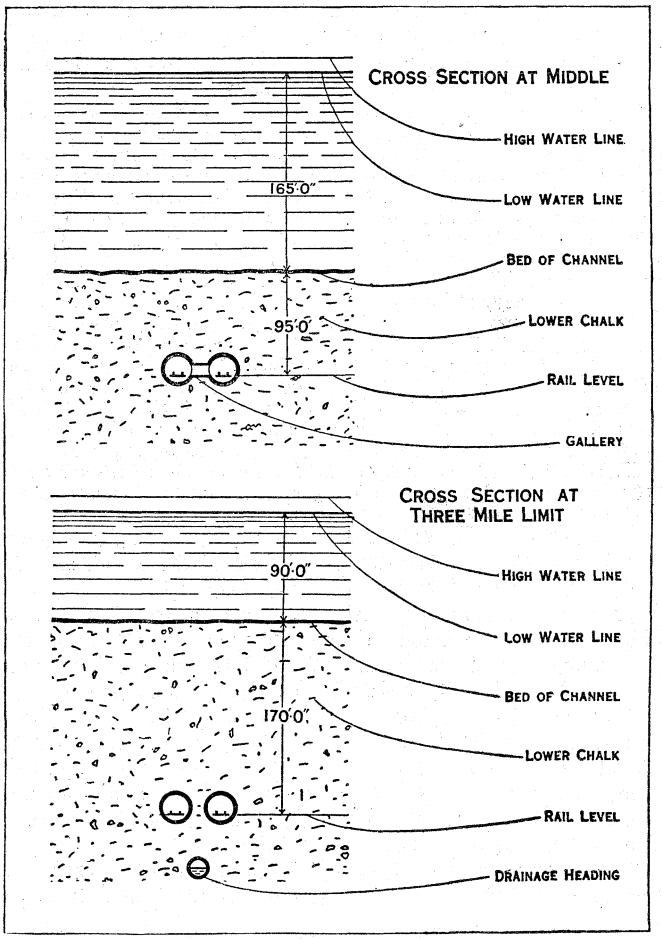


BY COURTESY OF THE CHANNEL TUNNEL COMPANY

FIG. 1.—ENGLISH HALF, SHOWING SECTION OF TUNNEL FROM BEHIND DOVER CLIFFS TO MID-CHANNEL. THE TUNNEL WOULD INCLUDE TWO TUBES IN THE IMPERMEABLE GREY CHALK, AND DRAINAGE HEADING WITH SHAFT ON THE SHORE, WHERE THE WATER WOULD BE PUMPED UP INTO THE SEA

The estimated time for the whole work is five to six years.

Cost.—The cost is estimated at between 25 and 30 million pounds. It is proposed that one-half the cost be borne by each country. The French companies interested in the scheme believe that it would be financially very profitable—perhaps a second Suez canal—and they have offered, if desired, to find the whole capital,



BY COURTESY OF THE CHANNEL TUNNEL COMPANY

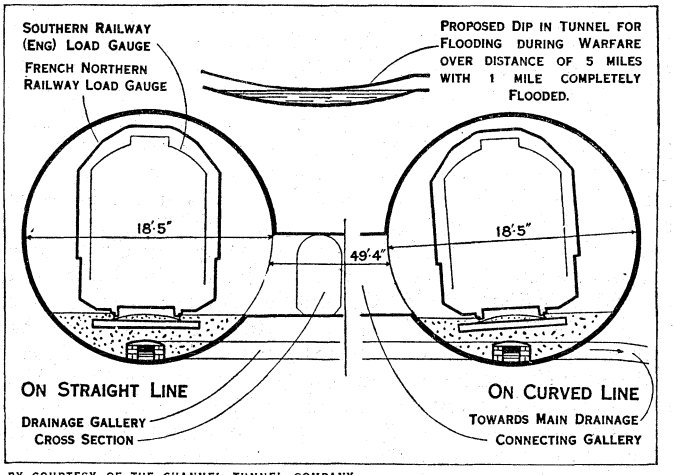
FIG. 2.—CROSS SECTIONS OF THE PROPOSED CHANNEL TUNNEL

but the English companies would not entertain the idea and parliament would not be likely to sanction it.

The tunnel would be bored in the bed of grey chalk which outcrops on the cliffs on both sides, and which, the geologists say, continues right across the straits. Two preliminary tubes, each 1¼ miles long, have been driven from Sangatte near Calais and from the shore under Shakespeare cliff, where the old works can be seen from the railway between Folkestone and Dover. Although these tubes were not lined, the percolation of water into them has been almost nil. The railway tunnels would be lined with steel throughout like the London tubes.

The size of the tunnels would permit the passage of the largest continental express carriages with sleeping and restaurant cars. That English rolling stock can run on the continent was proved during the World War, but the broader and loftier French cars are too big for the English platforms and tunnels and bridges.

The Southern railway, to meet this difficulty, propose to build a new electric railway direct from London to Dover to carry the continental traffic only. It would avoid the towns and be without stations. The present railway lines would be quite unequal to the work of carrying the traffic expected, and the new line should save



BY COURTESY OF THE CHANNEL TUNNEL COMPANY

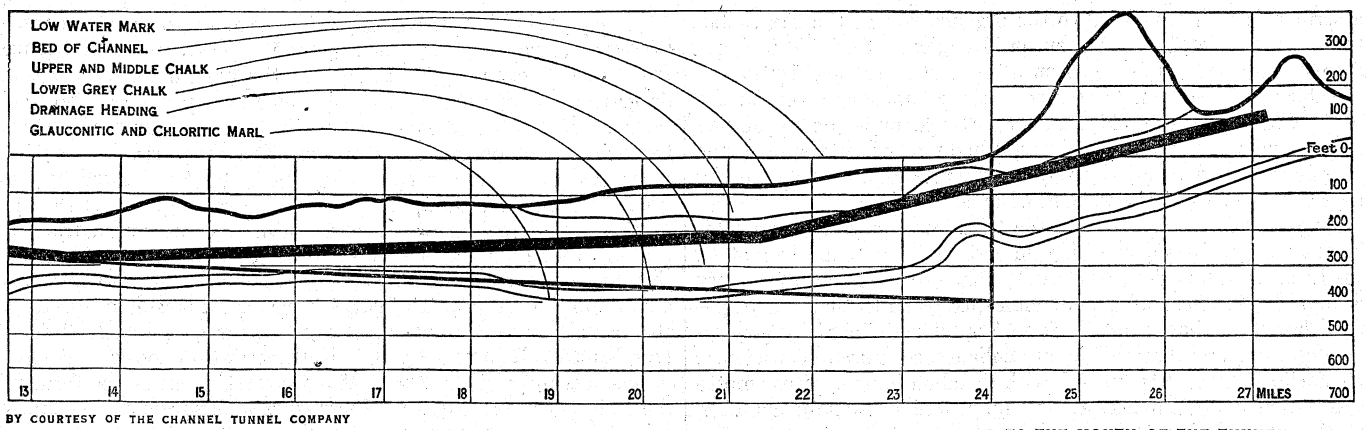
FIG. 3.—DETAILS OF THE PROPOSED TWIN CHANNEL TUNNEL, SHOWING CONNECTING GALLERY AND DRAINAGE HEADING, ALSO DIFFERENCE IN THE SIZE OF ENGLISH AND CONTINENTAL ROLLING STOCK

another half hour on the journey. Victoria station is too small for the present traffic and cannot well be enlarged. A new continental terminus would therefore have to be built, probably at the junction of Waterloo bridge road and Stamford street.

From this station would run the half hourly service to Paris, the great international expresses to Berlin and Russia, to Brussels, Vienna, and Constantinople, to Rome and Naples, to Madrid and Lisbon, to Biarritz and to the Riviera and Switzerland.

It is a great project, comparable only to the Suez and Panama canals, and one which would do much to ensure the prosperous future of London and England.

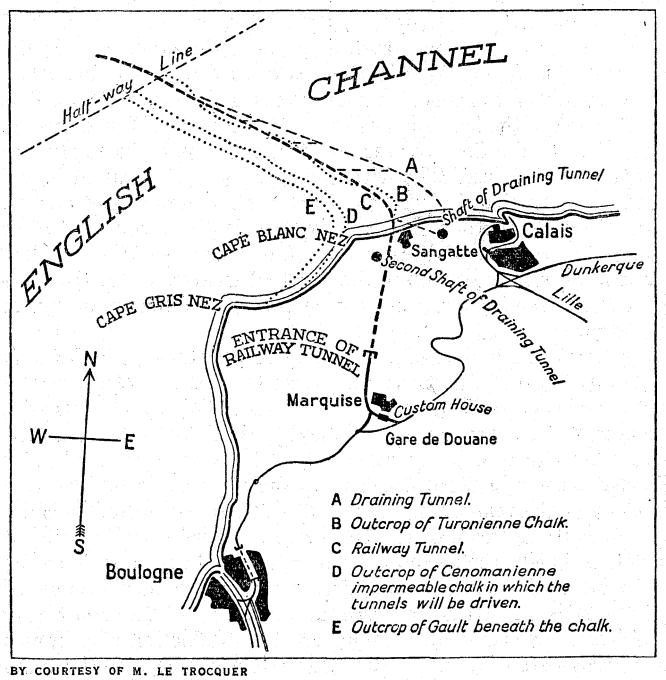
History of the Project.—The history of the channel tunnel is sad, dreary, and confused reading. It reflects no credit on any one concerned except the engineers who have perfected the scheme. A French engineer, Thomé de Gamond (1807–75) in 1856 submitted to Napoleon III. the first scheme for a channel



BY COURTESY OF THE CHANNEL TUNNEL COMPANY

FIG. 4.—LONGITUDINAL SECTION OF FRENCH HALF, SHOWING LEVEL OF TUNNEL FROM MID-CHANNEL TO THE MOUTH OF THE TUNNEL IN FRANCE, BEHIND CAP BLANC NEZ, BETWEEN CALAIS AND BOULOGNE, WITH DRAINAGE HEADING AND SHAFT FOR PUMPS ON SEA-SHORE NEAR SANGATTE

tunnel, and he was joined in his work by our great engineers, Isambard Brunel, Joseph Lock, and Robert Stephenson, and later by Sir John Hawkshaw. Queen Victoria and the prince consort were enthusiastic, and the project was seriously taken up by the railway companies on each side of the channel. A convention with the French Government to regulate it was signed in 1875. Then the bitter rivalry of the South Eastern and the Chatham and Dover railway companies created difficulties. The politicians began to play their part. Gladstone, John Bright, Lord Lansdowne, and Lord Salisbury were keen supporters; Joseph Chamberlain and the War Office opposed. The subject was referred to a joint select committee of the Commons, which considered many reports by generals in favour of the proposal and a memorandum by Lord Wolseley, which was a philippic against it. They decided against



BY COURTESY OF M. LE TROCQUER

FIG. 5.—PLAN OF THE FRENCH PORTION OF PROPOSED CHANNEL TUNNEL, SHOWING POSITION OF CUSTOM HOUSE, JUNCTION WITH THE NORTHERN RAILWAY OF FRANCE, AND THE ROUTE OF THE TUNNEL TO MID-CHANNEL.

the proposal by 6 to 4, Lord Lansdowne, the chairman, voting with the minority. Since that date the succeeding British Governments have all opposed the scheme.

Bleriot landed in his aeroplane at Dover in 1909, and a spontaneous movement in the House of Commons resulted in the formation of a channel tunnel committee which ultimately numbered over 400 members of parliament, under the chairmanship of Sir Arthur Fell. The Labour Party joined *en bloc*, and Mr. Asquith promised to have enquiries made. The World War broke out and nothing could be done. Mr. Lloyd George promised to make more enquiries. Mr. Bonar Law and Mr. Baldwin made no move. Mr. MacDonald in July 1924 offered to consult all the living ex-Prime Ministers. The five met, and, after a 40 minutes meeting, rejected the project, although a majority amongst M.P.s of two to one supported it. Mr. Winston S. Churchill in an article in the *Weekly Dispatch* (July 27, 1924), wrote: "There is no doubt about their promptitude. The question is: Was their decision right or wrong? I do not hesitate to say it was wrong."

So the channel tunnel scheme was again shelved, but it cannot be killed. It is unquestionably the greatest engineering proposal before the world and in the words of Marshal Foch spoken at a gathering at the Cercle Interallie, Paris, in 1922: "If the channel tunnel had been built it might have prevented the war, and in any event it would have shortened its duration by one half."

The French Channel Tunnel Company has a concession from their Government and can resume work at any moment, but the English Channel Tunnel Company can do nothing without an act of parliament to which no British Government has yet consented.

BIBLIOGRAPHY.—*Blue Book*, Joint Select Committee, Report and Evidence, 1883 (47); "Le Tunnel sous-marin," Albert Sartiaux, gen. man. Nord railway of France, *Revue des Deux Mondes*, Oct. 1913; "Channel Tunnel," paper read to Royal Society of Arts, Dec. 17, 1913, Arthur Fell, M.P.; *Military Aspect of the Tunnel*, Lord Sydenham of Combe, June 29, 1914; Article *Weekly Dispatch*, July 27, 1924, Winston S. Churchill; "Engineering Features of Channel Tunnel," Paper, Institute of Structural Engineers, May 6, 1927, Yves le Trocquer. (A. F.)

CHANNING, WILLIAM ELLERY (1780–1842), American divine and philanthropist, was born in Newport (R.I.), April 7, 1780. Channing seemed to have inherited from his father sweetness of temper and warmth of affection, and from his mother that strong moral discernment and straightforward rectitude of purpose and action which formed striking features of his character. He prepared for college in New London under the care of his uncle, the Rev. Henry Channing, to this period tracing the beginning of his spiritual life, and in 1794 entered Harvard college. In his college vacations he taught at Lancaster (Mass.), and in term time he stinted himself in food to save time for study—an experiment which produced acute dyspepsia. Nevertheless, he felt that he got little good from his college course.

After graduating in 1798, he lived at Richmond as tutor in the family of David Meade Randolph, U.S. marshal for Virginia. He returned "a thin and pallid invalid," to spend a year and a half in Newport, which had always delighted him by its beauty, and in 1802 went to Cambridge as regent (or general proctor) in Harvard; in the autumn of 1802 he began to preach. On June 1, 1803, he was ordained pastor of the Federal street Congregational church in Boston. He did not become known as "the apostle of Unitarianism" until after his sermon preached at the ordination of the Rev. Jared Sparks in 1819 and the publication of his articles in *The Christian Disciple*, "Objections to Unitarian Christianity Considered" and "The Moral Argument against Calvinism." He took a keen interest in all public questions; and in 1816 he preached

a sermon on war which led to the organization of the Massachusetts peace society. His sermon on "Religion, a Social Principle," helped to procure the omission from the state constitution of the third article of Part I., which made compulsory a tax for the support of religious worship. In Aug. 1821 he undertook a journey abroad, where he met many distinguished men of letters, including Wordsworth and Coleridge; the latter wrote of him, "He has the love of wisdom and the wisdom of love."

As a result of a visit to the West Indies he began to write his book *Slavery* (1835), in which he asserted that "man cannot be justly held and used as property"; that the tendency of slavery is morally, intellectually, and domestically bad; that emancipation, however, should not be forced on slave-holders by governmental interference, but by an enlightened public conscience. He declined to identify himself with the abolitionists, whose motto was "Immediate Emancipation" and whose passionate agitation he thought unsuited to the work they were attempting. In 1837 he published *Thoughts on the Evils of a Spirit of Conquest, and on Slavery: A Letter on the Annexation of Texas to the United States,* addressed to Henry Clay—arguing that the Texan revolt from Mexican rule was largely the work of land-speculators, and of those who resolved "to throw Texas open to slave-holders and slaves"—and warning of its serious consequences. Channing's pamphlet *Emancipation* (1840) dealt with the success of emancipation in the West Indies, as related in Joseph John Gurney's *Familiar Letters to Henry Clay of Kentucky* (1840). In 1842 he published *The Duty of the Free States; or Remarks Suggested by the Case of the Creole,* a careful analysis of the letter of complaint from the American to the British government, and a defence of the position taken by the British government. On Aug. 1, 1842, he delivered at Lenox (Mass.) an address celebrating the anniversary of emancipation in the British West Indies. Two months later, Oct. 2, 1842, he died at Bennington, Vermont.

Physically, Channing was short and slight; his eyes were unnaturally large; his voice wonderfully clear. He was not a great pastor, and lacked social tact, but by the few who knew him well he was almost worshipped. His sermons were noted for their rare simplicity and gracefulness of style. To the name "Unitarian" Channing objected strongly, thinking "unity" as abstract a word as "trinity" and as little expressing the close fatherly relation of God to man. It is to be noted that he strongly objected to the growth of "Unitarian orthodoxy" and its increasing narrowness. Channing believed in historic Christianity and in the story of the resurrection, "a fact which comes to me with a certainty I find in few ancient histories," although he held that the Scriptures were not inspired but merely records of inspiration. In the controversies into which he was forced he continually displayed the greatest breadth and catholicity of view. The differences in New England churches he considered were largely verbal, and he said that "would Trinitarians tell us what they mean, their system would generally be found little else than a mystical form of the Unitarian doctrine." His opposition to Calvinism was so great, however, that even in 1812 he declared "existence a curse" if Calvinism be true. Possibly his boldest and most elaborate defence of Unitarianism was his sermon on *Unitarianism most favourable to Piety,* preached in 1826, and the election sermon of 1830 was his greatest plea for spiritual and intellectual freedom.

Channing's reputation as an author was probably based largely on his publication in *The Christian Examiner* of *Remarks on the Character and Writings of John Milton* (1826), *Remarks on the Life and Character of Napoleon Bonaparte* (1827–28), and an *Essay on the Character and Writings of Fénelon* (1829). An *Essay on Self-Culture* introduced Franklin lectures delivered in Boston in 1838. Channing was an intimate friend of Horace Mann, and his views on the education of children are stated by Elizabeth Palmer Peabody to have anticipated those of Froebel. His *Complete Works* have appeared in various editions since 1841.

See the *Memoir* by W. H. Channing (1848); Elizabeth P. Peabody, *Reminiscences of the Rev. William Ellery Channing, D.D.* (1880), intimate but inexact; J. W. Chadwick, *William Ellery Channing, Minister of Religion* (1903); W. M. Salter, "Channing as a Social Reformer," *Unitarian Review* (March 1888); and C. W. Eliot, *Four American Leaders* (1906).

CHANSONS DE GESTE, the name given to the epic chronicles which take so prominent a place in the literature of France from the 11th to the 15th century. Gaston Paris defined a chanson de geste as a song the subject of which is a series of historical facts or *gesta.* These facts form the centre around which are grouped sets of poems, called cycles. It seems probable that as early as the 9th century epic poems began to be chanted by the itinerant minstrels, known as jongleurs. It is conjectured that in a base Latin fragment of the 10th century we possess a translation of a poem on the siege of Girona. Gaston Paris dates from this lost epic the open expression of what he calls "the epic fermentation" of France. The earliest existing chanson de geste is also by far the noblest and most famous, the *Chanson de Roland* (*see* ROLAND, LEGEND OF). It is in the crowd of looser and later poems, less fully characterized, that we can best study the form of the typical chanson de geste. These epics were national and historical; their anonymous writers composed them spontaneously, to a common model, with little regard to the artificial niceties of style. The earlier examples are monotonous, primitive and superficial. Two great merits, however, all the best of these poems possess, force and lucidity; they are full of Gallic pride, they breathe the spirit of an indomitable warlike energy. All their figures belong to the same social order of things, and all illustrate the same fighting aristocracy. The moving principle is that of chivalry, and what is presented is, invariably, the life of a mediaeval soldier.

Perhaps the most important cycle of chansons de geste was that which was collected around the name of Charlemagne, and was known as the *Geste du roi.* A group of this cycle dealt with the history of the mother of the emperor, and with Charlemagne himself down to the coming of Roland. To this group belong *Bertha Greatfoot* and *Aspremont,* both of the 12th century, and a variety of chansons dealing with the childhood of Charlemagne and of Ogier the Dane. A second group deals with the struggle of Charlemagne with his rebellious vassals. This includes *Girart de Viane* and *Ogier the Dane,* both of the 13th century or late 12th. A third group follows Charlemagne and his peers to the East. It is in the principal of these poems, *The Pilgrimage to Jerusalem,* that Alexandrine verse first makes its appearance in French literature. This must belong to the beginning of the 12th century. A fourth group, antecedent to the Spanish war, is of *c.* 1200; it includes *Aiquin, Fierabras* and *Otinel.* The fifth class discusses the war in Spain, and it is to this that *Roland* belongs; there are minor epics dealing with the events of Roncevaux, and independent chansons of *Gui de Bourgogne, Gaidon* and *Anseïs de Carthage.* A sixth and last group deals with events up to the death of Charlemagne; this contains *Huon de Bordeaux* and a vast number of poems of minor importance.

Another cycle is that of Duke William Shortnose, *La Geste de Guillaume.* It includes the very early and interesting *Departure of the Aimeri Children, Aliscans* and *Rainoart.* This cycle deals with the heroes of the South who remained faithful to the throne. The poems belonging to it are numerous. These chansons find their direct opposites in those which form the great cycle of *La Geste de Doon de Mayence,* sometimes called "la faulse geste," because it deals with the feats of the traitors, of the rebellious family of Ganelon. This is the geste of the Northmen, always hostile to the Carlovingian dynasty. It comprises some of the most famous of the chansons, in particular *Parise la duchesse* and *The Four Sons of Aymon.* Several of its sections are the production of a known poet, Raimbert of Paris. From this triple division of the main body of the chansons are excluded certain poems of minor importance.

All the best of the early chansons de geste are written in ten-syllable verse, divided into stanzas or *laisses* of different length, united by a single assonance. Rhyme came in with the 13th century, and had the effect in languid bards of weakening the narrative; the sing-song of it led at last to the abandonment of verse in favour of plain historical prose.

See G. Paris, *Histoire poétique de Charlemagne* (1865) and *La Littérature française au moyen âge* (1890); P. Meyer, *Recherches sur l'épopée française* (1867); A. Longnon, *Les Quatre Fils Aimon,* etc. (1879); L. Gautier, *Les Epopées françaises* (4 vols., 1878–94).

CHANT, the name given to the tunes used in the English Church since the Reformation for the psalms and canticles (Fr. *chant,* from Lat. *cantare,* to sing). For the chant or *cantus firmus* of the Roman Church *see* PLAINSONG. In the English chant each section consists of a reciting note of indefinite length, followed by a phrase in regular time called a "mediation." Chants are "single," if written for one verse only, "double," if for two. "Quadruple" chants for four verses have also been written.

CHANTABUN or CHANDABURI, a town on the east side of the Gulf of Siam, Thailand, in 102° 6′ E., 12° 38′ N. Chantabun changvad (district) has an area of 2,301 sq.mi., and a pop. (1937) of 100,938, divided among Thai, Cambodians, Chinese and minor races. It lies about 12 mi. from the sea on a river navigable for small craft. Rice is the leading crop, but the 1,300 ac. of pepper produce three-fourths of the country's 200-ton annual output. There is trade in rubies, sapphires, cardamoms and rosewood. As part of the nationwide road-building program inaugurated about 1935, Chantabun was connected with Bangkok by a 209-mi. all-weather highway. An extension leads to Trat, close to the Indo-China frontier. In 1905 it was made headquarters of a high commissioner of a circle. Circles were abolished in 1932. Roman Catholic missionaries have been active since the 17th century, and converts are numerous.

CHANTADA, a city of northwestern Spain, in Lugo province, on the left bank of the Rio de Chantada, a small right-hand tributary of the river Miño, and on the main road from Lugo to Orense. Pop. (1940) 1,552 (mun., 15,127). Chantada is the chief town of the fertile region between the Miño and the heights of El Faro. Despite the lack of railway communication, it has a thriving trade in grain, flax, potatoes and dairy produce.

CHANTAL, JANE FRANCES, BARONESS DE (1572–1641), French saint and founder of the Order of the Visitation, was born Jan. 28, 1572, at Dijon, the daughter of the president of the *parlement* of Burgundy. At the age of 20 she married Baron de Chantal, but on his death, four years later, resolved to devote herself to the religious life. In 1604 she met St. Francis de Sales, and her four children being provided for, she went to Annecy where she founded the Congregation of the Visitation in June 1610. She was canonized in 1767, her feast being observed Aug. 21.

See F. M. de Chaugy, *Ste. J. F. de Chantal,* 8 vols. (1874–79); H. Bremond, *Sainte Chantal* (1912); and *The Spirit of St. J. F. de Chantal as shown in her Letters* (1922).

CHANTARELLE, an edible fungus, known botanically as *Cantharellus cibarius* (family, Agaricaceae) found in woods in summer. It is golden yellow, somewhat inversely conical in shape and about 2 in. broad and high. The cap is flattened above with a central depression and a thick-lobed irregular margin. Running down into the stem from the cap are a number of shallow thick gills. The substance of the fungus is dry and opaque with a peculiar smell suggesting ripe apricots or plums. The flesh is whitish tinged with yellow. The chantarelle is sold in the markets of Europe, where it forms a regular article of food, but seems little known in Great Britain; it is common in coniferous woods in northeastern United States and Canada. Before being cooked they should be allowed to dry, and then thrown into boiling water.

Care should be taken to distinguish the true chantarelle from the false Chantarelle (*C. aurantiacus*), a closely related species which is suspected of having caused poisoning. The latter species is more orange in colour, with thinner, broader and closer gills.

CHANTAVOINE, HENRI (1850–1918), French man of letters, was born at Montpellier on Aug. 6, 1850, and died at Galuire (Rhône) on Aug. 15, 1918. He was associated with the *Nouvelle Revue* from its foundation in 1879, and he joined the *Journal des débats* in 1884. His poems include *Poèmes sincères* (1877), *Satires contemporaines* (1881), *Ad memoriam* (1884), *Au fil des jours* (1889).

CHANTILLY, a town of northern France, in the department of Oise, 25 mi. N. of Paris on the Northern railway to St. Quentin. Pop. (1936) 5,054. It is situated to the north of the forest of Chantilly and is one of the favourite Parisian resorts. Its name was long associated with the manufacture, now decayed, of lace and blonde; it is still more celebrated for its château and its park (laid out originally in the 17th century), and as the scene of the annual races of the French Jockey Club. The château consists of the palace built from 1876 to 1885 and of an older portion adjoining it known as the châtelet. In the reign of Charles VI. the lordship belonged to Pierre d'Orgemont, chancellor of France. In 1484 it passed to the house of Montmorency, and in 1632 to the house of Condé. Louis II., prince de Condé, enjoyed here the society of La Bruyère, Racine, Molière, La Fontaine, Boileau and others. The stables close to the racecourse were built from 1719 to 1735 by the duke of Bourbon. The grand château was destroyed about the time of the Revolution, but the châtelet still remains one of the finest specimens of Renaissance architecture in France. The château d'Enghien, facing the entrance to the grand château, was built in 1770 as a guest-house. In 1830 the estate passed into the hands of Henri, duc d'Aumale, fourth son of Louis Philippe. In 1852 the house of Orléans was declared incapable of possessing property in France, and Chantilly was accordingly sold by auction, but passed back into the hands of the duc d'Aumale who built the palace, on the foundations of the grand château. He installed in the châtelet a valuable library and a collection of paintings. In 1886 he gave the park and château with its collections to the Institute of France in trust for the nation, reserving to himself only a life interest.

CHANTREY, SIR FRANCIS LEGATT (1781–1841), English sculptor, was born on April 7, 1781, at Norton, near Sheffield. After receiving lessons in carving and painting, Chantrey went to try his fortune in Dublin and Edinburgh, and finally (1802) in London. He exhibited pictures at the Academy for some years from 1804, but from 1807 onwards devoted himself mainly to sculpture. His first imaginative work in sculpture was the model of the head of Satan, which was exhibited at the Royal Academy in 1808. He afterwards executed for Greenwich hospital four colossal busts of the admirals Duncan, Howe, Vincent and Nelson; and the next bust which he executed, that of Horne Tooke, procured him commissions to the extent of £12,000. He received many honours, was elected R.A. in 1818, and received a knighthood in 1835. He died suddenly on Nov. 25, 1841.

His principal works are the statues of Washington in the State House at Boston, U.S.A.; of George III. in the Guildhall, London; of George IV. at Brighton; of Pitt in Hanover Square, London; of James Watt in Westminster Abbey; of Canning in Liverpool; of Lord President Blair and Lord Melville in Edinburgh. Of his equestrian statues the most famous are those of Sir Thomas Munro in Calcutta and the duke of Wellington in front of the London Exchange. But the finest of Chantrey's works are his busts and his delineations of children. The figures of two children asleep in each other's arms, which form a monumental design in Lichfield cathedral, have always been admired for beauty, simplicity and grace. Allan Cunningham and Weekes were his chief assistants, and were indeed the active executants of many works that pass under Chantrey's name. *See* A. J. Raymond, *Life and work of Sir Francis Chantrey* (1904); for his will *see* CHANTREY BEQUEST.

CHANTREY BEQUEST. By the will dated Dec. 31, 1840, Sir Francis Chantrey (*q.v.*), left his whole residuary personal estate after the decease or on the second marriage of his widow (less certain specified annuities and bequests) in trust for the president and trustees of the Royal Academy (or in the event of the dissolution of the Royal Academy, to such society as might take its place), the income to be devoted to the encouragement of British fine art in painting and sculpture only, by "the purchase of works of fine art of the highest merit . . . that can be obtained." The funds might be allowed to accumulate for not more than five years; works by British or foreign artists might be acquired, so long as such works were entirely executed in Great Britain. The prices were to be "liberal," and no sympathy for an artist or his family was to influence the selection or the purchase of works, which were to be acquired solely on the ground of intrinsic merit. No commission or orders might be given: the works must be finished before purchase. An annual sum of £300 and £50 was to be paid to the president of the Royal Academy and the secretary respectively, for the discharge of their duties in

carrying out the provisions of the will.

Lady Chantrey died in 1875, and two years later the fund became available for the purchase of paintings and sculptures. The capital sum amounted to £105,000. Galleries in the Victoria and Albert Museum at South Kensington were at first used, until in 1898 the Royal Academy arranged with the Treasury for the transference of the collection to the National Gallery of British Art, which had been erected by Sir Henry Tate at Millbank.

A growing discontent with the interpretation by the Royal Academy of the terms of the will found forcible expression in the press in 1903, and a debate in the House of Lords led to the appointment of a select committee of that House (June to Aug. 1904). Its report made recommendations with a view to the prevention of certain former errors of administration, but dismissed other charges against the Academy. A memorandum was issued by the Royal Academy (Feb. 1905) disagreeing with certain recommendations, but allowing others.

See *The Administration of the Chantrey Bequest*, by D. S. MacColl (1904), a highly controversial publication; *Chantrey and His Bequest*, by Arthur Fish, a complete illustrated record of the purchases, etc. (1904); *The Royal Academy, its Uses and Abuses*, by H. J. Laidlay (1898), controversial; *Report from the Select Committee of the House of Lords on the Chantrey Trust; together with the Proceedings of the Committee, Minutes of Evidence and Appendix* (1904).

CHANT ROYAL, one of the fixed forms of verse invented by the ingenuity of the poets of mediaeval France. It is composed of five verses, identical in arrangement, of 11 lines each, and of an envoi of five lines. All the verses are written on the five rhymes exhibited in the first verse, the entire poem, therefore, consisting of 60 lines in the course of which five rhymes are repeated. It has been conjectured that the chant royal is an extended ballade, or rather a ballade conceived upon a larger scale; but which form preceded the other appears to be uncertain. On this point Henri de Croĭ, who wrote about these forms of verse in his *Art et science de rhétorique* (1493), throws no light. He dwells, however, on the great dignity of what he calls the "Champt Royal," and says that those who defy with success the ardour of its rules deserve crowns and garlands for their pains. Étienne Pasquier (1529–1615) points out the fact that the chant royal, by its length and the rigidity of its structure, is better fitted than the ballade for solemn and pompous themes. In old French, the most admired chants royaux are those of Clement Marot; his *Chant royal chrestien,* with its refrain

Santé au corps, et Paradis à l'âme,

was celebrated. Théodore de Banville defines the chant royal as essentially belonging to ages of faith, when its subjects could be either the exploits of a hero of royal race or the processional splendours of religion. La Fontaine was the latest of the French poets to attempt the chant royal, until it was resuscitated in modern times.

This species of poem was unknown in English mediaeval literature and was only introduced into Great Britain in the last quarter of the 19th century. The earliest chant royal in English was that published by Edmund Gosse in 1877, "The Praise of Dionysus."

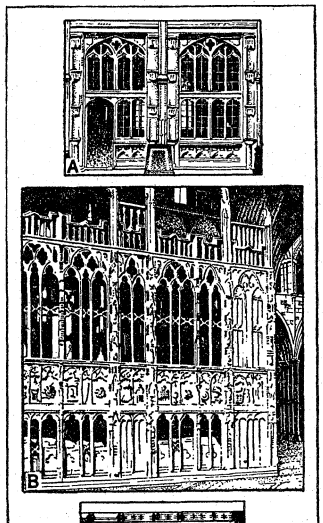
In the middle ages the chant royal was largely used for the praise of the Virgin Mary. Eustache Deschamps (1340–1410) distinguishes these Marian chants royaux, which were called "serventois," by the absence of an envoi. These poems are first mentioned by Rutebeuf, a *trouvère* of the 13th century. The chant royal is practically unknown outside French and English literature.

CHANTRY, a small chapel in or adjoining a church, endowed for maintaining priests to chant masses for the soul of the founder or of some one named by him. It generally contained the founder's tomb and had an entrance from the outside for the chantry priest. The word is applied either to the endowment funds or to the chapel itself.

CHANUTE, a city of Neosho county, Kansas, U.S.A., 120 mi. S.S.W. of Kansas City, near the Neosho river. It is on federal highways 59, 169 and state highways 39 and 57. It is served by the Missouri-Kansas-Texas and the Santa Fe railways. Pop. (1940) 10,142. Chanute is in the mid-continent oil and gas field and is surrounded by a farming and fruit-growing country. Shale and clay are found near by. Chanute is headquarters of a division of the Atchison, Topeka and Santa Fe railway system. The principal industries are: refineries, railway shops; brick, tile, cement and oil-field machinery manufactures; dress, broom, mattress and boiler factories; and machine and tank shops.

Four towns—New Chicago, Tioga, Chicago Junction and Alliance—founded here about 1870, were consolidated in 1872, and named after Octave Chanute (b. 1832), civil engineer and aeronautist, who was the engineer of the railway then under construction. Natural gas and oil were discovered in 1899.

CHANZY, ANTOINE EUGÈNE ALFRED (1823–1883), French general, was born at Nouart (Ardennes) on March 18, 1823. The son of a cavalry officer, he was educated at the naval school at Brest, but enlisted in the artillery, and was commissioned in the Zouaves in 1843. Although he acquired an excellent professional reputation during war service in Algeria and in Lombardy, he was in bad odour at the War Office on account of suspected contributions to the press, and at the outbreak of the Franco-German War was refused a brigade command. After the revolution, however, the government of national defence gave him command of the XVI. Corps of the army of the Loire. (For the operations of the Orleans campaign which followed, *see* FRANCO-GERMAN WAR.) After the second battle of Orleans and the separation of the two wings of the French army, Chanzy was appointed to command that in the west, designated the second army of the Loire. He displayed conspicuous moral courage in the fighting from Beaugency to the Loire, in his retreat to Le Mans, and in retiring to Laval behind the Mayenne. He was made a grand officer of the Legion of Honour, and was elected to the National Assembly. At the beginning of the commune, Chanzy, then at Paris, fell into the hands of the insurgents, by whom he was liberated on giving his parole not to serve against them. A ransom of £40,000 was also paid by the Government for him. In 1872 he became a member of the committee of defence and commander of the VII. Army Corps, and in 1873 was appointed governor of Algeria, where he remained for six years. In 1875 he was elected a life senator, in 1878 received the grand cross of the Legion of Honour, and in 1879, without his consent, was nominated for the presidency of the republic, receiving a third of the total votes. For two years he was ambassador at St. Petersburg (Leningrad). He died suddenly, while commanding the VI. Army Corps at Châlons-sur-Marne, on Jan. 4, 1883, and his remains received a state funeral. He was the author of *La Deuxième Armée de la Loire* (1872).



BY COURTESY OF SIMPSON, "HISTORY OF ARCHITECTURAL DEVELOPMENT" (LONGMANS, GREEN & CO.); GARDNER, "A GUIDE TO ENGLISH GOTHIC ARCHITECTURE" (CAMBRIDGE UNIVERSITY PRESS); SIR BANISTER FLETCHER, "HISTORY OF ARCHITECTURE ON THE COMPARATIVE METHOD," EIGHTH ED. (1928) BATSFORD

A, CHANTRY TOMB, CHRIST CHURCH, HAMPSHIRE (*c.* 1530). B, TOMB OF PRINCE ARTHUR, WORCESTER CATHEDRAL (*c.* 1505)

See J. M. Villefranche, *Historie du Général Chanzy* (1890).

CHAOS, in the Hesiodic theogony, the infinite empty space which existed before all things (*Theog.* 116, 123). It is not, however, a mere vacuum, being filled with clouds and darkness; from it proceed Erebus and Nyx (Night), whose children are Aether (upper air) and Hemera (Day). In the Orphic cosmogony the origin of all goes back to Chronos, the personification of time, who produces Aether and Chaos. In the Aristophanic parody (*Birds*, 691) the winged Eros in conjunction with gloomy Chaos brings forth the race of birds. The later Roman conception (Ovid, *Metam.* i. 7) makes Chaos the original crude, shapeless

mass, into which the architect of the world introduces order and harmony, and from which individual forms are created. When contrasted with cosmos (the orderly universe) the word has various meanings:—the space between heaven and earth; the underworld and its ruler; the immeasurable darkness; the indefinite in space and time. In modern usage "chaos" denotes a state of disorder and confusion.

CHAPACURAN, a tribe or small group of tribes of South American Indians, regarded on rather slender evidence as constituting an independent linguistic stock. The stock, which comprises the Ites, Pawumwas and other smaller tribes in addition to the Chapacuras, seems to have occupied the whole of the basin of the Rio Blanco in north-eastern Bolivia, together with the Guaporé from the mouth of the Blanco to its confluence with the Mamore, as well as the eastern tributaries of the Guaporé between 12° and 13° S. Lat. The Chapacuras themselves lived on the Rio Blanco and about lake Chitiopa. They were a peaceful, sedentary agricultural folk, whose culture was generally similar to that of the Chiquitos (*q.v.*). The Pawumwas go almost naked, and use the blow-gun with poisoned darts.

See G. de Crequi-Montfort and P. Rivet, *Linguistique Bolivienne; La famille linguistique Capakura* (*J. Soc. Americanistes de Paris* [n.s.], vol. x., pp. 119–173); J. D. Haseman, *Some notes on the Pawumwa Indians* (*American Anthropologist* [n.s.], vol. xiv., pp. 333–350).

CHAPAIS, SIR (JOSEPH AMABLE) THOMAS (1858–), Canadian lawyer, statesman and historian, was born at St. Denis-de-la-Bouteillerie, Quebec, on March 23, 1858, son of Senator J. C. Chapais, one of the "Fathers of Confederation." Chapais was educated at St. Anne's college, Laval university, and was called to the Quebec bar in 1879. In March 1892 he was called to the legislative council of Quebec, was a minister without portfolio in the Taillon Government, and was elected leader of the Government in the executive council (Jan. 1893); speaker of the legislative council (April 1895); president of the executive council (May 1896), and minister of colonization and mines (Jan. 1897). He retired from office in May, 1897. From 1884 to 1901 Chapais edited *Le Courrier du Canada* of Quebec. In 1907 he was appointed professor at Laval university, and has published several works on history and law, including *Cours d'Histoire du Canada, 1760–1814* (8 vols., 1919–35); *Jean Talon* (1904); and *Le Marquis de Montcalm* (1911). On Dec. 31, 1919, he was called to the senate of Canada. He was knighted in 1935.

CHAPARRAL, a mixed forest formation of low hard-leaved, stunted trees and shrubs resulting from short, wet, cool winters and long, arid, hot summers. The word is believed to have been derived from *chaparro,* the Spanish name for live oak. Chaparral grows slowly and shrubs 25 years old will usually average not more than 2 or 3 in. in diameter and 5 or 6 ft. in height. This type of forest growth occurs chiefly in southern California in the United States, along the coast of Chile, in Europe and Asia along the Mediterranean and as far east as Turkistan, in Africa near the Cape of Good Hope and on the southern and southwestern coasts of Australia and Tasmania. Its chief economic value lies in its ability to conserve water supply, which it accomplishes below the surface through its root system and above the surface by breaking the force of hot winds and shading the ground to prevent evaporation.

Of the 150 different species of woody plants believed to exist in the chaparral of Southern California 20 dominant types—among them chamise, manzanita, ceanothus, sumac, sage-brush, scrub oak and buckthorn (*qq.v.*)—represent 90% of the growth. In former times the Indians used the nuts, berries and seeds of several of the varieties for food. Some species were once in demand as fuel supply and others are still used for fencing. The bee industry flourishes in the chaparral region, several profusely flowering shrubs, as the black sage, being excellent honey plants. It is estimated that there are 5,500,000 acres of chaparral in the United States. Chaparral formations protect the upper watersheds of the coastal streams in California for a distance of about 450 miles.

CHAPBOOK, the comparatively modern name applied by booksellers and bibliophiles to the little stitched tracts written for the common people and formerly circulated in England, Scotland and the American colonies by itinerant dealers or chapmen, consisting chiefly of vulgarized versions of popular stories, such as *Tom Thumb, Jack the Giant Killer, Mother Shipton,* and *Reynard the Fox*—travels, biographies and religious treatises. Few of the older chapbooks exist. Samuel Pepys collected some of the best and had them bound into small quarto volumes which he called *Vulgaria;* also four volumes of a smaller size, which he lettered *Penny Witticisms, Penny Merriments, Penny Compliments* and *Penny Godlinesses.* The early chapbooks were the direct descendants of the black letter tracts of Wynkyn de Worde. It was in France that the printing-press first began to supply reading for the common people. At the end of the 15th century there was a large popular literature of farces, tales in verse and prose, satires, almanacs, etc., stitched together so as to contain a few leaves, and circulated by itinerant booksellers, known as colporteurs. Most early English chapbooks are adaptations or translations of these French originals, and were introduced into England early in the 16th century. The chapbooks of the 17th century present us with valuable illustrations of the manners of the time; one of the best known is that containing the story of Dick Whittington. In France literature of this kind has been the object of close and systematic study, and *L'Histoire des livres populaires ou de la littérature du colportage* by Charles Nisard (1854) goes deeply into the subject. Amongst English books may be mentioned *Notices of Fugitive Tracts and Chapbooks,* by J. O. Halliwell-Phillipps (1849); *Chapbooks of the 18th Century,* by John Ashton (1882), and some reprints by the Villon Society in 1885.

CHAPE, a cover or metal plate, such as the cap upon the needle in the compass, also the transverse guard of a sword which protects the hand (Fr. *chape,* a hood, cope or sheath); also, a support or catch to attach one thing to another, as the hook on a belt to which the sword is fastened; and the tip of a fox's brush.

CHAPEL, a place of religious worship, either a subordinate division of a church, or a separate building distinguished from a church by the special conditions of its foundation or use. *Capella,* the diminutive of *cappa,* a cloak, was the name given to the shrine in which the cloak (*cappa brevior*) of St. Martin was kept and carried about by the Frankish kings on their journeys, when oaths were taken on it. This peculiar use was transferred to any sanctuary containing relics, the priest of which was called *capellanus* or chaplain. By a further extension, the word was identified with all places of worship which were not mother churches (*ecclesiae matrices*), so as to include a large number of miscellaneous foundations. Most nearly akin to the original meaning is the application of the term to the oratories attached to royal residences. Thus the Sainte Chapelle, the palace chapel at Paris, consecrated in 1248, was built by St. Louis to enshrine the relic of the Crown of Thorns, ransomed by him from the Venetians, who held it in pawn from John of Brienne, the Latin emperor of the East. In the next century, chapels were founded by princes of the French royal house at Bourges, Riom and elsewhere for which the same title was adopted. Such chapels royal were usually founded as collegiate establishments, like Edward III.'s chapels of St. Stephen at Westminster and St. George at Windsor. Collegiate chapels were also founded by prelates and noblemen in connection with their castles and manor-houses, such as the chapel of St. Mary and the Holy Angels at the gate of the palace at York, founded by Archbishop Roger (1154–81), and that of St. Elizabeth before the gate of Wolvesey Castle at Winchester, founded by Bishop John of Pontoise (1282–1304).

The chapel of the castle or manor-house, however, was generally served by a single domestic chaplain. For oratories in connection with private houses an episcopal licence was required, so as to safeguard the rights of the churches in whose parishes they were established. Though frequently within the house itself, they were also erected as separate buildings, and some, which served as churches for the lord of the manor and his tenants, acquired the status of free chapels, which implied exemption from parochial and archidiaconal, and occasionally, though not always, from episcopal jurisdiction. Certain churches, in the patronage of the Crown or

owing their foundation to the king, were regarded as royal free chapels and free chapels on manors probably originated in the grant of special privileges to their owners by the Crown. In time, such free chapels, governed by rectors, sometimes lost their peculiar character and were reckoned as parish churches; but, where the status of a free chapel remained, their incumbents were held to be without cure of souls.

Parish Chapels.—More numerous, however, than free chapels were the chapels in outlying hamlets of large parishes, maintained by the inhabitants and served daily, or on certain days in the week, by chaplains provided at the expense of the parochial incumbent. Some of these, which, as time went on, acquired rights of baptism and burial, were parochial chapels; others, merely chantry chapels in small villages, without such rights, were, properly speaking, chapels of ease. The origin of such foundations was usually the difficulty experienced by the inhabitants in attending the mother church in bad weather, when the streams were swollen and the roads impassable. In Leicestershire, early in the thirteenth century, there were more than a hundred of these dependent chapels in about two hundred parishes, and the proportion elsewhere was not very different.

Subordinate Buildings.—The idea of a chapel as a subordinate or dependent building is implied by its use for the areas appropriated to the minor altars within or projecting from the walls of a church. The services held in these were called chantries (*cantariae*), and, by a transference of ideas to which there are many parallels in mediaeval usage, the chapels themselves were often known as chantries. Of the use of chapel to signify the oratory of a private establishment, the most familar examples are the chapels of colleges at Oxford and Cambridge. Similarly the places of worship in hospitals, almshouses, etc., are called chapels, as well as those which, like chapels of cemeteries, are generally restricted to some special use. Proprietary chapels, founded in London and other English towns during the eighteenth and early nineteenth centuries, were established, with a licence for divine service, by private individuals or groups of trustees. The growth of Nonconformity, however, gave the word a particular application to dissenting places of worship. In Ireland the term has clung persistently to those of the Roman Church, a survival of an old use which in England was derived from the chapels or religious establishments maintained by Henrietta Maria and other Roman Catholic queens. But, apart from this, the modern tendency is to abandon the employment of the word for special classes of religious building, and to give the title church to all indiscriminately.

There are many instances in mediaeval wills and inventories of the application of the term chapel to sets of vestments and altar furniture, as constituting the necessary fittings of a private oratory. Another transference of the sense occasionally found is from the chapel itself to the collective members of the foundation.

(A. H. T.)

CHAPEL. In the printing trade, the name of the fellowship of compositors (and, nowadays, of all crafts) in a printing works. The president is termed the "father of the chapel." In the United States he is called "the chairman." The name chapel is used not only of the fellowship itself but of the meetings which it holds. At these meetings, the chapel discusses such things as the general welfare of the body, the conditions of work, relations with employers, and trade union matters.

The accepted version of the origin of the use of the word chapel in this connection is that it is derived from the fact that Caxton first set up his press in or near Westminster Abbey. Writing in 1716, Myles Davies, in his *Athenae Britannicae* says, "William Caxton first practis'd Printing in the Abbey of Westminster, A.D. 1471, thence a Printing-Room came to be call'd a Chappell amongst our Printers." Another explanation is offered by Joseph Moxon, who in his *Mechanick Exercises* (1683) says, "Every Printing-house is by the Custom of Time out of mind, called a Chappel: and all the Workmen that belong to it are Members of the Chappel: and the oldest Freeman is Father of the Chappel. I suppose this stile was originally conferred upon it by the courtesie of some great Churchman, or men (doubtless when Chappels were in more veneration than of late years they have been here in England), who for the Books of Divinity that proceeded from a Printing-house gave it the Reverend Title of Chappel."

CHAPELAIN, JEAN (1595–1674), French poet and man of letters, was born in Paris and spent 17 years in the service of M. de la Trousse, grand provost of France. He was employed by Richelieu in the organization of the Académie Française. In 1632, in a conversation with the cardinal, he had laid down the canon of the unities of time and space which should govern the drama. The unities had already been advocated by Scaliger (*Art poétique,* 1561) and by the abbé d'Aubignac (*Pratique du théâtre,* 1657), but the doctrine appears to have been unfamiliar to Richelieu, who invited Chapelain to draw up the *Sentiments de l'Académie sur le Cid,* in which deviation from the rule is denounced. His great reputation seemed to be enhanced by the success of the first 12 cantos of his epic *La Pucelle* (1656), on which he had been at work for 20 years, but it was shattered by Boileau in his early satires, and the remaining cantos of the epic remained unprinted until 1882, when they were edited by H. Herluison.

Chapelain drew up the statutes of the Academy, and laid down the rules for the great grammar and dictionary to be produced. In 1663 he was employed by Colbert to draw up a list of men of letters with observations for use by the Crown in the distribution of honours and pensions. This task showed him to be a generous and kindly critic.

BIBLIOGRAPHY.—There is a very favourable estimate of Chapelain's merits as a critic in George Saintsbury's *History of Criticism,* ii. 256–261. An analysis of *La Pucelle* is given in pp. 23–79 of Robert Southey's *Joan of Arc. See* also *Les Lettres de Jean Chapelain* (edit. P. Tanuzey de Larroque, 1880–82); *Lettres inédites . . . à P. D. Huet* (1658–73, edit. L. G. Pellissier, 1894); Julien Duchesne, *Les Poèmes épiques du XVIIe siècle* (1870); the abbé A. Fabre, *Les Ennemis de Chapelain* (1888), *Chapelain et nos deux premières Académies* (1890); A. Muehlan, *Jean Chapelain* (1893).

CHAPEL-EN-LE-FRITH, a market town in Derbyshire, England, 5 mi. N. of Buxton, on the L.M.S.R. Pop. (1938) 18,140. The foundation of the church of St. Thomas of Canterbury is attributed to foresters of the royal forest or *frith* of the Peak in the 13th century; hence the town's name. The chief industries are the manufacture of brake and clutch linings and wadding.

CHAPEL HILL, a town of Orange county, North Carolina, U.S.A., on a high ridge 28 mi. N.W. of Raleigh, in a tobacco and cotton-growing district. It is on federal highways 15 and 501; served by the Southern railway. The population in 1940 was 3,654. It is the seat of the University of North Carolina, which occupies a beautiful campus of 106 ac. and owns an adjoining tract of 500 ac. in forest lands. The town has a council-manager form of government.

CHAPELLE ARDENTE, the chapel or room in which the corpse of a sovereign or other exalted personage lies in state pending the funeral service. The name is in allusion to the many candles which are lighted round the catafalque. This custom is first chronicled as occurring at the obsequies of Dagobert I. (602–638).

CHAPERON, originally a cap or hood (Fr. *chape*) worn by nobles and Knights of the Garter in full dress, and after the 16th century by middle-aged ladies. In the 19th century the word was used of a married or elderly lady (*cf.* "duenna") escorting or protecting a young and unmarried girl in public places and in society.

CHAPLAIN, originally, according to Du Cange (*Gloss. med. et inf. Lat.*), the custodian of the cloak (*cappa* or *capella*) of St. Martin of Tours, which was preserved as a relic by the French kings, and carried with the army in war-time, when it was kept in a tent known itself as *capella* (Fr. *chapelain;* M. Lat. *capellanus*). It is also suggested that the *capella* was the tent-like canopy erected by the French kings over the altar for soldiers in the field, without special reference to St. Martin. However this may be, the name *capellanus* was generally applied to custodians of sacred relics preserved in royal chapels, etc.; and the office gradually extended its scope, *capellani* acquiring spiritual jurisdiction and increasing in number, so that an arch-chaplain was appointed as their head, who from the time of Charlemagne was a high prelate,

and who became an important personage in the realm. In France the arch-chaplain was grand-almoner, and both in France and in the Holy Roman Empire was also high chancellor of the realm. The office was abolished in France in 1789, revived by Pius IX. in 1857, and again abolished on the fall of the Second Empire. The word chaplain now signifies a clergyman attached to the household of a sovereign or his representatives (ambassadors, judges, etc.), or of a bishop or nobleman, or private individual having a chapel in his house, to the army or navy, or to institutions (*e.g.* parliament, colleges, cemeteries, prisons). As chaplain he has no parochial duties, but in some cases a parish priest is also appointed to a chaplaincy; *e.g.* an Anglican bishop often appoints beneficed clergymen as his examining chaplains. The British sovereign has 36 "Chaplains in Ordinary," who officiate in rotation, as well as "Honorary Chaplains" and "Domestic Chaplains." There are also royal chaplains in Scotland. The Indian civil service appoints a number of chaplains of the Church of England and the Church of Scotland, who are subject to the same conditions as other civil servants. Chaplains are also appointed under the Foreign Office to embassies, consulates, etc. Workhouse chaplains are appointed by overseers and guardians on the direction of the Ministry of Health. Prison chaplains are appointed by the home secretary.

In the British army there are two kinds of chaplains, permanent and occasional. The former, described as Chaplains to the Forces, hold commissions, serving throughout the empire except in India; they number about 100, and include a Chaplain-General who ranks as a major-general, and four classes of subordinate chaplains who rank respectively as colonels, lieutenant-colonels, majors and captains. Special chaplains (Acting Chaplains for Temporary Service) may be appointed by a secretary of state. Permanent chaplains may be Church of England, Roman Catholic or Presbyterian; Wesleyans (if they prefer not to accept commissions) may be appointed Acting Chaplains. In the navy, every large ship in commission has a chaplain; at the head of the naval chaplains is the Chaplain of the Fleet. But the ecclesiastical superior of all Roman Catholic chaplains in both army and navy is the archbishop of Westminster, by decree of Propaganda (1906). In 1909 a Chaplains' Department of the Territorial Force was formed, having no denominational restriction.

In France, military and naval chaplaincies were abolished on the separation of Church and State. In the army of the United States of America the establishment of chaplains was fixed in 1904 by Congress at 57 (15 with the rank of major), 12 for the artillery corps and one each for the cavalry and infantry regiments. There is no distinction of sect. In the U.S. navy the chaplains number 24, 13 ranking as lieutenants, seven as commanders, four as captains.

The Roman Catholic Church also recognizes a class of beneficed chaplains, supported out of "pious foundations" for the specific duty of saying, or arranging for, certain masses, or taking part in certain services. These chaplains are classified as follows:—*Ecclesiastical,* if the foundation has been recognized officially as a benefice; *Lay,* if this recognition has not been obtained; *Mercenary,* if the benefaction has been entrusted to a layman to procure the desired celebration (such trustees are sometimes called "Lay Chaplains"); *Collative,* if it is provided that a bishop shall erect the foundation into a benefice.

Other classes of chaplains are:—(1) *Parochial* or *Auxiliary Chaplains,* appointed to assist a parish priest (usually by the bishop, but sometimes by the parish priest, as allowed by the Council of Trent); (2) *Chaplains of Convents,* appointed by a bishop: these must be men of mature age, should not be regulars if secular priests can be obtained, and are not generally appointed for life; (3) *Pontifical Chaplains,* some of whom (known as Private Chaplains) assist the pontiff in the celebration of Mass; others attached directly to the pope are honorary private chaplains who occasionally assist the private chaplains, private clerics of the chapel, common chaplains and supernumerary chaplains. The common chaplains were instituted by Alexander VII., and in 1907 were definitely allowed the title "Monsignore"—pertaining also to cardinals, archbishops, and bishops—by Pius X.

CHAPLIN, CHARLES SPENCER (1889–), cinema actor, was born April 16, 1889, of English parentage, and passed his childhood in London. At an early age he appeared on the music-hall stage with his father and his brother Sydney, taking small parts in vaudeville. After a short experience on the legitimate stage, he re-entered vaudeville in London as a member of the Fred Karno company. In 1910 he went to the United States as leading comedian in a Karno production, *A Night in an English Music Hall.* He attracted the attention of Joseph M. Schenck, and on the latter's suggestion he was engaged by Mack Sennett to make films with the Keystone Comedy Company at Hollywood, California. In his first picture, made in 1913, he adopted the eccentric costume which has ever since been associated with his name. His success was immediate, continuous and universal. In 1918 he formed his own company, and he produced a series of films which placed him in the front rank of artists and in a category of his own in the field of screen comedy. Among the more successful of his later releases were: *A Dog's Life* (1918), *Shoulder Arms* (1918), *The Kid* (1921), *The Idle Class* (1921), *The Gold Rush* (1925), and *The Circus* (1926). In all of these he was the central figure. In 1931, he produced and acted in *City Lights,* which tells the story of the life of a blind girl, and in 1936 *Modern Times.*

CHAPLIN, HENRY CHAPLIN, 1ST VISCOUNT (1840–1923), English statesman, son of the Rev. Henry Chaplin, of Blankney, Lincolnshire, was born Dec. 22, 1840, and died May 29, 1923. He was educated at Harrow and Christ Church, Oxford. Entering parliament in 1868, he sat as Conservative member, first for Mid-Lincolnshire (1868–1906), and then for Wimbledon. As the typical English country gentleman, the "Squire of Blankney" was one of the leaders of the agricultural interest. He was chancellor of the duchy of Lancaster (1885–86) and president of the new Board of Agriculture (1889–92); as president of the Local Government Board (1895–1900) he was responsible for the Agricultural Rates Act of 1896, and he was a member of Mr. Chamberlain's Tariff Commission. During the Coalition government of 1915, Chaplin was the leader of the nominal opposition until his elevation to the peerage in 1916.

See E. Stewart, *Henry Chaplin* (1926).

CHAPMAN, FRANK M. (1864–1945), American ornithologist, was born at Englewood, N.J. on June 12, 1864. From 1887–1908 he served as associate curator of ornithology and mammalogy, and from then until 1942 as curator of ornithology, American Museum of Natural History. In 1897 he was elected president of the Linnaean Society of New York, and, in 1911, of the American Ornithologists' Union. He was originator of the habitat bird groups and seasonal bird exhibits at the American Museum of Natural History, and was a pioneer in bird study with a camera in America. He acted as director of the Bureau of Publications of the American Red Cross (1917–18) and commissioner of the American Red Cross to Latin America (1918–19). He was associate editor of *The Auk* (1894–1911) and editor-in-chief of *Bird-Lore,* which he founded in 1899. After 1911 he devoted much time to a study of the origin of Andean bird-life and explored in the Andes. He died on Nov. 15, 1945, in New York city.

His publications are: *Handbook of Birds of Eastern North America* (1895); *Bird-Life, a Guide to the Study of our Common Birds* (1897); *Bird Studies with a Camera* (1900); *A Color Key to North American Birds* (1903); *The Economic Value of Birds to the State* (1903); *The Warblers of North America* (1907); *Camps and Cruises of an Ornithologist* (1908); *The Travels of Birds* (1916); *The Distribution of Bird-Life in Colombia* (1917); *Our Winter Birds* (1918); *What Bird is That?* (1920); *Birds of the Urubamba Valley, Peru* (1921); *The Distribution of Bird-Life in Ecuador* (1926); *My Tropical Air Castle* (1929); also numerous papers on birds and mammals.

CHAPMAN, GEORGE (1559–1634), English poet and dramatist, translator of Homer, was born near Hitchin. There is no record of his university career, though Anthony Wood (*Athen. Oxon.* ii. 575) claims that he spent some time in Oxford. He had become a play-writer in London, and had published some poems when he appeared in Henslowe's *Diary* on Feb. 12, 1596, as the author of the *Blind Beggar of Alexandria.* Thenceforward his name repeatedly appears in connection with payments for various plays until 1599, after which date he appears to have

written masques for the Children of the Chapel (afterwards of the Revels) in the intervals of working on the translation of Homer. In 1598 he had completed Marlowe's poem, *Hero and Leander.* Apparently he was imprisoned for a short time for his share in the play *Eastward Ho,* which gave offence to James I by certain quips against the Scots. He was encouraged in his translation of Homer by Prince Henry, to whom he was server in ordinary, but on the prince's death in 1612 Chapman lost his appointment and the promise of a life pension made by the prince was not fulfilled. He found a new patron in Robert Carr, earl of Somerset, to whom the two folio volumes *The Whole Works of Homer, Prince of Poets, in his Iliads and Odysses* (1616) are dedicated. *The Crowne of all Homer's Workes, Batrachomyomachia, or the Battaile of Frogs and Mise. His Hymns and Epigrams* appeared in 1624. The poet died on May 12, 1634.

Chapman enjoyed the friendship and admiration of his great contemporaries. John Webster in the preface to his *White Devil* praised his "full and heightened style," and Ben Jonson told Drummond of Hawthornden that Fletcher and Chapman "were loved of him." But the good relations with Jonson were apparently interrupted later. It was suggested by William Minto, who has been followed by later writers, that Chapman was the "rival poet" of Shakespeare's sonnets. Sir E. K. Chambers, however, thinks that the assumption would be more plausible if any relation between the earl of Southampton and Chapman, earlier than a stray dedication shared with others in 1609, could be established.

Chapman's *Homer* gives him a high place in English literature. Swinburne, in the criticism contributed to an earlier edition of the *Encyclopædia Britannica,* gave an admirable and considered judgment of the work. "The objections," he said, "which a just and adequate judgment may bring against Chapman's master-work, his translation of Homer, may be summed up in three epithets: it is romantic, laborious, Elizabethan. The qualities implied by these epithets are the reverse of those which should distinguish a translator of Homer; but setting this apart, and considering the poems as in the main original works, the superstructure of a romantic poet on the submerged foundations of Greek verse, no praise can be too warm or high for the power, the freshness, the indefatigable strength and inextinguishable fire which animate this exalted work."

On the great qualities of his tragedies and comedies Swinburne wrote: "The most notable examples of his tragic work are comprised in the series of plays taken, and adapted sometimes with singular licence, from the records of such parts of French history as lie between the reign of Francis I. and the reign of Henry IV., ranging in date of subject from the trial and death of Admiral Chabot to the treason and execution of Marshal Biron. The two plays bearing as epigraph the name of that famous soldier and conspirator are a storehouse of lofty thought and splendid verse, with scarcely a flash or sparkle of dramatic action. The one play of Chapman's whose popularity on the stage survived the Restoration is *Bussy d'Ambois* (d'Amboise)—a tragedy not lacking in violence of action or emotion, and abounding even more in sweet and sublime interludes than in crabbed and bombastic passages. His rarest jewels of thought and verse detachable from the context lie embedded in the tragedy of *Caesar and Pompey,* whence the finest of them were first extracted by the unerring and unequalled critical genius of Charles Lamb. In most of his tragedies the lofty and labouring spirit of Chapman may be said rather to shine fitfully through parts than steadily to pervade the whole; they show nobly altogether as they stand, but even better by help of excerpts and selections. But the excellence of his best comedies can only be appreciated by a student who reads them fairly and fearlessly through, and, having made some small deductions on the score of occasional pedantry and occasional indecency, finds in *All Fools, Monsieur d'Olive, The Gentleman Usher,* and *The Widow's Tears* a wealth and vigour of humorous invention, a tender and earnest grace of romantic poetry, which may atone alike for these passing blemishes and for the lack of such clear-cut perfection of character and such dramatic progression of interest as we find only in the yet higher poets of the English heroic age."

The list of the principal plays of George Chapman is as follows: *The Blinde Begger of Alexandria . . .* (acted 1596, printed 1598), a popular comedy; *An Humerous dayes Myrth* (May 1597; printed 1599); *Al Fooles, A Comedy* (1599, if it may be taken as identical with a play entered by Henslowe as "The World runs on wheels," printed 1605); *The Gentleman Usher* (*c.* 1601, pr. 1606), a comedy; *Monsieur d'Olive* (1604, pr. 1606), one of his most amusing and successful comedies; *Eastward Ho* (1605), written in conjunction with Ben Jonson and John Marston, an excellent comedy of city life; *Bussy d'Ambois, A Tragedie* (1604, pr. 1607, 1608, 1616, 1641, etc.), the scene of which is laid in the court of Henry III.; *The Revenge of Bussy d'Ambois, a Tragedie* (pr. 1613, but probably written much earlier); *The Conspiracie, And Tragedie of Charles Duke of Byron, Marshall of France . . . in two plays* (1608; pr. 1608 and 1625), severely cut after its first performance, which provoked a lively protest from the French ambassador; *May-Day, A witty Comedie* (pr. 1611, but probably acted as early as 1601); *The Widdowes Teares. A Comedie* (pr. 1612; produced perhaps as early as 1605); *Caesar and Pompey* (pr. 1631), written, says Chapman in the dedication, "long since," but never staged.

In *The Tragedie of Chabot Admirall of France* (*c.* 1613; pr. 1639) he collaborated with James Shirley, and in *Eastward Ho* (1605, pr. 1605), with Jonson and Marston. *The memorable Masque of the two Honourable Houses or Inns of Court,* was performed at court in 1613 in honour of the marriage of the Princess Elizabeth.

The standard edition of Chapman is the *Works,* edited by R. H. Shepherd (1874–75), the third volume of which contains an "Essay on the Poetical and Dramatic Works of George Chapman," by Swinburne, printed separately in 1875. The selection of his plays (1895) for the Mermaid Series is edited by W. L. Phelps. The edition by T. M. Parrott (1910–14) includes *Alphonsus, Emperor of Germany,* and other plays sometimes attributed to Chapman. For the sources of the plays *see* Emil Koeppel, "Quellen Studien zu den Dramen George Chapman's, Philip Massinger's und John Ford's," in *Quellen und Forschungen zur Sprach und Kulturgeschichte* (vol. 82, Strassburg, 1897). The suggestion of W. Minto (see *Characteristics of the English Poets,* 1885) that Chapman was the "rival poet" of Shakespeare's sonnets is amplified in A. Acheson's *Shakespeare and the Rival Poet* (1903). For the relations between Shakespeare and Chapman, *see* also J. M. Robertson, *Shakespeare and Chapman* (1917).

For other criticisms of his translation of Homer *see* Matthew Arnold, *Lectures on translating Homer* (1861), and Dr. A. Lohff, *George Chapman's Ilias-Übersetzung* (1903).

CHAPMAN, one who buys or sells, a trader or dealer, especially an itinerant pedlar. The word "chap," now a slang term, meant originally a customer. The word chapman is from Mid. Eng. *cheap,* to barter, from which we get the name of the famous London thoroughfare "Cheapside."

CHAPONE, HESTER (1727–1801), English essayist, daughter of Thomas Mulso, a country gentleman, was born at Twywell, Northamptonshire, on Oct. 27, 1727. At the age of nine she wrote a romance entitled *The Loves of Amoret and Melissa.* While on a visit to Canterbury she met the learned Mrs. Elizabeth Carter, and then became one of the little court of women who gathered at North End, Fulham, around Samuel Richardson, and in Miss Susannah Highmore's sketch of the novelist reading *Sir Charles Grandison* to his friends Miss Mulso is the central figure. In 1760 Miss Mulso, with her father's reluctant consent, married the attorney, John Chapone, who had been befriended by Richardson. Her husband died within a year of her marriage. Her best known work, *Letters on the Improvement of the Mind* (1772) brought her numerous requests from distinguished persons to undertake the education of their children. She died on Dec. 25, 1801.

See *The Posthumous Works of Mrs. Chapone, containing her correspondence with Mr. Richardson; a series of letters to Mrs. Elizabeth Carter . . . together with an account of her life and character drawn up by her own family* (4 vols. 1807).

CHAPPE, CLAUDE (1763–1805), French engineer, was born at Brûlon (Sarthe) in 1763. With his brother, Ignace (1760–1829), he was the inventor of an optical telegraph widely used in France until it was superseded by the electric telegraph. His device consisted of an upright post, on the top of which was fastened a transverse bar, while at the ends of the latter two smaller arms moved on pivots. The position of these bars represented words or letters; and by means of machines placed at such intervals that each was distinctly visible from the next, messages could be conveyed through 50 leagues in a quarter of an hour. The machine was adopted by the Legislative Assembly in 1792, and in the following year Chappe was appointed *ingénieur-télégraphe;* but the originality of his invention was so much ques-

tioned that he was seized with melancholia and (it is said) committed suicide at Paris, on Jan. 23, 1805.

CHAPPELL, WILLIAM (1809–1888), English writer on music, a member of the London musical firm of Chappell and Co., was born on Nov. 20, 1809, eldest son of Samuel Chappell (d. 1834), who founded the business. William Chappell deserves remembrance for having started the Musical Antiquarian Society in 1840 and for his *Popular Music of the Olden Time* (1855–59)—an expansion of a collection of "national English airs" made by him in 1838–40. The modern revival of interest in English folk-songs owes much to this work, which has since been re-edited by Professor H. E. Wooldridge (1893). His brother, Thomas Patey Chappell (d. 1902), started (1859) the Monday and Saturday Popular Concerts at St. James's Hall, which were successfully managed by a younger brother, S. Arthur Chappell, till they came to an end towards the close of the last century.

CHAPTAL, JEAN ANTOINE CLAUDE, COMTE DE CHANTELOUP (1756–1832), French chemist and statesman, was born in Nogaret, Lozère, on June 4, 1756. The son of an apothecary, he studied chemistry at Montpellier. In 1781 the States of Languedoc founded a chair of chemistry for him at the school of medicine in Montpellier, where he taught the doctrines of Lavoisier. The capital he acquired by the death of a wealthy uncle he employed in the establishment of chemical works for the manufacture of the mineral acids, alum, white-lead, soda and other substances. During the Revolution he undertook, in 1793, the management of the saltpetre works at Grenelle. In the following year he went to Montpellier, where he remained till 1797, when he returned to Paris. After the *coup d'état* of the 18th of Brumaire (Nov. 9, 1799) he was made a councillor of State by the First Consul, and succeeded Lucien Bonaparte as minister of the interior, in which capacity he established a chemical manufactory near Paris, a school of arts, and a society of industries; he also reorganized the hospitals and introduced the metric system of weights and measures. A misunderstanding between him and Napoleon (who conferred upon him the title of comte de Chanteloup) occasioned Chaptal's retirement from office in 1804; but before the end of that year he was again received into favour. On Napoleon's return from Elba, Chaptal was made director-general of commerce and manufactures and a minister of State. He contributed largely to the development of modern industry by the application of the science of chemistry to technical ends. Chaptal wrote many works on applied chemistry, and treatises on the technical aspects of the dyeing industry, etc. He died at Paris on July 30, 1832.

See *Mes souvenirs sur Napoléon,* ed. Vte. Anatole Chaptal (1893); W. Henning, *Die Erinnerungen des Grafen Chaptal an Napoleon I.* (1908).

CHAPTER, a principal division or section of a book, and so applied to acts of parliament, as forming "chapters" of the legislation of a session. The name is also given to the permanent body of canons of a cathedral or collegiate church and to the meetings of the monks of a particular monastery ("conventual") or of the members of the order in a province ("provincial"), or of the whole order ("general"). This use of the word is said to be derived from the custom of reading a chapter of the *regula* at such meetings. The title "chapter" is similarly used of the assembled body of knights of a military or other order. Chapter is a shortened form of *chapiter,* a word still used in architecture; Fr. *chapitre,* Lat. *capitulum,* diminutive of *caput,* head. (*See* also CANON; CATHEDRAL; DEAN.)

CHAPTER-HOUSE, the chamber in which the chapter or heads of the monastic bodies (*see* ABBEY and CATHEDRAL) assemble to transact business. They are of various forms; some are oblong apartments, as Canterbury, Exeter, Chester, Gloucester, etc.; some octagonal, as Salisbury, Westminster, Wells, Lincoln, York, etc. That at Lincoln has ten sides, and that at Worcester is circular; most are vaulted internally and polygonal externally, and some, as Salisbury, Wells, Lincoln, Worcester, etc., depend on a single slight vaulting shaft for the support of the massive vaulting. They are often provided with a vestibule, as at Westminster, Lincoln and Salisbury, and are almost exclusively English. On the continent of Europe the chapter-house is universally rectangular, and frequently of great size and dignity.

In the United States the word chapter-house refers almost invariably to the campus meeting or residence halls of the members of the collegiate Greek letter societies—fraternities or sororities with names chosen from various combinations of the Greek alphabet, as Delta Theta Psi, Sigma Alpha, etc.

CHAPU, HENRI (1833–1891), French sculptor and medallist, born in Le Mée (Seine et Marne) on Sept. 29, 1833. He studied at the École des Beaux-Arts under Pradier and Duret, and, having gained the Prix-de-Rome in 1855, spent five years in Rome. He was famous as a portrait medallist, and he executed many portrait busts and monuments; his statuary representing allegorical and mythological figures is sincere in feeling and poetical in conception.

His first success was attained by a figure of "Mercury" (1861, Luxembourg museum, Paris); then followed "The Sower" (1865); the "Nymph Clythia" (1866, Dijon museum). His fame was established by his statue of "Jeanne d'Arc" (1870, Luxembourg museum), representing her as a simple peasant kneeling in prayer. In 1872 Chapu undertook the monument to Henri Regnault with the fine figure of "Jeunesse" in the courtyard of the École des Beaux-Arts. In 1877 he sculptured the tomb of the Contesse Agoult (Daniel Stern) at Père Lachaise, and in 1887 he completed the monument to the archbishop Dupanloup. Among his portrait work may be mentioned Leon Bonnat (1864); Alexandre Dumas (1876); the bronze of J. E. Schneiders (1878) at Le Creuzot; the monument to the Galignani brothers (1888), representing them in modern costume, which was then an innovation and excited much comment, and the bust of Alexandra, princess of Wales. The monument to Flaubert, with an allegorical figure of "Truth," is his last important work. Chapu died in Paris on April 21, 1891. The museums of Rouen and Bayonne contain a number of his drawings.

See O. Fidère, *Chapu, sa vie et son oeuvre* (1894).

CHAPU, a port of China on the north shore of Hangchow bay (30° 39′ N., 121° 6′ E.). It is built on a series of low hills and was long an outport of Hangchow. Chapu was the only harbour at Hangchow bay near Shanghai (50 mi.). At Chapu the Japanese succeeded in landing, in Nov. 1937, on the flank of the Chinese armies retreating from Shanghai.

CHAPULTEPEC, a suburb, and ancient seat of the Montezumas, situated about two miles southwest of the City of Mexico. On its rocky heights stands the summer palace of the president of the republic, in which is housed also the National Military School. At the base of this rising ground which commands the surrounding country is located a famous grove of cypresses estimated to be some thousand years old. Upon this whole critical position was fought the last actual battle of the War between Mexico and the United States (1846–1848). Major General Winfield Scott after the disaster of El Molino del Rey found that he had available about 7,000 badly shaken United States troops, far from their base and in the heart of a hostile country. Opposing him General Santa Anna, the president of the republic, controlled at least twice that number. The natural and artificial strength of the palace, its proximity to the American goal, and its meaning relative to governmental power, made its possession by the contending forces of the greatest moment. After several days of reconnaissance, feints and preparations, Scott decided that this stronghold between him and the capital must be taken.

On September 12, 1847, an all-day bombardment of the buildings, surrounding forts and redoubts convinced him of the necessity of an assault. During the following night both the American and Mexican batteries and positions were strengthened and Scott's plans for an attack in front and reverse were crystallized. Major General J. A. Quitman's troops were directed to advance to the rear of the palace by way of the Tacubaya road, whereas Major General G. J. Pillow's division was given the task of striking the front by way of El Molino del Rey and the cypress grove. From early dawn on September 13 until eight o'clock—about two hours and a half—the American guns hurled solid shot, grape, canister and shells at the barriers of stone and mortar. At the end of that

time the infantry went forward to the assault, the main blow being delivered by regular troops upon the Mexican points of vantage in the cypress grove. Lieutenant "Stonewall" Jackson, later of Civil War fame, handled on his own initiative a section of Magruder's field battery in such a manner as to cut off the northern retreat of the Mexican fugitives. The major portion of Scott's forces went forward doggedly under severe fire. Officers on both sides became casualties to a disproportionate degree. When the United States' troops finally reached the ditch they found there no ladders with which to scale the parapets. Although Brigadier General P. F. Smith gallantly led a turning movement toward the rear of the palace, he was met by such a galling fire that his losses, including the wounded Lieutenant James Longstreet, were sufficient to stop him.

The suspense and curtailment of enthusiasm among Scott's troops as they crouched behind any available cover, while waiting for the implements that would enable them to go over the top of the barrier, lent serious apprehensions as to the success of the American effort. When, after some twenty minutes, the ladders arrived, the previous restiveness reacted upon the men in the form of ardour to proceed. They swarmed over the parapets with such impetus that in a very few minutes of sharp hand to hand fighting Chapultepec was in their hands. Since its capture was but a means to an end, and the exploitation of the success involved the seizure of the City of Mexico itself, it was necessary to move onward immediately. Quitman set out over the Belen causeway toward the capital. After overwhelming a field redan in his front he came upon decided opposition at the gate which was protected by a formidable citadel beyond. From its embrasures belched a withering fire. Quitman's ammunition having been exhausted and all his staff officers having been killed or wounded, his position was not fortunate.

To check Mexican reinforcements, Scott sent Brigadier General Worth's brigade, together with some smaller units, along the Verónica causeway. Finding his advance likewise blocked by heavy fire, Worth sent Colonel John Garland's force through the fields to outflank the San Cosme gate which lay about a mile north of Quitman's troops. By crawling through mud, forcing their way through houses and using such cover as was available, in small bodies they reached the rear of the position. During this procedure, Lieutenant U. S. Grant had a mountain howitzer dragged through the mud and mounted upon the roof of a building. About six o'clock in the evening Worth forced an entrance into the city proper, and shortly activities ceased for the night. Though the capital was not yet under American control, General Santa Anna chose to retire with his forces to Guadalupe Hidalgo. Next morning when Scott was ready to renew hostilities, the City of Mexico was unexpectedly surrendered.

BIBLIOGRAPHY.—Justin H. Smith, *The War with Mexico,* Vol. I. (1919); George B. McClellan, *The Mexican War Diary* (1917); C. M. Wilcox, *History of the Mexican War* (1892); W. A. Ganoe, *The History of the United States Army* (1924); Original Correspondence and Reports in Old Files Section, Adjutant General's Office, Washington, D.C. (W. A. G.)

CHAR, the name given to fishes of the genus *Salvelinus,* which differs from *Salmo* (salmon and trout) in having the vomerine teeth present only on the head of the bone, which is raised and has a boat-shaped depression behind it. *Salvelinus alpinus* of the Arctic ocean is a marine fish that enters rivers to breed and may form freshwater colonies, especially in lakes. It is represented by many isolated colonies in lakes that it entered in glacial times, far to the south of its present range in the sea, in Scandinavia and the Alps, in Scotland, Ireland and the Lake District of England, and in North America. Many of these lacustrine forms differ considerably from the northern migratory char, and have been described as distinct species; they are more or less similar to trout, but have smaller scales and are generally beautifully coloured—bluish or olive above, often with bright orange spots on the sides; the belly varies from pink to scarlet, the coloration being most intense in the breeding males. The migratory fish are silvery, with the spots inconspicuous. *Salvelinus fontinalis,* the brook trout of eastern North America, is mainly a river fish, distinguished by the blackish mottling of the back and the dorsal and caudal fins; sea-run individuals (the Canadian "salmon trout") are plain silvery. *Cristivomer namaycush,* the Great Lake trout of North America, is a grayish fish with dark markings on the dorsal and caudal fins; it is distinguished from other char by the widely forked caudal fin; it reaches a weight of 100 pounds.

(C. T. R.)

CHARABANC, a large form of wagonette-like vehicle for passengers, but with benched seats arranged in rows, looking forward, commonly used for large parties, whether as public conveyances or for excursions. The word is French for benched carriage; in the English motor trade the term "motor coach" is preferred.

CHARACTER. To ask what character is, reveals the confusion of ordinary thought about it. Instincts, habits, impulses, desires, emotions, sentiments all belong to it. But what relation do they bear to one another? What is the part of character that has to be controlled and what is its controlling part? Whence come those things that are called "principles" of conduct, and "ideals," and the multitude of "qualities of character"—courage, steadfastness, sincerity, tolerance, generosity, patience and honesty and their opposites? We do not know. The first general problem of the psychology of character is therefore to transform the chaos of the ordinary conception of it into one in which the parts of character are seen to bear a clear and intelligible relation to the whole.

There are certain common but useful antitheses "character and intelligence"; "character and circumstances"; "character and conduct." Conduct is the expression of character; only actions that are in some degree under voluntary control are included in conduct. Reflex actions are not included in conduct; instinctive actions are. Character is the driving force; intelligence guides it to its destination; together they sum up the human mind and are inseparable in it.

Stages of Character.—These may be classed under three heads, which roughly correspond to three levels of mental development: (1) the instinctive; (2) the emotional; (3) the level of sentiment; and again roughly these three are represented in (1) the life of the animal; (2) the life of the child; and (3) the life of the adult human being. The first is the most perfect in organization; but also the most rigid, in which intelligence has least formative influence. The second is the most helpless and marks the transition from a lower to a higher form of organization, for which the guidance of the adult mind is indispensable. The third is the most plastic and comprehensive; but its organization is never completed. In it reflection, reason and self-control have their full opportunities; yet it is the region of folly and error, with which we can hardly charge the animals; of mistaken valuations followed by disillusions; of progress and decadence; of constancy and infidelity. It has never been understood.

The Human Instincts.—Animal instincts are inherited dispositions having specific patterns of behaviour for the attainment of their ends. An impulse felt in consciousness precedes their operation; attention accompanies it, and serves to adapt the pattern of behaviour to the actual situation. Human instincts have lost these patterns except in the case of simple instincts, as sucking, shrinking and clinging; in others the child must learn by experience to acquire new means to replace the old. The end for an animal is perceived—a hole or cover; the end for man may be conceived—a secret thought. In this sense, as instinctive impulses defined by their ends, we can enumerate the most important human instincts. They are flight and pursuit, concealment and display, domination and submission, attraction and repulsion, destruction and construction, crying for protection and giving protection, curiosity and search, and the food and sex instincts. The ends are only proximate ones, assumed to have been selected first for their biological utility; but in man they are also indispensable to the ends which he invents—wealth, power, fame, well-being, happiness, perfection.

The instincts sometimes act independently of emotion, finding in their own impulses when unchecked the force to attain their ends; but (1) when their impulses are obstructed they tend to arouse anger or fear; (2) when they attain their ends, joy or

satisfaction; (3) when they fail completely, sorrow or despair. The emotions never act independently of instincts, and tend to organize in their systems all that subserve their ends. Hence we find concealment not only in fear, but in the anger of revenge; in shame; in envy; in sorrow; in the joy of children's games. This seems to be the relation between instincts and emotions.

Difference Between Instinct and Emotion.—An instinct advancing to its end unchecked does not need to arouse emotion. In itself it is unlike emotion; it is most like habit. Both instinct and habit are orderly and stable, showing so little variability in action that we forecast the course of it. Emotion unrestrained is unstable and disorderly; its actions often surprise us. We follow our strong habits often without recognizing them; they are calm and unobtrusive; we cannot help recognizing our strong emotions. Hence it is, when emotion and instinct are conjoined, the second as it comes into operation tends to calm the first. It is the moments before action, we remark, that are so tense. For the force which emotion brings is for the needs of a certain situation. It should not therefore persist for long, and if it does, it tends to become pathological, as we see in the case of our morbid fears.

Besides these differences between instincts and emotions there are those based on the nature of their systems. Emotion is potentially more complex. Concealment is only one of many instincts organized in fear which may choose this instinct or any other better adapted to the actual situation: flight, shrinking or clutching, or shrieks for protection. From the time of Bain it has been recognized that strong emotion is accompanied by a diffused nervous disturbance; and this may render emotion more adaptable to a changing situation; whereas when an instinct is unchecked, and following out the normal course of its behaviour, the nervous discharge tends to be restricted to those channels which sustain this behaviour. Here the intervention of emotion would be not only superfluous but harmful.

The value of emotion lies in these two points of difference from instinct: (1) the force which it brings to deal with a given situation, and (2) its potentially more complex and adaptable system. It is indispensable to the sentiments, and without it there could neither be love nor hate. All great changes of character are initiated by emotion.

The Stage of the Sentiments.—That which has to exercise control must have a wider outlook than that which is to be controlled; but unless it moves us its warnings are ineffectual. It must move us by some other influence than emotion. Self-control comes from a higher system than emotion, and one that by its comprehensiveness more adequately represents the self. Love and hate, the chief sentiments, have this comprehensiveness. They are that governing part of character to which we have referred; and all the part which has to be governed is beneath them, under their authority. Love obtains its great organizing desires directed to its unchanging ends of union, happiness and well-being of the loved object, reciprocity of love, and the desire to be happy in the love of the object. But in hate these ends are reversed: not preservation and union, but destruction and separation; not happiness and well-being, but misery and the worst possible state of the object, and yet withal, the desire to be happy in the separation, misery and destruction of the object.

In these great desires love and hate find the principles of their self-control—not in their emotions.

Repression.—Repression is an extreme form of the self-control of sentiments. For if some of their emotions have to be regulated as being either too strong or too weak, others which are judged to be harmful in view of their ends have to be repressed. Such repression of things within the mind corresponds most nearly to "destruction" of things without us. We would destroy some things in our character if we could; but we can only repress them, which means to exclude them from consciousness, and prevent as far as possible their return to it.

Conscience.—There is another sentiment distinct from both love and hate, which, like them, often undergoes repressions. The uniqueness of conscience makes it difficult to interpret, for there is a particular conscience belonging to all love of which its ideals are a part. This is partial to the loved object. It is the repository of that part of the moral beliefs of the community in which the individual has been instructed and which he has adopted through authority and suggestion. It is therefore apt to differ from one person to another. But when it is a living force of character, it grows with a man's experience of life, and through the illusions and disappointments of love. These impress certain ideals and duties upon his mind differently from hearsay, however often repeated. They become the most vital part of his conscience, being there freed from the partiality to which love at first confined them. And as the ideals of love are much the same in its different varieties, the most general and important duties come to be impressed, sooner or later, on most men.

Thus is shown in merest outline how the parts of character are related to one another and the whole—how the instincts, habits, emotions and desires function in the sentiments of man, and there represent the unity of his character. Yet how incompletely they represent it. The potentials of his character transcend for better and worse everything that he has drawn from them to build up his actual loves and hates, and remain a perpetual enigma to him. The word is also applied to symbols of notation; letters of the alphabet, and, more particularly to ideographs; in such phrases as "the characters of the Chinese language number nearly 50,000." By extension of the philosophical meaning a "character" has almost become synonymous with "reputation." Still further development of this idea is found in the description of a person as "a character" ("an odd or eccentric person").

BIBLIOGRAPHY.—A. Bain, *The Study of Character* (1861); A. F. Shand, *Foundations of Character* (1914); A. A. Robaek, *The Psychology of Character* (1927); Theophrastus' *Characters,* contains the oldest extant sketches of types of character. (A. F. S.)

CHARADE, a kind of riddle, probably invented in France during the 18th century, in which a word of two or more syllables is divined by guessing and combining into one word (the answer) the different syllables, each of which is described, as an independent word, by the giver of the charade. Charades may be either in prose or verse. Of poetic charades those by W. Mackworth Praed are well known and excellent examples, while the following is a good specimen in prose. "My *first* is company; my *second* shuns company; my *third* collects company; and my *whole* amuses company." The solution is *Co-nun-drum.* The most popular form of this amusement is the acted charade, in which the meaning of the different syllables is acted out on the stage, the audience being left to guess each syllable and thus, combining the meaning of all the syllables, the whole word. A brilliant description of the acted charade is given in Thackeray's *Vanity Fair.*

CHARADRIIDAE: *see* LAPWING; PLOVER; TURNSTONE.

CHARADRIIFORMES, an order of birds, also called Limicolae, most members of which are shore haunting waders. The young are active and down-clad at hatching. *See* ORNITHOLOGY, CURLEW, PHALAROPE, PLOVER, SHEATHBILL, SNIPE, WOODCOCK.

CHARCOAL. Charcoal is the residue obtained when carbonaceous materials, of either animal or vegetable origin, are partially burned or heated so that the tarry and volatile matter is removed: in most cases the residues may be roughly described as impure carbon (*q.v.*). The same process of "carbonization" or "destructive distillation" is applied to coal in the manufacture of ordinary illuminating gas, but the residue obtained in this case is termed "coke."

It is customary to speak of "animal charcoal," "sugar charcoal" and "wood charcoal," the origin of the material being indicated in this way. The first of these products is obtained by strongly heating blood or bones, and accordingly may be either "blood charcoal" or "bone charcoal." Since bones consist very largely of phosphate of lime and other inorganic constituents which are not driven off on heating, bone charcoal contains relatively little carbon—only about 10–12% deposited in a finely divided state over the surface of the inorganic material.

Of the various charcoals, that obtained from sugar most nearly approaches pure carbon, and on this account is of considerable scientific interest, although of minor significance from the indus-

trial standpoint. When carefully prepared from pure sugar, it is practically free from inorganic constituents, and, accordingly on burning, leaves behind a negligible proportion of ash.

Wood Charcoal.—Wood charcoal is a material the production of which has been practised for centuries in regions where timber is abundant. The old procedure consisted in building the cut wood into heaps or stacks with a vent in the middle, and then setting it alight. The heat developed by the combustion of part of the wood served to carbonize the remainder, the extent of the combustion being limited by controlling the access of air and by covering the stack with moist turf or soil. In modern methods, on the other hand, the wood is heated in retorts, and this procedure makes possible the recovery of certain valuable by-products, such as wood tar, acetone, wood spirit and acetic acid.

The proportion of charcoal obtainable from wood is roughly about one-quarter of the *weight* of the wood, varying naturally with the method of carbonization employed. The relative reduction in volume, however, is not so great, for wood charcoal is an extremely porous material, and its bulk is approximately two-thirds of the bulk of the wood from which it has been prepared.

The composition and properties of the product depend on the temperature of carbonization. The higher the temperature and the longer the duration of carbonization, the greater is the proportion of carbon in the charcoal obtained, and by protracted treatment at a red heat the proportion of hydrogen may be reduced to a comparatively small figure. A charcoal, for example, obtained by heating birch wood for six hours at 750° C was found to contain only 0·5% of hydrogen. The amount of ash left on the complete combustion of wood charcoal varies with the wood employed and with the conditions of its carbonization, but is generally not more than 2–3%.

Charcoal was originally produced mainly for use as fuel. Since during carbonization the bulk of the tarry and volatile matter is driven off, charcoal is a clean fuel, and the heat given out in the combustion of a fixed weight—the so-called calorific value—is twice as great for charcoal as for the original wood. While charcoal prepared at a high temperature is difficult to ignite, the product obtained by carbonization at, say, 300° C, retaining a considerable proportion of volatile inflammable matter, it ignites readily.

In earlier days large quantities of wood charcoal were prepared for the reduction of iron from its ores, an operation in which coke is now mainly employed. So great was the demand for charcoal where iron ores were found that serious inroads were made on the timber in these districts. This was the case, for example, in the county of Sussex, where at one time the smelting of iron was extensively practised.

Another purpose for which wood charcoal has been required in large quantities is the manufacture of gunpowder. The constituents of this material are nitre, sulphur and charcoal, and the last-mentioned ingredient is obtained by the carbonization, at a fairly low temperature, of certain light woods, such as alder and willow.

Wood charcoal or charred wood differs from ordinary wood in exceptional resistance to decay—a characteristic which was known to the ancients. Some time ago a quantity of oak stakes were found in the bed of the river Thames at the spot where, according to Tacitus, the Britons fixed a vast number of such stakes in order to oppose the passage of a Roman army. These stakes, which were found to be charred superficially, had retained their form, and were sound at the heart. In this connection it is further noteworthy that the wooden piles on which many Venetian houses stand have all been charred in order to secure their preservation.

An extremely interesting property of charcoal is its power of adsorbing gases and of removing colouring matters from solution. It has long been known that charcoal will take up many times its own volume of a gas—in the case of ammonia 100–200, and at a low temperature its adsorptive capacity is very strikingly increased. Dewar found, for example, that the amount of nitrogen taken up by a certain charcoal was ten times as great at −185° C as at 0° C. This fact has been utilized in the production of high vacua. Freshly prepared charcoal, when exposed to air, gradually takes up water vapour and increases notably in weight—a further illustration of the adsorptive properties of this material.

Equally remarkable is the ability of charcoal to remove colouring matters from solutions, a property discovered more than 100 years ago and applied first in the treatment of beet-sugar juice. Coloured solutions, such as red wine or indigo, when treated with animal charcoal and then filtered, yield colourless liquids.

Activated Charcoal.—In recent years there have been notable developments in the applications of wood charcoal, dating back mainly to the World War of 1914–18. On the introduction of gas warfare in 1915 it became an urgent necessity to provide every soldier with some form of protection, and before long charcoal was generally adopted as an adsorbent for this purpose. Animal charcoal was first employed, since this material, according to a commonly accepted view, was more efficient than wood charcoal for absorbing gases. On grounds of economy, however, it was desired to use the latter material if possible, and investigations soon showed that when ordinary wood charcoal is kept for some time at a red heat with limited access of air, its power of absorbing gases is increased in a quite remarkable degree. It is said to be "activated."

It is worth while giving a few details in order to emphasize this marked effect of the "heat treatment" of wood charcoal. The efficiency of a particular birch-wood charcoal was tested by exposing a sample to a "dose" of poison gas. The material proved to be comparatively inefficient, retaining only 80% of the poison gas. The charcoal was then heated for 8 hours at 925° C with limited access of air, and a specimen of the product was tested in exactly the same way, showing a very different result, for the charcoal now adsorbed completely *four* consecutive doses, and retained even the half of a fifth dose.

The respirators supplied to the troops of all countries in the later stages of the war contained activated charcoal. Similar or even greater improvement in absorptive power can be achieved by heating wood charcoal in carbon dioxide or superheated steam, while impregnation with certain chemicals, such as zinc chloride, sulphuric acid or phosphoric acid, followed by exposure for some time to a high temperature, also yields an "active" product. This increase in absorptive capacity has been the subject of much investigation, and it appears that heat treatment such as that described augments the available surface of the charcoal. Activation is accompanied by a decrease of the bulk density, that is, a given weight of charcoal occupies more space after activation than it did before: its porosity is greater. It is probable also that the carbon molecules themselves undergo some modification on heating.

Activated charcoals are also of great importance from the industrial standpoint, more especially in connection with the adsorption of hydrocarbons such as gasoline, and the decolorizing of sugar juices. The well-known commercial materials, "Eponit" and "Norit," may be quoted as examples of these products, and evidence of the industrial significance of active charcoals is furnished by the numbers of fresh patents taken out for their manufacture from all sorts of vegetable substances. (*See* ADSORPTION.) (J. C. P.)

CHARCOT, JEAN MARTIN (1825–1893), French physician, was born in Paris on Nov. 29, 1825. In 1853 he took his M.D. at Paris, and three years later was appointed physician of the Central Hospital Bureau. In 1860 he became professor of pathological anatomy in the medical faculty of Paris, and in 1862 began his famous connection with the Salpêtrière where he created the greatest neurological clinic of modern times. As regards hysteria, which he defined as a psychosis superinduced by ideation, he threw the sexual theory into disrepute and studied the disease in relation to hypnotism. In muscular atrophy he differentiated between the ordinary wasting and the rarer amyotrophic lateral sclerosis (1874) and described with Pierre Marie the progressive neural or peroneal type (1886). He differentiated the essential lesions of locomotor ataxia and described both the gastric crisis and the joint affections (Charcot's disease). He separated multiple sclerosis from paralysis agitans. In diseases of the brain, the most notable contributions were his articles on

cerebral localization, the studies of aphasia and the discovery of the miliary aneurisms and their importance in cerebral haemorrhage. He also published writings on senile diseases, liver and kidney diseases, gout, chronic pneumonia and tuberculosis. Charcot greatly promoted the study of medicine in art (see: *Nouvelle Iconographie de la Salpêtrière,* 1888). He died on Aug. 16, 1893.

His best known works are *Leçons sur les maladies du système nerveux,* 5 vols. (1872–93) and *Leçons du mardi à la Salpêtrière,* 2 vols. (1889–90).

See F. Garrison, *Hist. of Medicine,* 3rd ed. (1921), and W. Osler memorial notice in *Johns Hopkins Hospital Bulletin* (1893).

CHARD, JOHN ROUSE MERRIOTT (1847–1897), British soldier, was born at Boxhill, near Plymouth, on Dec. 21, 1847, and in 1868 entered the Royal Engineers. In 1878 Lieut. Chard was ordered to South Africa to take part in the Zulu War, and was stationed at the small post of Rorke's Drift to protect the bridges across the Buffalo river and some sick men and stores. Here, with Lieut. Gonville Bromhead (1856–91) and 80 men of the 2nd 24th Foot, he conducted the gallant defence of Rorke's Drift against 3,000 Zulus, which saved Natal from a Zulu invasion. The gallantry of Chard and Bromhead was rewarded with the V.C. and immediate promotion to the rank of captain and brevet-major. Chard was made colonel in 1897. He died the same year at Hatch-Beauchamp, near Taunton, on Nov. 1.

CHARD, a market town and municipal borough in the Yeovil parliamentary division of Somersetshire, England, 12 mi. S.S.E. of Taunton. Pop. (1938) 4,306. Area, 1.6 sq. mi. It stands on high ground within 1 mi. of the Devonshire border with railway stations S.R. (Chard Town) and G.W.R. (Chard Joint Station). Chard (*Cerdre, Cherdre, Cherde*) was originally a trade centre near the Roman road to the west. There are two Roman villas in the parish. The bishop of Bath held Chard in 1086, and in 1234 his successor granted the first charter which made it a free borough. This charter was confirmed in 1253, 1280 and 1285. Chard is said to have been incorporated by Elizabeth, as the corporation seal dates from 1570. It was incorporated by grant of Charles I in 1642, and Charles II gave a charter in 1683. A market on Mondays and fair on July 25 were granted in 1253, and confirmed in 1642 and 1683, when two more fair days were added (Nov. 2 and May 3). The market day is now Thursday, fairs being held on the first Wednesday in May, August and November, for corn and cattle only, their mediaeval importance as centres of the cloth trade having departed. The cruciform parish church of St. Mary the Virgin is Perpendicular of the 15th century. A fine east window is preserved. The manufactures include lace and other textiles.

CHARD or **SWISS CHARD,** a name given to the edible leaf-beet (*Beta vulgaris* var. *cicla*), a variety of the beet (*q.v.*) in which the leaves and leafstalks, instead of the roots, have become greatly developed. The plant is a biennial with somewhat branched and thickened but not fleshy roots, and large leaves borne on stalks sometimes 2 ft. long and 1 in. to 3 in. wide. It is grown for the tender leaves and leafstalks; the former are boiled and served like spinach, the latter, like asparagus. Swiss chard is popular as a home garden pot herb because of its ease of culture, productiveness and tolerance to moderately hot weather. It furnishes an abundance of greens after the weather becomes too warm for growing spinach and other early greens.

CHARDIN, JEAN SIMÉON (1699–1779), French *genre* painter, the son of Jean Chardin, master carpenter, was born in Paris on Nov. 2, 1699, and died Dec. 6, 1779. He became famous for his still-life pictures and domestic interiors, which are well represented at the Louvre, and for figure painting, as in his *Le Bénédicité* (1740) and is one of the great French colourists.

See A. Dayot, *J. B. Siméon Chardin* (1905); H. E. A. Furst, *Chardin* (1911); E. Pilon, *Chardin* (1911).

CHARDIN, SIR JOHN (1643–1713), French traveller, was born in Paris in 1643. In 1665 he set out for Persia and India. He returned in 1670 and published *Récit du Couronnement du roi de Perse Soliman III.* in 1671. In Aug. 1671 he left again for Persia, going by Smyrna, Constantinople, the Crimea, Caucasia, Mingrelia and Georgia, and reached Ispahan in June 1673. He spent four years in Persia, visited India, and returned by the Cape of Good Hope in 1677. In 1681 the persecution of Protestants drove him to London, and in 1683 he went to Holland as representative of the East India Company. In 1686 he published the first part of *The Travels of Sir John Chardin,* etc. He died in 1713 and was buried in Westminster Abbey.

BIBLIOGRAPHY.—The complete account of Chardin's travels appeared at Amsterdam in 1711, under the title of *Journal du voyage du chevalier Chardin.* The Persian portion is to be found in vol. ii. of Harris's *Collection* (1705), and extracts are reprinted by Pinkerton in vol. ix. The best complete reprint is by Langlès (1811).

CHARENTE, an inland department of south-western France, comprehending the ancient province of Angoumois, and small portions of Saintonge, Poitou, Marche, Limousin and Périgord. It is bounded north by the departments of Deux-Sèvres and Vienne, east by those of Haute Vienne and Dordogne, south by Dordogne and Charente-Inférieure, and west by Charente-Inférieure. Area 2,306 square miles. Pop. (1936) 309,279. The Confolentais (known also as the *Terres Froides*) in the north-east is a region of granitic rocks which may be considered as a western extension of the Plateau Central. Here some parts exceed 1,000 ft. in height and the whole provides good upland pasture for cattle. The remainder of the department, known as the Terres Chaudes, consists of Jurassic, Cretaceous and Tertiary deposits and provides rich arable land. Cereals and potatoes are the principal crops and chestnuts, walnuts and cider-apples the chief fruits. The Terre Champagne is noted for its vines, much of the wine produced being distilled into brandy named after the town of Cognac. A large area drains to the river Charente, the chief affluents of which, in this section, are the Tardoire, the Touvre and the Né. The Confolentais is watered by the Vienne, a tributary of the Loire, while the district of Barbezieux, noted for its poultry farming, belongs almost wholly to the basin of the Gironde. Charente has stone quarries, peat workings and beds of clay which supply brick and tileworks and earthenware manufactories. There is a large foundry of naval guns at Ruelle. Flour mills and leatherworks are numerous. Angoulême is a paper-making centre and manufactures gunpowder. Coal, salt and timber are prominent imports. Exports include paper, brandy, stone and agricultural products. The department is served chiefly by the Orléans and Ouest-État railways, and the Charente is navigable below Angoulême. Charente is divided into the three arrondissements of Angoulême, Cognac and Confolens (29 cantons, 425 communes). It belongs to the region of the XII army corps, to the province of the archbishop of Bordeaux, and to the *académie* (educational division) of Poitiers. Its court of appeal is at Bordeaux. Angoulême (*q.v.*) is the capital, and Cognac, Confolens, Jarnac (*qq.v.*), and La Rochefoucauld are other towns. The department abounds in churches of Romanesque architecture, of which those of Bassac, St. Amant-de-Boixe (portions of which are Gothic), Plassac and Gensac-la-Pallue may be mentioned. There are remains of a Gothic abbey church at La Couronne, and Roman remains at St. Cybardeaux, Brossac and Chassenon (where are ruins of the Gallo-Roman town of Cassinomagus).

CHARENTE-INFÉRIEURE, a maritime department of south-western France, comprehending the old provinces of Saintonge and Aunis, and a small portion of Poitou, and including the islands of Ré, Oléron, Aix and Madame. Area, 2,792 sq. miles. Pop. (1936) 419,021. It is bounded north by Vendée, north-east by Deux-Sèvres, east by Charente, south-east by Dordogne, south-west by Gironde and the estuary of the Gironde, and west by the Bay of Biscay. The department is low-lying and consists of Jurassic, Cretaceous, Tertiary and Quaternary deposits which run in a north-westerly direction. This trend can be traced also in many sections of the coast and in the islands of Oléron and Ré. Post-Pleistocene submergence has resulted in the formation of many inlets and estuaries, particularly the Gironde, and there are several good harbours, the chief of which are La Rochelle and Rochefort. The latter has developed at the expense of Tonnay-Charente which is too high up the river to cope with modern shipping. Oysters and mussels are bred in the neighbourhood of La Rochelle and Marennes and there are many fishing villages. Royan, on the north shore of the Gironde, is a much-frequented

watering-place. The chief crops are wheat, oats, maize, barley and potatoes. Horse and cattle-raising is carried on and dairying is prosperous. A considerable quantity of wine, most of which is distilled into brandy, is produced. The department has a few peat-workings, and produces freestone, lime and cement; the salt-marshes of the coast are important. Ship-building, iron-founding, machine construction and the making of glass, pottery, bricks and earthenware are also carried on. The railways traversing the department belong to the Ouest-État system, except one section of the Paris-Bordeaux line belonging to the Orléans company. Internal communication is facilitated by the navigable reaches of the Charente, the Sèvre Niortaise, the Boutonne, the Seudre and the Gironde and by the canals of the coast. There are four arrondissements (40 cantons, 483 communes), cognominal with the towns of La Rochelle, Rochefort, Saintes and Jonzac. The department forms the diocese of La Rochelle, and is attached to the 18th military region, and in educational matters to the *académie* of Poitiers. Its court of appeal is at Poitiers.

La Rochelle, St. Jean d'Angély, Rochefort and Saintes are the principal towns. Surgères and Aulnay possess fine Romanesque churches. Pons has a château of the 15th and 16th centuries and a keep of the 12th century.

CHARENTON-LE-PONT, a town of northern France in the department of Seine, situated on the right bank of the Marne, at its confluence with the Seine. Pop. (1936) 20,946. *Le Pont* refers to the stone bridge of ten arches which crosses the Marne and unites the town with Alfortville, well known for its veterinary school founded in 1766. In the 16th and 17th centuries Charenton was the scene of the ecclesiastical councils of the Protestant party, which had its principal church in the town. At the neighbouring St. Maurice is the well known Hospice de Charenton. Charenton has a port on the Canal de St. Maurice, beside the Marne, and carries on boatbuilding and the manufacture of tiles and porcelain.

CHARES, of Lindus in Rhodes, a sculptor pupil of Lysippus, who fashioned for the Rhodians a colossal bronze statue of the sun-god, the cost of which was defrayed by selling the warlike engines left by Demetrius Poliorcetes after the siege in 303 B.C. (Pliny, *Nat. Hist.* xxxiv. 41). The colossus was seventy cubits (105ft.) in height. The notion that it bestrode the harbour is absurd. It was thrown down by an earthquake after 56 years.

See E. A. Gardner, *Handbook of Greek Sculpture* (1915), § 61.

CHARES, of Mytilene, a Greek belonging to the suite of Alexander the Great, to whom he was appointed court-marshal. He wrote a history of Alexander in ten books, dealing mainly with the private life of the king. The fragments are chiefly preserved in Athenaeus.

See *Scriptores Rerum Alexandri* (pp. 114–20) in the Didot edition of Arrian.

CHARES, Athenian general, is first heard of in 366 B.C. as assisting the Phliasians against Argos and Sicyon. In 361 he helped the oligarchs at Corcyra to expel the democrats. In 357 he was appointed to the command in the Social War, together with Chabrias, after whose death before Chios he was associated with Iphicrates and Timotheus (for the naval battle in the Hellespont, *see* TIMOTHEUS). Chares, having successfully thrown the blame for the defeat on his colleagues, was left sole commander, but receiving no supplies from Athens, joined the revolted satrap Artabazus. A complaint from the Persian king led to the conclusion of peace (355) between Athens and her revolted allies, and the recall of Chares. In 349, he was sent to the assistance of Olynthus against Philip II of Macedon, but effected nothing. In 340 he was appointed to the command of a force sent to aid Byzantium against Philip, but the inhabitants, remembering his former plunderings and extortions, refused to receive him. In 338 he was defeated by Philip at Amphissa, and was one of the commanders at the disastrous battle of Chaeroneia (*q.v.*). After the conquest of Thebes by Alexander (335), Chares is said to have been one of the Athenian orators and generals whose surrender was demanded. Two years later he was living at Sigeum, Arrian (*Anabasis,* i. 12). In 332 he entered the service of Darius. He is last heard of at Taenarum, and is supposed to have died at Sigeum. Chares was not lacking in personal courage, and was among the best Athenian generals of his time. At the best, however, he was "hardly more than an ordinary leader of mercenaries" (A. Holm).

See Diod. Sic. xv. 75, 95, xvi. 7, 21, 22, 85–88; Plutarch, *Phocion,* 14; Theopompus, *ap.* Athenaeum, xii. p. 532; A. Holm, *History of Greece* (Eng. trans., 1896), vol. iii.; *Cambridge Ancient History,* vol. vi. (1927), chapters viii. and ix. (with useful bibliography).

CHARGE, a load (Late Lat. *carricare,* to load in a *carrus* or wagon); *cf.* "cargo," "charger," a large dish. The word is used also for the powder and shot to load a firearm, the accumulation of electricity in a battery, the necessary quantity of dynamite or other explosive in blasting, and a device borne on an escutcheon in heraldry. "Charge" can mean a burden, and so a care or duty laid upon one, as in the instructions given by a judge to a jury, or by a bishop to the clergy of his diocese. In the sense of a pecuniary burden the word is applied to the price of goods, to an encumbrance on property and the expense of running a business. Further uses of the word are of an attack by cavalry, or by a bull or elephant, or football player; "charger," originally a horse ridden in a charge, now means a horse ridden by an officer, whether of infantry or cavalry.

CHARGÉ D'AFFAIRES: *see* AMBASSADOR; DIPLOMACY.

CHARGER, a riding horse allotted to a military officer for war; any mechanism adapted for charging, as for placing explosives in bore-holes for blasting, and that used in loading a magazine rifle or a machine gun, etc.; a large shallow dish.

CHARGING ORDER: *see* PRACTICE AND PROCEDURE.

CHARIBERT (d. 567), king of the Franks, was the son of Clotaire I. On Clotaire's death in 561 his estates were divided between his sons, Charibert receiving Paris as his capital, together with Rouen, Tours, Poitiers, Limoges, Bordeaux and Toulouse. Besides his wife, Ingoberga, he had unions with Merofleda, a wool-carder's daughter, and Theodogilda, the daughter of a neatherd. He was one of the most dissolute of the Merovingian kings.

(C. PF.)

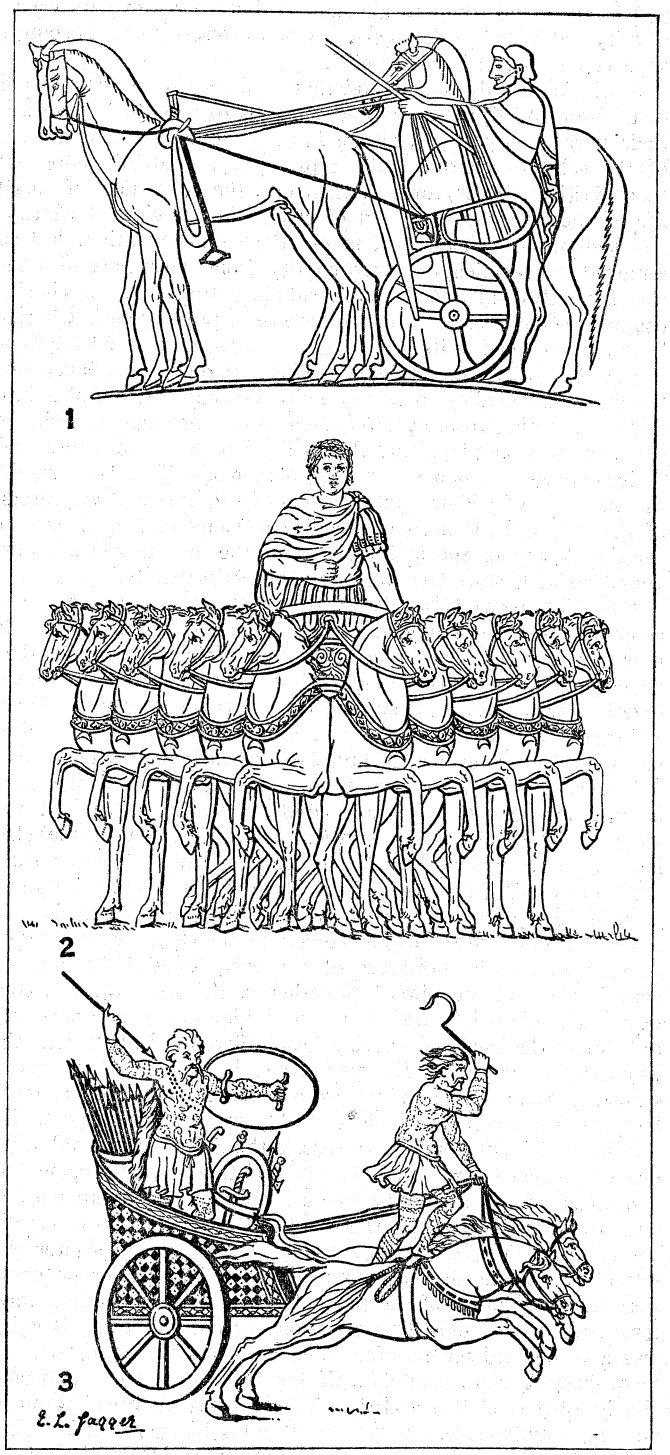
CHARIDEMUS, of Oreus in Euboea, Greek mercenary leader. About 367 B.C. he fought under the Athenian general Iphicrates against Amphipolis, but later joined Cotys, king of Thrace, against Athens. Soon afterwards he fell into the hands of the Athenians and accepted the offer of Timotheus to re-enter their service. Having been dismissed by Timotheus (362) he joined the revolted satraps Memnon and Mentor in Asia; after more service under the Athenians, he again joined Cotys, on whose murder (360) he was appointed guardian to his youthful son Cersobleptes. In 357, on the arrival of Chares with considerable forces, the Chersonese was restored to Athens. The supporters of Charidemus represented this as due to his efforts, and, in spite of the opposition of Demosthenes, he was honoured with a golden crown and it was resolved that his person should be inviolable. In 351 he commanded the Athenian forces in the Chersonese against Philip II. of Macedon, and in 349 he superseded Chares as commander in the Olynthian War. He achieved little success, but made himself detested and was in turn replaced by Chares. After Chaeroneia the war party would have entrusted Charidemus[1] with the command against Philip, but the peace party secured the appointment of Phocion. He was one of those whose surrender was demanded by Alexander after the destruction of Thebes, but escaped with banishment. He fled to Darius III., who received him with distinction. But, having expressed his dissatisfaction with the preparations made by the king just before the battle of Issus (333), he was put to death.

See Diod. Sic. xvii. 30; Plutarch, *Phocion,* 16, 17; Arrian, *Anabasis,* i. 10; Quintus Curtius iii. 2; Demosthenes, *Contra Aristocratem;* A. Schäfer, *Demosthenes und seine Zeit* (1885).

CHARING CROSS, the locality about the west end of the Strand and the north end of Whitehall, on the south-east side of Trafalgar square, London. It falls within the bounds of the city of Westminster. Here Edward I. erected the last of the series of

[1]According to some authorities, this is a second Charidemus, the first disappearing from history after being superseded by Chares in the Olynthian War.

crosses to the memory of his queen Eleanor (d. 1290). It stood near the present entrance to Charing Cross station, the terminus of the S.R. A fine modern cross has been erected within a few feet of the exact site. A popular derivation of the name connected it with Edward's "dear queen" (*chère reine*), but a village of Cherringe or Charing existed here some time before her death.



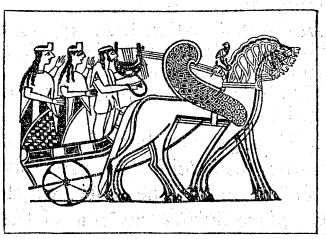
FROM THE "JOURNAL OF HELLENIC STUDIES"

TYPES OF CHARIOTS USED BY THREE NATIONS OF ANTIQUITY

1. Light Greek chariot equipped with four-spoked wheels (from a vase)
2. Roman chariot of the type driven in triumphal processions (from a medal of the Emperor Trajan)
3. Irish chariot used in battle. Closed in the back and open in front, this model is the reverse of those employed by the Greeks, Romans and Assyrians

The true origin of the name is not known; it is connected by some with that of a Saxon family, Cerring.

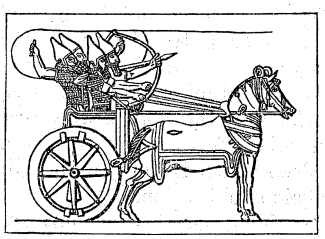
CHARIOT. In antiquity, a car used in battle, for the chase, in public processions and in games. The Greek chariot had two wheels and was made to be drawn by two horses; if a third, or more commonly, two reserve horses were added, they were attached on each side of the main pair by a single trace fastened to the front of the chariot, as may be seen on two prize vases in the British Museum from the Panathenaic games at Athens. On the monuments there is no other sign of traces, from the want of which wheeling round must have been difficult. Immediately on the axle (ἄξων, *axis*), without springs of any kind, rested the basket or body (δίφρος) of the chariot, which consisted of a floor to stand on, and a semicircular guard round the front about half the height of the driver. It was entirely open at the back, so that the combatant might readily leap to the ground and up again as was necessary. There was no seat, and generally only room for the combatant and his charioteer to stand in. The pole (ῥυμός, *temo*) was probably attached to the middle of the axle, though it appears to spring from the front of the basket; at the end of the pole was the yoke (ζυγόν, *jugum*), which consisted of two small saddles fitting the necks of the horses, and fastened by broad bands round the chest. Besides this the harness of each horse consisted of a bridle and a pair of reins, mostly the same as in use now, made of leather and ornamented with studs of ivory or metal. The reins were passed through rings attached to the collar bands or yoke, and were long enough to be tied round the waist of the charioteer in case of his having to defend himself. The wheels and body of the chariot were usually of wood, strengthened in places with bronze or iron; the wheels had four to eight spokes and tires of bronze or iron. This description applies generally to the chariots of all the nations of antiquity.



FROM DAREMBERG ET SAGLIO, "DICTIONNAIRE DES ANTIQUITÉS"

A GREEK CHARIOT (REPRODUCED FROM THE MELOS VASE)

Chariot Mountings.—The chariots of the Egyptians and Assyrians, with whom the bow was the principal arm of attack, were richly mounted with quivers full of arrows, while those of the Greeks, whose characteristic weapon was the spear, were plain except as regards mere decoration. Among the Persians, again, and more remarkably among the ancient Britons, there was a class of chariot having the wheels mounted with sharp, sickle-shaped blades, which cut to pieces whatever came in their way. This was probably an invention of the Persians; Cyrus the younger employed these chariots in large numbers. Among the Greeks and Romans, on the other hand, the chariot had passed out of use in war before historical times, and was retained only for races in the public games, or for processions, without undergoing any alteration apparently, its form continuing to correspond with the description of Homer, though it was lighter in build, having to carry only the charioteer. On two Panathenaic prize vases in the British Museum are figures of racing *bigae*, in which, contrary to the description given above, the driver is seated with his feet resting on a board hanging down in front close to the legs of his horses. The *biga* itself consists of a seat resting on the axle, with a rail at each side to protect the driver from the wheels. The chariot was unsuited to the uneven soil of Greece and Italy, and it is not improbable that these nations had brought it with them as part of their original habits from their former seats in the East. The Jews used "iron" chariots apparently strengthened by metal.



FROM DAREMBERG ET SAGLIO, "DICTIONNAIRE DES ANTIQUITÉS"

ASSYRIAN CHARIOT CARRYING BOWMEN

The chief authorities are J. C. Ginzrot, *Die Wagen und Fahrwerke der Grieche und Römer* (1817); C. F. Grashof, *Über das Fuhrwerk bei Homer und Hesiod* (1846); W. Leaf in *Journal of Hellenic Studies*, v.; E. Buchholz, *Die homerischen Realien* (1871–85); W. Helbig, *Das homerische Epos aus den Denkmälern erlautert* (1884), and the article "Currus" in Daremberg and Saglio, *Dictionnaire des Antiquités*.

CHARISIUS, FLAVIUS SOSIPATER, Latin grammarian, flourished about the middle of the 4th century A.D. He was probably an African by birth, summoned to Constantinople to take the place of Euanthius, a learned commentator on Terence. The *Ars Grammatica* of Charisius, part of which is still extant, is valuable as containing excerpts from the earlier writers on grammar, who are in many cases mentioned by name—Q. Remmius Palaemon, C. Julius Romanus, Cominianus.

The best edition is by H. Keil, *Grammatici Latini,* i. (1857); *see* also article by G. Götz in Pauly-Wissowa's *Realencyklopädie,* iii. 2 (1899); Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans.), § 419, 1. 2; Fröhde, in *Jahr. f. Philol.,* 18 suppl., 567–672 (1892). New edition by Barwick in Teubner series (1925).

CHARITON, of Aphrodisias, in Caria, the author of a Greek romance entitled *The Loves of Chaereas and Callirrhoë,* probably flourished in the 4th century A.D. The action of the story, which is to a certain extent historical, takes place during the time of the Peloponnesian War.

Editions by J. P. D'Orville (1783), G. A. Hirschig (1856), and R. Hercher (1859); there is an (anonymous) English trans. (1764); *see* also E. Rohde, *Der griechische Roman* (1900).

CHARITON, a city of southern Iowa, U.S.A., on the Chariton river, 53 mi. S.E. of Des Moines; the county seat of Lucas county. It is on federal highway 34, and is served by the Burlington and Rock Island railways. The population by 1940 federal census was 5,754. Coal is mined in the vicinity, and the city has creameries, and broom and wagon factories. It was settled about 1850.

CHARITY. Few words have suffered greater changes either in meaning or in application than the word "Charity." It represents both a personal and a social endeavour to ameliorate the conditions which prevail in society. The endeavour should be founded on an intelligent examination of the factors that go to make up our social and industrial life and should be guided by a definite purpose. Most people have some sort of theory as to what is just and right in our relations with our fellowmen, but it is often so vague and undefined that its application is ineffective if not positively harmful. Most of the words used in Greek, Roman or Hebrew literature to signify good will are primarily words expressive of the affections, of the relations existing between parents and children or between husband and wife, such as *ἀγάπη amor, amicitia. Caritas* or charity on the other hand had a somewhat different meaning and referred rather to the relation of the individual to those outside his family; in the first instance *caritas* signified a high price, thus dearness. It was not dissimilar in meaning to the word *χάρις* which also had a commercial sense but signified as well gratitude, grace, kindness. In English ecclesiastical documents it was spelt *charitas.* In the authorized version of the New Testament *ἀγάπη* is translated charity, and it was used by St. Paul as a translation of the Hebrew word *hēsēd,* which in the same version of the Old Testament is translated "mercy"; *e.g.,* "I desired mercy and not sacrifice." Almsgiving, *sedāquāh,* is translated by the word *ἐλεημοσύνη* in the Septuagint and in the Authorized Version by the word "righteousness"; it represents the deed which is done or the gift which is made under a sense of religious obligation.

In the early Christian period almsgiving has this meaning applied to a wide range of actions and contracts. The word *caritas,* charity or love, gradually assumes a higher meaning and represents an ideal social relation; *e.g.,* in such phrases as "love of man." It has no necessary relation to relief or alms. It may mean a consideration shown for the welfare of others either individually or generally, although as a matter of fact charity has largely concerned itself with the help of the class usually called the poor, and with problems of distress. Relief need not, however, be an essential part of charity or charitable work; it is only one method by which those who have the means at their disposal can come to the assistance of others. The history of charity is a history of many social and religious theories, influences and endeavours that have left their mark alike upon the popular and cultivated thought of the present day. Inconsistencies of charitable effort may be accounted for by the evolution of society itself, by the growth of the educated social instinct. It is now generally recognized that in addition to such suffering and want as befalls the evil-doer as a result of his ill deeds, there is a vast amount of suffering due to general social causes for which the sufferer is not responsible. Formerly it was the custom to say that the individual should alleviate this distress; to-day the feeling is general that society has a large amount of responsibility and is bound not only to alleviate it, but to remove its cause. Charity and in its broadest sense—philanthropy—is thus becoming an accepted part of social politics.

It will be readily understood that a history of charity would be a history of all the social and religious forces which have left their mark upon past generations in many countries. The growth of the habit of charity really represents a gradually educated social instinct. Every investigation into the conditions of social life has necessitated some sort of change in our view of charity, and legislation, as expressed in practical administration, has so removed the recipients of such charity from the sphere of what was formerly understood by charitable action that no charity can now be considered without reference to public relief. Charity has to be regarded in its bearing on every form of social relationship; *e.g.,* thrift and national savings, parochial management, hospitals and medical relief, friendly visiting and almonership, distress resulting from unemployment, insurance against sickness and against unemployment, the utilization of endowments and their adaptation to new needs and emergencies. To a large extent the questions of widows and orphans, of vagrants and wayfarers, of the sick and the aged (in mediaeval times entirely a matter for the charity of the individual or of the institution) are now bound up with State law and public administration.

The Historical Growth of Charity.—The study of early communities is the study of the development of the family. It is only slowly that the larger social life of the tribe or clan has developed. In the earlier stages of civilization men were drawn together by unconscious physical causes which only very slowly and gradually, after thousands of years, became conscious ethical motives. At first even the child hardly belonged to the family; it belonged to the tribe. But when the social value of the bond between mother and father and child came to be recognized, the social value of the bond between members of the same clan became more obvious. As the parents' responsibility for their child increased, the interest of the State also developed, although even up to the 18th century it was undefined and uncertain.

The Greek Community.—If we take the Odyssey and Hesiod as representing the literature of the early Greeks we find the clan family and the phratry together constituting the self-contained unit of society with fairly clear views as to the necessity of helping the poor, of offering hospitality, of dealing with the wayfarer or vagrant. Everyone outside the phratry was a stranger; the man who had no brotherhood and was subject to no law, who had no hearth and no family was always suspect. He was in a difficult position because, although he wandered from place to place and received the alms of the community, he was a stranger, and in a country where hospitality was unknown and strangers were feared, he was liable to be attacked. Generally speaking, however, the wayfarer could find food and shelter and water for washing at the houses of the well-to-do, or he could share the hospitality of the peasants. The man who was a wayfarer and beggar almost by profession was not unknown. Begging was a recognized means of gaining a livelihood. Penelope, not recognizing Ulysses, said that if his tale were true she would give him better clothes and then he might beg his bread throughout the country-side. A system of almsgiving was recognized as a duty. The laws of social life as stated by Hesiod about 700 B.C. are comparatively simple. The groundwork of Hesiod's charity is neighbourly help, but this help is limited in character in so far as the community is concerned. A beggar is expected to do some sort of work in return for his food and shelter.

In the later Greek State, society consisted of citizens and slaves, the slaves enabling the citizens to have leisure for education, war and government. The slaves formed the larger part of the population and were permanently dependent upon members of the civic class, so that the only poverty was that of the poor

citizens, who were cared for in the first instance by the clan family. There was a growing sense of responsibility in regard to orphans, and guardians were appointed to care for them. Public policy and charity both dictated the policy of relieving the poverty of citizens and preserving citizenhood. In Crete and Sparta the citizens were wholly supported out of the public resources. In Attica the citizens were aided in various ways; *e.g.*, by legal enactments for release from debts, by emigration, a free supply of corn, poor relief for the infirm, and relief for the children of those fallen in war, not to speak of voluntary public service and gifts from individuals. Aristotle criticises very severely the distribution of public money to the poorer citizens and suggests the direction in which reform must be sought. He thinks that the habit of distributing the surplus revenues to the poor instead of holding back a certain proportion for a time of greater need is a mistake. He regards it as pouring water through a sieve. The problem for him is how to contrive that poverty should become temporary and not permanent, and his proposals are adequate public aid and voluntary charity. Public relief, he urges, should be given in larger amounts so as to help people to purchase small farms or start in business; the well-to-do should in the meantime subscribe to pay the poor for their attendance at the public assemblies. Aristotle evidently tried to show that unless the purpose of civil and social life was carefully considered and clearly realized by those who desire to improve its conditions, no change for the better could result from individual or associated action.

Charity in Roman Times.—The two words which most clearly define the Roman attitude towards what we call charity are *liberalitas* and *beneficium*. *Liberalitas,* according to Cicero, lays stress on the mood, the attitude of the *liber,* the free-born man who is independent and superior giving help to someone who is dependent and inferior. *Beneficium* on the other hand indicates the deed and its purpose. Cicero lays down three conditions which should be observed:—(1) Not to do harm to the person one would benefit; (2) not to exceed one's means; (3) to have regard to merit. The character of the person whom we would benefit should be considered and the deed or gift graded according to social relationship. In this connection there were three important factors in Roman life: the family, the *plebs* and slavery. The *plebs* who were the clients of the great patrician families were gradually impoverished and slavery increased *pari passu.* The impoverishment of the *plebs* led to the *annona civica* or free supply of corn to the poorer citizens, to the *sportula* or organized food supply for poor clients, and ultimately to the maintenance of children of citizens by voluntary and imperial bounty. The task of relief became hopeless under these conditions and the impoverished citizen degenerated into dependent, beggar, pauper and slave. The clan family in Rome was the dominant political factor. In its development it became unsocial, and the stronger clan families crushed the weaker. They obtained possession of the *ager publicus* which belonged to the State and in early days was distributed to citizens without property. More and more this land was acquired by the rich families, and although many attempts were made to compel them to surrender it, they were mostly unsuccessful, and other measures had to be taken to enable the poorest citizens to live. The right to relief was dependent on the right of citizenship; it was hereditary and passed from father to son. It was thus in the nature of a continuous endowed charity affecting not one family or group of families, but the whole population.

The Lex Claudia, passed in 58 B.C., which gave corn gratuitously to the *plebs urbana,* naturally attracted to Rome many people who wished to live without working and found it difficult to live elsewhere. The same system was introduced into Constantinople, Alexandria and Antioch. Later on, it became an imperative necessity to restrict the civic bounty to as few persons as possible. Those who received it, received it as a statutory right and no labour was required in return. The system was bad because it compelled those who worked hard to maintain the idlers, and it led to an increase of slavery since the man who could not live upon his grant had no alternative but to become a slave. Thousands of citizens were unable to obtain land upon which they might have been able to gain a livelihood, and so were compelled to live in the towns, becoming gradually subjected to the conditions of a degrading pauperism. The *sportula,* to which reference has already been made, represented the charity of the patron to his clients and of the head of the clan family to those who attended at his house. It became a charity sufficiently important for State regulation; Nero limited the amount that might be paid in money and Domitian restored the custom of giving food.

Jewish and Christian Charity.—Throughout the Old Testament we find frequent references to the necessity for acts of charity, although almost always the kindred are entitled to the first consideration. Within the clan and tribe there are many poor oppressed by the rich. These rich are denounced frequently by the Prophets, and their denunciations form a valuable part of the national literature. In Job we find the family life developed side by side with the life of charity; the relief of the widow, the fatherless and the stranger are all enjoined, and this is the classification of dependents in the Christian Church. In the "*Didache*" (a Jewish Christian writing of about A.D. 90–120) the great commandments are adapted from St. Matthew's gospel, first "Thou shalt love God who made thee," second "thy neighbour as thyself"; and "all things whatsoever thou wouldst not have done unto thee, neither do thou to another." It is not necessary to dwell upon the sources of relief among the Jews but they were not systematized until at last permanent provision almost equal to a poor rate was made for the relief of the poor. In the early Christian Church this became free will offerings, first fruits and voluntary tithes brought to the bishop and used for the poor. The Jews in pre-Christian and Talmudic times supported the stranger or wayfarer by the distribution of food. The strangers were lodged in private houses and there were inns provided at which no money was taken. Subsequently special societies were formed for the entertainment of the resident poor and of strangers. These conditions prevailed in the Christian Church also. The Xenodocheion was the first form of Christian hospital both for strangers and for members of the Christian churches, and there are precedents both Jewish and Greek. In the Christian community the endowed charity comes into existence in the 4th century, but not among the Jews until the 13th century. Up to that time the charities of the synagogue were regarded as sufficient. St. Paul in his Epistle to the Corinthians represents the views of the early Christian Church on charity, and St. Francis at a much later date revives the same idea, though for hundreds of years afterwards little advance was made. In many respects there was retrogression in so far as the conception and purpose of charity is concerned. St. Paul considers charity in relation to a community of fellow-believers. He speaks as an outsider in relation to the State although he is technically a citizen, but social life and its needs are not uppermost in his thoughts because he is intent on creating a spiritual association. Paul wished to create a body of men and women linked together by love outside the normal life of the community. This was a new form of religious organization. According to the Christian maxim rightly understood "loving one's neighbour as oneself" set the standard of charity. The nobler the self, the completer the charity, and the charity of the best men, men who love and understand their neighbours best, having regard to their chief good, is the best and most effective charity. In later Christian thought the whole idea degenerated. The aid of the poor was not considered as an end in itself, an act of brotherly love, but as a means by which the almsgiver "makes God his debtor." Charity has nothing whatever to do with rewards and punishments, and yet St. Chrysostom says "if there were no poor, the greater part of your sins would not be removed; they are the healers of your wounds." Alms are thus the medicine of sin and this same thought is found in the penitential system. Almsgiving thus becomes detached from charity on the one side and social good on the other. It is considered that alms are paid to the credit of the giver and realized by him in the next world, a false view which has been handed down through

successive generations. The general idea of almsgiving for some hundreds of years has nothing whatever to do with social progress. It has no width of vision to understand the needs of those who are suffering from sickness or distress and no moral energy to effect their permanent relief. Those who hold this view of charity believe that "the poor will never cease from out the land," and indeed that it would be a bad thing if they did so cease because it would hinder their own spiritual progress.

The sub-apostolic church was congregational, the centre of a system of voluntary and personal relief connected with the congregational meals, the ἀγάπαι and under the supervision of a single officer or bishop. Out of this was developed a system of relief controlled by a bishop assisted by deacons or presbyters, while the ἀγάπαι consisting of offerings laid before the altar still remained. Finally these offerings became a dole of food or poor people's meal. The church fund during the second period of Christianity (*c.* A.D. 150–200) was a friendly fund supported by voluntary gifts used to succour and bury the poor, to help destitute and orphan children, old household slaves and those who suffered for the faith. With the growth of the parochial system parishes were placed under the charge of priests and deacons. It was the duty of the deacons to care for the poor, widows, orphans, wards and old people of their several districts. They drew up lists of those who received regular relief, and in Rome, as this system developed, the sick and infirm were superintended by persons appointed to inspect every street and a distribution was made in kind on the first day of every month. Before St. Gregory sat down to his meal a portion was separated and sent out to the hungry at his door. The Roman *plebs* had thus become the *pauperes Christi.* At the same time there was a system of relief independent of the churches, and the *hospitium* was now part of a common organization of relief very much on the lines of poor relief in the middle ages when the churches on the one hand and the public authorities on the other relieved the poor in times of scarcity and distress.

The Endowment of Charity.—The endowed charity grew up during the Byzantine period and officers appear like the almoner and the steward to superintend and distribute the alms and manage the property of the institution. St. Basil at Caesarea founded quite a colony of institutions, guest houses, poor houses, orphanages and houses for infant children. Bequests to the church were frequent for such institutions and in course of time the clergy became the owners of large properties and the administrators of endowed charities which with modifications continued throughout the middle ages and exists even to this day in various forms of parochial relief. Monasticism failed to solve the problem of the relief of the poor, although the institutions set up by the monasteries became extremely powerful and in some cases wealthy. The monasteries were out of sympathy with the charities of the parish, and as they were a class apart from other charities, they were separately administered. The belief in poverty as a fixed condition, only to be alleviated and never removed, was fundamental with monasticism. At the close of the period which ends with St. Gregory and the founding of the mediaeval church, economic and social conditions were adverse, and charity is reflected in the attempts to alleviate the suffering and the misery of those times. The public service was corrupt, the rich evaded taxation, the poor were oppressed, well-to-do society seemed to be decaying. Hospitals increased, but medicine was unprogressive. There were years of famine and of pestilence with which the authorities were unable to cope and there were constant wars. This will account for the large number of the poor who became a charge on the Church. The Church helped widows, orphans and the sick, it ransomed slaves, although it did not abolish slavery. The serf who was attached to the soil took the place of the slave, and almsgiving took the place of the *annona civica* and the *sportula.* Economic conditions were unfavourable to the independence and self-support of society as a whole, and this state of things continued for some hundreds of years.

We have referred to the two methods of relief which have usually been prominent, relief administered locally, chiefly to residents in their own homes, and relief administered in an institution. At the time of Charlemagne (742–814) the system of relief was parochial, consisting principally of assistance in the home. After that time, except probably in England, the institutional method appears to have predominated and the monastery or hospital in one form or another gradually encroached on the parish. St. Francis differed from the teachers of his own period since he brought reality once more to bear upon the question of social duty. For him the poor were once again the *pauperes Christi;* to follow Christ was to live among the people the life of the poor man. The disciple was to work with his hands, to receive no money, to earn the actual necessaries of life, though what he could not earn he might beg. To work for food and lodging was a right so long as he was bringing a better life into the world, and anything in excess of his normal requirements must be given to the poor. He would possess no property, no buildings or endowments, and in effect the movement was a lay movement, the force of which consisted in its simplicity and directness. It was inspired by a social endeavour and entirely transformed the idea of charity.

Five Centuries of Charity in England.—If we turn to England in the 14th and 15th centuries we find the population almost stationary, the towns comparatively small and London almost the only one with a population of 40,000 or 50,000. There was much poverty even though the 15th century was supposed to be the golden age of the labourer. Side by side with the charitable relief system of the parish was the self-supporting system of the manor, the manor being an economic unit, the estate of a lord on which there were associated the lord with his desmesne, tenants free of service, and villeins and others who were tenants by service. But in addition to the parish as the centre of relief there were the monasteries and the hospitals. The almonry of the monastery was near the church of the monastery and the almoner distributed his doles to travellers, palmers, chaplains and mendicants. It was his duty to visit and relieve the old, infirm, lame and blind, who were confined to their beds, and the remnants of meals and the old clothes of the monks were given to the almoner for distribution. The monasteries often established hospitals which served also as schools both for the gentry and for the poor. The monasteries began seriously to decline in the 15th century and their resources were greatly crippled. They had no common controlling organization and were just miscellaneous centres of relief. They stood outside the parish and rather hampered than helped its development. The hospitals were at first established for various purposes—for the poor, the infirm, the lame and blind, and for lepers outside the towns. The hospital in its modern sense was only very slowly created, St. Bartholomew's being founded in 1123 for the entertainment of poor diseased persons until they got well and for the maintenance until the age of seven of all children whose mothers died in the house. Amongst the mendicant orders the Franciscans attended the sick and poor in the slums of the towns with great devotion.

The system of relief had thus become a system of charitable endowments in connection with churches, monasteries and hospitals. This must be contrasted with the modern method of voluntary associations or rate-supported institutions. As the towns grew in size, guilds sprang up and charities were founded for members of the guilds. Rich men left their estates to their guilds to maintain decayed members in hospitals and almshouses, to educate their children, to give dowries to their daughters and to assist their widows. The boroughs also established charities, gave outdoor relief to the registered poor, and took over the duty of caring for the orphans; and thus towards the close of the middle ages the towns were gradually usurping what had formerly been the province of the Church. By the Statutes of Labourers, beginning in 1531, an endeavour was made to enforce a settled wage and restrain migration from the country to the town. An attempt was also made to suppress mendicity, the idea being to keep the people in some settled industry of the crafts or of agriculture or to force them back into such occupation if they had left it. The beggar was punished as unsocial. It is his fault if he belongs to no one; he must be made some-

body's dependent and kept so, and if no one will keep him his mendicity must be organized. Out of the failure to organize mendicity springs the poor law, and for at least two centuries the idea of statutory wage control and statutory poor relief seems to have been firmly fixed in the English legislative mind. In Henry VIII.'s time the system of relief from endowed charities, supported chiefly by rents from landed property, began to disappear and since the monasteries and religious houses were dissolved, little was left but relief in the shape of alms given in an isolated and unmethodical way. The property of the hospitals and the guilds was in many cases confiscated and a new organization of charitable relief had to be created. The poor could only be relieved as it seemed by a compulsory rate, and the administration of statutory relief naturally devolved on the central government. A poor law was enacted which still remains on the statute-book, although it has been modified by innumerable Local Government Board orders. The principle of poor law relief from a compulsory rate having been adopted, it was enacted (1572–73) that the aged and infirm should be cared for by the overseers of the poor, a new authority, and in 1601 the duplicate acts were passed, viz., that for the relief of the poor (43 Eliz. 2) and that for the furtherance and protection of endowed charities. Thus the poor were given the condition of a legally recognized class endowed with a claim for relief.

Poor Relief Act, 1662.—The Poor Relief Act of 1662 brought in the law of settlement which made the English labourer a settled but landless serf, supported by a fixed wage and a State bounty. The poor law was philanthropic in its origin, but philanthropy rapidly disappeared. Its object was to relieve the poor by home industries, to apprentice children, and to provide necessary relief for the poor unable to work. The economic fallacy of home industries founded on rate-supplied capital soon declared itself, and when workhouses were established in the 18th century, the same industrial fallacy recurred. The farmer paid the labourer as small a wage as possible and left it to the parish to provide whatever he might require in addition during his working life and his old age. The policy adopted by Queen Elizabeth for the relief of the poor included a scheme for the reorganization of voluntary charity as well as plans for the extension of rate-aided relief. Accordingly in the poor law it was arranged that the overseers (the new civic authority) and the church wardens (the old parochial or charitable authority) —should act in conjunction and should raise the necessary means by taxation of every inhabitant. What the church wardens were unable to obtain from endowments they and the overseers could secure by taxation. Towards the end of the 18th century, when the administration of poor relief fell into confusion, many charities were lost or were in danger of being lost and many were mismanaged. In 1786 and 1788 a committee of the House of Commons reported on the subject. In 1818, chiefly through the instrumentality of Lord Brougham, a commission of enquiry on educational charities was appointed, and in 1819 another commission was set up to investigate charities for the poor in England and Wales. These inquiries were continued until 1838 when a select committee of the House of Commons made a strong report urging the establishment of a permanent and independent board of inquiry to compel the production of accounts, to secure the safe custody of charity property and to adapt it to new uses.

Charity Commissioners, 1853.—A commission followed in 1849, and eventually in 1853 the first Charitable Trust Act was passed under which the charity commissioners of England and Wales were appointed. Where charities have been remodelled under schemes of the charity commissioners, there are now appointed, besides trustees elected by corporations, *ex officio* trustees who represent some office or institution of importance in connection with charities. The charity commissioners have power where the objects for which a charity was founded are obsolete or the directions of the testator obscure to apply the income of the charity to other purposes as far as possible in accordance with the charitable intention of the founder. In the remodelling of charities for the general benefit of the poor some one or more of 13 objects are usually included, such as a medical charity, provident club, friendly society, assistance to nurses, etc. Homes for abandoned children were established during the 17th century both in France and in England, and grants from parliament supported the movement. The Foundling Hospital was established in 1739. As a rule these foundling homes were badly managed and the infant death rate was enormous. General reforms were made, especially through the instrumentality of Jonas Hanway, to check infant mortality, and metropolitan parishes were required to provide for their children outside of London. Penitentiaries were established in 1758 and lock hospitals and lying-in hospitals in 1749–52. In Queen Anne's reign there was a new education movement, a charity school to teach poor children the alphabet and the principles of religion. This was followed by a Sunday school movement in 1780, and about the same time (1788) by the school of industry to employ children and teach them to be industrious. In 1844 the Ragged Schools Union was established and continued to do educational work until the Education Act of 1870. Industrial and reformatory schools were established to prevent crime and reform child criminals in 1854–56. The orphanage movement continued to grow and, supported by voluntary gifts, has greatly increased in size. After the Civil War the old hospital foundations of St. Bartholomew and St. Thomas became endowed charities, partly supported by voluntary contributions, and in the case of Christ's Hospital the voting system made its appearance.

Towards the end of the 18th century the dispensary movement was developed, culminating in the provident dispensary which made it possible for patients by means of small contributions in time of health to provide for sickness without having to make large payments. Hospital funds have also been established for making grants to various hospitals both in London and elsewhere. The magnitude of this accumulating provision of charitable relief in connection with churches and voluntary societies cannot well be estimated, but undoubtedly it has reached a huge total. Dr. Munsterberg once said "there is no country in the world in which so large an amount is given in charity as in England and no country where less good is done with it."

It is extremely difficult to estimate either the income or the expenditure of charitable societies in Great Britain, but an estimate has been made in connection with metropolitan charities, although these are often provincial as well and receive contributions from all parts of the country and even from abroad. It is estimated that for the year 1924–25 the turnover of the institutions for which information is available was £14,965,307. The voluntary contributions amounted to £6,192,883. The receipts from interest on invested funds and rents of property were £2,653,599. In addition a sum of £4,115,231 was due to payments by or for beneficiaries, an amount which must vary considerably from time to time. Legacies represented £1,387,166. The remaining sum was due to trading and industrial operations and miscellaneous receipts. The expenditure on these institutions amounted to £11,538,717 upon maintenance, out of which £1,234,739 was the charge for management or about 10% upon the gross expenditure.

Charity Organization Society.—The feeling that many charitable efforts were wasted and did more harm than good led to the establishment in the early 19th century of anti-mendicity societies. In 1869 the movement for the organization of charity led to the formation of the Charity Organization Society, originally the Society for Organizing Charitable Relief and Suppressing Mendicity. The movement spread to America and the British Colonies, the first American Charitable Organization Society being formed in 1877. All these societies resolutely opposed indiscriminate and casual alms-giving, and organized a relief system based on careful personal inquiry. The charity organization movement, while it has never succeeded in winning the complete confidence of the working classes, has nevertheless made it clear to most people that ill-considered philanthropy may do much more harm than good and that personal interest and sympathy may be the decisive factor in any attempt to help the individual or family in distress. Certainly the Charity Organization Society

has never thought it right to accept the poor as a permanent class, and whatever view may be taken of its methods, the idea underlying its efforts has always been to avoid the creation of a dependent class and to raise the poor above the conditions of serfdom.

As a result of the continued interest taken in the administration of charity, the Association for Befriending Young Servants was formed as well as workhouse aid committees to prevent a relapse into pauperism on the part of those who as children or young women receive relief from the poor law. For a time at least a restricted out-door relief policy was adopted and such a policy would still be the aim of organized charity, but for many reasons it has broken down, and it is impossible to assert that in times of serious unemployment restricted out-door relief can be maintained. The well known Elberfeld system (*q.v.*) on the Continent had a considerable influence upon thought both in England and America. It was a system of municipal relief administered by unpaid almoners, each dealing with a few cases, and seems to have been attended with great success wherever it has been carefully practised. Its success, however, depends upon the services of a sufficient number of unselfish almoners who have tact and ability and a desire to serve the best interest not only of the individual but of the community.

The work of the Charity Organization Society followed the lines laid down by the late C. S. Loch. The methods are briefly as follow: the central committee is composed of representatives of relief societies, religious agencies, endowed societies and representatives of local authorities, such as poor law guardians; full inquiry is made into each case and all the particulars are registered so as to prevent the possibility of overlapping; when help is given it is obtained so far as possible from relatives, employers and various charities. A system of training has been established for those who are engaged in this work, and Charity Organization Society workers when trained often become poor law guardians, secretaries of charitable societies and district visitors.

The investigations of Charles Booth, Seebohm Rowntree and others, the influence of men like Canon Barnett and Arnold Toynbee, and the university settlements generally, have somewhat changed the method of charity, which has now assumed the form of a new devotion to the duties of citizenship. Perhaps this was hardly possible until the scope of legislation had been more accurately determined and until statistics and investigation had made it clear how far charity itself failed to remove the causes of poverty. But the view of those who contend that so far as possible help should only be given after careful inquiry by organized charity is still widely held.

The Charity Organization Society is perhaps justified in contending that the poor law relief tends to increase. The average number of persons in receipt of domiciliary relief returned as being ordinarily employed, with their dependents, was for the year 1926–27 1,217,083, or 313 per 10,000 of the population and for 1925–26 478,454 or 123 per 10,000 of the population. This immense discrepancy was due of course to certain dominant features in 1926–27; viz., the increase of pauperism resulting from a general stoppage in the coal mining industry and from the general strike. Roughly speaking, we may say that 1,000,000 British people are as a rule in receipt of domiciliary relief other than medical relief, and of these nearly half would be insured persons and their dependents. The poor law is very much what the guardians chose to make it. It may become an influence definitely antagonistic to the proper development of family life, or even a method of pauperizing the working classes.

Certain boards of guardians have been removed from their position by the ministry of health, and in each case a commission of three guardians has been appointed to take the place of the board. The boards were accused of making illegal payments and of reckless extravagance. It is not necessary in this article to enter into details with regard to these boards of guardians, but apart altogether from the controversial question of the abolition of the poor law and the distribution of the duties of the guardians amongst other local authorities, it is obvious that some administrative changes are required. In large industrial districts in which there is a considerable amount of unemployment and poverty, there may be thousands of voters who are unwilling to vote for any guardians except such as promise to give them relief on the highest possible scale. This is an impossible state of affairs which will have to be remedied; otherwise no honourable person will come forward as a candidate for the board of guardians in places where they are subject to extreme pressure on the part of electors who are themselves to benefit as a result of the election by securing relief out of the rates. Even where the elector is not unemployed or in distress at the time of the election he may have in view the possibility of requiring assistance in the immediate future, and if he allows unworthy motives to influence his action he is in exactly the same position as the elector who requires immediate assistance and votes only for those candidates who are known to be generous with the rate-payers' money. In such cases, relief out of the rates becomes a public charity administered in a spirit which is demoralizing both to the giver and to the receiver. Some solution must be found of this difficult problem, otherwise the Ministry of Health will be compelled to deal with other boards of guardians as they have dealt with certain local authorities in the past. It would of course be impossible to disqualify the elector who has not received assistance but fears he may require it in the near future; but it seems just that votes should be withheld from those electors who are personally interested in the return of certain guardians because they are known to give relief with a lavish hand. The other alternative would be to appoint commissioners for the administration of relief who would serve much the same purpose as the commissioners appointed in certain American cities where corruption has been rampant. It has been argued that as each elector contributes to the rates he has the right to vote for any person he thinks fit; but as a matter of fact the electors to whom reference has been made do not contribute to the rates even in the shape of rent, for the rent itself is defrayed out of the rates.

The attitude of the Charity Organization Society towards much social legislation is that while it aims at improving social conditions, it weakens society itself. Charity, it is argued, has never objected to prison reform, industrial schools, child protection, housing and food reform. It has been a friendly ally in many reforms that affect industry very closely; *e.g.*, in the introduction of the Factory Acts, but it has never aimed at recasting society itself on a new economic plan. The organizers of charity object that British legislation is gradually creating a new industrial society in which the wage is regulated and everyone subsidized. They argue that the State maintenance of school children, old age pensions, and State provision for the unemployed all lead to a final stage in which everyone will be supported by society or be dependent on it industrially. In their opinion this would exclude motives for energy and endeavour and would also exclude the ethical element from life. Organized charity believes that such quasi-socialistic action will sooner or later mean a fatal want of initiative in the class helped. From a wider point of view, it must be remembered that the mistakes made by the nation in the past have been largely due to ignorance. It is only recently that the possibility of more thorough remedies has been grasped and that social responsibility has been recognized for evils which are avoidable. Statistics have shown not only the extent of social distress but the method of remedy in many cases, and social philosophy now teaches that poverty and disease are not always the result of misdemeanour on the part of the sufferer. There can be no doubt that a vast amount of suffering is due to general social causes; for such distress society is responsible and is bound to alleviate and remove it.

State and Private Action.—It is difficult to say what are the limits of public and private work respectively in the sphere of relieving distress, but again and again the State has been compelled to take over tasks for which private philanthropy found itself unfitted. In a British white paper published in Nov. 1927, dealing with public social services, a financial statement is given regarding the cost of such services as national insurance, old age pensions, unemployment, war pensions, educa-

tion, public health acts, housing of the working classes, lunacy, inebriates, mental deficiency. It is there shown that for 1926, the latest available year for statistics, the cost of these services in England and Wales was out of local rates £74,987,149, and out of Parliamentary votes and grants £155,747,237. The amount contributed from other sources; *i.e.*, revenue from endowments, voluntary contributions both of employers and employed, etc. was £83,239,745. This large sum of over £80,000,000 in England and Wales and over £10,000,000 in Scotland represents money contributed to objects which formerly would have been regarded as in the sphere of private charity. In this sum is included £6,226,433 contributed towards the cost of education in England and Wales, chiefly from endowments, and £1,009,325 in Scotland from similar sources.

There is perhaps another reason for the gradual encroachment of the State on the province of charity; whereas charity formerly confined itself to efforts for alleviation, to-day prevention is regarded as primary. Indeed, the whole theory of government has changed, for we no longer aim at merely holding the scales between the different classes of the community. The idea of government is to consider also how the value of life may be enhanced. We remember with gratitude that charity stepped in to help the poor when the poor seemed to have no other helper, but we must remember at the same time that such assistance was often very inadequate. Whether we consider the lunatic asylums or the prisons or the many other fields of charitable labour that were at one time in the hands of the philanthropists, we must admit that at last it became necessary for the State to step in and to do for the poor of all grades what charity had been unable to do for them. And always a deep debt of gratitude remains to the many great philanthropists of this transition period, such as Wilberforce, Howard, Owen, Allen and Mrs. Fry.

The Charity Organization Society itself sees that the State is slowly encroaching upon the sphere of charity, but it is right in its assertion that in this transition stage organization is necessary and that as a condition precedent to all organization there must be in each town or township some local centre of association for information and common help. This local centre is sometimes the Charity Organization Society itself, sometimes a guild of help, and in 40 or 50 towns a branch of the National Council of Social Service. The method is that of associated help combined with personal work, and is adopted, with innumerable varieties, in America, Germany and elsewhere. In the United States relief is now often given out of a common pool called the Community Chest and every endeavour is made to prevent overlapping.

Widows, Orphans and Old Age Pensions Act.—Recent legislation in Great Britain has shown how help that was formerly given by a committee is now rendered by the State through the medium of the local authority; in Jan. 1928 the Widows, Orphans and Old Age Pensions Act came into operation by which a large class of individuals formerly assisted by private charity was absorbed in the scheme of social insurance. This comprises insurance against old age as a supplement to the Old Age Pensions Act of 1890, insurance against sickness, unemployment insurance, help for widows and orphans under certain definite conditions, and other benefits. The original Old Age Pensions Act was non-contributory and was therefore opposed by the Charity Organization Society, but the subsequent Acts are rendered less dangerous in their view by the contributory principle.

Finally, we may attribute much recent British legislation to a change which has come over public opinion as a result of investigations into the causes and extent of poverty. Sociologists have shown us that, whatever may be our view of the remedies, the causes are not purely individual. Their studies have created a predisposition towards concerted social action. Charity was a pre-scientific attempt to do something which needed to be done, but which could only succeed in slightly ameliorating, and never in curing, the evil itself. The accumulated weight of social knowledge which has been acquired has changed our view of the function of charity. Statistical inquiry has discovered a much more intricate social interdependence than has been suspected. This interdependence is progressive. The more complex our society, the more interdependent we are, and the greater becomes the need for recognizing that society is something more than an aggregate of units. Statistics have helped enormously in the study of sociology because they bring together the facts calculated to illustrate the condition and prospects of society. The sociology of to-day gives us a new reading of human nature and a deeper conception of our social life. The State has intervened and has annexed a large part of what was formerly the sphere of charity, as in the cases of elementary education and the health of the child.

In Great Britain the State has also divided its responsibility for disease and sickness with the local authorities, friendly societies and approved societies. This is also noticeable in the case of hospitals; some are controlled by the municipality while others are supported by voluntary contributions. Sometimes the State co-operates, as with the Prisoners Aid Society, and occasionally it attempts to co-ordinate and supervise, as with the inebriate homes, etc. Both the State and the local authority are active, but there is still plenty of room for voluntary service, not only in connection with education but in prisons and reformatories, infirmaries and hospitals. With regard to the latter, it is interesting to note that the income of King Edward's Hospital Fund for the year 1926 was £285,749 and that the total receipts of all the London voluntary hospitals in that year was £3,887,000. The income of the Hospital Saturday (General) Fund amounted in 1926 to £79,192. There are still a few cases in which charitable societies carry out work which would seem to be the responsibility of the State; *e.g.*, the Society for the Prevention of Cruelty to Children, which has a royal charter and obtains from the public by subscriptions the necessary funds for maintaining its work.

All charitable work has now to take account of these new factors and this fresh view of social responsibility. It used to be assumed that our social and industrial system was satisfactory on the whole, and that it was the individual who was solely to blame. But men fail in life from all kinds of misfortunes over which they have no control, and in all such cases of injustice and hardship the most important thing is to aim at a change of circumstances. Everyone admits that the standard of life has been raised from century to century, and that the working classes are infinitely better off than in the middle ages, but who would contend that this is due to the administration of charity? The improvement is due to economic causes and the growth of an educated public opinion. What remains to be done is something more than the effort of organized charity, valuable as it is in the relief of distress. Constructive philanthropy must unite with all the forces that make for social betterment, including the work of local authorities and of parliament. The philanthropist will always bear in mind that a considerable proportion of the people have inherited conditions which, although an improvement upon the environment of their forefathers, are nevertheless a severe handicap to social advancement. A world wide depression beginning in 1929 strained the resources of private charity. In many countries, particularly the United States and England, the state stepped in to assume much of the burden. (*See* also POOR LAW; CHARITY COMMISSIONERS FOR ENGLAND AND WALES; CASUAL WARD; OLD AGE PENSIONS; UNEMPLOYMENT INSURANCE; ELBERFELD POOR RELIEF SYSTEM.)

CHARITY COMMISSIONERS FOR ENGLAND AND WALES. Between 1818 and 1850 investigations were made into the condition of British charities by a Parliamentary Commission of Enquiry (1818–37), by a Committee of the House of Commons (1835), and a Royal Commission appointed in 1849. The reports made by these recommended the appointment of a permanent board to which should be entrusted wide powers to improve the administration of all charities, to safeguard their funds and secure their proper investment, and to give ready and effectual expression of the doctrine of *cy pres*, as administered by Courts of Equity, by framing schemes for adapting the administration of charities to the altered circumstances, whether of the charity property, of the locality, or of society generally.

By the Charitable Trusts acts, 1853–1925, the Charity Com-

mission was set up to carry out these important duties. In addition to their powers under the Charitable Trusts acts, the Charity Commissioners exercise jurisdiction in relation to charities under numerous acts of Parliament, including the Local Government act, 1894, the Mortmain and Charitable Uses acts, 1888–92, the Commons act, 1899, the War Charities act, 1916, the Blind Persons act, 1920, and the Charity Fuel Allotments act, 1939. The jurisdiction of the Commissioners (subject to certain exemptions) extends to all endowed Charities in England and Wales, other than Educational Charities.

The exemptions from the jurisdiction of the Commissioners are universities, cathedrals, registered places of worship, Queen Anne's Bounty, the British Museum, friendly societies and savings banks, religious or charitable institutions maintained by voluntary contributions, and mixed charities (*i.e.*, charities partly voluntary and partly endowed) so far as regards the income which is derived from voluntary contributions.

The Charitable Trusts acts make provision for safeguarding charitable endowments by the constitution of:—

(*a*) The Official Trustee of Charity Lands. A Corporation Sole for taking and holding Charity Lands which may be vested in him by any Court of competent jurisdiction or by an order of the Charity Commissioners.

(*b*) The Official Trustees of Charitable Funds, incorporated for holding stocks, shares, securities and monies.

These are bare trustees only, and have no power to interfere in the administration of the lands or securities vested in them, or in the management of any charity.

The greater part of charity land is now vested in the Official Trustee of Charity Lands, whilst the total sum of stocks and investments held by the Official Trustees of Charitable Funds was on December 31, 1938, £92,600,000 and is increasing annually.

CHARIVARI, a French term of uncertain origin, but probably onomatopoeic, for a mock serenade, "rough music," made by beating on kettles, fire-irons, tea-trays or tin pans. The charivari was anciently in France a regular wedding custom, all bridal couples being thus serenaded. Later it was reserved for ill-assorted and unpopular marriages, and as a mockery for all who were unpopular. At the beginning of the 17th century, wedding charivaris were forbidden by the Council of Tours, but the custom still lingers in rural districts. The French of Louisiana and Canada introduced the charivari into America, where it became known under the corrupted name of "shivaree."

CHARKHARI, an Indian state in the Bundelkhand agency of Central India. Area, 785 sq.mi.; pop. (1941) 123,594. It is surrounded on all sides by other states of Central India, except near Charkhari town, where it meets the United Provinces. It was founded by Bijai Bahadur, a *sanad* being granted him in 1804 and another in 1811. The chief, whose title is maharaja, is a Rajput of the Bundela clan, descended from Chhatar Sal, the champion of the independence of Bundelkhand in the 18th century. In 1857 Raja Ratan Singh received a hereditary salute of 11 guns, a *khilat* and a perpetual *jagir* of £1300 a year in recognition of his services during the Mutiny. The town of Charkhari (locally *Maharajnagar*) is 40 mi. W. of Banda; pop. 9,582.

CHARLATAN, originally one who "patters" to a crowd to sell his wares (Ital. *ciarlatano,* from *ciarlare,* to chatter), like a "cheap-jack" or "quack" doctor—"quack" being similarly derived from the noise made by a duck; so an impostor who pretends to have some special skill or knowledge.

CHARLEMAGNE LEGENDS. Innumerable legends soon gathered round the memory of the great emperor. He was represented as a warrior performing superhuman feats, as a ruler dispensing perfect justice, and even as a martyr suffering for the faith. It was confidently believed towards the close of the 10th century that he had made a pilgrimage to Jerusalem; and, as in the case of many other great rulers, it was reported that he was only sleeping to awake in the hour of his country's need. The legendary Charlemagne and his warriors were endowed with the great deeds of earlier kings and heroes of the Frankish kingdom, for the romancers were not troubled by considerations of chronology. National traditions extending over centuries were grouped round Charlemagne, his father Pippin, and his son Louis. The history of Charles Martel especially was absorbed in the Charlemagne legend. But if Charles's name was associated with the heroism of his predecessors he was credited with equal readiness with the weaknesses of his successors. In the histories of the wars with his vassals he is often little more than a tyrannical dotard, who is made to submit to gross insult. This picture of affairs is drawn from later times, and the sympathies of the poet are generally with the rebels against the monarchy.

Charlemagne's wars in Italy, Spain and Saxony formed part of the common epic material, and there are references to his wars against the Slavs; but especially he remained in the popular mind as the great champion of Christianity against the creed of Mohammed. In 1164 Charles was canonized; yet this gave him no real claim to saintship, but his festival was observed in some places until comparatively recent times. Charlemagne was endowed with the good and bad qualities of the epic king, and as in the case of Agamemnon and Arthur, his exploits paled beside those of his chief warriors. These were not originally known as the peers famous in later Carolingian romance. The peers numbered 12 most probably by analogy with the 12 Apostles. The lists of them are very various, but all include the names of Roland and Oliver. The chief heroes who fought Charlemagne's battles were Roland; Ganelon, afterwards the traitor; Turpin, the fighting archbishop of Reims; Duke Naimes of Bavaria, the wise counsellor who is always on the side of justice; Ogier the Dane, the hero of a whole series of romances; and Guillaume of Toulouse, the defender of Narbonne.

The defeat of Roncesvalles, which so deeply impressed the popular mind, has not a corresponding importance in real history. But it chanced to find as its exponent a poet whose genius established in the *Chanson de Roland* (*see* ROLAND, LEGEND OF) a model for his successors, and definitely fixed the type of later heroic poems. The other early *chansons* to which reference is made in *Roland* are *Aspremont, Enfances Ogier, Guiteclin, Balan,* relating to Charlemagne's wars in Italy and Saxony. *Basin* or *Carl et Elégast* (preserved in Dutch and Icelandic), the *Pèlerinage de Charlemagne* and *Le Couronnement Looys* also belong to the heroic period. The purely fictitious and romantic tales added to the personal history of Charlemagne and his warriors in the 13th century are inferior in manner, and belong to the decadence of romance. The old tales, very much distorted in the 15th century prose versions, were to undergo still further degradation in 18th century compilations.

According to *Berte aus grans piés,* in the 13th century *remaniement* of the Brabantine *trouvère* Adenet le Roi, Charlemagne was the son of Pippin and of Berte, the daughter of Flore and Blanchefleur, king and queen of Hungary. *Mainet* (12th century) and the kindred poems in German and Italian relate the *enfances* (youthful exploits) of Charlemagne. He delivered Rome from the besieging Saracens, and returned to France in triumph. But his wife Galienne, daughter of Galafre, whom he had converted to the Christian faith, died on her way to rejoin him. Charlemagne then made an expedition to Italy (*Enfances Ogier* in the Venetian *Charlemagne,* and the first part of the *Chevalerie Ogier de Dannemarche* by Raimbert of Paris, 12th century) to raise the siege of Rome, which was besieged by the Saracen emir Corsuble. *Aspremont* (12th century) describes a fictitious campaign against the Saracen King Agolant in Calabria, and is chiefly devoted to the *enfances* of Roland. The wars of Charlemagne with his vassals are described in *Girart de Roussillon, Renaut de Montauban, Huon de Bordeaux,* and in the latter part of the *Chevalerie Ogier,* which belong properly to the cycle connected with Doon of Mayence.

The legend of the pilgrimage of Charlemagne to the Holy Sepulchre probably originated in a desire to authenticate the relics in the abbey of Saint Denis, supposed to have been brought to Aix by Charlemagne, and is preserved in a 12th-century romance, *Le Pèlerinage de Charlemagne.* The legend of the conquest of Armorica is preserved in *Aiquin* (12th century). *La destruction de Rome* is a 13th-century version of the older *chanson* of the emir Balan, who collected an army in Spain and sailed to Rome. The defenders were overpowered and the city destroyed before the

advent of Charlemagne, who, however, avenged the disaster by a great battle in Spain. The romance of *Fierabras* (13th century) was one of the most popular in the 15th century, and by later additions came to have pretensions to be a complete history of Charlemagne. *Otinel* (13th century) is also pure fiction. *L'Entrée en Espagne,* preserved in a 14th-century Italian compilation, relates the beginning of the Spanish War, the siege of Pampeluna, and the legendary combat of Roland with Ferragus. Charlemagne's march on Saragossa, and the capture of Huesca, Barcelona and Girone, gave rise to *La Prise de Pampelune* (14th century, based on a lost *chanson*); and *Gui de Bourgogne* (12th century) tells how the children of the barons, after appointing Guy as king of France, set out to find and rescue their fathers, who are represented as having been fighting in Spain for 27 years. The *Chanson de Roland* relates the historic defeat of Roncesvalles on Aug. 15, 778, and forms the very crown of the whole Carolingian legend. The two 13th-century romances, *Gaidon* and *Anseis de Carthage,* contain a purely fictitious account of the end of the war in Spain, and of the establishment of a Frankish kingdom under the rule of Anseis. Charlemagne was recalled from Spain by the news of the outbreak of the Saxons. The contest between Charlemagne and Widukind (*Guiteclin*) offered abundant epic material. Unfortunately the original *Guiteclin* is lost, but the legend is preserved in *Les Saisnes* (*c.* 1300) of Jehan Bodel, which is largely occupied by the loves of Baudouin and Sibille, the wife of Guiteclin. The adventures of Blanchefleur, wife of Charlemagne, form a variation of the common tale of the innocent wife falsely accused, and are told in *Macaire* and in the extant fragments of *La Reine Sibille* (14th century). After the conquest of the Saracens and the Saxons, the defeat of the Northmen, and the suppression of the feudal revolts, the emperor abdicated in favour of his son Louis (*Le Couronnement Looys,* 12th century). Charles's harangue to his son is in the best tradition of epic romance. The memory of Roncesvalles haunts him on his death-bed, and at the moment of death he has a vision of Roland.

The mythic element is practically lacking in the French legends, but in Germany some part of the Odin myth was associated with Charles's name. The constellation of the Great Bear, generally associated with Odin, is Karlswagen in German, and Charles's Wain in English. There were mediaeval chroniclers who did not fear to assert that Charles rose from the dead to take part in the Crusades. In the ms. *Annales S. Stephani Frisingenses* (15th century), which formerly belonged to the abbey of Weihenstephan, and is now at Munich, the childhood of Charlemagne is practically the same as that of many mythic heroes. This work, generally known as the chronicle of Weihenstephan, gives among other legends a curious history of the emperor's passion for a dead woman, caused by a charm given to Charles by a serpent to whom he had rendered justice. The charm was finally dropped into a well at Aix, which thenceforward became Charles's favourite residence. The story of Roland's birth from the union of Charles with his sister Gilles, also found in German and Scandinavian versions, has abundant parallels in mythology, and was probably transferred from mythology to Charlemagne.

The Latin chronicle, wrongly ascribed to Turpin (Tilpinus), bishop of Reims from 753 to 800, was in reality composed by a Frenchman between 1140 and 1150. Alberic Trium Fontium, a monk of the Cistercian monastery of Trois Fontanes in the diocese of Châlons, embodied much poetical fiction in his chronicle (*c.* 1249). A large section of the *Chronique rimée* (*c.* 1243) of Philippe Mousket is devoted to Charlemagne's exploits. At the beginning of the 14th century Girard of Amiens made a dull compilation known as *Charlemagne* from the *chansons de gests,* authentic history and the pseudo-Turpin. *La Conqueste que fit le grand roi Charlemaigne es Espaignes* (pr. 1486) is the same work as the prose compilation of *Fierabras* (pr. 1478), and Caxton's *Lyf of Charles the Grete* (1485).

The Charlemagne legend was fully developed in Italy, where it was to have later a great poetic development at the hands of Boiardo, Ariosto and Tasso. There are two important Italian compilations, ms. XIII. of the library of St. Mark, Venice (*c.* 1200), and the *Reali di Francia* (*c.* 1400) of a Florentine writer, Andrea da Barberino (b. 1370), edited by G. Vandelli (Bologna, 1892). The six books of this work are rivalled in importance by the ten branches of the Norse *Karlamagnus saga,* written under the reign of Haakon V. This forms a consecutive legendary history of Charles, and is apparently based on earlier versions of the French Charlemagne poems than those which we possess. It thus furnishes a guide to the older forms of stories, and moreover preserves the substance of others which have not survived in their French form. A popular abridgement, the *Keiser Karl Magnus Krönike* (pr. Malmö, 1534), drawn up in Danish, serves in some cases to complete the earlier work. The 2,000 lines of the German *Kaiserchronik* on the history of Charlemagne belong to the first half of the 12th century, and were perhaps the work of Conrad, the poet of the *Ruolantes Liet.* The German poet known as the Stricker used the same sources as the author of the chronicle of Weihenstephan for his *Karl* (*c.* 1230). The earliest important Spanish version was the *Chronica Hispaniae* (*c.* 1284) of Rodrigo de Toledo.

The French and Norman-French *chansons* circulated as freely in England as in France, and it was therefore not until the period of decadence that English versions were made. The English metrical romances of Charlemagne are:—*Rowlandes Song* (15th century); *The Taill of Rauf Coilyear* (*c.* 1475, pr. by R. Lekpreuik, St. Andrews, 1472), apparently original; *Sir Ferumbras* (*c.* 1380) and the *Sowdone of Babylone* (*c.* 1400) from an early version of *Fierabras;* a fragmentary *Roland and Vernagu* (Ferragus); two versions of *Otuel* (Otinel); and a *Sege of Melayne* (*c.* 1390), forming a prologue to Otinel unknown in French.

For the historical Charlemagne *see* CHARLES THE GREAT.

BIBLIOGRAPHY.—The most important works on the Charlemagne cycle of romance are J. Bédier, *Les légendes épiques* (4 vol., 1908–13) and *La Chanson de Roland* (1927), and for the German legend, vol. iii. of H. F. Massmann's ed. of the *Kaiserchronik* (Quedlinburg, 1849–54). *The English Charlemagne Romances* were edited (extra series) for the Early Eng. Text Soc. by Sidney J. Herrtage, Emil Hausknecht, Octavia Richardson and Sidney Lee (1879–81), the romance of *Duke Huon of Bordeaux* containing a general account of the cycle by Sidney Lee; the *Karlamagnussaga,* by C. R. Unger (Christiania, 1860), *see* also G. Paris in *Bibl. de l'Ecole des Chartes* (1864–65). For individual *chansons see* L. Gautier, *Les Épopées françaises* (new ed. 1919 etc.) and J. Bédier, *op. cit.,* to which the following should be added: A. Thomas, *L'Entrée d'Espagne* (Société des Anciens Textes Français, 1913); L. Brandin, *La Chanson d'Aspremont* (1923–24), and *Sir Otuel,* ed. S. J. Herrtage (*E.E.T.S.,* 1880). For the Carolingian romances relating to Roland, *see* ROLAND, LEGEND OF; *Les Saisnes,* ed. F. Michel (1839); *The Sege of Melaine,* introductory to *Otinel,* preserved in English only (ed. *E.E.T.S.,* 1880); *Simon de Pouille,* analysis in *Epop. fr.* (iii. pp. 346 *seq.*); *Voyage de C. à Jérusalem,* ed. E. Koschwitz (Heilbronn, 1879). For the chronicle of the Pseudo-Turpin, *see* an edition by Castets (Paris, 1881) for the "Société des langues romanes," and J. Bédier in *Légendes epiques,* t. iii. The Spanish versions of Carolingian legends are studied by Milà y Fontanals, *De la poesia heroico-popular castellana* (Barcelona, 1874). (L. B.)

CHARLEMONT, JAMES CAULFEILD, 1ST EARL OF (1728–1799), Irish statesman, son of the third viscount Charlemont, was born in Dublin on Aug. 18, 1728, and succeeded his father as fourth viscount in 1734. Lord Charlemont is historically interesting for his political connection with Flood and Grattan. For various early services in Ireland he was made an earl in 1763, but he disregarded court favours and cordially joined Grattan in 1780 in the assertion of Irish independence, being chosen commander-in-chief of the volunteer force. He was president of the volunteer convention in Dublin in November 1783, and was a strong opponent of the proposals for the Union. Lord Charlemont was a cultivated man, with liberal and artistic tastes, and his house was a centre of literary society in Dublin. He died on Aug. 4, 1799.

See F. Hardy, *Memoirs of the political and private life of James Caulfeild, Earl of Charlemont* (1810; 2nd ed., 1812); *Original Letters, principally from Lord Charlemont, . . . Edmund Burke, . . . etc.* (1820).

CHARLEROI (CAROLUS REX), a town in the province of Hainaut, Belgium. Pop. (1939) 28,183. It was founded in 1666 on the site of a village called Charnoy, by the Spanish governor Roderigo, and named after his sovereign Charles II. of Spain. Charleroi is the centre of the chief coalfield of Belgium, with im-

portant metallurgical and glass industries. It is connected by canal with Brussels, and from its position on the Sambre communicates by water with France. It was ceded soon after its foundation to France by the treaty of Aix-la-Chapelle, and Vauban fortified it. During the French occupation the town was considerably extended, and its fortifications strengthened to resist the attacks of William of Orange. In 1794 Charleroi again fell into the hands of the French, and it was dismantled by them. In 1816 it was re-fortified under Wellington's direction, but was finally dismantled in 1859. Parts of the old ramparts are left near the railway station. The battle of Charleroi (Aug. 22–23, 1914) was fought between German and French troops. In World War II, Charleroi was occupied by the Germans soon after the fall of Namur in May 1940.

CHARLEROI, a borough of Washington county, Pennsylvania, U.S.A., on the Monongahela river, 29 mi. S. of Pittsburgh; served by the Pennsylvania railroad. The population in 1920 was 11,516 (26% foreign-born white), and was 10,784 in 1940 by the federal census. It is in the "Pittsburgh" coal-field, and has important manufactures of iron, mine supplies and all types of glassware. There were 12 factories in Charleroi in 1937. Charleroi was founded in 1890.

CHARLES, a masculine proper name (Fr. *Charles;* Span. *Carlos;* Ital. *Carlo;* Ger. *Karl*), meaning originally "man." It has been borne by many European sovereigns and princes.

CHARLES (1525–1574), cardinal of Lorraine, French statesman, was the second son of Claude of Lorraine, duke of Guise, and brother of Francis, duke of Guise. He was archbishop of Reims in 1538 and cardinal in 1547. At first he was called the cardinal of Guise, but in 1550, on the death of his uncle John, cardinal of Lorraine, he in his turn took the style of cardinal of Lorraine. A master of intrigue, he was, like all the Guises, ambitious and devoid of scruples. With his brother, Duke Francis, the cardinal was all-powerful during the reigns of Henry II. and Francis II.; in 1558 and 1559 he was one of the negotiators of the treaty of Cateau-Cambrésis; he persecuted the reformers pitilessly and helped to provoke the crisis of the wars of religion. The death of Francis II. deprived him of power, but he remained one of the principal leaders of the Catholic party. In 1561, at the Colloquy of Poissy, he was commissioned to reply to Theodore Beza (*q.v.*). In 1562 at the Council of Trent, he at first defended the rights of the Gallican Church against the pretensions of the pope; but after the assassination of his brother he approached the court of Rome, and on his return to France he endeavoured, in vain, to obtain the promulgation of the decrees of the council (1564). In 1567, when the Protestants took up arms, he held for some time the first place in the king's council, but Catherine de' Medici soon grew weary of his arrogance and in 1570 he had to leave the court. He endeavoured to regain favour by negotiating at Rome the dispensation for the marriage of Henry of Navarre with Margaret of Valois (1572). He died on Dec. 26, 1574, at the beginning of the reign of Henry III.

A large amount of correspondence is preserved in the Bibliothèque Nationale. *See* also J. J. Guillemin, *Le Cardinal de Lorraine* (1847); René de Bouillé, *Histoire des ducs de Guise* (1849); H. Forneron, *Les Guises et leur époque* (1877); H. N. Williams, *The Brood of False Lorraine* (1918).

CHARLES, ST., called THE GOOD (le Bon), or THE DANE (*c.* 1084–1127), count of Flanders, was the only son of St. Canute or Knut IV., king of Denmark, by Adela, daughter of Robert the Frisian, count of Flanders. On the assassination of Canute in 1086, his widow fled to Flanders, with her son. Charles was brought up by his mother and grandfather, Robert the Frisian, on whose death he did great services to his uncle, Robert II., and his cousin, Baldwin VII., counts of Flanders. Baldwin died of a wound in 1119, and, having no issue, left his countship by will to Charles the Dane. Charles had to fight for his heritage, but he soon won, and secured his position by his clemency. He devoted himself to the welfare of his subjects, and exerted himself in the cause of Christianity, both by his bounty and by his example. He well deserved the surname of *Le Bon.* He refused the crown of Jerusalem on the death of Baldwin, and in 1125 nomination as a candidate for the imperial crown in succession to Henry V. He was murdered while praying in the church of St. Donatian at Bruges on March 2, 1127, because, by throwing open granaries there in a famine, he had broken the merchants' monopoly.

See J. Perneel, *Histoire du Règne de Charles le Bon, précédé d'un résumé de l'histoire de Flandres* (Brussels, 1830), and *Charles le Bon, Comte de Flandre* (Lille, 1853).

CHARLES THE GREAT (CHARLEMAGNE), king of the Franks and emperor, born April 2, 742 or 743, was the eldest son of Pepin III. by Berta (Bertrada), daughter of Charibert of Laon. At that date the Franks were governed by Pepin and his brother Carloman, who ruled as mayors of the palace under a fainéant Merovingian king. By the abdication of Carloman, in 747, Pepin became sole ruler, as his father Charles Martel had been. In 751 Pepin deposed the last Merovingian (Childeric III.) and himself assumed the Frankish crown, with the approbation of Pope Zacharias. In 754 Pope Stephen II. visited Pepin at Paris and anointed him as king, together with his two sons, Charles and Carloman. Between these two the kingdom was equally divided by Pepin on his death-bed (768), Charles receiving Austrasia, Neustria and western Aquitaine. This arrangement was displeasing to his junior, who perhaps claimed the whole inheritance on the ground that he was born after their father's coronation (751). In 769 Charles suppressed an Aquitanian rising, led by the aged Duke Hunold, and received the submission of Lupus, duke of Gascony, although Carloman declined to give any assistance. In 770 Charles married the daughter of Desiderius, king of the Lombards, probably to strengthen the influence which Pepin III. had acquired in Italian politics. But in 771 he repudiated the Lombard princess and married Hildegarde, a Suabian lady, who became the mother of his three legitimate sons, Charles, Pepin and Lewis. Desiderius naturally resented the slight put upon his daughter and seized the first opportunity of revenge. This presented itself in 771, when King Carloman died and Charles, in accordance with Frankish law, appropriated the vacant kingdom to the exclusion of his brother's infant sons. Their mother, Queen Gerberga, fled with them to the court of Desiderius, who announced his intention of supporting their claims and vainly urged the pope to crown them (772). Hadrian, who had lately succeeded Stephen II., endangered the safety of the papal States by refusing this demand, since Charles was preoccupied with his first Saxon campaign, and Desiderius plundered and conquered at his will in central Italy. But in the autumn of 772 Charles gave ear to Hadrian's appeal for help, and demanded satisfaction from the Lombards for himself and for the pope. Since Desiderius was defiant, the Frankish host was summoned to meet at Geneva in May 773. From Geneva the main army, led by Charles himself, marched over the Mt. Cenis to Susa, where it encountered the Lombard army, under Desiderius, holding a fortified position, and was brought to a halt. Meanwhile a second Frankish army, which had crossed the Great St. Bernard, threatened the communications of the Lombards, who as soon as they perceived their danger fell back in haste, some to Pavia and others to Verona. Verona surrendered to the Franks in the winter of 773–774, and here the nephews of Charles fell into his hands. Their fate is uncertain, but they troubled him no more. Pavia was reduced, after a long blockade, in the following summer. Desiderius, who was found there, ended his days as a monk at Corbie on the Somme. After the fall of Pavia Charles took the title of king of the Lombards. Frankish garrisons and Frankish officials were established at Pavia and in other cities of the kingdom. But some of the Lombard dukes in north and central Italy were allowed to remain in office as vassals of the conqueror. The ducal house of Benevento remained *de facto* independent, though in 788 the reigning duke agreed to pay an annual tribute, to date his charters by the regnal years of Charles, and to inscribe the name of Charles upon his coinage. Charles abstained from meddling with the Greek possessions in south Italy—Calabria, Apulia, Naples, Salerno, Amalfi. But later in his reign he acquired the Greek provinces of Venetia, Istria and Dalmatia. His relations with the papacy were defined during a visit which he paid to Rome at the Easter feast of 774. He was then acclaimed as Patrician of the Romans, and he confirmed the so-called Donation of 754 by which his father had guaranteed to the papacy its ancient and law-

ful possessions in Italy. The text of the Donation only survives in a corrupt and interpolated copy. It cannot have been precisely worded since Hadrian and Charles, who were otherwise good friends, differed sharply about its interpretation. As Patrician, Charles claimed the right of hearing appeals from the Roman law-courts, and he exacted an oath of allegiance from the Romans when Hadrian's successor was elected, though he did not interfere with the election. In 800 he presided over the tribunal before which Leo III. purged himself of various accusations. But it was Lewis the Pious who first established (in 824) the right of the emperor to supervise the temporal administration of the pope through an envoy permanently residing in Rome.

From 774 to 799 Charles was at war with the Saxons, a heathen race whose lands lay east of the Rhine and north of Hesse and Thuringia. Though troublesome neighbours of the Franks they had become tributaries of Pepin III. in 758, and the Frankish annalists do not explain the first Saxon war of Charles (in 772) by reference to any provocation that he had received. Their paganism may have been their chief offence; the chief event of the campaign was the destruction of the sacred pillar Irminsul, together with its grove and temple. The Saxons retaliated by raiding Hesse while Charles was absent in Italy, and on his return, in 775, he opened a war of conquest which was only completed in the 14th campaign. There was no cohesion between the Saxon tribes, and they were much inferior to the Franks in military science and equipment. But their country had strong natural defences (the hills and forests of the Teutoburger Wald and the Harz country, the Weser and the Elbe with their tributary streams) which made it difficult for the Franks to invade rapidly or to retreat with impunity. The Frankish host was only available in the summer months, and it was difficult to find garrisons for conquered districts. The Saxons usually offered submission when they were attacked in force, and rebelled again when Charles withdrew his forces. He did not make his difficulties lighter when he insisted that those who submitted should accept baptism. His chief opponent was the Westphalian chieftain Widukind who, in 778, raided the east bank of the Rhine up to Coblenz, and, in 782, destroyed a Frankish punitive force in Saxony. The second of these exploits was atrociously revenged in the massacre of Verden, where Charles put to the sword no less than 4,500 Saxon captives in one day. In 785 Widukind submitted upon terms and was baptized, after Charles had wintered in Saxony, and had harried the land continuously for some months. After this year the chief centres of resistance were the marshes on the left bank of the lower Elbe and Nordalbingia (Schleswig). To these districts Charles applied in 799 and 804 a policy of deportations, transplanting combatants and non-combatants alike to other parts of his empire. He legislated for the conquered lands on more than one occasion. His *Capitulatio de Partibus Saxoniae* (probably of 785) denounces penalties of the severest kind against idolators and those who wrong churches or ecclesiastics; it also obliges the whole population to pay tithes to the Church. His *Capitulare Saxonicum* (797), issued after consultation with representatives of the Saxons, modifies in some respects the customary law of the race, to make it conformable with Frankish law. The customary law itself is recorded in his *Lex Saxonum,* of uncertain date. Charles founded in Saxony the bishoprics of Munster, Minden, Osnabrück, Paderborn and Bremen. He appointed Saxon nobles as his counts, and required them to hold law-courts in the Frankish manner. He directed the clergy to report to himself those counts who perverted the course of justice. In or before 797 he began to send his *missi dominici* to perambulate in Saxony. No public assembly of the Saxons was lawful unless convoked by these officials. Under this system Saxony was tranquil after 804. In the ninth century the Saxons, while retaining much of their primitive law and culture, became fervently Christian and thoroughly reconciled to Frankish rule.

Bavaria was annexed by Charles more easily and earlier than Saxony. Tassilo, the last Bavarian duke of the Agilolfing line received the duchy in 748 from the hands of Pepin III., to whom he took the oath of fealty; but he persistently absented himself from the annual assembly, and took no part in the campaigns of Pepin or of Charles. Under pressure he renewed his fealty in 781 and 787. But on the second occasion he only took the oath when the Frankish host was on the march to invade Bavaria, and in 788 he was indicted before the assembly for conspiring with the Avars. His life was spared, but he was relegated to a monastery, and Bavaria was divided between Frankish counts. In the 9th century the Bavarians were the chief support of the East Frankish monarchy and Regensburg was the chief residence of Lewis the German. As the master of Bavaria Charles came into collision with the Avars, who had been settled in the Hungarian steppes since 568. In 791 he harried their western lands, between the rivers Enns and Raab. The fortified camp (Ring) of the Avar Khan was sacked in 795 by the Margrave Eric of Friuli, and totally destroyed by Pepin, the second son of Charles in 796. After this disaster the Avars sent to Aachen certain of their chiefs who made peace and accepted baptism. Bishop Arno of Salzburg was commissioned by Charles to convert the Avar nation, and in 805 the Khan, finding himself hard pressed by the Slavs, became a Christian and placed himself under the emperor's protection.

More celebrated, but historically less important, than this easterly expansion of Frankish power is the campaigning with which Charles and his lieutenants harassed the Arabs of northern Spain. In 778 Charles himself commanded an expedition against Saragossa. It was a failure, since he did not receive the support which he had expected from some rebellious emirs. As he was retreating through the Pyrenees his rear-guard was destroyed, not by the Arabs, but by the Christian Basques of Pampeluna, whom he had exasperated by destroying the walls of that city. Einhard the biographer of Charles, treats this disaster as insignificant; but the fate of Roland, the Warden of the Breton march, who fell at Roncevaux with other famous warriors (Aug. 15, 778), passed into legend and song. To repair his relations with the Spanish Christians Charles took their side in the Adoptianist controversy, when they indicted the archbishop of Toledo as a heretic. He desired to create a Frankish march on the south slope of the Pyrenees, as an outwork for the defence of Narbonne and Septimania; and in this object he succeeded. In 801 Barcelona was captured by his son Lewis with the help of Count William of Toulouse, a hero whose name, like that of Roland, lives in mediaeval epic. In 807 Pampeluna accepted the protection of Charles and became the second bastion of the "Spanish Mark," which effectively defended both the western and the eastern passes of the Pyrenees.

Only thrice between 774 and 779 did Charles revisit Italy. In each case his primary object was to tighten his hold upon the Lombard kingdom. In 775 he crushed a Lombard rebellion in which the dukes of Friuli, Chiusi and Spoleto were supported by their compatriot, the independent ruler of Benevento; Rotgaud of Friuli lost his duchy, and Hildebrand of Spoleto, who had placed himself under the Pope's protection in 773, was forced to become a royal vassal. In 780 and in 787 Charles crossed the Alps to assert his supremacy over Benevento, an object, which, as already noted, he did not completely realize. During the second of these three visits he induced Pope Hadrian to crown his sons Pepin and Lewis as kings of Italy and Aquitaine. The Teutonic lands he reserved for himself and for his eldest son and namesake. These arrangements suggest that Italian affairs did not occupy the first place in his thoughts and calculations; and it is significant that, even after his imperial coronation, he held to the plan of 780. In this same year, while still in Italy he accepted the suggestion of the Empress Irene that his eldest daughter Rotrude should marry Irene's son and ward, the young Constantine VI. But Charles repudiated this arrangement in 787, probably because Irene and her son in that year induced the Seventh Council of Nicaea to restore image worship in the Greek Church, and called upon the Latin Church to imitate a policy which Charles and the Frankish clergy regarded as superstitious and absurd. Pope Hadrian, whose legates were present at the Council of Nicaea, agreed with its decision, but his wishes were ignored by the king. In 794 Charles held a council of the Frankish Church at Frankfurt to refute the worshippers of images. It was attended by Papal envoys and representatives of the Italian, Spanish, and English clergy. The arguments on which Charles and his advisers

relied are set forth in the *Libri Carolini,* four tracts composed in the years 789–791 by the king's orders, and published in his name. It is uncertain whether Charles was inspired by religious zeal or by a desire to discredit the Greek empire. The *Libri Carolini* expressly dispute the right of Constantine VI. to be regarded as the lawful heir of the *Imperium Romanum;* but there is no other evidence to suggest that Charles at this time coveted the imperial dignity. Perhaps the long struggle for the extirpation of Saxon idolatry was responsible for the vigour with which he and the Frankish Church pursued this controversy. There was no irremediable rupture of relations with the Greek empire; for in 798 Irene sent ambassadors to Aachen to inform Charles that Constantine VI. had been deposed and that she had been acknowledged as her son's successor. Among the Frankish clergy it appears to have been the accepted view that Constantine was infamously treated and that a woman was incapable of holding the empire. There is nothing to suggest that Irene's ambassadors were discourteously received. But in 800 Charles allowed himself to be crowned as emperor at Rome by Pope Leo III.

The secret history of this coronation, and the motives of those who counselled it, can only be conjectured. Leo III., the successor of Hadrian, was freely elected by the Roman clergy and people in 795. Charles readily acknowledged the validity of the election, but until 799 we hear of no further correspondence between the papal and the Frankish courts. In 799 a Roman faction, who accused Leo of adultery and perjury, endeavoured to get rid of him. Brutally assaulted in the streets of Rome, he narrowly escaped the loss of tongue and eyes and was confined in a Roman monastery; but his attendants succeeded in conveying him to the Duke of Spoleto for protection. Leo's character was unfavourably judged by some of the Frankish clergy; for which reason Charles declined to reinstate him until the accusations of his enemies were disproved. In July 799 Leo was brought to the king at Paderborn, ostensibly as an honoured guest, and remained there for some days. He was finally sent back to Rome, escorted by a commission of archbishops, bishops and counts, who held a judicial enquiry and reported that nothing had been proved against the Pope. In Nov. 800 the king appeared at Rome, and spent more than three weeks in reviewing the situation. His chief difficulty, we are told, was still to decide how he would deal with the pope. No accuser dared to state a case against Leo, but it is evident that he was not generally popular in Rome. At last, on Dec. 23, Leo cleared himself in St. Peter's church, taking a solemn oath upon the Gospels, that he was innocent. On Christmas Day, after celebrating mass in the same church, he crowned Charles as emperor in the presence of the Roman people who were evidently not taken by surprise, since they acclaimed Charles in the set form of words which was used to welcome a patrician. Two theologians of the emperor, Anghilbert and Alcuin prophesied obscurely (in prose and verse) the imperial coronation some months before it actually occurred. Charles may have hesitated to run the risk of a war with Constantinople; but the biographer's statement, that he was crowned unawares and against his will, is not convincing.

Once crowned, he showed himself ready and eager to come to some arrangement with Constantinople. In 801 he made an offer of marriage to Irene, but she was deposed shortly after his envoys arrived at the Greek court. They were well treated by her successor Nicephorus I., who made counter-proposals for an honourable peace between West and East. Charles responded amicably and proposed a boundary line which would have given him Venetia, and the coast towns of Istria and Dalmatia. But Nicephorus preferred to fight for these newly lost provinces, and there ensued a naval war in the Adriatic, conducted on the Frankish side by King Pepin. After the death of Pepin (July 8, 810) Charles hurriedly offered peace, with the surrender of all his claims to the disputed territories. The offer was accepted by Michael Rhangabé, who succeeded Nicephorus in 811; and in 812 Greek envoys came to Aachen and saluted the emperor of the West as *Basileus,* thus acknowledging the equality of the two empires. In view of these facts it cannot reasonably be contended that Charles regarded the Roman empire as indivisible.

In 806 Charles, in accordance with Frankish custom, drew up a scheme for the partition of his realms between his three legitimate sons. It provided that each son should be absolute in his own sphere, and did not designate a successor to the empire. But in 813, when peace had been made with Constantinople, and Charles the Young and Pepin were dead, he nominated Lewis the Pious as his consort and successor in the empire, at the same time assigning Italy to Bernhard the son of Pepin. Charles thus asserted the hereditary character of the empire. It is remarkable that the coronation of Lewis took place, not at Rome, but at Aachen, and that Charles himself placed the crown upon his son's head, as if with the intention of showing to the world that the pope had no voice in the disposal of the empire. Next to the Greeks the Danes were the chief enemies with whom Charles had to deal in his last years. A Danish kingdom was already in existence, and it menaced his north-eastern frontier; Danish pirates were already harrying the British Isles. In 809 Charles built a fort at Itzehoe to protect the right bank of the Elbe. In 811 and 812 he concluded treaties with Danish kings. But he relied especially upon his North sea fleet which was based upon Boulogne, and built in his shipyards at Ghent. He ordered that ships should be found for defence of all ports and navigable rivers on his northern coasts. He also maintained patrols in the Mediterranean from Narbonne to the mouth of the Tiber, to guard against the descents of Arab pirates, but the danger from this side did not engage his personal attention. By capitularies of 802 and 811 he made naval service obligatory on all the inhabitants of maritime provinces, even upon the magnates. It was no fault of his that the Franks failed to create a strong naval power against the evil days that were in sight.

The reign of Charles witnessed a revival of arts and letters in Francia. Illuminators, goldsmiths, workers in ivory and metal reached a high degree of skill, although the higher arts were still neglected, and the emperor's chapel at Aachen was adorned with pillars and bronze portals fetched from Rome and Ravenna. Among the Frankish clergy scholarship was encouraged in the reign of Pepin, by the king himself and by the Englishman Boniface, archbishop of Mainz. Charles stimulated the clergy to further efforts. He himself studied Latin grammar with Peter of Pisa, rhetoric and dialectic and astronomy with Alcuin of York, and he listened with attention while his clerks read to him works of history or St. Augustine's *De Civitate Dei.* The effect of classical studies, upon Charles himself and his advisers, is revealed in his legislation which is more grammatically and intelligently composed than those of his predecessors. He aspired to emulate the legislators of Constantinople. Though he never attempted to make a code, he revised the laws of the Salian and Ripuarian Franks, and caused those of the Saxons, Thuringians and Frisians to be written down. His Capitularies, which were binding on his subjects without respect of race, supply a remarkable conspectus of Frankish institutions. In these texts we can study the duties of his counts and *missi,* the functions of the local law courts and assemblies, the law of vassalage, the rights of exempted estates (*immunitates*), the composition of the national host; the *Capitulare de Villis* even supplies full information concerning the management of the royal demesnes. The credit for the details of this legislation is due to the arch-chaplain and the clerks of the royal chaplain, ecclesiastics who were trained in seminaries of the Carlovingian renaissance. By his *Admonitio Generalis* (789) Charles required that every bishop should test the theological education of his priests, and that reading schools should be everywhere established. For a select minority a higher type of education was provided in cathedral schools, such as those of Orleans and Lyons, and in such monastic schools as those of Tours, Corbie, St. Riquier, Metz and St. Wandrille. The Palace school, a Merovingian institution, was reorganized by Alcuin in the years 782–796. In it were educated the emperor's children, the sons of great nobles and also some ecclesiastics who afterwards did much to promote the new studies, as for example Adalhard of Corbie and Anghilbert of St. Riquier. The Palace school declined after the death of Charles, but the new cathedral and monastic schools produced a remarkable race of literati. To the libraries founded

in connection with such schools we are indebted for the oldest extant manuscripts of Caesar, Sallust, Lucretius, Tacitus and Suetonius, and many of the works of Cicero. In the emperor's lifetime, and with his encouragement, the text of the Latin Vulgate was restored to a purer form by Alcuin and other scholars. One of these recensions not the work of Alcuin, was officially recommended to the Frankish bishops by the encyclical *De Emendatione Librorum* (*c.* 787). The scholars whom Charles patronized are well remembered as excellent grammarians. In their hands Latin became once more a polished and flexible medium of literary expression. The thoughts which they expressed in copious prose and verse are often banal pleasantries or insipid exhortations. Alcuin's letters, a few topical poems by Alcuin and Theodulf of Orleans, and the biography of Charles by Einhard, one of the royal clerks, are the cream of this Carolingian literature.

At Aachen he built a palace (of which no trace is left) and a chapel which, with many alterations and restorations, is incorporated in the existing cathedral. He commenced to build another palace at Ingelheim near Mainz, which was the great bridge-head for his armies, and a third at Nymwegen (near the Saxon border) of which the chapel, consecrated by Leo III., is the only relic. For three years, 792–794, he settled at Regensburg, the old Bavarian capital, but this step was taken for political and military reasons. At Aachen he was in his homeland. The forests of the neighbourhood gave him good hunting; with his sons and his nobles and his bodyguards he bathed and swam in the hot springs which still feed the *Kaiserbad*. In his dress, as in his pastimes, he affected the old Frankish mode, and he disdained elaborate banquets, preferring a simple, heavy meal at which the staple dish was broiled venison, served to him on the spit by his huntsmen. When business of State was in hand he was prompt, methodical and labourious. He prided himself on the magnificent furniture of his chapel and on the decorum with which its services were celebrated. He kept to the end his interest in scholarship and in theology, and left a large library of manuscripts. But his private life was lax in one respect. Though a devoted husband to three of his four wives, he had illegitimate offspring by five mistresses. His court was dissolute and the conduct of his daughters caused grave scandals.

Charles died on Jan. 28, 814, after four years of failing health, from an attack of pleurisy. He was buried in the chapel at Aachen, probably in the antique sarcophagus which is preserved there; this at all events is the coffin in which his bones were found in 1165, when they were disinterred by Frederick Barbarossa.

BIBLIOGRAPHY.—Eginhardus (Einhard), *Vita Kardi Imperatoris* (1883), in G. H. Pertz, *Scriptores Rerum Germanicarum* (1839 etc.); *Capitularia Regum Francorum* (1881), in *Monumenta Germaniae historica* Gesellschaft für ältere deutsche Geschichtkunde (ed. by A. Boretius. Hanover and Berlin, 1877 etc.); *Annales Regni Francorum* (ed. by F. Kurze 1895) in the Octavo series of Pertz's *Scriptores*. Among mod. works: S. Abel, *Jahrbücher des Fränkischen Reiches unter Karl dem. Grossen* (1888), in *Jahrbücher der deutschen Geschichte*. Herausgegeben durch die historische Commission bei der königl. Academie der Wissenschaft (Berlin and Leipzig, 1862, etc.); T. Hodgkin, *Charles the Great* (1897), in Foreign Statesmen (ed. by J. B. Bury, 1896, etc.), and *Italy and Her Invaders* vol. viii. (2nd ed. 1892–99); H. W. C. Davis, *Charlemagne, Charles the Great, The Hero of Two Nations* (1900); Charles Edward Russell, *Charlemagne, First of the Moderns* (1930). (H. W. C. D.)

CHARLES II.,[1] called THE BALD (823–877), Roman emperor and king of the West Franks, the son of the emperor Louis the Pious, was born in 823. The death of the emperor in 840 was the signal for the outbreak of war between his sons. Charles allied himself with his brother Louis the German to resist the pretensions of the emperor Lothair, and the two allies conquered him in the bloody victory of Fontenoy-en-Puisaye (June 25, 841). In the following year the two brothers confirmed their alliance by the celebrated oaths of Strasbourg (*see* FRANCE: *History*). The war was brought to an end by the treaty of Verdun (Aug. 843), which gave to Charles the Bald the kingdom of the western Franks, which practically corresponded with what is now France, as far as the Meuse, the Saône and the Rhone, with the addition of the Spanish March as far as the Ebro. The first years of his reign up to the death of Lothair I. (855) were comparatively peaceful, and during them was continued the system of "confraternal government" of the sons of Louis the Pious, who had various meetings with one another, at Coblenz (848), at Meersen (851), and at Attigny (854). In 858 Louis the German invaded the kingdom of Charles. In 860 he in his turn tried to seize the kingdom of his nephew, Charles of Provence, but met with a repulse. On the death of Lothair II. in 869 he tried to seize his dominions, but by the treaty of Meersen (870) was compelled to share them with Louis the German. Besides this, Charles had to struggle against the incessant rebellions in Aquitaine, against the Bretons, who inflicted on the king the defeats of Ballon (845) and Juvardeil (851), and especially against the Normans, who devastated the country in the north of Gaul, the valleys of the Seine and Loire, and even up to the borders of Aquitaine. Charles led various expeditions against the invaders, and tried to put a barrier in their way by having fortified bridges built over all the rivers. In 875, after the death of the emperor Louis II., Charles the Bald, supported by Pope John VIII., descended into Italy, receiving the royal crown at Pavia and the imperial crown at Rome. But Louis the German revenged himself for Charles's success by invading and devastating his dominions. Charles was recalled to Gaul, and after the death of Louis the German (Aug. 28, 876), in his turn made an attempt to seize his kingdom, but at Andernach met with a shameful defeat (Oct. 8, 876). In the meantime, John VIII., who was menaced by the Saracens, was continually urging him to come to Italy, and Charles again crossed the Alps. At the same time Carloman, son of Louis the German, entered northern Italy. Charles started on his way back to Gaul, and died while crossing the pass of the Mont Cenis, Oct. 5 or 6, 877. He was succeeded by his son Louis the Stammerer.

BIBLIOGRAPHY.—The most important authority for the history of Charles's reign is represented by the *Annales Bertiniani*, which were the work of Prudentius, bishop of Troyes, up to 861, then up to 882 of the celebrated Hincmar, archbishop of Reims. This prince's charters are to be found published in the collections of the *Académie des Inscriptions*, by M. M. Prou. The most complete history of the reign is found in E. Dümmler, *Geschichte des ostfränkischen Reiches* (3 vols., Leipzig, 1887–88). *See* also J. Calmette, *La Diplomatie carolingienne du traité de Verdun à la mort le Charles le Chauve* (Paris, 1901), and F. Lot, "Une Année du règne de Charles le Chauve," in *Le Moyen-Âge* (1902), pp. 393–438; F. Lot and L. Halphen, *Le Règne de Charles le Chauve* (1909); M. Jusselin, *La Chancellerie de Charles le Chauve d'après les notes tironiennes* (1922).

CHARLES III., THE FAT (832–888), Roman emperor and king of the West Franks, was the youngest of the three sons of Louis the German, and received from his father the kingdom of Swabia (Alamannia). After the death of his two brothers in succession, Carloman (880) and Louis the Young (882), he inherited the whole of his father's dominions. He was crowned emperor at Rome by Pope John VIII. (Feb. 881). On his return to Germany he led an expedition against the Norsemen of Friesland, but instead of engaging with them he preferred to make terms and paid them tribute. In 880 the death of Carloman brought into his possession the west Frankish realm, and in 885 he got rid of his rival Hugh of Alsace, an illegitimate son of Lothair II. In spite of six expeditions into Italy, he did not succeed in pacifying the country, nor in delivering it from the Saracens. He was equally unfortunate in Gaul and in Germany against the Norsemen, who in 886–887 besieged Paris. The emperor appeared before the city with a large army (Oct. 886), but contented himself by buying the retreat of the invaders at the price of a heavy ransom, and his permission for them to ravage Burgundy without his interfering. On his return to Alamannia the general discontent showed itself openly and a conspiracy was formed against him. He was deposed by an assembly which met at Frankfürt or at Tribur (Nov. 887), and died in poverty at Neidingen on the Danube (Jan. 18, 888).

See E. Dümmler, *Geschichte des Ostfränkischen Reiches*, vol. iii. (Leipzig, 1888); W. Stubbs, *Germany in the Early Middle Ages*, edit. A. Hassall, ch. iv. (1908).

CHARLES IV. (1316–1378), Roman emperor and king of Bohemia, the eldest son of John of Luxemburg, king of Bohemia,

[1] For Charles I., Roman emperor, *see* CHARLES THE GREAT; *cf.* under Charles I. of France below.

and Elizabeth, sister of Wenceslas III., was born at Prague on May 14, 1316, and in 1323 went to the court of his uncle, Charles IV., king of France, where he remained for seven years. He married Blanche, sister of King Philip VI., the successor of Charles IV. In 1333 he was made margrave of Moravia. Three years later he undertook the government of Tirol on behalf of his brother John Henry, and was soon actively concerned in a struggle for the possession of this country. In consequence of an alliance between his father and Pope Clement VI., the relentless enemy of the emperor Louis IV., Charles was chosen German king in opposition to Louis by some of the princes at Rense on July 11, 1346. Confirming the papacy in the possession of wide territories, he promised to annul the acts of Louis against Clement, to take no part in Italian affairs, and to defend and protect the church. In 1346 he fought at Crécy, where his father was killed. As king of Bohemia he returned to Germany, and after being crowned German king at Bonn on Nov. 26, 1346, prepared to attack Louis. After the death of the emperor in October 1347 Charles was soon the undisputed ruler of Germany.

In 1350 the king was visited at Prague by Cola di Rienzi, who urged him to go to Italy, where the poet Petrarch and the citizens of Florence also implored his presence. Charles kept Rienzi in prison for a year, and then handed him over to Clement at Avignon. Four years later, however, he crossed the Alps without an army, received the Lombard crown at Milan on Jan. 6, 1355, and was crowned emperor at Rome by a cardinal on April 5. On his return Charles was occupied with the administration of Germany, then just recovering from the Black Death, and in 1356 he promulgated the Golden Bull (*q.v.*) to regulate the election of the king. He was unremitting in his efforts to secure other territories and to strengthen the Bohemian monarchy. To this end he purchased part of the upper Palatinate of the Rhine in 1353, and in 1367 annexed Lower Lusatia to Bohemia and bought numerous estates in various parts of Germany. On the death in 1363 of Meinhard, duke of Upper Bavaria and count of Tirol, Upper Bavaria was claimed by the sons of the emperor Louis IV., and Tirol by Rudolph IV., duke of Austria. Both claims were admitted by Charles on the understanding that if these families died out both territories should pass to the house of Luxemburg. About the same time he was promised the succession to the margravate of Brandenburg, which he actually obtained for his son Wenceslas in 1373. He also gained a considerable portion of Silesian territory, partly by inheritance through his third wife, Anna, daughter of Henry II., duke of Schweidnitz. In 1365 Charles visited Pope Urban V. at Avignon and undertook to escort him to Rome; and on the same occasion was crowned king of Burgundy, or Arles, at Arles on June 4, 1365. During his later years the emperor took little part in German affairs beyond securing the election of his son Wenceslas as king of the Romans in 1376, and negotiating a peace between the Swabian league and some nobles in 1378. After dividing his lands between his three sons, he died on Nov. 29, 1378, at Prague, where he was buried.

Charles, who according to the emperor Maximilian I. was the step-father of the empire, but the father of Bohemia, brought the latter country to a high state of prosperity. In 1348 he founded the university of Prague, and afterwards made this city the seat of an archbishop. He was an accomplished diplomatist, possessed a penetrating intellect, and was capable of much trickery in order to gain his ends. He was superstitious and peace-loving, had few personal wants, and is described as a round-shouldered man of medium height, with black hair and beard, and sallow cheeks.

His autobiography, the "Vita Caroli IV.," which deals with events down to the year 1346, and various other documents relating to his life and times, are published in the *Fontes rerum Germanicarum*, Band I., edited by J. F. Böhmer (Leipzig, 1885). For other documents relating to the time see *Die Regesten des Kaiserreichs unter Kaiser Karl IV.*, edited by J. F. Böhmer and A. Huber (Innsbruck, 1889); *Acta Karoli IV. imperatoris inedita* (Innsbruck, 1891); E. Werunsky, *Excerpta ex registris Clementis VI. et Innocentii VI.* (Innsbruck, 1885). *See* also E. Werunsky, *Geschichte Kaiser Karls IV. und seiner Zeit* (Innsbruck, 1880–92); H. Friedjung, *Kaiser Karl IV. und sein Antheil am geistigen Leben seiner Zeit* (Vienna, 1876); A. Gottlob, *Karls IV. private und politische Beziehungen zu Frankreich* (Innsbruck, 1883); O. Winckelmann, *Die Beziehungen Kaiser Karls IV. zum Königreich Arelat* (Strasbourg, 1882); K. Palm, "Zu Karls IV. Politik gegen Baiern," in the *Forschungen zur deutschen Geschichte*, Band xv. (Göttingen, 1862–66); Th. Lindner, "Karl IV. und die Wittelsbacher," and S. Stienherz, "Die Beziehungen Ludwigs I. von Ungarn zu Karl IV.," and "Karl IV. und die österreichischen Freiheitsbriefe," in the *Mittheilungen des Instituts für österreichische Geschichtsforschung* (Innsbruck, 1880); G. G. Walsh, *The Emperor Charles IV.* (1924).

CHARLES V. (1500–1558), Roman emperor and (as Charles I.) king of Spain, was born in Ghent on Feb. 20, 1500. His parents were Philip of Burgundy and Joanna, third child of Ferdinand and Isabella. Philip died in 1506, and Charles succeeded to his Netherland possessions and the county of Burgundy (Franche Comté). His grandfather, the emperor Maximilian, as regent, appointed his daughter Margaret vice-regent, and under her strenuous guardianship Charles lived in the Netherlands until the estates declared him of age in 1515. In Castile, Ferdinand, king of Aragon, acted as regent for his daughter Joanna, whose intellect was already clouded. On Jan. 23, 1516, Ferdinand died. Charles's visit to Spain was delayed until the autumn of 1517, and only in 1518 was he formally recognized as king conjointly with his mother, firstly by the cortes of Castile and then by those of Aragon. Joanna lived to the very eve of her son's abdication, so that he was only for some months technically sole king of Spain. During this Spanish visit Maximilian died, and Charles succeeded to the inheritance of the Habsburgs, to which was shortly added the duchy of Württemberg. Maximilian had also intended that he should succeed as emperor. In spite of the formidable rivalry of Francis I. and the opposition of Pope Leo X., pecuniary corruption and national feeling combined to secure his election in 1519. Charles hurriedly left Spain, and after a visit to Henry VIII. and his aunt Catherine was crowned at Aix on Oct. 23, 1520.

The difficulty of Charles's reign consists in the complexity of interests caused by the unnatural aggregate of distinct territories and races. The Crown of Castile brought with it the two recently conquered kingdoms of Navarre and Granada, together with the new colonies in America and scattered possessions in northern Africa. That of Aragon comprised the three distinct States of Aragon, Valencia and Catalonia, and in addition the kingdoms of Naples, Sicily and Sardinia, each with a separate character and constitution of its own. No less than eight independent cortes or parliaments existed in this Spanish-Italian group, adding greatly to the intricacy of government. In the Netherland provinces again the tie was almost purely personal; there existed only the rudiments of a central administration and a common representative system, while the county of Burgundy had a history apart. Much the same was true of the Habsburg group of States, but Charles soon freed himself from direct responsibility for their government by making them over, together with Württemberg, to his brother Ferdinand. The empire entailed serious liabilities on its ruler without furnishing any reliable assets; only through the cumbrous machinery of the diet could Charles tap the military and financial resources of Germany. His problem here was complicated by the growth of Lutheranism, which he had to face at his very first diet in 1521. In addition to such administrative difficulties Charles had inherited a quarrel with France, to which the rivalry of Francis I. for the Empire gave a personal character. Almost equally formidable was the advance of Sultan Suleiman up the Danube, and the union of the Turkish naval power with that of the Barbary States of northern Africa. Against Lutheran Germany the Catholic emperor might hope to rely upon the pope, and against France on England. But the attitude of the popes was almost uniformly disagreeable, while from Henry VIII. and Edward VI. Charles met with more unpleasantness than favour.

The difficulty of Charles himself is also that of the historian and reader of his reign. It is probably more instructive to treat it according to the emperor's several problems than in strict chronological order. Yet an attempt to distinguish the several periods of his career may serve as a useful introduction. The two best dividing lines are, perhaps, the coronation as emperor at Bologna in 1530, and the peace of Crépy in 1544. Until his visit to Italy (1529) Charles remained in the background of the European stage, except for his momentous meeting with Luther

at the diet of Worms (1521). This meeting in itself forms a subdivision. Previously to this, during his nominal rule in the Netherlands, his visit to Spain and his candidature for the Empire, he seemed, as it was said, spell-bound under the ferule of his minister Chièvres. Almost every report represented him as colourless, reserved and weak. His dependence on his Flemish counsellors provoked the rising in Castile, the feebleness of his government the social war in Aragon. The religious question first gave him a living interest, and at this moment Chièvres died. Aleander, the papal nuncio at Worms, now recognized that public opinion had been wrong in its estimate of Charles. Never again was he under tutelage. The necessity, however, of residence in Spain prevented his taking a personal part in the great fight with Francis I. for Italy. He could claim no credit for the capture of his rival at Pavia. When his army sacked Rome and held Pope Clement VII. prisoner, he could not have known where this army was. And when later the French overran Naples, and all but deprived him of his hold on Italy, he had to instruct his generals that they must shift for themselves. The world had become afraid of him, but knew little of his character. In the second main division of his career Charles changed all this. No monarch until Napoleon was so widely seen in Europe and in Africa. At the head of his army Charles forced the Turks backwards down the Danube (1532). He personally conquered Tunis (1535), and was only prevented by "act of God" from winning Algiers (1541). The invasion of Provence in 1536 was headed by the emperor. In person he crushed the rebellion of Ghent (1540). In his last war with Francis (1542–44) he journeyed from Spain to the Netherlands, brought the rebellious duke of Cleves to his knees, and was within easy reach of Paris when he made the peace of Crépy (1544). In Germany, meanwhile, from the diet of Augsburg (1530) onwards, he had presided at the diets or conferences, which, as he hoped, would effect the reunion of the Church.

Peace with France and the Turk and a short spell of friendliness with Pope Paul III. enabled Charles at last to devote his whole energies to the healing of religious schism. Conciliation proving impossible, he led the army which received the submission of the Lutheran States, and then captured the elector of Saxony at Mühlberg, after which the other leader, Philip of Hesse, capitulated. The Armed Diet of 1548 was the high-water mark of Charles's power. Here, in defiance of the pope, he published the Interim which was meant to reconcile the Lutherans with the Church, and the so-called Reform which was to amend its abuses. During the next four years, owing to ill-health and loss of insight, his power was ebbing. In 1552 he was flying over the Brenner from Maurice of Saxony, a princeling whose fortunes he had made. Once again the old complications had arisen. His old enemy's son, Henry II., had attacked him indirectly in Piedmont and Parma, and then directly in Germany in alliance with Maurice. Once more the Turk was moving in the Danube and in the western Mediterranean. The humiliation of his flight gave Charles new spirit, and he once more led an army through Germany against the French, only to be checked by the duke of Guise's defence of Metz. Henceforth the waves of his fortune plashed to and fro, until his abdication without much ostensible loss or gain.

Charles's Policy.—Charles had abundance of good sense, but little creative genius, and he was by nature conservative. Consequently he never sought to impose any new or common principles of administration on his several States. He took them as he found them, and at most, as in the Netherlands, improved upon what he found. So also in dealing with rival powers his policy may be called opportunist. He was indeed accused by his enemies of emulating Charlemagne, of aiming at universal empire. Historians have frequently repeated this charge. Charles himself in later life laughingly denied the imputation, and facts are in favour of his denial. When Francis I. was in his power he made no attempt to dismember France, in spite of his pledges to his allies Henry VIII. and the duke of Bourbon. He did, indeed, demand the duchy of Burgundy, because he believed this to have been unrighteously stolen by Louis XI. from his grandmother when a helpless girl. The claim was not pressed, and at the height of his fortunes in 1548 he advised his son never to surrender it, but also never to make it a cause of war. When Clement VII. was his prisoner he was vehemently urged to overthrow the temporal power, to restore imperial dominion in Italy, at least to make the papacy harmless for the future. In reply he restored his enemy to the whole of his dominions, even reimposing him by force on the Florentine republic. To the end of his life his conscience was sensitive as to Ferdinand's expulsion of the house of Albret from Spanish Navarre, though this was essential to the safety of Spain. Though always at war he was essentially a lover of peace, and all his wars were virtually defensive. "Not greedy of territory," wrote Marcantonio Contarini in 1536, "but most greedy of peace and quiet." For peace he made sacrifices which angered his hot-headed brother Ferdinand. He would not aid in expelling the sultan's puppet Zapolya from Ferdinand's kingdom of Hungary, and he suffered the restoration of the ruffianly duke of Württemberg, to the grave prejudice of German Catholicism. In spite of his protests, Henry VIII. with impunity ill-treated his aunt Catherine, and the feeble Government of Edward VI. bullied his cousin Mary, who had been his fiancée. No serious efforts were made to restore his brother-in-law, Christian II., to the throne of Denmark, and he advised his son Philip to make friends with the usurper. After the defeat of the Lutheran Powers in 1547 he did not gain a palm's breadth of territory for himself. He resisted Ferdinand's claim for Württemberg, which the duke had deserved to forfeit; he disliked his acceptance of the voluntary surrender of the city of Constance; he would not have it said that he had gone to war for the benefit of the house of Habsburg.

On the other hand, Charles V.'s policy was not merely negative. He enlarged upon the old Habsburg practice of marriage as a means of alliance of influence. Previously to his election as emperor, his sister Isabella was married to Christian II. of Denmark, and the marriages of Mary and Ferdinand with the king of Hungary and his sister had been arranged. Before he was 20 Charles himself had been engaged some ten times with a view to political combinations. Naturally, therefore, he regarded his near relations as diplomatic assets. The federative system was equally familiar; Germany, the Netherlands, and even Spain, were in a measure federations. Combining these two principles, he would within his more immediate spheres of influence strengthen existing federations by intermarriage, while he hoped that the same means would convert the jarring Powers of Europe into a happy family. He made it a condition of the Treaty of Madrid (1526) that Francis I. should marry his sister Eleanor, Manuel of Portugal's widow, in the hope, not that she would be an ally or a spy within the enemy's camp, but an instrument of peace. His son's marriage with Mary Tudor would not only salve the rubs with England, but give such absolute security to the Netherlands that France would shrink from war. The personal union of all the Iberian kingdoms under a single ruler had long been an aim of Spanish statecraft. So Charles had married his sister Eleanor, much against her will, to the old king Manuel, and then his sister Catherine to his successor. The empress was a Portuguese infanta, and Philip's first wife was another. It is thus small wonder that, within a quarter of a century of Charles's death, Philip became king of Portugal.

In the wars with Francis I. Italy was the stake. In spite of his success Charles for long made no direct conquests. He would convert the peninsula into a federation mainly matrimonial. Savoy, the important buffer state, was detached from France by the marriage of the somewhat feeble duke to Charles's capable and devoted sister-in-law, Beatrice of Portugal. Milan, conquered from France, was granted to Francesco Sforza, heir of the old dynasty, and even after his treason was restored to him. In the vain hope of offspring Charles sacrificed his niece, Christina of Denmark, to the valetudinarian duke. In the long negotiations for a Habsburg-Valois dynasty which followed Francesco's death, Charles was probably sincere. He insisted that his daughter or niece should marry the third rather than the second son of Francis I., in order, apart from other reasons, to run less risk of

the duchy falling under French dominion. The final investiture of Philip was forced upon him, and does not represent his saner policy. The Medici of Florence, the Gonzaga of Mantua, the papal house of Farnese, were all attached by Habsburg marriages. The republics of Genoa and Siena were drawn into the circle through the agency of their chief noble families, the Doria and Piccolomini; while Charles behaved with scrupulous moderation towards Venice in spite of her active hostility before and after the League of Cognac. Occasional acts of violence there were, such as the participation in the murder of Pierluigi Farnese, and the measures which provoked the rebellion of Siena. These were due to the difficulty of controlling the imperial agents from a distance, and in part to the faults of the victim prince and republic. On the whole, the loose federation of viceroyalties and principalities harmonized with Italian interests and traditions. The alternative was not Italian independence, but French domination. At any rate, Charles's structure was so durable that the French met with no real success in Italy until the 18th century.

Germany offered a fine field for a creative intellect, since the evils of her disintegration stood confessed. On the other hand, princes and towns were so jealous of an increase of central authority that Charles, at least until his victory over the League of Schmalkalden, had little effective power. Owing to his wars with French and Turks he was rarely in Germany, and his visits were very short. His problem was infinitely complicated by the union of Lutheranism and princely independence. He fell back on the old policy of Maximilian, and strove to create a party by personal alliances and intermarriage. In this he met with some success. The friendship of the electors of Brandenburg, whether Catholic or Protestant, was unbroken. In the war of Schmalkalden half the Protestant princes were on Charles's side or friendly neutrals. At the critical moment which preceded this, the lately rebellious duke of Cleves and the heir of Bavaria were secured through the agency of two of Ferdinand's invaluable daughters. The relations, indeed, between the two old enemies, Austria and Bavaria, were permanently improved. The elector palatine, whose love affairs with his sister Eleanor Charles as a boy had roughly broken, received in compensation a Danish niece. Her sister, widow of Francesco Sforza, was utilized to gain a hold upon the French dynasty which ruled Lorraine. More than once there were proposals for winning the hostile house of Saxony by matrimonial means. After his victory over the League of Schmalkalden, Charles perhaps had really a chance of making the imperial power a reality. But he lacked either courage or imagination, contenting himself with proposals for voluntary association on the lines of the defunct Swabian League, and dropping even these when public opinion was against them. Now, too, he made his great mistake in attempting to foist Philip upon the Empire as Ferdinand's successor. Gossip reported that Ferdinand himself was to be set aside, and careless historians have given currency to this. Such an idea was impossible. Charles wished Philip to succeed Ferdinand, while he ultimately conceded that Ferdinand's son Maximilian should follow Philip, and even in his lifetime exercise the practical power in Germany. This scheme irritated Ferdinand and his popular and ambitious son at the critical moment when it was essential that the Habsburgs should hold together against princely malcontents. Philip was imprudently introduced to Germany, which had also just received a foretaste of the unpleasant characteristics of Spanish troops. Yet the person rather than the policy was, perhaps, at fault. It was natural that the quasi-hereditary succession should revert to the elder line. France proved her recuperative power by the occupation of Savoy and of Metz, Toul and Verdun, the military keys of Lorraine. The separation of the Empire and Spain left two weakened Powers not always at accord, and neither of them permanently able to cope on equal terms with France. Nevertheless, this scheme did contribute in no small measure to the failure of Charles in Germany. The main cause was, of course, the religious schism, but his treatment of this requires separate consideration.

The characteristics of Charles's government, its mingled conservatism and adaptability, are best seen in Spain and the Netherlands, with which he was in closer personal contact than with Italy and Germany. In Spain, when once he knew the country, he never repeated the mistakes which on his first visit caused the rising of the communes. The cortes of Castile were regularly summoned, and though he would allow no encroachment on the Crown's prerogatives, he was equally scrupulous in respecting their constitutional rights. Indirectly, Crown influence increased owing to the greater control which had gradually been exercised over the composition of the municipal councils, which often returned the deputies for the cortes. Charles was throughout nervous as to the power and wealth of the greater nobles. They rather than the Crown had conquered the communes, and in the past they rather than the towns had been the enemies of monarchy. In the cortes of 1538 Charles came into collision with the nobles as a class. They usually attended only on ceremonial occasions, since they were exempted from direct taxation, which was the main function of the cortes. Now, however, they were summoned because Charles was bent upon a scheme of indirect taxation which would have affected all classes. They offered an uncompromising opposition, and Charles somewhat angrily dismissed them, nor did he ever summon them again.

Charles was well served by his ministers, whom he very rarely changed. After the death of the Piedmontese Gattinara he relied mainly on Nicolas Perrenot de Granvella for Netherland and German affairs, and on Francisco de los Cobos for Spanish, while the younger Granvella was being trained. From 1520–55 these were the only ministers of high importance. Above all, Charles never had a court favourite, and the only women who exercised any influence were his natural advisers, his wife, his aunt Margaret and his sister Mary. In all these ladies he was peculiarly fortunate.

The reign of Charles was in America the age of conquest and organization. Upon his accession the settlements upon the mainland were insignificant; by 1556 conquest was practically complete, and civil and ecclesiastical government firmly established. Actual expansion was the work of great adventurers starting on their own impulse from the older colonies. To Charles fell the task of encouraging such ventures, of controlling the conquerors, of settling the relations between colonists and natives, which involved those between the colonists and the missionary colonial Church. He must arrest de-population, provide for the labour market, regulate oceanic trade, and check military preponderance by civil and ecclesiastical organization. In America Charles took an unceasing interest; he had a boundless belief in its possibilities, and a determination to safeguard the interests of the Crown. Cortes, Pedro de Alvarado and the brothers Pizarro were brought into close personal communication with him. If he bestowed on Cortes the confidence which the loyal conqueror deserved, he showed the sternest determination in crushing the rebellious and autonomous instincts of Almagro and the Pizarros. But for this, Peru and Chile must have become independent almost as soon as they were conquered. Throughout he strove to protect the natives, to prevent actual slavery, and the consequent raids upon the natives. If in many respects he failed, yet the organization of Spanish America and the survival of the native races were perhaps the most permanent results of his reign. It is a proof of the complexity of his interests that the march of the Turk upon Vienna and of the French on Naples delayed until the following reign the foundation of Spain's eastern empire. Charles carefully organized the expedition of Magellan, which sailed for the Moluccas and discovered the Philippines. Unfortunately, his straits for money in 1529 compelled him to mortgage to Portugal his disputed claim to the Moluccas, and the Philippines consequently dropped out of sight.

If in the administration of Spain Charles did little more than mark time, in the Netherlands advance was rapid. Of the seven northern provinces he added five, containing more than half the area of the later United Provinces. In the south he freed Flanders and Artois from French suzerainty, annexed Tournai and Cambrai, and closed the natural line of French advance through the great bishopric of Liège by a line of fortresses across its western frontier. Much was done to convert the aggregate of jar-

ring provinces into a harmonious unity by means of common principles of law and finance, and by the creation of a national army. While every province had its own assembly, there were at Charles's accession only the rudiments of estates-general for the Netherlands at large. At the close of the reign the common parliamentary system was in full swing, and was fast converting the loosely knit provinces into a State.

In the Netherlands Charles showed none of the jealousy with which he regarded the Spanish nobles. He encouraged the growth of large estates through primogeniture; he gave the nobles the provincial governorships, the great court offices, the command of the professional cavalry. In the Order of the Golden Fleece and the long established presence of the court at Brussels, he possessed advantages which he lacked in Spain. The nobility were utilized as a link between the court and the provinces. Very different was it with the Church. By far the greater part of the Netherlands fell under foreign sees, which were peculiarly liable to papal exactions and to the intrigues of rival Powers. Thus the usual conflict between civil and ecclesiastical jurisdiction was peculiarly acute. To remedy this dualism of authority and the consequent moral and religious abuses, Charles early designed the creation of a national diocesan system, and this was a cherished project throughout his life. The papacy unfortunately thwarted him, and the scheme, which under Charles would have been carried with national assent and created a national Church-system, took the appearance under Philip of alien domination. If in Germany Charles was emperor, he was in the Netherlands territorial prince, and thus his interests might easily be at disaccord with those of the Empire. Consequently, just as he had shaken off French suzerainty from Flanders and Artois, so he loosened the tie of the other provinces to Germany. In 1548 they were declared free and sovereign principalities not subject to imperial laws, and all the territories were incorporated in the Burgundian circle. It was, indeed, agreed that they should contribute to imperial taxation, and in return receive imperial protection. But this soon became a dead letter, and the Netherlands were really severed from the Empire, save for the nominal feudal tie in the case of some provinces.

Charles's Religious Aims.—Charles V. is, in the eyes of many, the very picture of a Catholic zealot. Popular opinion is probably based in the main upon the letters written from Yuste in 1558, when two hot-beds of heresy had been discovered in Spain herself, and on the contemporary codicil to his will. Charles was not then the responsible authority. There is a long step between a violent letter and a violent act. Few men would care to have their lives judged by letters written in the last extremities of gout. Less pardonable was the earlier persecution of the Valencian Moriscoes in 1525–26. The edict of persecution was cruel and unnecessary, and all expert opinion in Valencia was against it. It was not, however, actually enforced until after the victory of Pavia. It seems likely that Charles in a fit of religious exaltation regarded the persecution as a sacrificial thank-offering for his miraculous preservation. Henceforth the reign was marked by extreme leniency. Spain enjoyed a long lull in the activity of her Inquisition. At Naples in 1547 a rumour that the Spanish Inquisition was to be introduced to check the growth of heresy in influential quarters produced a dangerous revolt. The briefs were, however, issued by Paul III., no friend of Charles, and when a Neapolitan deputation visited the emperor he disclaimed any intention of making innovations. Of a different type to all the above was the persecution in the Netherlands. Here it was deliberate, chronic, and on an ascending scale. In the Netherlands the heretics were his immediate subjects, and as in every other State, Catholic or Lutheran, they must conform to their prince's religion. But there was more than this. After the suppression of the German peasant revolt in 1525 many of the refugees found shelter in the teeming Netherland cities, and heresy took the form, not of Lutheranism, but of Anabaptism, which was believed to be perilous to society and the State. The Government put down Anabaptism, as a modern Government might stamp out anarchism. The edicts were, indeed, directed against heresy in general, and were as harsh as they could be—at least on paper. Yet when Charles was assured that they were embarrassing foreign trade he let it be understood that they should not affect the foreign mercantile communities. Prudential considerations proved frequently a drag upon religious zeal.

The relations of Charles to heresy must be judged in the main by his treatment of German Lutheranism. Here he had to deal with organized Churches protected by their princes, supported by revenues filched from his own Church and stiffened by formulae as rigid as those of Catholicism. The length and stubbornness of the conflict will serve to show that Charles's religious conservatism had a measure of elasticity, that he was not a bigot and nothing more. The two more obvious courses towards the restoration of Catholic unity were force and reconciliation, in other words, a religious war or a general council. Neither of these was a simple remedy. The latter was impossible without papal concurrence, inoperative without the assistance of the European Powers, and merely irritant without the adhesion of the Lutherans. It was most improbable that the papacy, the Powers and the Lutherans would combine in a measure so palpably advantageous to the emperor. Force was hopeless save in the absence of war with France and the Turk, and of papal hostility in Italian territorial politics. Charles must obtain subsidies from ecclesiastical sources, and the support of all German Catholics, especially of the traditional rival, Bavaria. Even so the Protestants would probably be the stronger, and therefore they must be divided by utilizing any religious split, any class distinction, any personal or traditional dislikes, or else by bribery. Force and reconciliation seeming equally difficult; could an alternative be found in toleration? The experiment might take the form either of individual toleration, or of toleration for the Lutheran States. The former would be equally objectionable to Lutheran and Catholic princes as loosening their grip upon their subjects. Territorial toleration might seem equally obnoxious to the emperor, for its recognition would strengthen the anti-imperial particularism so closely associated with Lutheranism. If Charles could find no permanent specific, he must apply a provisional palliative. It was absolutely necessary to patch, if not to cure, because Germany must be pulled together to resist French and Turks. Such palliatives were two—suspension and comprehension. Suspension deferred the execution of penalties incurred by heresy, either for a term of years, or until a council should decide. Thus it recognized the divorce of the two religions, but limited it by time. Comprehension instead of recognizing the divorce would strive to conceal the breach. It was a domestic remedy, German and national, not European and papal. To become permanent it must receive the sanction of pope and council, for the Roman emperor could not set up a Church of Germany. Yet the formula adopted might conceivably be found to fall within the four corners of the faith, and so obviate the necessity alike of force or council. Such were the conditions of the emperor's task, and such the methods which he actually pursued. He would advance now on one line, now on another, now on two or three concurrently, but he never definitely abandoned any. This fusion of obstinacy and versatility was a marked feature of his character.

Suspension was of course often accidental and involuntary. The two chief stages of Lutheran growth naturally corresponded with the periods, each of nine years, when Charles was absent. Deliberate suspension was usually a consequence of the failure of comprehension. Thus at Augsburg in 1530 the wide gulf between the Lutheran confession and the Catholic confutation led to the definite suspensive treaty granted to the Lutherans at Nuremberg (1532). Charles dared not employ the alternative of force, because he needed their aid for the Turkish war. In 1541, after a series of religious conferences, he personally presented a compromise in the so-called Book of Regensburg, which was rejected by both parties. He then proposed that the articles agreed upon should be compulsory, while on others toleration should be exercised until a national council should decide. Never before nor after did he go so far upon the path of toleration, or so nearly accept a national settlement. He was then burning to set sail for Algiers. His last formal suspensive measure was that of Spires (Speyer) in 1544, when he was marching against Francis.

He promised a free and general council to be held in Germany, and, as a preparation, a national religious congress. The Lutherans were privately assured that a measure of comprehension should be concluded with or without papal approval. Meanwhile all edicts against heresy were suspended. No wonder that Charles afterwards confessed that he could scarcely reconcile these concessions with his conscience, but he won Lutheran aid for his campaign. The peace of Crépy gave all the conditions required for the employment of force. He had peace with French and Turk, he won the active support of the pope, he had deeply divided the Lutherans and reconciled Bavaria. Finding that the Lutherans would not accept the council summoned by the pope to Trent, he resorted to force, and force succeeded. At the Armed Diet of 1548 reunion seemed within reach. But Paul III. in direct opposition to Charles's wish had withdrawn the council from Trent to Bologna. Charles could not force Lutherans to submit to a council which he did not himself recognize, and he could not bring himself to national schism. Thus, falling back upon his old palliatives, he issued the Interim and the accompanying Reform of the Clergy, pending a final settlement by a satisfactory general council. These measures pleased neither party, and Charles at the very height of his power had failed. He was conscious of failure, and made few attempts even to enforce the Interim. Henceforward political complications gathered round him anew. The only remedy was toleration in some form, independent of the papacy and limitless in time. To this Charles could never assent. His ideal was shattered, but it was a great ideal, and the patience, the moderation, even at times the adroitness with which he had striven towards it, proved him to be no bigot.

Abdication and Death.—The idea of abdication had long been present with Charles, and in 1555 he acted upon it. To Ferdinand he gave his full authority as emperor, although at his brother's earnest request formal abdication was delayed until 1558. In the Hall of the Golden Fleece at Brussels on Oct. 25, 1555, he formally resigned to Philip the sovereignty of his beloved Netherlands. Turning from his son to the representatives of the estates he said: "Gentlemen, you must not be astonished if, old and feeble as I am in all my members, and also from the love I bear you, I shed some tears." In the Netherlands at least the love was reciprocal, and tears were infectious among the thousand deputies who listened to their sovereign's last speech. On Jan. 16, 1556, Charles resigned his Spanish kingdoms and that of Sicily, and shortly afterwards his county of Burgundy. On Sept. 17 he sailed from Flushing on the last of his many voyages, an English fleet from Portland bearing him company down the channel. In Feb. 1557 he was installed in the home which he had chosen at Yuste in Estremadura.

The excellent books which have been written upon the emperor's retirement have inspired an interest out of all proportion to its real significance. His little house was attached to the monastery, but was not within it. He was neither an ascetic nor a recluse. Gastronomic indiscretions still entailed their inevitable penalties. Society was not confined to interchange of civilities with the brethren. His relations, his chief friends, his official historians, all found their way to Yuste. Couriers brought news of Philip's war and peace with Pope Paul IV., of the victories of Saint Quentin and Gravelines, of the French capture of Calais, of the danger of Oran. As head of the family he intervened in the delicate relations with the closely allied house of Portugal; he even negotiated with the house of Navarre for reparation for the wrong done by his grandfather Ferdinand, which appeared to weigh upon his conscience. Above all he was shocked by the discovery that Spain, his own court, and his very chapel were infected with heresy. His violent letters to his son and daughter recommending immediate persecution, his profession of regret at having kept his word when Luther was in his power, have weighed too heavily on his reputation. The feverish phrases of religious exaltation due to broken health and unnatural retirement cannot balance the deliberate humanity and honour of wholesome manhood. Apart from such occasional moments of excitement, the emperor's last years passed tranquilly enough. At first he would shoot pigeons in the monastery woods, and till his last illness tended his garden and his animal pets, or watched the operations of Torriani, maker of clocks and mechanical toys. After an illness of three weeks the call came in the early hours of the Feast of St. Matthew, who, as his chaplain said, had for Christ's sake forsaken wealth even as Charles had forsaken empire. The dying man clasped his wife's crucifix to his breast till his fingers lost their hold. The archbishop held it before his eyes, and with the cry of *"Ay Jesus!"* died, in the words of his faithful squire, D. Luis de Quijada, "the chief of men that had ever been or would ever be." Posterity need not agree, but no great man can boast a more honest panegyric.

In character Charles stands high among contemporary princes. It consists of pairs of contrasts, but the better side is usually stronger than the worse. Steadfast honesty of purpose was occasionally warped by self-interest, or rather he was apt to think that his own course must needs be that of righteousness. Self-control would give way, but very rarely, to squalls of passion. Obstinacy and irresolution were fairly balanced, the former generally bearing upon ends, the latter upon means. His own ideals were constant, but he could gradually assimilate the views of others, and could bend to argument and circumstance; yet even here he had a habit of harking back to earlier schemes which he had seemed to have definitely abandoned. As a soldier he must rank very high. It was said that his being emperor lost to Spain the best light horseman of her army. At every crisis he was admirably cool, setting a truly royal example to his men. His mettle was displayed when he was attacked on the burning sands of Tunis, when his troops were driven in panic from Algiers, when in spite of physical suffering he forded the Elbe at Mühlberg, and when he was bombarded by the vastly superior Lutheran artillery under the walls of Ingolstadt. When blamed for exposing himself on this last occasion, "I could not help it," he apologized; "we were short of hands, I could not set a bad example." Nevertheless he was by nature timid. Just before this very action he had a fit of trembling, and he was afraid of mice and spiders. The force of his example was not confined to the field. Melanchthon wrote from Augsburg in 1530 that he was a model of continence, temperance and moderation, that the old domestic discipline was now only preserved in the imperial household. He tenderly loved his wife, whom he had married for pecuniary and diplomatic reasons. Of his two well-known illegitimate children, Margaret was born before he married, and Don John long after his wife's death, but he felt this latter to be a child of shame. His sobriety was frequently contrasted with the universal drunkenness of the German and Flemish nobles, which he earnestly condemned. But on his appetite he could place no control, in spite of the ruinous effects of his gluttony upon his health. In dress, in his household, and in his stable he was simple and economical. He loved children, flowers, animals and birds. Professional jesters amused him, and he was not above a joke himself. Maps and mechanical inventions greatly interested him, and in later life he became fond of reading. He takes his place indeed among authors, for he dictated the commentaries on his own career. Of music he possessed a really fine knowledge, and his high appreciation of Titian proves the purity of his feeling for art. The little collection of books and pictures which he carried to Yuste is an index of his tastes. Charles was undeniably plain. He confessed that he was by nature ugly, but that as artists usually painted him uglier than he was strangers on seeing him were agreeably disappointed. The protruding lower jaw and the thin pale face were redeemed by the fine open brow and the bright speaking eyes. He was, moreover, well made, and in youth had an incomparable leg. Above all no man could doubt his dignity; Charles was every inch an emperor. (E. Ar.)

Bibliography.—*Memoirs* written by Charles in 1550, and treating somewhat fully of the years 1543–48; W. Robertson, *History of the Emperor Charles V.* (many editions), an English classic, which needs supplementing by later authorities; *Commentaires de Charles-quint*, ed. Baron Kervyn de Lettenhove (Brussels, 1862); G. de Leva, *Storia documentata di Carlo V. in correlazione all' Italia* (5 vols., Venice, 1862–94), a general history of the reign, though with special reference to its Italian aspects, and extending to 1552; article by L. P. Gachard in *Biographie nationale*, vol. iii. (1872), an excellent compressed account; F. A. Mignet, *Rivalité de François I. et de*

Charles-quint (2 vols., 1875); H. Baumgarten, *Geschichte Karls V.* (3 vols., Stuttgart, 1885–93), very full but extending only to 1539; E. Armstrong, *The Emperor Charles V.* (2 vols., 1902), to which reference may be made for monographs and collections of documents bearing on the reign. The life of Charles V. at Yuste may be studied in L. P. Gachard's *Retraite et mort de Charles-quint au monastère de Yuste* (Brussels, 1854–55), and in Sir W. Stirling-Maxwell's *The Cloister Life of the Emperor Charles V.* (4 editions from 1852); also in W. H. Prescott's edition of Robertson's *History* (1857). *See* also F. Harting, *Karl V. und die deutsche Reichstände von 1546 bis 1555* (1910); P. Mexia, *Historia de Carlos Quinto* (1918); P. Kalhoff, *Die Kaiserwahl Friedrichs IV. und Karl V.* (1925); M. Rosi, *Il Primato di Carlo V.* (1925).

CHARLES VI. (1685–1740), Roman emperor, was born on Oct. 1, 1685, at Vienna. He was the second son of the emperor Leopold I. by his third marriage with Eleanore, daughter of Philip William of Neuburg, elector palatine of the Rhine. When the Spanish branch of the house of Habsburg became extinct in 1700, he was put forward as the lawful heir in opposition to Philip V., the Bourbon to whom the Spanish dominions had been left by the will of Charles II. of Spain. He was proclaimed at Vienna on Sept. 19, 1703, and made his way to Spain by the Low Countries, England and Lisbon, remaining in Spain till 1711, mostly in Catalonia, where the Habsburg party was strong. Although he had a certain tenacity of purpose he displayed none of the qualities required in a prince who had to gain his throne by the sword (*See* SPANISH SUCCESSION, WAR OF). In 1708 he was married at Barcelona to Elizabeth Christina of Brunswick-Wolfenbüttel (1691–1750), a Lutheran princess who was persuaded to accept Roman Catholicism. On the death of his elder brother Joseph I. on April 17, 1711, Charles inherited the hereditary possessions of the house of Habsburg and their claims on the Empire. The death of Joseph without male issue had been foreseen, and Charles had at one time been prepared to give up Spain and the Indies on condition that he was allowed to retain Naples, Sicily and the Milanese. But when the case arose his natural obstinacy led him to declare that he would not think of surrendering any of the rights of his family. It was with great difficulty that he was persuaded to leave Spain, months after the death of his brother (on Sept. 27, 1711). Only the emphatic refusal of the European powers to tolerate the reconstruction of the empire of Charles V. forced him to give a sullen submission to necessity. He abandoned Spain and was crowned emperor in December 1711, but for a long time he would not recognize Philip V. Charles showed an enlightened, though not always successful, interest in the commercial prosperity of his subjects, but from the date of his return to Germany till his death his ruling passion was to secure his inheritance against dismemberment. As early as 1713 he had begun to prepare the "Pragmatic Sanction" which was to regulate the succession, and it became the object of his policy to obtain the recognition of his daughter Maria Theresa as his heiress. His last days were embittered by a disastrous war with Turkey, in which he lost almost all he had gained by the peace of Passarowitz. He died at Vienna on Oct. 20, 1740, and with him expired the male line of his house.

For the personal character of Charles VI. *see* A. von Arneth, *Geschichte Maria Theresias* (Vienna, 1863–79). Dr. Franz Krones, R. v. Marchland, *Grundriss der österreichischen Geschichte* (Vienna, 1882), gives a very copious bibliography. *See* also J. Ziekursch, *Die Kaiserwahl Karls VI.* (1902).

CHARLES VII. (1697–1745), Roman emperor, known also as Charles Albert, elector of Bavaria, was the son of the elector Maximilian Emanuel and his second wife, Theresa Cunigunda, daughter of John Sobieski, king of Poland. He was born on Aug. 6, 1697. His father having taken the side of Louis XIV. of France in the War of the Spanish Succession (*q.v.*), Bavaria was occupied by the allies. Charles and his brother Clement, afterwards archbishop of Cologne, were carried prisoners to Vienna, and were educated by the Jesuits under the name of the counts of Wittelsbach. When his father was restored to his electorate Charles was released, and in 1717 he led the Bavarian contingent of the imperial army which served under Prince Eugene against the Turks, and is said to have distinguished himself at Belgrade. On Sept. 25, 1722, he was betrothed to Maria Amelia, the younger of the two orphan daughters of the emperor Joseph I. Her uncle Charles VI. insisted that the Bavarian house should recognize the Pragmatic Sanction which established his daughter Maria Theresa as heiress of the Habsburg dominions. They did so, but with secret protests and mental reservations of their rights, which were designed to render the recognition valueless. The electors of Bavaria had claims on the possessions of the Habsburgs under the will of the emperor Ferdinand I., who died in 1564.

Charles succeeded his father on Feb. 26, 1726. His policy was to keep on good terms with the emperor while slipping out of his obligation to accept the Pragmatic Sanction and intriguing to secure French support for his claims whenever Charles VI. should die. These claims were advanced immediately after the death of Charles VI. on Oct. 20, 1740. Charles Albert now entered into the league against Maria Theresa, to the great misfortune of himself and his subjects. By the help of her enemies he was elected emperor in opposition to her husband Francis, grand duke of Tuscany, on Jan. 24, 1742, under the title of Charles VII. and was crowned at Frankfurt-am-Main on Feb. 12. But as his army had been neglected, he was utterly unable to resist the Austrian troops. While he was being crowned his hereditary dominions in Bavaria were being overrun. During the War of the Austrian Succession (*q.v.*) he was a mere puppet in the hands of the anti-Austrian coalition, and was often in want of mere necessities. In the changes of the war he was able to re-enter his capital, Munich, in 1743, but had immediately afterwards to take flight again. He was restored by Frederick the Great in Oct. 1744, but died worn out at Munich on Jan. 20, 1745.

See A. von Arneth, *Geschichte Maria Theresias* (Vienna, 1863–79), and P. T. Heigel, *Der österreichische Erbfolgestreit und die Kaiserwahl Karls VII.* (Munich, 1877).

CHARLES I. (1887–1922), emperor of Austria and king of Hungary, born Aug. 17, 1887, in Persenbeug, in Lower Austria, was the son of the archduke Otto (1865–1906), and Princess Maria Josepha of Saxony (1867–1944). The death of his father in 1906 and the renunciation by his uncle, the archduke Francis Ferdinand, on his marriage with the countess Chotek (1900) of any right of succession for the children of this union, made him heir-presumptive to his great-uncle, the emperor, Francis Joseph. In Oct. 1911 he married the princess Zita of Bourbon-Parma. Of this marriage there were several sons and daughters, the eldest of whom, Otto, was born in 1912. Charles' relations with the emperor were not intimate, and those with Francis Ferdinand not cordial. After the death of Francis Ferdinand the old emperor took steps to initiate him in affairs of State; but these studies were interrupted almost immediately by the outbreak of the World War. After a period at headquarters at Teschen, Charles commanded the 20th Corps in the offensive of 1916 against Italy, later commanding an army on the eastern front.

Charles as Emperor.—On Nov. 21, 1916, he succeeded to the throne, at a period of extreme difficulty, which he hoped to meet by making a complete change in the leading military and political posts in the monarchy. The changes, however, usually proved unfortunate. Charles himself was an amiable man of excellent intentions, but his abilities were mediocre and his preparatory training inadequate. He lacked calmness and endurance, and was prone to headlong, precipitate actions. He was powerfully influenced by his immediate entourage—his wife and mother-in-law—while distrusting all other advisers. But he was most bitterly—and justly—reproached for insincerity. Not merely his enemies, but his allies, particularly German statesmen and the emperor William, soon felt that they could not trust his word; a sentiment shared by the peoples of the Danubian monarchy.

On Charles' accession the Constitution in Austria was still suspended. In May 1917 he summoned parliament once more, but the concessions Charles now made to the Slavonic nationalities remained fruitless, merely alienating the majority of the German Austrians, while his concessions to the Magyars in Hungary similarly irritated the conservatives of Vienna and the non-Magyars of Hungary, without checking the separatist movement. He was equally unfortunate in his peace proposals. While refusing the idea of a separate peace for Austria, he endeavoured to persuade

Germany to buy a general peace by territorial concessions in the west. But the negotiations opened by Count Czernin only bred ill-will, which culminated on the publication of the so-called "Sixtus letter" of March 24, 1917. Charles' belated effort to convert Austria into a Federal State on national lines (Oct. 16, 1918) was rendered futile by the failure to apply it to Hungary; and Charles was obliged to renounce participation in the Government of Austria on Nov. 11, 1918, and of Hungary two days later. (*See* HABSBURG.) After the proclamation of the Austrian republic, Charles retired to his castle of Eckartsau; thence he went, the Austrian Government having demanded his departure, on March 24, 1919, to Switzerland, where he stayed first at Schloss Gstaad and later at Prangins. His attempt at the end of March 1921 to secure his restoration as king of Hungary failed owing to the attitude of the regent, Horthy, and other leading Hungarians and the unanimous opposition of the Succession States and the Entente.

Charles returned to Switzerland, where a provisional prolongation of his residence was accorded him subject to certain conditions. In Oct. 1921, however, he made a surprise air flight with his wife from Switzerland to the Burgenland, where he was joined by a small force of armed Royalists, at whose head he marched on Budapest. But the Allied Powers, as well as the "Little Entente," made it clear that a *coup d'état* would not be tolerated, and there was a strong rally at Budapest to the side of the Horthy Government. The Royalists were met near Budapest and defeated, Charles and Zita being themselves arrested at Tihany.

On instructions from the Powers, the definite deposition of Charles and renunciation of his claims to the throne were insisted upon, and he and his wife were handed over to the custody of the Allies for internment. Refused the right of asylum by Switzerland, on the ground that he had not adhered to the conditions agreed upon, and accorded a reception by Portugal alone, he was conveyed upon the English ship "Cardiff" to Funchal, Madeira. Here he lived in straitened circumstances until his death on April 1, 1922.

BIBLIOGRAPHY.—Karl Werkmann, *Der Tote auf Madeira* (1923); Aladar von Boroviczeny, *Der König und sein Reichverweser* (1924); R. Fester, *Kaiser Karl und der Wendepunkt des Weltkrieges* (1925).

CHARLES I. (1600–1649), king of Great Britain and Ireland, second son of James I. and Anne of Denmark, was born at Dunfermline on Nov. 19, 1600. At his baptism he was created duke of Albany, and on Jan. 16, 1605 duke of York. In 1612, by the death of his elder brother Henry, he became heir-apparent, and was created prince of Wales on Nov. 3, 1616. In 1620 he took up warmly the cause of his sister the queen of Bohemia, and in 1621 he defended Bacon, using his influence to prevent the chancellor's degradation from the peerage. The prince's marriage with the Infanta Maria, daughter of Philip III. of Spain, had been for some time the subject of negotiation, James desiring to obtain through Spanish support the restitution of his son-in-law, Frederick, to the Palatinate; and in 1623 Charles was persuaded by Buckingham, who now obtained a complete ascendancy over him in opposition to wiser advisers and the king's own wishes, to make a secret expedition himself to Spain, put an end to all formalities, and bring him his mistress himself; "a gallant and brave thing for his Highness." "Steenie" and "Baby Charles," as James called them, started on Feb. 17, arriving at Paris on the 21st and at Madrid on March 7, where they assumed the unromantic names of Mr. Smith and Mr. Brown. They found the Spanish court by no means enthusiastic for the marriage and the princess herself averse. The prince's immediate conversion was expected, and a complete religious tolerance for the Roman Catholics in England demanded. James engaged to allow the infanta the right of public worship and to use his influence to modify the law, but Charles himself went much further. He promised the alteration of the penal laws within three years, conceded the education of the children to the mother till the age of 12, and undertook to listen to the infanta's priests in matters of religion, signing the marriage contract on July 25, 1623. The Spanish, however, did not trust to words, and Charles was informed that his wife could only follow him to England when these promises were executed. Moreover, they had no intention whatever of aiding the Protestant Frederick. Meanwhile Buckingham, incensed at the failure of the expedition, had quarrelled with the grandees, and Charles left Madrid, landing at Portsmouth on Oct. 5, to the joy of the people, to whom the proposed alliance was odious. He now with Buckingham urged James to make war on Spain, and in Dec. 1624 signed a marriage treaty with Henrietta Maria, daughter of Henry IV. of France. In April Charles had declared solemnly to the parliament that in case of his marriage to a Roman Catholic princess no concessions should be granted to recusants, but these were in Sept. 1624 deliberately promised by James and Charles in a secret article, the first instance of the duplicity and deception practised by Charles in dealing with the parliament and the nation. The French on their side promised to assist in Mansfeld's expedition for the recovery of the Palatinate, but Louis in October refused to allow the men to pass through France; and the army, without pay or provisions, dwindled away in Holland to nothing.

On March 27, 1625, Charles I. succeeded to the throne by the death of his father, and on May 1 he was married by proxy to Henrietta Maria. He received her at Canterbury on June 13, and on the 18th his first parliament assembled. On the day of his marriage, Charles had given directions that the prosecutions of the Roman Catholics should cease, but he now declared his intention of enforcing the laws against them, and demanded subsidies for carrying on the war against Spain. The Commons, however, responded coldly. Charles had lent ships to Louis XIII. to be used against the Protestants at La Rochelle, and the Commons were not aware of the subterfuges and fictitious delays intended to prevent their employment. The Protestant feelings of the Commons were also aroused by the king's support of the royal chaplain, Richard Montagu, who had repudiated Calvinistic doctrine. They only voted small sums, and sent up a petition on the state of religion, also reflecting upon Buckingham, whom they deemed responsible for the failure of Mansfeld's expedition, at the same time demanding counsellors in whom they could trust. Parliament was accordingly dissolved by Charles on Aug. 12. He hoped that greater success abroad would persuade the Commons to be more generous. On Sept. 8, 1625, he made the treaty of Southampton with the Dutch against Spain, and sent an expedition to Cadiz under Sir Edward Cecil, which, however, was a failure. In order to make himself independent of parliament he attempted to raise money on the crown jewels in Holland, and to diminish the opposition in the Commons he excluded the chief leaders by appointing them sheriffs. When the second parliament met, however, on Feb. 6, 1626, the opposition, led by Sir John Eliot, was more determined than before, and their attack was concentrated upon Buckingham. On March 29, Charles, calling the Commons into his presence, accused them of leading him into the war and of taking advantage of his difficulties to "make their own game." "I pray you not to be deceived," he said, "it is not a parliamentary way, nor 'tis not a way to deal with a king. Remember that parliaments are altogether in my power for their calling, sitting, and dissolution; therefore as I find the fruits of them good or evil, they are to continue or not to be." Charles, however, was worsted in several collisions with the two houses, with a consequent loss of influence. He was obliged by the peers to set at liberty Thomas Howard, earl of Arundel, whom he had put into the Tower, and to send a summons to the earl of Bristol, whom he had attempted to exclude from parliament, while the Commons compelled him, with a threat of doing no business, to liberate Eliot and Digges, the managers of Buckingham's impeachment, whom he had imprisoned. Finally in June the Commons answered Charles's demand for money by a remonstrance asking for Buckingham's dismissal, which they decided must precede the grant of supply. They claimed responsible ministers, while Charles considered himself the executive and the sole and unfettered judge of the necessities of the State. Accordingly on the 15th Charles dissolved the parliament.

The king was now in great need of money. He was at war with Spain and had promised to pay £30,000 a month to Christian

IV. of Denmark in support of the Protestant campaign in Germany. To these necessities was now added a war with France, Charles had never kept his promise concerning the recusants; disputes arose in consequence with his wife, and on July 31, 1626, he ordered all her French attendants to be expelled from Whitehall and sent back to France. At the same time several French ships carrying contraband goods to the Spanish Netherlands, were seized by English warships. On June 27, 1627, Buckingham with a large expedition sailed to the Isle of Ré to relieve La Rochelle, then besieged by the forces of Louis XIII. Though the success of the French Protestants was an object much desired in England, Buckingham's unpopularity prevented support being given to the expedition, and the duke returned to Plymouth on Nov. 11 completely defeated. Meanwhile Charles had endeavoured to get the money refused to him by parliament by means of a forced loan, dismissing Chief Justice Crewe for declining to support its legality, and imprisoning several of the leaders of the opposition for refusing to subscribe to it. These summary measures, however, only brought a small sum into the treasury. On Jan. 2, 1628, Charles ordered the release of all the persons imprisoned, and on March 17 summoned his third parliament.

Instead of relieving the king's necessities the Commons immediately proceeded to discuss the constitutional position and to formulate the Petition of Right, forbidding taxation without consent of parliament, arbitrary and illegal imprisonment, compulsory billeting in private houses, and martial law. Charles, on May 1, first demanded that they should "rest on his royal word and promise." He obtained an opinion from the judges that the acceptance of the petition would not absolutely preclude in certain cases imprisonments without showing cause, and after a futile endeavour to avoid an acceptance by returning an ambiguous answer which only exasperated the Commons, he gave his consent on June 7, in the full and usual form. Charles now obtained his subsidies, but no real settlement was reached, and his relations with the parliament remained as unfriendly as before. They proceeded to remonstrate against his government and against his support of Buckingham, and denied his right to tonnage and poundage. Accordingly, on June 26, they were prorogued. New disasters befell Charles, in the assassination of Buckingham, and in the failure of the fresh expedition sent to Ré. In Jan. 1629 the parliament reassembled, irritated by the exaction of the duties and seizure of goods during the interval, and suspicious of "innovations in religion," the king having forbidden the clergy to continue the controversy concerning Calvinistic and Arminian doctrines, the latter of which the parliament desired to suppress. While they were discussing these matters, on March 2, 1629, the king ordered them to adjourn, but amidst a scene of great excitement the speaker, Sir John Finch, was held down in his chair and the doors were locked, whilst resolutions against innovations in religion and declaring those who levied or paid tonnage and poundage enemies to their country were passed. Parliament was immediately dissolved, and Charles imprisoned nine members, leaders of the opposition, Eliot, Holles, Strode, Selden, Valentine, Coryton, Heyman, Hobart and Long. Eliot, the most formidable of his opponents, died in the Tower of consumption after long years of close and unhealthy confinement, Charles even refusing to surrender his corpse to his family.

For 11 years Charles ruled without parliaments and with some success. There seemed no reason to think that "that noise," to use Laud's expression concerning parliaments, would ever be heard again by those then living. A revenue of about £618,000 was obtained by enforcing the payment of tonnage and poundage, and—while avoiding the taxes, loans, and benevolences forbidden by the petition of right—by monopolies, fines for knighthood, and for pretended encroachments on the royal domains and forests, which enabled the king to meet expenditure at home. In Ireland, Charles, in order to get money, had granted the Graces in 1628, conceding security of titles of more than 60 years' standing, and a more moderate oath of allegiance for the Roman Catholics, together with the renunciation of the shilling fine for non-attendance at church. He continued, however, to make various attempts to get estates into his possession on the pretext of invalid title, and on May 12, 1635, the City of London estates were sequestered. Charles here destroyed one of the most valuable settlements in Ireland founded by James I. in the interests of national defence, and at the same time extinguished the historic loyalty of the city of London, which henceforth steadily favoured the parliamentary cause. In 1633 Wentworth had been sent to Ireland to establish a mediaeval monarchy and get money, and his success in organization seemed great enough to justify the attempt to extend the system to England. Charles at the same time restricted his foreign policy to scarcely more than a wish for the recovery of the Palatinate, to further which he engaged in a series of numerous and mutually destructive negotiations with Gustavus Adolphus and with Spain, finally making peace with Spain on Nov. 5, 1630, an agreement which was followed on Jan. 2, 1631, by a further secret treaty, the two kings binding themselves to make war on the Dutch and partition their territories. A notable feature of this agreement was that while in Charles's portion Roman Catholicism was to be tolerated, there was no guarantee for the security of Protestantism in the territory to be ceded to Spain.

In 1634 Charles levied ship-money from the seaport towns for the increase of the navy, and in 1635 the tax was extended to the inland counties, which aroused considerable opposition. In Feb. 1637 Charles obtained an opinion in favour of his claims from the judges, and in 1638 the great Hampden case was decided in his favour. The apparent success, however, of Charles was imperilled by the general and growing resentment aroused by his exactions and whole policy, and this again was small compared with the fears excited by the king's attitude towards religion and Protestantism. He supported zealously Laud's rigid Anglican orthodoxy, his compulsory introduction of unwelcome ritual, and his narrow, intolerant and despotic policy, which was marked by several savage prosecutions and sentences in the Star Chamber, drove numbers of moderate Protestants out of the Church into Presbyterianism, and created an intense feeling of hostility to the Government throughout the country. Charles further increased the popular fears on the subject of religion by his welcome given to Panzani, the pope's agent, in 1634, who endeavoured unsuccessfully to reconcile the two churches, and afterwards to George Conn, papal agent at the court of Henrietta Maria, while the favour shown by the king to these was contrasted with the severe sentences passed upon the Puritans.

The same imprudent neglect of the national sentiment was pursued in Scotland. Charles had already made powerful enemies there by a declaration announcing the arbitrary revocation of former church estates to the crown. On June 18, 1633, he was crowned at Edinburgh with full Anglican ceremonial, which lost him the hearts of numbers of his Scottish subjects and aroused hostility to his government in parliament. After his return to England, he gave further offence by ordering the use of the surplice, by his appointment of Archbishop Spottiswoode as chancellor of Scotland, and by introducing other bishops into the privy council. In 1636 the new *Book of Canons* was issued by the king's authority, ordering the communion table to be placed at the east end, enjoining confession, and declaring excommunicate any who should presume to attack the new prayer-book. The latter was ordered to be used on Oct. 18, 1636, but it did not arrive in Scotland till May 1637. It was intensely disliked both as "popish" and as English. A riot followed its first use in St. Giles' cathedral on July 23, and Charles's order to enforce it on Sept. 10 was met by fresh disturbances and by the establishment of the "Tables," national committees which now became the real though informal government of Scotland. In 1638 the national covenant was drawn up, binding those that signed it to defend their religion to the death, and was taken by large numbers with enthusiasm all over the country. Charles now drew back, promised to enforce the canons and prayer-book only in a "fair and legal way," and sent the marquis of Hamilton as a mediator. The latter, however, a weak and incapable man, desirous of popularity with all parties, and unfaithful to the king's interests,

yielded everything, without obtaining the return of Charles's subjects to their allegiance. The assembly met at Glasgow on Nov. 21, and in spite of Hamilton's opposition immediately proceeded to judge the bishops. On the 28th Hamilton dissolved it, but it continued to sit, deposed the bishops and re-established Presbyterianism. The rebellion had now begun and an appeal to arms alone could decide the quarrel between Charles and his subjects. On May 28, 1639, he arrived at Berwick with a small and ill-trained force, thus beginning what is known as the first Bishops' War; but being confronted by the Scottish army at Duns Law, he was compelled to sign the treaty of Berwick on June 18, which provided for the disbandment of both armies and the restitution to the king of royal castles, referring all questions to a general assembly and a parliament. When the assembly met it abolished episcopacy, but Charles, who on Aug. 3, had returned to Whitehall, refused his consent to this and other measures proposed by the Scottish parliament. His extreme financial necessities, and the prospect of renewed hostilities with the Scots, now moved Charles, at the instigation of Strafford, who in September had left Ireland to become the king's chief adviser, to turn again to parliament for assistance as the last resource, and on April 13, 1640, the Short Parliament assembled. But on its discussing grievances before granting supplies and finally refusing subsidies till peace was made with the Scots, it was dissolved on May 5. Charles returned once more to measures of repression, and on the 10th imprisoned some of the London aldermen who refused to lend money. He prepared for war, scraping together what money he could and obtaining a grant through Strafford from Ireland. His position, however, was hopeless; his forces were totally undisciplined, and the Scots were supported by the parliamentary opposition in England. On Aug. 20 the Scots crossed the Tweed, beginning the so-called second Bishops' War, defeated the king's army at Newburn on the 28th, and subsequently occupied Newcastle and Durham. Charles at this juncture, on Sept. 24, summoned a great council of the peers; and on Oct. 21 a cessation of arms was agreed to by the treaty of Ripon, the Scots receiving £850 a day for the maintenance of the army, and further negotiations being transferred to London. On Nov. 3 the king summoned the Long Parliament.

At this great crisis, which would indeed have taxed the resolution and resource of the most cool-headed and sagacious statesman, Charles failed signally. He might have taken his stand on the ancient and undoubted prerogative of the crown, resisted all encroachments on the executive by the parliament by legal and constitutional means, which were probably ample, and in case of necessity have appealed to the loyalty of the nation to support him in arms; or he might have waived his rights, and, acknowledging the mistakes of his past administration, have united with the parliament and created once more that union of interests and sentiment of the monarchy with the nation which had made England so powerful. Charles, however, pretended to do both simultaneously or by turns, and therefore accomplished neither. The illegally imprisoned members of the last parliament, now smarting with the sense of their wrongs, were set free to stimulate the violence of the opposition to the king in the new assembly. Of Charles's double statecraft, however, the series of incidents which terminated the career of the great Strafford form the most terrible example. Strafford had come to London in Nov., having been assured by Charles that he "should not suffer in his person, honour or fortune," but was impeached and thrown into the Tower almost immediately. Charles took no steps to hinder the progress of the proceedings against him, but entered into schemes for saving him by bringing up an army to London, and this step exasperated Strafford's enemies, and added new zeal to the prosecution. On April 23, after the passing of the attainder by the Commons, he repeated to Strafford his former assurances of protection. On May 1 he appealed to the Lords to spare his life and be satisfied with rendering him incapable of holding office. On the 2nd he made an attempt to seize the Tower by force. On the 10th, yielding to the queen's fears and to the mob surging round his palace, he signed his death-warrant. "If my own person only were in danger," he declared to the council, "I would gladly venture it to save my Lord Strafford's life; but seeing my wife, children, all my kingdom are concerned in it, I am forced to give way unto it." On the 11th he sent to the peers a petition for Strafford's life, the force of which was completely annulled by the strange postscript: "If he must die, it were a charity to reprieve him until Saturday." This tragic surrender of his great and devoted servant left an indelible stain upon the king's character, and he lived to repent it bitterly. One of his last admonitions to the prince of Wales was "never to give way to the punishment of any for their faithful service to the crown." It was regarded by Charles as the cause of his own subsequent misfortunes, and on the scaffold the remembrance of it disturbed his own last moments. The surrender of Strafford was followed by another stupendous concession by Charles, the surrender of his right to dissolve the parliament without its own consent, and the parliament immediately proceeded, with Charles's consent, to sweep away the star-chamber, high commission and other extra-legal courts, and all extra parliamentary taxation. Charles, however, did not remain long or consistently in the yielding mood. In June 1641 he engaged in a second army plot for bringing up the forces to London, and on Aug. 10 he set out for Scotland in order to obtain the Scottish army against the parliament in England; this plan was obviously doomed to failure and was interrupted by another appeal to force, the so-called Incident, at which Charles was suspected (in all probability unjustly) of having connived, consisting in an attempt to kidnap and murder Argyll, Hamilton and Lanark, with whom he was negotiating. Charles had also apparently been intriguing with Irish Roman Catholic lords for military help in return for concessions, and he was suspected of complicity in the Irish rebellion which now broke out. He left Scotland more discredited than ever, having by his concessions made, to use Hyde's words, "a perfect deed of gift of that kingdom," and without gaining any advantage.

Charles returned to London on Nov. 25, 1641, and was immediately confronted by the Grand Remonstrance (passed on the 22nd), in which, after reciting the chief points of the king's misgovernment, the parliament demanded the appointment of acceptable ministers and the constitution of an assembly of divines to settle the religious question. On Jan. 2, 1642, Charles gave office to the opposition members Colepeper and Falkland, and at the same time Hyde left the opposition partly to serve the king. Charles promised to take no serious step without their advice. Nevertheless, entirely without their knowledge, through the influence of the queen whose impeachment was intended, Charles on the 4th made the rash and fatal attempt to seize with an armed force the five members of the Commons, Pym, Hampden, Holles, Hesilrige and Strode, whom, together with Mandeville (afterwards earl of Manchester) in the Lords, he had impeached of high treason. No English sovereign ever had (or has since that time) penetrated into the House of Commons. So complete and flagrant a violation of parliamentary liberties, and an appeal so crude and glaring to brute force, could only be justified by complete success; but the court plans had been betrayed, and were known to the offending members, who, by order of the House, had taken refuge in the city before the king's arrival with the soldiers. Charles, on entering the House, found "the birds flown," and returned baffled, having thrown away the last chance of a peaceful settlement. (*See* LENTHALL, WILLIAM.) The next day Charles was equally unsuccessful in obtaining their surrender in the city. "The king had the worst day in London yesterday," wrote a spectator of the scene, "that ever he had, the people crying 'privilege of parliament,' by thousands and prayed God to turn the heart of the king, shutting up their shops and standing at their doors with swords and halberds." On the 10th, amidst general manifestations of hostility, Charles left Whitehall to prepare for war, destined never to return till he was brought back by his victorious enemies to die.

Several months followed spent in manoeuvres to obtain the control of the forces and in a paper war of controversy. On April 23 Charles was refused entry into Hull, and on June 2, the parliament sent to him the "Nineteen Propositions," claiming

the whole sovereignty and government for the parliament, including the choice of the ministers, the judges, and the control of the army, and the execution of the laws against the Roman Catholics. The military events of the war are described in the article GREAT REBELLION.

The negotiations carried on at Uxbridge during Jan. and Feb. 1645 failed to secure a settlement, and on June 14 the crushing defeat of the king's forces, by the new model army, at Naseby practically ended the civil war. Charles, however, refused to make peace on Rupert's advice, and considered it a point of honour "neither to abandon God's cause, injure my successors, nor forsake my friends." His chief hope was to join Montrose in Scotland, but his march north was prevented by the parliamentary forces, and on Sept. 24 he witnessed from the walls of Chester the rout of his followers at Rowton Heath. He now entered into a series of intrigues, mutually destructive, which, becoming known to the different parties, exasperated all and diminished still further the king's credit. One proposal was the levy of a foreign force to reduce the kingdom; another, the supply through the marquis of Ormonde of 10,000 Irish. Correspondence relating to these schemes, fatally compromising as they were if Charles hoped ever to rule England again, was discovered by his enemies, including the Glamorgan treaty, which went much further than the instructions to Ormonde, but of which the full responsibility has never been really traced to Charles, who on Jan. 29, 1646, disavowed his agent's proceedings. He simultaneously treated with the parliament, and promised toleration to the Roman Catholics if they and the pope would aid in the restoration of the monarchy and the church. Nor was this all. The parliamentary forces had been closing round Oxford. On April 27 the king left the city, and, on May 5, gave himself up to the Scottish army at Newark, arriving on the 13th with them at Newcastle. On July 13 the parliament sent to Charles the "Newcastle Propositions," which included the extreme demands of Charles's acceptance of the Covenants, the abolition of episcopacy and establishment of Presbyterianism, severer laws against the Roman Catholics and parliamentary control of the forces, with the withdrawal of the Irish cessation, and a long list of royalists to be exempted from pardon. Charles returned no definite answer for several months. He imagined that he might now find support in Scottish royalism, encouraged by Montrose's series of brilliant victories, but these hopes were destroyed by the latter's defeat at Philiphaugh on Sept. 13. The Scots insisted on the Covenant and on the permanent establishment of Presbyterianism, while Charles would only consent to a temporary maintenance for three years. Accordingly the Scots, in return for the payment of part of their army arrears by the parliament, marched home on Jan. 30, 1647, leaving Charles behind, who under the care of the parliamentary commissioners was conducted to Holmby House. Thence on May 12 he sent his answer to the Newcastle Propositions, offering the militia to the parliament for ten years and the establishment of Presbyterianism for three, while a final settlement on religion was to be reached through an assembly of 20 divines at Westminster. But in the midst of the negotiation with the parliament Charles's person was seized, on June 3, 1647, by Cornet Joyce under instructions of the army, which soon afterwards, occupied London and overpowered the parliament, placing Charles at Hampton Court.

If Charles could have remained firm to either one or the other faction, and have made concessions either to Presbyterianism or on the subject of the militia, he might even now have prevailed. But he had learned nothing by experience and continued at this juncture his characteristic policy of intrigue and double-dealing, "playing his game," to use his own words, negotiating with both parties at once, not with the object or wish to arrive at a settlement with either, but to augment their disputes, gain time and profit ultimately by their divisions. The "Heads of the Proposals," submitted to Charles by the army on July 28, 1647, were terms conceived on a basis far broader and more statesmanlike than the Newcastle Propositions, and such as Charles might well have accepted. The proposals on religion anticipated the Toleration Act of 1689. There was no mention of episcopacy, and its existence was thereby indirectly admitted, but complete religious freedom for all Protestant denominations was provided, and the power of the church to inflict civil penalties abolished, while it was also suggested that dangers from Roman Catholics and Jesuits might be avoided by means other than enforcing attendance at Church. The parliament was to dissolve itself and be succeeded by biennial assemblies elected on a reformed franchise, not to be dissolved without their own consent before 120 days, and not to sit more than 240 days in the two years. A council of state was to conduct the foreign policy of the state and conclude peace and war subject to the approval of parliament, and to control the militia for ten years, the commanders being appointed by parliament, as also the officers of state for ten years. No peer created since May 21, 1642, was to sit in parliament without consent of both Houses, and the judicial decisions of the House of Lords were to be ratified by the Commons. Only five persons were excepted from amnesty, but royalists were not to hold office for five years and not to sit in the Commons till the end of the second biennial parliament. Proposals for a series of reforms were also added. Charles, however, was at the same time negotiating with Lauderdale for an invasion of England by the Scots, and imagined he could win over Cromwell and Fairfax by "proffers of advantage to themselves." The precious opportunity was therefore allowed to slip by. On Sept. 9 he rejected the proposals of the parliament for the establishment of Presbyterianism. His hopes of gaining advantages by playing upon the differences of his opponents proved a complete failure. Fresh terms were drawn up by the army and parliament together on Nov. 10, but before these could be presented, Charles, on the 11th, had escaped to Carisbrooke Castle in the Isle of Wight. Thence on the 16th he sent a message offering Presbyterianism for three years and the militia for his lifetime to the parliament, but insisting on the maintenance of episcopacy. On Dec. 28 he refused his assent to the Four Bills, which demanded the militia for parliament for 20 years, and practically forever annulled the honours recently granted by the king and his declarations against the Houses, and gave to parliament the right to adjourn to any place it wished. On Jan. 3, 1648, the Commons agreed to a resolution to address the king no further, in which they were joined by the Lords on the 15th.

Charles had meanwhile taken a further fatal step which brought about his total destruction. On Dec. 26, 1647, he had signed at Carisbrooke with the Scottish commissioners the secret treaty called the "Engagement," whereby the Scots undertook to invade England on his behalf and restore him to the throne on condition of the establishment of Presbyterianism for three years and the suppression of the sectarians. In consequence the second civil war broke out and the Scots invaded England under Hamilton. The royalist risings in England were soon suppressed, and Cromwell gained an easy and decisive victory over the Scots at Preston. Charles was now left alone to face his enemies, with the whole tale of his intrigues and deceptions unmasked and exposed. The last intrigue with the Scots was the most unpardonable in the eyes of his contemporaries, no less wicked and monstrous than his design to conquer England by the Irish soldiers; "a more prodigious treason," said Cromwell, "than any that had been perfected before; because the former quarrel was that Englishmen might rule over one another; this to vassalize us to a foreign nation." Cromwell, who up to this point had shown himself foremost in supporting the negotiations with the king, now spoke of the treaty of Newport, which he found the parliament in the act of negotiating on his return from Scotland, as "this ruining hypocritical agreement." Charles had engaged in these negotiations only to gain time and find opportunity to escape. He had stipulated that no concession from him should be valid unless an agreement were reached upon every point. He had now consented to most of the demands of the parliament, including the repudiation of the Irish cessation, the surrender of the delinquents and the cession of the militia for twenty years, and of the offices of state to parliament, but remained firm in his refusal to abolish episcopacy, consenting only to Presbyterianism for

three years. Charles's devotion to the church is undoubted. In April 1646, before his flight from Oxford, inspired perhaps by superstitious fears as to the origin of his misfortunes, he had delivered to Sheldon, afterwards archbishop of Canterbury, a written vow (now in the library of St. Paul's cathedral) to restore all church lands held by the crown on his restoration to the throne; and almost his last injunction to the prince of Wales was that of fidelity to the national church. His present firmness, however, in its support was caused probably less by his devotion to it than by his desire to secure the failure of the whole treaty, and his attempts to escape naturally weakened the chances of success. Cromwell now supported the petitions of the army against the treaty. On Nov. 16 the council of officers demanded the trial of the king, "the capital and grand author of our troubles," and on Nov. 27 the parliamentary commissioners returned from Newport without having secured Charles's consent. Charles was removed to Hurst Castle on Dec. 1, where he remained till the 19th, thence being taken to Windsor, where he arrived on the 23rd. On the 6th "Pride's Purge" had removed from the Commons all those who might show any favour to the king. On the 25th a last attempt by the council of officers to come to terms with him was repulsed. On Jan. 1 the remnant of the Commons resolved that Charles was guilty of treason by "levying war against the parliament and kingdom of England"; on the 4th they declared their own power to make laws without the lords or the sovereign, and on the 6th established a "high court of justice" to try the king. On the 19th Charles was brought to St. James Palace, and on the next day his trial began in Westminster Hall, without the assistance of any of the judges, who all refused to take part in the proceedings. He laughed aloud at hearing himself called a traitor, and immediately demanded by what authority he was tried. He had been in treaty with the parliament in the Isle of Wight and taken thence by force; he saw no lords present. He was told by Bradshaw, the president of the court, that he was tried by the authority of the people of England, who had elected him king; and when Charles retorted that he was king by inheritance and not by election, and that England had been an hereditary kingdom for more than 1,000 years, Bradshaw cut short the discussion by adjourning the court. On the 22nd Charles repeated his reasoning, adding, "It is not my case alone; it is the freedom and liberty of the people of England, and do you pretend what you will, I stand more for their liberties, for if power without law may make laws . . . I do not know what subject he is in England that can be sure of his life or anything he calls his own." On the 23rd he again refused to plead. The court was adjourned, and there were several signs that the army in their prosecution of the king had not the nation at their back. While the soldiers had shouted "Justice! justice!" as the king passed through their ranks, the civilian spectators from the end of the hall had cried "God save the king!" After some considerable opposition and reluctance on the 26th the court decided unanimously upon his execution, and on the 27th Charles was brought into court for the last time to hear his sentence. His request to be heard before the Lords and Commons was rejected, and his attempts to answer the charges of the president were silenced. Sentence was pronounced, and the king was removed by the soldiers, uttering his last broken protest: "I am not suffered to speak. Expect what justice other people will have."

In these last hours, Charles, who was probably weary of life, showed a remarkable dignity and self-possession, and a firm resignation supported by religious faith and by the absolute conviction of his own innocence, which, says Burnet, "amazed all people and that so much the more because it was not natural to him. It was imputed to a very extraordinary measure of supernatural assistance . . .; it was owing to something within himself that he went through so many indignities with so much true greatness without disorder or any sort of affectation." Nothing in his life became Charles like the leaving it. "He nothing common did or mean Upon that memorable scene." On the morning of Jan. 29 he said his last sad farewell to his younger children, Elizabeth and Henry duke of Gloucester. On the 30th at ten o'clock he walked across from St. James's to Whitehall, calling on his guard "in a pleasant manner" to walk apace, and at two he stepped upon the scaffold from a window, probably the middle one, of the Banqueting House. He was separated from the people by large ranks of soldiers, and his last speech only reached Juxon and those with him on the scaffold. He declared that he had desired the liberty and freedom of the people as much as any; "but I must tell you that their liberty and freedom consists in having government. . . . It is not their having a share in the government; that is nothing appertaining unto them. A subject and a sovereign are clean different things." These, together with his declaration that he died a member of the Church of England, and the mysterious "Remember" spoken to Juxon, were Charles's last words. "It much discontents the citizens," wrote a spectator; "ye manner of his deportment was very resolutely with some smiling countenances, intimating his willingness to be out of his troubles." (*Notes and Queries*, 7th ser., viii. 326). "The blow I saw given," wrote another, Philip Henry, "and can truly say, with a sad heart, at the instant whereof I remember well, there was such a grone by the Thousands then present as I never heard before and desire I may never hear again. There was according to order one Troop immediately marching fromwards Charing Cross to Westminster and another fromwards Westminster to Charing Cross, purposely to masker" (*i.e.*, to overpower) "the people and to disperse and scatter them, so that I had much adoe amongst the rest to escape home without hurt" (*Letters and Diaries of P. Henry* [1882], 12).

Amidst such scenes of violence was at last effected the destruction of Charles. "It is lawful," wrote Milton, "and hath been held so through all ages for any one who have the power to call to account a Tyrant or wicked King, and after due conviction to depose and put him to death" (*Tenure of Kings and Magistrates*). But here (it might well be contended) there had been no "due conviction." The execution had been the act of the king's personal enemies, an act technically illegal, morally unjustifiable because the supposed crimes of Charles had been condoned by the later negotiations with him, and indefensible on the ground of public expediency, for the king's death proved a far greater obstacle to the re-establishment of settled government than his life could have been. The result was an extraordinary revulsion of feeling in favour of Charles and the monarchy, in which the incidents of his misgovernment were completely forgotten. He soon became in the popular veneration a martyr and a saint. His fate was compared with the Crucifixion, and his trials and sufferings to those of the Saviour. Handkerchiefs dipped in his blood wrought "miracles," and the *Eikon Basilike*, published on the day of his funeral, presented to the public a touching, if not a genuine, portrait of the unfortunate sovereign. At the Restoration the anniversary of his death was ordered to be kept as a day of fasting and humiliation, and the service appointed for use on the occasion was only removed from the prayer book in 1859. The conception of Charles as a martyr for religion has still its appeal. "Had Charles been willing to abandon the church and give up episcopacy," says Bishop Creighton, "he might have saved his throne and his life. But on this point Charles stood firm, for this he died and by dying saved it for the future" (*Lectures on Archbishop Laud* [1895], p. 25). Gladstone, Keble, Newman write in the same strain. "It was for the Church," says Gladstone, "that Charles shed his blood upon the scaffold" (*Remarks on the Royal Supremacy* [1850], p. 57). "I rest," says Newman, "on the scenes of past years, from the Upper Room in Acts to the Court of Carisbrooke and Uxbridge."

The injustice and violence of the king's death, however, the pathetic dignity of his last days, and the many noble traits in his character, cannot obscure the ultimate causes of his downfall and destruction. The constitutional struggle between the crown and parliament had not been initiated by Charles I. In some degree he inherited a situation for which he was not responsible. According to the ideas of kingship which then prevailed, he can not justly be blamed for defending the prerogatives of the crown as precious and sacred personal possessions which it was his duty to hand down intact to his successors; for his refusal to yield up

the control of the executive to the parliament or the army; or for his defence of the national church. But the great constitutional and religious points of dispute between the king and parliament, though doubtless involving principles vital to the national interests, would not alone have sufficed to destroy Charles. Monarchy was too much venerated, was too deeply rooted in the national life, to be hastily and easily extirpated. The statecraft of Charles had consisted throughout in an unhappy series of subterfuges, falsehoods and deception from the fraud concerning the concessions to the Roman Catholics at his marriage, and the evasions with which he met the Petition of Right, to the abandonment of Strafford, and the simultaneous negotiation with, and betrayal of, all parties. The bond of union between his people and himself had been early broken, and compromise is only possible between parties which can trust one another, and which are sincere in their endeavour to reach agreement. Thus on Charles himself largely falls the responsibility for the catastrophe.

His character and motives fill a large place in English history, but they have never been fully understood and possibly were largely due to physical causes. His weakness as a child was so extreme that his life was despaired of. He outgrew physical defects, and as a young man excelled in horsemanship and in the sports of the times, but always retained an impediment of speech. At the time of his accession his reserve and reticence were especially noticed. Buckingham was the only person who ever enjoyed his friendship, and after his death Charles placed entire confidence in no man. His character was marked by a weakness which shirked and postponed the settlement of difficulties, by a meanness and ingratitude even when dealing with his most devoted followers, by an obstinacy which only feigned compliance, by an untruthfulness which differed widely from his son's unblushing deceit. Yet Charles, in spite of his failings, had many fine qualities. Clarendon, who was fully conscious of them, who does not venture to call him a good king, and allows that "his kingly virtues had some mixture and alloy that hindered them from shining in full lustre," declares that "he was if every any, the most worthy of the title of an Honest Man, so great a lover of justice that no temptation could dispose him to a wrongful action except that it was disguised to him that he believed it just," "the worthiest of gentlemen, the best master, the best friend, the best husband, the best father and the best Christian that the age in which he lived produced." With all its deplorable mistakes and failings Charles I.'s reign belongs to a sphere infinitely superior to that of his unscrupulous, corrupt, selfish but more successful son. His private life was without a blemish. Immediately on his accession he had suppressed the disorder which had existed in the household of James I., and let it be known that whoever had business with him "must never approach him by backstairs or private doors" (Salvetti's Corresp. in *Hist. MSS. Comm.* 11th Rep. app. pt. i. p. 6). He maintained a strict sobriety in food and dress. He had a fine artistic sense, and Milton reprehends him for having made Shakespeare, "the closest companion of his solitudes." "Monsieur le Prince de Galles," wrote Rubens in 1625, "est le prince le plus amateur de la peinture qui soit au monde." He succeeded in bringing together during 20 years an unrivalled collection, of which a great part was dispersed at his death. He showed a noble insensibility to flattery. He was deeply and sincerely religious. He wished to do right, and was conscious of the purity of his motives. Those who came into contact with him, even the most bitter of his opponents, were impressed with his goodness. The great tragedy of his life, to be read in his well-known, dignified, but weak and unhappy features, and to be followed in his inexplicable and mysterious choice of baneful instruments, such as Rupert, Laud, Hamilton, Glamorgan, Henrietta Maria—all in their several ways working out his destruction—seems to have been inspired by a fateful insanity or infirmity of mind or will, recalling the great Greek dramas in which the poets depicted frenzied mortals rushing into their own destruction, impelled by the unseen and superior powers.

The king's body, after being embalmed, was buried by the few followers who remained with him to the last, hastily and without any funeral service, which was forbidden by the authorities, in the tomb of Henry VIII., in St. George's Chapel, Windsor, where his coffin was identified and opened in 1813. An "account of what appeared" was published by Sir Henry Halford, and a bone abstracted on the occasion was replaced in the vault by the prince of Wales (afterwards Edward VII.) in 1888. Charles I. left, besides three children who died in infancy, Charles (afterwards Charles II.); James (afterwards James II.); Henry, duke of Gloucester (1639–1660); Mary (1631–1660), who married William of Orange; Elizabeth (1635–1650); and Henrietta, duchess of Orleans (1644–1670).

BIBLIOGRAPHY.—The leading authority for the life and reign of Charles I. is S. R. Gardiner, *History of England* (1883), and *History of the Great Civil War* (1893), with references there given; an excellent account of Charles I.'s reign is in G. M. Trevelyan, *England under the Stuarts* (1904, 12th ed. rev. 1925). Among recent works may be mentioned E. B. Chancellor, *Life of Charles I., 1600–1625* (1886); *The Manner of the Coronation of King Charles I.* (ed. by C. Wordsworth, Henry Bradshaw Soc., 1892); C. Phillips, *The Picture Gallery of Charles I.* (1896), in *The Portfolio* Monographs No. 25 (1870, etc.); Sir J. Skelton, *Charles I.* (1898), valuable for its illustrations; C. S. Terry, *The Visits of Charles I. to Newcastle* (1898), in *Archaeologia Aeliana* (Newcastle-on-Tyne, 1822, etc.); A. Fea, *Memoirs of the Martyr King* (1905); *Cambridge Modern History*, vol. iv. ch. 8., and bibl. (ed. by Lord Acton, 1906); B. Murdoch, *The Royal Stuarts in connection with Art and Letters* (1909); E. M. G. Evans, *The Principal Secretary of State . . . 1558–1680*, ch. v. p. 83. Publications of the Univ. of Manchester. Hist. series. No. xliii. (1923); *The Journal of Sir Simonds d'Ewes* (ed. by W. Notestein, 1923); C. W. Coit, *The Royal Martyr* (1925); *Charles I. in Captivity, Contemporary Records* (ed. by G. S. Stevenson, 1927). *See* also *Calendars of State Papers, Irish and Domestic Series; Hist. MSS. Comm. Series,* esp. mss. of J. Eliot Hodgkin, F. J. Savile Foljambe, Lord Montagu of Beaulieu, duke of Rutland at Belvoir castle, marquis of Ormonde, Earl Cowper (coke mss.), earl of Lonsdale (note-books of parliaments of 1626 and 1628), duke of Buccleuch at Montagu house, duke of Portland, duke of Hamilton, *Salvetti Correspondence,* Lord Braye; add. mss. Brit. mus. 33,596 fols. 21–32 (keys to cyphers), 34,171, 35,297; *Notes and Queries,* ser. vi., vii., viii., ix. indexes; S. R. Gardiner, "Charles and Glamorgan" in *Eng. Hist. Review,* vol. ii. p. 687, and vol. vii. p. 176; C. H. Firth, "Execution of Charles" in *The Cornhill Magazine,* vol. 75 (Jan. 1897); W. W. Seton, "The Early Years of Henry Frederick, Prince of Wales, and Charles, Duke of Albany, 1593–1605" in *The Scottish Historical Review* (July 1916).

CHARLES II. (1630–1685), king of Great Britain and Ireland, 2nd son of Charles I. and Henrietta Maria, was born on May 29, 1630. About 1638 the duke of Newcastle was appointed as his governor, but his education was interrupted by the Civil War. In 1645 Charles I. sent him into the west of England, where his council included, among others, Sir Edward Hyde. In March 1646 the Royalist defeats drove him to the Scilly Isles and later to Jersey, and in July he joined his mother in Paris. He remained there under her control for two years, and continued his studies, Hobbes being his tutor for mathematics.

In 1648 Charles cruised with some English ships off the mouth of the Thames, but effected nothing and retired to Holland. In Jan. 1649 he sent a blank sheet of paper, bearing his signature, to parliament, for the insertion of any terms which would save his father's life. After Charles I.'s execution on Jan. 30, 1649, he was proclaimed king in Scotland and parts of Ireland and in the Channel Islands. He went to Jersey in September, but was obliged to retire to Breda (Feb. 1650), and from that place he came to terms with the Scots, accepting the Covenant and abandoning Montrose. He landed in Scotland on June 23, 1650, after pledging himself to Presbyterianism in both Scotland and England. An attempt to escape from the Covenanters, known as "the Start," failed, and on Jan. 1, 1651, Charles was crowned as king of Scots at Scone. Cromwell's advance forced him to march into England and on Sept. 3 Cromwell defeated him at Worcester. Charles showed great courage in the battle, and after an amazing series of adventures, including his concealment in the "Royal Oak" at Boscobel, sailed from Brighton for France on Oct. 15.

His advisers were henceforward the legitimists, Hyde, Ormond and Nicholas. Plots for risings in England and Scotland and for Cromwell's assassination failed. In 1654 Cromwell's negotiations with France drove Charles to Germany, but after Cromwell's alliance with France he made a treaty with Spain (April 1656) and resided at Bruges or Brussels. His chief source of income

was a Spanish pension; nevertheless he was very poor. Cromwell's death did not immediately alter his position and in 1659 he went to Fuenterrabia, where the Peace of the Pyrenees was being negotiated between France and Spain, to ask for military aid. This journey and a Royalist rising in England were alike fruitless.

Events in England brought about the Restoration, which the Royalists alone could not have accomplished. By the end of 1659 a return to the old Constitution was the only escape from the alternatives of military government or anarchy. Monck (Albemarle) advanced with an armed force from Scotland; by recalling the secluded members of the Long Parliament, power was transferred from the Independents to the Presbyterians. A "Free Parliament" was summoned to meet in April 1660 while Monck opened negotiations with Charles, who, following his advice, issued the Declaration of Breda (*see* BREDA) April 4. Largely the work of Hyde, it promised a general amnesty and liberty of conscience, and guaranteed the transfers of land, leaving the final settlement in each case to parliament; it also promised full arrears of pay to all ranks in the army. The Convention Parliament, in which the secular peers again sat, accepted the Declaration and Charles was proclaimed king on May 8. On May 26 he landed at Dover, where he was met by Monck, and on May 29, amid universal rejoicing, arrived at Whitehall.

The agreement of Charles and Monck in leaving the settlement to parliament meant that the Restoration was a restoration of parliamentary government, not of personal monarchy. Charles was not a conqueror and had no armed force of his own, while during the last 20 years almost all classes in England had acquired a permanent interest in politics. The administration could not be carried on without the help of men who had already been employed by the revolutionary Governments and the new council included faithful Royalists and ex-rebels. The willing cooperation of the Convention and the unbounded loyalty of its successor in its earlier years encouraged Charles to entrust many matters to parliament. The Restoration dissolved the legislative union with Scotland and Ireland, but led to the re-establishment of their separate parliaments. In Scotland it was complete, and brought back Episcopacy and repression; in Ireland the Cromwellian settlement was firmly established and was upheld by English opinion.

Hyde, created earl of Clarendon, was still Charles's chief adviser, and directed the work of reconstruction in England. All the acts of the revolutionary Governments since 1642 were held to be invalid; judicial proceedings since that date were confirmed by a special act. The Navigation Act of 1651 was re-enacted; the abolition of feudal incidents, completed in 1656, was maintained by a new act. The Indemnity bill led to disputes between Charles and parliament, Charles desiring lenity. Thirteen regicides and young Sir Henry Vane were executed; 25 regicides, Lambert and Hesilrige were imprisoned for life; otherwise the amnesty was complete. Crown and Church lands, and other lands sequestered by the revolutionary Governments, reverted to their former owners, but Royalists who had sold part of their lands to meet the fines inflicted on them received no compensation. By means of special taxes the army was paid off by Feb. 1661; Charles, who had only a few Life and Foot Guards, retained Monck's regiment of infantry, known henceforward as the Coldstream Guards, and a cavalry regiment, the Blues. By 1685, mainly by the return of regiments from Dunkirk and Tangier, this force was increased by five regiments of foot and one of dragoons. The Government's income was fixed at £1,200,000, but the sources allocated did not produce that amount, and the Government was involved from the start in pecuniary difficulties for which it was not responsible.

The restoration of the Church was slower. Charles was pledged to toleration, and plans for comprehension were put forward. The Convention was dissolved in Dec. 1660 without settling anything, and the Savoy conference, between Anglicans and Presbyterians, proved sterile. Charles was crowned on April 23, 1661, and a new parliament met on May 8; as it sat until 1679 it is called the Long Parliament of the Restoration, and sometimes the Cavalier or the Pensionary Parliament. It was composed at the start almost entirely of Anglicans and thorough-going Royalists, and Charles and Clarendon could not restrain it on religious questions. The bishops returned to the Upper House on Nov. 20, 1661. On May 19, 1662, the Act of Uniformity was passed, enjoining the use of the Book of Common Prayer, which had been specially revised, and included new services of Jan. 30 and May 29 (the dates of the execution of Charles I. and the Restoration); as a result about 1,200 of the clergy, who refused to conform, left their livings on St. Bartholomew's Day (Aug. 12); another 800 had already been ejected. The Puritans, who had hitherto tried to gain control of the national Church while remaining within it, took up a position definitely outside it; they came to be known as Nonconformists or Dissenters. Charles tried to relieve them and the Roman Catholics by a declaration issued on Dec. 26, 1662, but it was opposed by Clarendon and by parliament; and a series of acts was passed, including the Conventicle and Five Mile Acts, forbidding the Nonconformists their special forms of worship; it is unjustly called the Clarendon Code. The Corporation Act (1661) drove the Nonconformists from power in the boroughs; the Press Act (1662), establishing a censorship, and the repeal of the Triennial Act (1664) completed the reconstruction of the Constitution.

Charles's foreign policy was largely a continuation of Cromwell's, although based on material rather than on religious considerations. Peace was made with Spain, but Jamaica and Dunkirk were retained, and Charles, when he married the Portuguese Catherine of Braganza in 1662, pledged himself to give Portugal military support in its struggle with Spain. The marriage, which brought Bombay and Tangier to England as parts of Catherine's dowry, drew England closer to France; the two countries were further connected by the marriage of Charles's sister, Henrietta Anne, to the duke of Orleans and by the sale of Dunkirk to France. Dunkirk was a costly possession and had lost most of its military or naval value, especially after the acquisition of Tangier. In 1664 English commercial expansion and minor political differences led to war with the Dutch. The struggle was indecisive, but England was weakened by the Great Plague in 1665, and the Fire of London in 1666. Financial exhaustion led to negotiations, and in 1667 the Dutch, by burning the English ships in the Medway, enforced the conclusion of the Peace of Breda. Both sides kept their conquests, England obtaining New York and New Jersey. Parliament demanded a sacrifice and attacked Clarendon. Charles was annoyed by his opposition to toleration and tired of his lectures on his private misconduct; to the delight of the courtiers and the younger politicians he allowed him to be exiled.

Free from tutelage, Charles determined to follow his own policy. He disliked parliamentary control and believed that he could establish a strong monarchy upon the alliance of the Catholics and the dissenters; his desire for toleration and his personal inclination towards Catholicism, increased by his knowledge of the attitude of his brother James, duke of York, alike recommended this policy. He also wanted to revenge himself on the Dutch for his humiliation at Chatham. Henceforward he never gave complete confidence to any minister. He now employed Clifford and Arlington—both Catholics—but allowed Buckingham some show of power. These three, with Ashley and Lauderdale, formed the notorious Cabal, so-called because the first letters of their names formed that word. It was not a ministry in the modern sense, there being no common policy or joint responsibility. Charles hoped to attain his ends by the support of Louis XIV., who, engaged in promoting his queen's claims to the Spanish succession, was prepared to buy the alliance or the neutrality of England.

The Triple Alliance, formed in 1668 between England, Holland and Sweden, appeared for a time to threaten Louis's projects. It was extremely popular in England, but Charles excused his share in it to Louis, whom it estranged from the Dutch. In 1669 Charles declared to the French ambassador his desire to be reconciled to Rome, and through the duchess of Orleans negotiated with Louis the secret Treaty of Dover, signed on May 22, 1670. Charles was to declare himself a Catholic; in view of possible disturbances Louis was to pay him £150,000 and to provide

6,000 men; thereafter France and England were to join in a war against the Dutch. (*See* DOVER, TREATY OF.) Only Clifford and Arlington among the ministers signed this treaty; in Dec. 1670 the whole Cabal signed a feigned treaty, which omitted the conversion clauses. Charles was easily led to postpone them; what importance he attached to them cannot be determined. In 1671 Louis sent to England, to become Charles's mistress, Louise de Kéroualle, later duchess of Portsmouth.

The war against the Dutch began in 1672; at the same time Charles issued the Declaration of Indulgence, suspending the penal laws, and postponed all payments of assignations on the revenue; this was the "Stop of the Exchequer," affecting the London bankers. The war, although it established British commercial and naval supremacy, was unpopular. In 1673 parliament forced Charles to cancel the Declaration of Indulgence and to pass the Test Act, which drove Catholics, including Clifford and James, from office. In 1674 Charles was obliged to make peace with the Dutch.

Danby (Sir Thomas Osborne, later duke of Leeds) succeeded the Cabal. His policy, based on the alliance of Church and Crown, was calculated to detach from the opposition the loyalists driven to it by hatred of the Cabal; by patronage and corruption he increased their number and formed a strong "Court Party" in parliament. Ashley, now earl of Shaftesbury, led the opposition "Country Party" to which the bye-elections furnished recruits. It was generally predominant, but French subsidies enabled Charles to resist it. Danby was obliged to concur in this, but tried to direct foreign policy along more popular lines, and in Nov. 1677 brought about the marriage of James's daughter, Mary, with William of Orange (afterwards William III. and Mary II.). Charles turned against Louis who, not without bribery, persuaded the Country Party to refuse supplies for the army; he then made the Peace of Nijmwegen with the Dutch.

Hatred of the Cabal and distrust of Charles had prepared the way for Titus Oates, who, in Aug. 1678 denounced an intended rising of the Catholics. This, the "Popish Plot," was almost entirely fictitious, as Charles readily discovered, but received apparent confirmation from Coleman's letters and Godfrey's death. Shaftesbury promoted the ensuing general panic. Charles let the agitation take its course, intervening only when Oates accused the queen; between 1678 and 1680 some 35 victims were executed, although Charles knew most of them to be innocent of the charges brought against them. He now realized the importance of the unhesitating support of the Church. He dissolved parliament in Jan. 1679 to save Danby from impeachment; for Louis XIV. had revenged himself on Danby by divulging one of the letters written by Charles's order relating to the subsidy. The Press Act lapsed immediately, resulting in a flood of pamphlets and newspapers. James was sent abroad; an experimental reform of the Council failed; the new parliament had to be dissolved within a few months. The exclusion of James from the succession to the throne was now proposed; his place was to be taken by Monmouth, Charles's eldest illegitimate son. A new parliament met in Oct. 1680; the Exclusion bill passed the Commons but was defeated in the Lords by the genius of Halifax. The Commons refused to consider the alternative plan, which Charles was prepared to accept, of limiting the powers of a Catholic successor. In March 1681 a new parliament met at Oxford, where the London mob could not dominate it, but as the Exclusion bill was introduced immediately, it was dissolved after sitting for one week only. Henceforward Charles governed without parliaments.

It was at this time that the terms "Whig" and "Tory" emerged as party names. Charles attacked the leading Whigs but the London grand jury threw out the charge against Shaftesbury. A writ of *quo warranto* brought against the City of London compelled it to surrender its charter, whereupon a general attack was made on the municipal charters throughout the kingdom. The new charters gave the Tories control over the appointment of municipal officers and the return of the borough members. James returned from exile. Some of the defeated Whigs formed the Rye House Plot in 1683; its discovery led to the execution of Lord William Russell and Algernon Sidney. The Tory reaction had now reached its climax, but shortage of income compelled Charles, in spite of subsidies from Louis XIV., to abandon Tangier (1683) and to allow the navy to decay; meanwhile he could only watch the increase of French power, including the seizure of Strasbourg. He may have been considering a change of policy when he was taken seriously ill on Feb. 2, 1685. He made a profession of the Catholic faith, received the sacrament and died on Feb. 6.

In appearance Charles was tall and dark; besides numerous portraits there is a wax effigy, taken from the corpse, in Westminster Abbey. He was active, walked rapidly and was an excellent horseman; he loved all outdoor sports, but was happiest at sea. He was a keen patron of the turf and rode himself. He had an excellent constitution, was careful about his diet and rarely drank to excess. His manners were excellent; he was affable and easy, but too good-natured to be able to refuse requests. His wit was more suitable for a private gentleman than for a king, but was free from malice. His fits of anger were rare and brief. His memory was excellent. His gaiety, good nature and freedom from pretence made him generally popular. His notorious lasciviousness contained no "seraphic" element; he accepted the mistresses chosen for him. The sums he spent on them did not embarrass his finances, but made it difficult for him to ask parliament for money for other purposes. He had no legitimate children; the most important of his many illegitimate children were: By Lucy Walter, James Scott, duke of Monmouth and Buccleuch (1649–1685); by Lady Castlemaine (later duchess of Cleveland), Charles, Henry and George Fitzroy, dukes of Southampton, Grafton and Northumberland, and the countesses of Sussex and Lichfield; by the duchess of Portsmouth, Charles Lennox, duke of Richmond; by Nell Gwyn, Charles Beauclerk, duke of St. Albans; by Catherine Peg, Charles FitzCharles, earl of Plymouth; by Lady Shannon, the countess of Yarmouth; by Mary Davis, the countess of Derwentwater. Nell Gwyn, an actress, was the most popular of the mistresses and Charles appreciated her wit.

Charles once said that "he was no atheist, but he could not think God would make a man miserable only for taking a little pleasure out of the way." He inclined towards Roman Catholicism, partly on political grounds, but Halifax, perhaps reflecting Charles's own view, thought that creed most compatible with his lax morality. The date of his change of belief is uncertain, but in 1660 he was apparently determined to marry a Catholic. He was not reconciled to Rome until his death-bed, and attended Anglican services regularly during his life. He was a good judge of sermons and did not object to remonstrances so long as he was not expected to reform and they were in good taste. His desire for toleration was based on indifference and good nature and the memory of his promises, not on principle. Charles was interested in science, had his own laboratory, and gave the Royal Society its charter. He encouraged applied science, especially when it concerned navigation; his knowledge of naval architecture was praised by Pepys, but was considered by most contemporaries to be greater than his rank permitted. He patronized the theatre and enjoyed the lighter forms of literature.

The reign was politically sterile because Charles's achievements were undone and his foreign policy reversed by the Revolution of 1688; but the transfer of power from the Crown to the House of Commons went on steadily during the existence of the Long Parliament of the Restoration. It was a time of administrative progress, notably in the navy and in the Treasury system, and between 1660 and 1688 the administration of the old colonial empire reached its highest point of efficiency. Charles himself contributed by his interest in naval, commercial and colonial expansion, but sacrificed these objects too easily to his personal and dynastic policy. Attempts to vindicate the latter have failed; much of his conduct admits no justification. He was too lazy and fond of pleasure to apply himself steadily to business, but energetic on occasion and always intelligent. Halifax notes his powers of dissimulation. He was unwilling to face prolonged opposition, being determined "not to go on his travels again." He was selfish and callous but not vindictive. During the reign there was great material and intellectual progress and some improvement in manners. Writers who denounce the morals of the age rely too

much on Pepys and Grammont. The tendency has been to judge the country at large by Charles's characteristics, and to dwell on his vices without considering his gifts. Closer study is modifying many of the older verdicts.

BIBLIOGRAPHY.—Article by Sir A. W. Ward in *Dictionary of National Biography* (1887); P. Cunningham, *Story of Nell Gwyn*, etc., edit. Wheatley (1892); J. Cartwright (Mrs. Ady), *Madame*, containing letters from Charles II. to his sister (1894); H. C. Foxcroft, *Life of Sir George Savile, Marquis of Halifax*, containing Halifax's "Character of Charles II.," a most important study (1898); G. Burnet, *History of My Own Time*, edit. Airy (1900); O. Airy, *Charles II.*, the only satisfactory biography (1904); chapters by Sir Charles Firth in *Cambridge Modern History*, vol. iv., ch. xix.; vol. v., ch. v. (1906–08); R. Crawfurd, *Last Days of Charles II.* (1909); Dr. W. A. Shaw, *Calendars of Treasury Books* (1660–85), with introductions attempting to vindicate Charles II. (1904–16). There are several personal histories of varying merit. The general histories of Ranke and Sir Richard Lodge (*Political History of England*, vol. viii.) should also be consulted. (*See* also ENGLISH HISTORY.)

CHARLES I. and **II.**, kings of France. By the French, Charles the Great, Roman emperor and king of the Franks, is reckoned the first of the series of French kings named Charles (*see* CHARLES THE GREAT). Similarly the emperor Charles II. the Bald (*q.v.*) is reckoned as Charles II. of France. In some enumerations the emperor Charles III. the Fat (*q.v.*) is reckoned as Charles II. of France, Charlemagne not being included in the list, and Charles the Bald being styled Charles I.

CHARLES III., the Simple (879–929), king of France, was a posthumous son of Louis the Stammerer and of his second wife Adelaide. On the deposition of Charles the Fat in 887 he was excluded from the throne owing to his youth; but during the reign of Odo, who had succeeded Charles, he gained the recognition of a certain number of notables and secured his coronation at Reims on Jan. 28, 893. He now obtained the alliance of the emperor, and forced Odo to cede part of Neustria. In 898, by the death of his rival (Jan. 1), he obtained possession of the whole kingdom. His most important act was the treaty of Saint-Clair-sur-Epte with the Normans in 911. Some of them were baptized; the territory which was afterwards known as the duchy of Normandy was ceded to them; but the story of the marriage of their chief Rollo with the king's sister Gisda, related by the chronicler Dudo of Saint Quentin, is very doubtful. The same year Charles, on the invitation of the barons, took possession of the kingdom of Lotharingia. In 920 the barons, jealous of the growth of the royal authority and discontented with the favour shown by the king to his counsellor Hagano, rebelled, and in 922 elected Robert, brother of King Odo, in place of Charles. Robert was killed in the battle of Soissons, but the victory remained with his party, who elected Rudolph, duke of Burgundy, king. In his extremity Charles trusted himself to Herbert, count of Vermandois, who deceived him and imprisoned him at Château-Thierry and afterwards at Péronne, where he died on Oct. 7, 929. In 907 he had married Frederona, sister of Bovo, bishop of Chalons. After her death he married Eadgyfu (Odgiva), daughter of Edward the Elder, king of the English, who was the mother of Louis IV. (*See* NORMANDY.)

See A. Eckel, *Charles le Simple* (1899).

CHARLES IV. (1294–1328), king of France, called THE FAIR, was the third and youngest son of Philip IV. the Fair and Jeanne of Navarre. In 1316 he was created count of La Marche, and succeeded his brother Philip V. as king of France and Navarre early in 1322. He followed the policy of his predecessors in enforcing the royal authority over the nobles, but the machinery of a strong centralized government increased the royal expenditure, to meet which Charles had recourse to doubtful financial expedients. Civil offices were put up to auction; duties were imposed on exported merchandise and on goods brought into Paris; the salaries of the magistrates were made dependent on the exaction of heavy fines; on the pretext of a crusade to free Armenia from the Turks, Charles obtained from the pope a tithe levied on the clergy, the proceeds of which he kept for his own use; he also confiscated the property of the Lombard bankers who had been invited to France by his father at a time of financial crisis. The history of the assemblies summoned by Charles IV. is obscure, but in 1326, on the outbreak of war with England, an assembly of prelates and barons met at Meaux. Commissioners were afterwards despatched to the provinces to state the position of affairs and to receive complaints. The king justified his failure to summon the estates on the ground of the expense incurred by provincial deputies.

Charles IV. maintained excellent relations with Pope John XXII., who made overtures to him, indirectly, offering his support in case of his candidature for the imperial crown. He tried to form a party in Italy in support of the pope against the emperor Louis IV. of Bavaria, but failed. A treaty with the English which secured the district of Agenais for France was followed by a feudal war in Guienne. Isabella, Charles's sister and the wife of Edward II., was sent to France to negotiate, and with her brother's help arranged the final conspiracy against her husband. Charles's first wife was Blanche, daughter of Otto IV., count of Burgundy. In May 1314, by order of King Philip IV., she was arrested and imprisoned in the Château-Gaillard with her sister-in-law Marguerite, daughter of Robert II., duke of Burgundy, and wife of Louis Hutin, on a charge of adultery. Tradition has involved and obscured the story, which is the origin of the legend of the Tour de Nesle made famous by the drama of A. Dumas the elder. Blanche died in 1326. In 1322, freed from his first marriage, by papal decree on the ground of kinship, Charles married his cousin Mary of Luxemburg, daughter of the emperor Henry VII., and upon her death, two years later, Jeanne, daughter of Louis, count of Evreux. Charles IV. died at Vincennes on Feb. 1, 1328. He left no issue by his first two wives to succeed him, and daughters only by Jeanne of Evreux. He was the last of the direct line of Capetians.

See L. G. Oudart Feudrix de Brequigny, "Mémoire sur les différends entre la France et l'Angleterre sous le règne de Charles le Bel," in *Collection des meilleures dissertations relatifs à l'histoire de France*, ed. J. M. C. Leber, vol. xiii. (1826–38); H. Lot, "Projets de croisade sous Charles le Bel et sous Philippe de Valois," in *Bibl. de l'École de Chartes*, Series IV., vol. v. pp. 503–509 (1859); "Chronique parisienne anonyme de 1316 à 1339," ed. A. Hellot, in *Mém de la soc. de l'hist. de Paris*, vol. xi. pp. 1–207, (1884); A. d'Herbomez, "Notes et documents pour servir à l'histoire des rois fils de Philippe le Bel," in *Bibl. de l'École de Chartes*, vol. lix., 479, 689 (1898).

CHARLES V. (1337–1380), king of France, called THE WISE, was born at the château of Vincennes, on Jan. 21, 1337, the son of John II. and Bonne of Luxembourg. In 1349 he became dauphin of the Viennois by purchase from Humbert II. and in 1355 he was created duke of Normandy. After the battle of Poitiers (1356) where his father was taken prisoner by the English, he arranged for the government of Normandy, and proceeded to Paris, where he took the title of lieutenant of the kingdom. During the years of John II.'s imprisonment in England, Charles was virtually king of France. He summoned the States-General of northern France (Langue d'oïl) to Paris in Oct. 1356 to obtain men and money to carry on the war. But under the leadership of Étienne Marcel, provost of the Parisian merchants and president of the third estate, and Robert le Coq, bishop of Laon, president of the clergy, a partisan of Charles of Navarre, the states refused any "aid" except on conditions which Charles declined to accept. They demanded the dismissal of a number of the royal ministers; the establishment of a commission elected from the three estates to regulate the dauphin's administration, and of another board to act as council of war; also the release of Charles the Bad, king of Navarre, who had been imprisoned by King John. The estates of Languedoc, summoned to Toulouse, also made protests against misgovernment, but they agreed to raise a war-levy on terms to which the dauphin acceded. Charles sought the alliance of his uncle, the emperor Charles IV., to whom he did homage at Metz as dauphin of the Viennois, and he was also made imperial vicar of Dauphiné, thus acknowledging the imperial jurisdiction. But he gained small material advantage from these proceedings. The States-General were again convoked in Feb. 1357. Their demands were more moderate than in the preceding year, but they nominated members to replace certain obnoxious persons on the royal council, demanded the right to assemble without the royal summons, and certain administrative reforms. In return they promised to raise and finance an army of 30,000 men, but the money—a tithe levied on the annual reve-

nues of the clergy and nobility—voted for this object was not to pass through the dauphin's hands. Charles appeared to consent, but the agreement was annulled by letters from King John, who announced at the same time the conclusion of a two years' truce, and the reformers failed to secure their ends. Charles had escaped from their power by leaving Paris, but he returned for a new meeting of the estates in the autumn of 1357.

Meanwhile, Charles of Navarre had been released by his partisans, and allying himself with Marcel had become a popular hero in Paris. The dauphin was obliged to receive him and to undergo an apparent reconciliation. In Paris Étienne Marcel was supreme. He forced his way into the dauphin's palace (Feb. 1358), and Charles's servant, Jean de Conflans, marshal of Champagne, and Robert de Clermont, marshal of Normandy, were murdered before his eyes. Charles was powerless openly to resent these outrages, but he obtained from the provincial assemblies the money refused him by the States-General, and deferred his vengeance until the dissensions of his enemies should offer him an opportunity. Charles of Navarre, now in league with the English and master of lower Normandy and of the approaches to Paris, returned to the immediate neighbourhood of the city, and Marcel found himself driven to avowed co-operation with the dauphin's enemies, the English, and the Navarrese. Charles had been compelled in March to take the title of regent to prevent the possibility of further intervention from King John. In defiance of a recent ordinance prohibiting provincial assemblies, he presided over the estates of Picardy and Artois, and then over those of Champagne. The States-General of 1358 were summoned to Compiègne instead of Paris, and granted a large aid.

The condition of northern France was rendered more desperate by the outbreak (May–June 1358) of the peasant revolt known as the Jacquerie, which was repressed with a ferocity far exceeding the excesses of the rebels. Within the walls of Paris, Jean Maillart had formed a royalist party; Marcel was assassinated (July 31, 1358), and the dauphin entered Paris in the following month. A reaction in Charles's favour had set in, and from the estates of 1359 he regained the authority he had lost. They supported him in repudiating the Treaty of London (1359), which King John had signed in anxiety for his personal freedom, and voted money unconditionally for the continuation of the war. From this time the estates were only once convoked by Charles, who contented himself thenceforward by appeals to the assembly of notables or to the provincial bodies. Charles of Navarre was now at open war with the regent; Edward III. landed at Calais in October; and a great part of the country was exposed to double depredations from the English and the Navarrese troops. In the scarcity of money Charles had recourse to the debasement of the coinage, which suffered no less than 22 variations in the two years before the Treaty of Brétigny. This disastrous financial expedient was made good later, the coinage being established on a firm basis during the last 16 years of Charles's reign in accordance with the principles of Nicolas Oresme. On the conclusion of peace, King John was restored to France, but being unable to raise his ransom, he returned in 1364 to England, where he died in April, leaving the Crown to Charles, who was crowned at Reims on May 19.

The new king found an able servant in Bertrand du Guesclin, who won a victory over the Navarrese troops at Cocherel and took prisoner their best general, Jean de Grailly, captal de Buch. The establishment of Charles's brother, Philip the Bold, in the duchy of Burgundy, though it constituted in the event a serious menace to the monarchy, put an end to the king of Navarre's ambitions in that direction. A treaty of peace between the two kings was signed in 1365, by which Charles of Navarre gave up Mantes, Meulan and the county of Longueville in exchange for Montpellier. Negotiations were renewed in 1370 when Charles of Navarre did homage for his French possessions, though he was then considering an offensive and defensive alliance with Edward III. Du Guesclin undertook to free France from the depredations of the "free companies," mercenary soldiers put out of employment by the cessation of the war. An attempt to send them on a crusade against the Turks failed and Du Guesclin led them to Spain to put Henry of Trastamara on the throne of Castile. By the marriage of his brother, Philip the Bold with Margaret of Flanders, Charles detached the Flemings from the English alliance, and as soon as he had restored something like order in the internal affairs of the kingdom, he provoked a quarrel with the English.

The text of the Treaty of Brétigny presented technical difficulties of which Charles availed himself. The English power in Guienne was weakened by the disastrous Spanish expedition of the Black Prince, whom Charles summoned before the *parlement* of Paris in Jan. 1369 to answer the charges preferred against him by his subjects, thus expressly repudiating the English supremacy in Guienne. War was renewed in May after a meeting of the States-General. Between 1371 and 1373 Poitou and Saintonge were reconquered by Du Guesclin, and soon the English had to abandon all their territory north of the Garonne. John IV. of Brittany (Jean de Montfort) had won his duchy with English help by the defeat of Charles of Blois, the French nominee at Auray in 1364. His sympathies remained English, but he was now (1373) obliged to take refuge in England, and later in Flanders, while the English only retained a footing in two or three coast towns. Charles's generals knew that their general levies were no match for the English men-at-arms in a pitched battle; they contented themselves with defensive and guerrilla tactics. The towns were defended, and the English left to do as they would in the countryside. There they could not maintain themselves; they gradually retreated until in 1380 only Bayonne, Bordeaux, Brest and Calais were still in English hands.

Charles had in 1378 obtained proof of Charles of Navarre's treasonable designs. He seized the Norman towns held by the Navarrese, while Henry of Trastamara invaded Navarre, and imposed conditions of peace which rendered his lifelong enemy at last powerless. A premature attempt to amalgamate the duchy of Brittany with the French Crown failed. Charles summoned the duke to Paris in 1378, and on his non-appearance committed one of his rare errors of policy by confiscating his duchy. But the Bretons rose to defend their independence, and recalled their duke. The matter was still unsettled when Charles died at Vincennes on Sept. 16th, 1380. His health, always delicate, had been further weakened, according to popular report, by a slow poison prepared for him by the king of Navarre. His wife, Jeanne of Bourbon, died in 1378, and the succession devolved on their elder son Charles, a boy of twelve. Their younger son was Louis, duke of Orleans.

Personally Charles was no soldier. He owed the signal successes of his reign partly to his skilful choice of advisers and administrators, to his chancellors Jean and Guillaume de Dormans and Pierre d'Orgemont, to Hugues Aubriot, provost of Paris, Bureau de la Rivière and others; partly to a singular coolness and subtlety in the exercise of a not over-scrupulous diplomacy, which made him a dangerous enemy. He had learnt prudence and self-restraint in the troubled times of the regency, and did not lose his moderation in success. He modelled his private life on that of his predecessor, St. Louis, but was no fanatic in religion, for he refused his support to the violent methods of the Inquisition in southern France, and allowed the Jews to return to the country, at the same time confirming their privileges. His support of the schismatic pope Clement VII. at Avignon was doubtless due to political considerations, as favouring the independence of the Gallican Church.

Charles V. was a student of astrology, medicine, law and philosophy and collected a large and valuable library at the Louvre, which became the nucleus of the great *Bibliothèque Royale*. He gathered round him a group of distinguished writers and thinkers, among whom were Raoul de Presles, Philippe de Mézières, Nicolas Oresme and others. The ideas of these men were applied by him to the practical work of administration, though he confined himself chiefly to the consolidation and improvement of existing institutions. The power of the nobility was lessened by restrictions which, without prohibiting private wars, made them practically impossible. The feudal fortresses were regularly inspected by the central authority, many of them were demolished on the pretext that they might serve as vantage points for the English invaders,

and the nobles themselves became in many cases paid officers of the king. The feudal nobility was further weakened by the accession to the *noblesse* of many townsmen. Further, Charles reserved to the Crown the right of giving charters, of coining money; in fact he deprived the great nobles of many sovereign rights hitherto exercised by them. Charles made the *parlement* of Paris a permanent instead of a temporary body, and established it in the former palace of St. Louis, which became the Palais de Justice. He strengthened the Crown itself by substituting a fixed revenue to princes and princesses of the royal house for the apanages which had led to civil strife in former reigns. He tried to free industry by declaring that every competent workman was free to practise his trade outside the guild if he wished, but custom was too strong, and the guilds retained their monopoly for centuries later. He established indirect taxes on objects of consumption so as to bring all classes under contribution; and he secured the payment of the *gabelle* or salt-tax on a firm basis. Under Charles V. the system of royal commissioners for the collection of the revenue took shape, and the *Cour des aides* was definitely established as a court of appeal in taxation cases. He established a merchant marine and a formidable navy, which under Jean de Vienne threatened the English coast between 1377 and 1380. The States-General were silenced and the royal prerogative increased; the royal domains were extended, and the wealth of the Crown was augmented; additions were made to the revenue by the sale of municipal charters and patents; and taxation became heavier, since Charles set no limits to the gratification of his tastes, either in the collection of jewels and precious objects, of books, or of his love of building, examples of which are the renovation of the Louvre and the erection of the palace of Saint Paul in Paris.

See Froissart, *Chronicles;* Lord Berners' trans., edit. W. P. Ker (1901); *Les Grandes Chroniques de France,* 4 vols., edit. R. Delachanel (1910–20); Christine de Pisan, *Le Livre des fais et bonnes moeurs du sage roy Charles V.,* written 1404, edit. J. F. Michaud and J. J. F. Poujoulat, vol. ii. (1836); L. Delisle, *Mandements et actes divers de Charles V.* (1886); letters of Charles V. in J. J. Champollion-Figeac, *Lettres de rois et de reines,* vol. ii., pp. 167, *seq.* (1839); the anonymous *Songe du vergier* or *Somnium viridarii,* written in 1376, and giving the political ideas of Charles V. and his advisers; J. B. Hauréau, *Notes et extraits,* chap. xxxi. (1890); C. Benoist, *La Politique du roi Charles V.* (1874); R. Delachanel, *Histoire de Charles V.* (1908).

CHARLES VI. (1368–1422), king of France, son of Charles V. and Jeanne of Bourbon, was born in Paris on Dec. 3, 1368. He received the apanage of Dauphiné at his birth, and was thus the first of the princes of France to bear the title of dauphin from infancy. Charles V. entrusted his education to Philippe de Mézières, and fixed his majority at 14. He succeeded to the throne in 1380 at the age of 12, and the royal authority was divided between his paternal uncles, Louis, duke of Anjou, John, duke of Berry, Philip the Bold, duke of Burgundy, and his mother's brother, Louis II., duke of Bourbon. Considerable discontent existed in the south of France at the time of the death of Charles V., and when the duke of Anjou re-imposed certain taxes which the late king had remitted at the end of his reign there were revolts at Puy and Montpellier. Paris, Rouen, the cities of Flanders, with Amiens, Orleans, Reims and other French towns, also rose (1382) in revolt against their masters. (For the regency of Louis of Anjou, *see* FRANCE: *History.*) Charles VI. marched to the help of the count of Flanders against the insurgents headed by Philip van Artevelde, and gained a complete victory at Roosebeke (Nov. 27, 1382). Strengthened by this success the king, on his return to Paris in the following January, exacted vengeance on the citizens by fines, executions and the suppression of the privileges of the city. The help sent by the English to the Flemish cities resulted in a second Flemish campaign. In 1385 Jean de Vienne made an unsuccessful descent on the Scottish coast, and Charles equipped a fleet at Sluys for the invasion of England, but a series of delays ended in the destruction of the ships by the English.

In 1385 Charles VI. married Elizabeth, daughter of Stephen II., duke of Bavaria, her name being gallicized as Isabeau. Three years later, with the help of his brother, Louis of Orleans, duke of Touraine, he threw off the tutelage of his uncles, whom he replaced by Bureau de la Rivière and others among his father's counsellors, nicknamed by the royal princes the *marmousets* because of their humble origin. Two years later he deprived the duke of Berry of the government of Languedoc. The opening years of Charles VI.'s effective rule promised well, but excess in gaiety of all kinds undermined his constitution, and in 1392 he had an attack of madness at Le Mans, when on his way to Brittany to force from John V. the surrender of his cousin Pierre de Craon, who had tried to assassinate the constable Olivier de Clisson in the streets of Paris. Other attacks followed, and it became evident that Charles was unable permanently to sustain the royal authority. Clisson, Bureau de la Rivière, Jean de Mercier, and the other *marmousets* were driven from office, and the royal dukes regained their power. The rivalries between the most powerful of these (the duke of Burgundy, who during the king's attacks of madness practically ruled the country, and the duke of Orleans) were a constant menace to order.

In 1396 peace with England seemed assured by the marriage of Richard II. with Charles VI.'s daughter Isabella, but the Lancastrian revolution of 1399 destroyed the diplomatic advantages gained by this union. In France the country was disturbed by the papal schism. At an assembly of the clergy held in Paris in 1398 it was resolved to refuse to recognize the authority of Benedict XIII., who succeeded Clement VII. as schismatic pope at Avignon. The question became a party one; Benedict was supported by Louis of Orleans, while Philip the Bold and the university of Paris opposed him. Obedience to Benedict's authority was resumed in 1403, only to be withdrawn again in 1408, when the king declared himself the guardian and protector of the French church, which was indeed for a time self-governing. Edicts further extending the royal power in ecclesiastical affairs were even issued in 1418, after the schism was at an end.

The king's intelligence became yearly feebler, and in 1404 on the death of Philip the Bold the influence of the duke of Orleans increased. Queen Isabeau, who had generally supported the Burgundian party, was now practically separated from her husband, and was replaced by a young Burgundian lady, Odette de Champdivers. Isabeau of Bavaria was freely accused of intrigue with the duke of Orleans. The relations between John the Fearless and the duke of Orleans became more embittered, and on Nov. 23, 1407, Orleans was murdered in the streets of Paris at the instigation of his rival. The young duke Charles of Orleans formed alliances with the dukes of Berry, Bourbon and Brittany, and others who formed the party known as the Armagnacs (*see* ARMAGNAC), against the Burgundians who had gained the upper hand in the royal council. In 1411 John the Fearless contracted an alliance with Henry IV. of England, and civil war began in the autumn, but in 1412 the Armagnacs in their turn sought English aid, and, by promising the sovereignty of Aquitaine to the English king, gave John the opportunity of posing as defender of France. In Paris the Burgundians were hand in hand with the corporation of the butchers, who were the leaders of the Parisian populace. The malcontents, who took their name from one of their number, Caboche, penetrated into the palace of the dauphin Louis, and demanded the surrender of the unpopular members of his household. A royal ordinance, promising reforms in administration, was promulgated on May 27, 1413, and some of the royal advisers were executed. The king and the dauphin, powerless in the hands of Duke John and the Parisians, appealed secretly to the Armagnac princes for deliverance. They entered Paris in September; the ordinance extracted by the Cabochiens was rescinded, and many of the insurgents were banished from the city.

In the next year Henry V. of England, after concluding an alliance with Burgundy, resumed the pretensions of Edward III. to the crown of France, and in 1415 followed the disastrous battle of Agincourt. The two elder sons of Charles VI., Louis, duke of Guienne, and John, duke of Touraine, died in 1415 and 1417, and Charles, count of Ponthieu, became heir apparent. Paris was governed by Bernard of Armagnac, constable of France, who expelled all suspected of Burgundian sympathies and treated Paris like a conquered city. Queen Isabeau was imprisoned at Tours, but escaped to Burgundy. The capture of Paris by the Burgundians on May 29, 1418, was followed by a series of horrible

massacres of the Armagnacs; and in July Duke John and Isabeau, who assumed the title of regent, entered Paris. Meanwhile Henry V. had completed the conquest of Normandy. The murder of John the Fearless in 1419 under the eyes of the dauphin Charles threw the Burgundians definitely into the arms of the English, and his successor Philip the Good, in concert with Queen Isabeau, concluded (1420) the treaty of Troyes with Henry V., who became master of France. Charles VI. had long been of no account in the government, and the state of neglect in which he existed at Senlis induced Henry V. to undertake the re-organization of his household. He came to Paris in Sept. 1422, and died on Oct. 21.

BIBLIOGRAPHY.—The chief authorities for the reign of Charles VI. are: *Chronica Caroli VI.*, written by a monk of Saint Denis, commissioned officially to write the history of his time, ed. by C. Bellaguet with a French trans. (6 vols. 1839–52); Jean Juvénal des Ursins, *Chronique*, printed by D. Godefroy in *Histoire de Charles VI.* (1653), chiefly an abridgment of the monk of St. Denis's narrative; a fragment of the *Grandes Chroniques de Saint Denis* covering the years 1381–83 (ed. J. Pichon, 1864); corres. of Charles VI. printed by Champollion-Figeac in *Lettres de rois*, vol. ii.; *Choix de pièces inèdites rel. au règne de Charles VI.* (2 vols. 1863–64), ed. by L. Douët d'Ar q for the Société de l'Histoire de France; J. Froissart, *Chroniques;* Enguerrand de Monstrelet, *Chroniques*, covering the first half of the 15th century (Eng. trans. 4 vols. 1809); *Chronique des quatre premiers Valois*, by an unknown author, ed. S. Luce (1862). *See* also E. Lavisse, *Hist. de France*, iv. 267 *seq.;* E. Petit, "Séjours de Charles VI." *Bull. du com. des travaux hist.* (1893); Vallet de Viriville, "Isabeau de Bavière," *Revue Française* (1858–59); M. Thibaut, *Isabeau de Bavière* (1903); F. Funck-Brentano, *Le Moyen Age* (Eng. Trans. *The Middle Ages*), ch. xix. and bibl. there given (1922).

CHARLES VII. (1403–1461), king of France, fifth son of Charles VI. and Isabeau of Bavaria, was born in Paris on Feb. 22, 1403. The count of Ponthieu, as he was called in his boyhood, was betrothed in 1413 to Mary of Anjou, daughter of Louis II., duke of Anjou and king of Sicily, and spent the next two years at the Angevin court. He received the duchy of Touraine in 1416, and in the next year the death of his brother John made him dauphin of France. He became lieutenant-general of the kingdom in 1417. He became regent in Dec. 1418, but his authority in northern France was paralysed in 1419 by the murder of John the Fearless, duke of Burgundy, in his presence at Montereau. Although the deed was not apparently premeditated, as the English and Burgundians declared, it ruined Charles's cause for the time. He was disinherited by the treaty of Troyes in 1420, and at the time of his father's death in 1422 had retired to Mehun-sur-Yèvre, near Bourges, which had been the nominal seat of government since 1418. He was recognized as king in Touraine, Berry and Poitou, in Languedoc and other provinces of southern France; but the English power in the north was presently increased by the provinces of Champagne and Maine, as the result of the victories of Crevant (1423) and Verneuil (1424). The Armagnac administrators who had been driven out of Paris by the duke of Bedford gathered round the young king, nicknamed the "king of Bourges," but he was weak in body and mind, and was under the domination of Jean Louvet and Tanguy du Chastel, the instigators of the murder of John the Fearless, and other discredited partisans. The power of these favourites was shaken by the influence of the queen's mother, Yolande of Aragon, duchess of Anjou. She sought the alliance of John V., duke of Brittany, who, however, vacillated throughout his life between the English and French alliance, concerned chiefly to maintain the independence of his duchy. His brother, Arthur of Brittany, earl of Richmond (comte de Richemont), was reconciled with the king, and became constable in 1425, with the avowed intention of making peace between Charles VII. and the duke of Burgundy. Richemont caused the assassination of Charles's favourites Pierre de Giac and Le Camus de Beaulieu, and imposed one of his own choosing, Georges de la Trémoille, an adventurer who rapidly usurped the constable's power. For five years (1427–32) a private war between these two exhausted the Armagnac forces, and central France returned to anarchy.

Meanwhile Bedford had established settled government throughout the north of France, and in 1428 he advanced to the siege of Orleans. For the movement which was to lead to the deliverance of France from the English invaders, *see* JOAN OF ARC. The siege of Orleans was raised by her efforts on May 8, 1429, and two months later Charles VII. was crowned at Reims. But the court put every difficulty in the way of her military career, and received the news of her capture before Compiègne (1430) with indifference. No measures were taken for her deliverance or her ransom, and Normandy and the Isle of France remained in English hands. Fifteen years of anarchy and civil war intervened before peace was restored. The duke of Bedford died in 1435, and in the same year Philip the Good of Burgundy concluded a treaty with Charles VII. at Arras, after fruitless negotiations for an English treaty. From this time Charles's policy was strengthened. La Trémoille had been assassinated in 1433 by the constable's orders, with the connivance of Yolande of Aragon. For his former favourites were substituted energetic advisers, his brother-in-law Charles of Anjou, Dunois (the famous bastard of Orleans), Pierre de Brézé, Richemont and others. Richemont entered Paris on April 13, 1436, and in the next five years the finance of the country was re-established on a settled basis. Charles himself commanded the troops who captured Pontoise in 1441, and in 1442 he made a successful expedition in the south.

Meanwhile the princes of the blood and the great nobles made a formidable league against the crown in 1440 which included Charles I., duke of Bourbon, John II., duke of Alençon, John IV. of Armagnac, and the dauphin, afterwards Louis XI. The revolt broke out in Poitou in 1440 and was known as the Praguerie. Charles VII. repressed the rising, and finally bought over the rebel nobles individually by considerable concessions. In 1444 a truce was concluded with England at Tours, and Charles proceeded to organize a regular army. The central authority was gradually made effective. Domestic troubles in their own country weakened the English in France. The conquest of Normandy was completed by the battle of Formigny (April 15, 1450). Guienne was conquered in 1451 by Dunois, but not subdued, and another expedition was necessary in 1453, when Talbot was defeated and slain at Castillon. Meanwhile in 1450 Charles VII. had resolved on the rehabilitation of Joan of Arc. This was granted in 1456 by the Holy See. The only foothold retained by the English on French ground was Calais. The change which made Charles take an active part in public affairs is said to have been largely due to the influence of Agnes Sorel, who became his mistress in 1444 and died in 1450. She was the first to play a public and political rôle as mistress of a king of France. Pierre de Brézé, who had had a large share in the repression of the Praguerie, obtained through her a dominating influence over the king. Charles and René of Anjou retired from court, and the greater part of the members of the king's council were drawn from the bourgeois classes. The most famous of all these was Jacques Coeur (*q.v.*). It was by the zeal of these councillors that Charles obtained the surname of "The Well-Served."

Charles VII. continued his father's general policy in church matters. He desired to preserve as far as possible the liberties of the Gallican church. With the council of Constance (1414–18) the great schism was practically healed. Charles, while careful to protest against its renewal, supported the anti-papal contentions of the French members of the council of Basle (1431–49), and in 1438 he promulgated the Pragmatic Sanction at Bourges, by which the patronage of ecclesiastical benefices was removed from the Holy See, while certain interventions of the royal power were admitted. Bishops and abbots were to be elected, in accordance with ancient custom, by their clergy. After the English had evacuated French territory Charles still had to cope with feudal revolt, and with the hostility of the dauphin, who was in open revolt in 1446, and for the next ten years ruled like an independent sovereign in Dauphiné. He took refuge in 1457 with Charles's most formidable enemy, Philip of Burgundy. Charles VII. nevertheless found means to prevent Philip from attaining his ambitions in Lorraine and in Germany. But the dauphin succeeded in embarrassing his father's policy at home and abroad, and had his own party in the court itself. Charles VII. died at Mehun-sur-Yèvre on July 22, 1461. He believed that he was poisoned by his son, who cannot, however, be accused of anything more than an eager expectation of his death.

BIBLIOGRAPHY.—The history of the reign of Charles VII. has been written by two modern historians—Vallet de Viriville, *Histoire de Charles VII. . . . et de son époque* (3 vols., 1862–65), and G. du Fresne de Beaucourt, *Hist. de Charles VII.* (6 vols., 1881–91), which gives a detailed bibliography. There is abundant contemporary material. The herald, Jacques le Bouvier or Berry (b. 1386), whose *Chronicques du feu roi Charles VII.* was first printed in 1528 as the work of Alain Chartier, was an eye-witness of many of the events he described. The *Histoire de Charles VII.* by Jean Chartier, historiographer-royal from 1437 was re-edited by Vallet de Viriville (3 vols., 1858–59).

CHARLES VIII. (1470–1498), king of France, was the only son of Louis XI. On the death of Louis XI. in 1483 Charles, a lad of 13, was absolutely incapable of governing. Until 1492 he abandoned the Government to his sister Anne of Beaujeu. In 1491 he married Anne, duchess of Brittany. Urged by his favourite, Étienne de Vesc, he threw off the yoke of the Beaujeus, and at the same time discarded their wise and able policy. He proposed at first to claim the rights of the house of Anjou, to which Louis XI. had succeeded, on the kingdom of Naples, and to use this as a stepping-stone to the capture of Constantinople from the Turks and his own coronation as emperor of the East. He sacrificed everything to this adventurous policy, signed disastrous treaties to keep his hands free, and set out for Italy in 1494. On May 12, 1495, he entered Naples in great pomp, clothed in the imperial insignia. A general coalition was, however, formed against him, and he was forced to return to France. He was preparing a fresh expedition when he died on April 8, 1498.

See *Histoire de Charles VIII., roy de France,* by G. de Jaligny, André de la Vigne, etc., edit. Godefroy (1684); C. De Cherrier, *Histoire de Charles VIII.* (1868); H. Fr. Delaborde, *Expédition de Charles VIII. en Italie* (1888); *Anne de Beaujeu, roi de France* (1926). For a complete bibliography *see* H. Hauser, *Les Sources de l'histoire de France, 1494–1610,* vol. i. (1906); and E. Lavisse, *Histoire de France,* vol. v., part 1., by H. Lemonnier (1903).

CHARLES IX. (1550–1574), king of France, was the second son of Henry II. and Catherine de Medici. He became king in 1560 by the death of his brother Francis II., but as he was only ten years old the power was in the hands of the queen-mother, Catherine. Charles seems to have been a youth of good parts, but he was left to his whims and to his taste for violent exercises; and the excesses to which he gave himself up ruined his health. Proclaimed of age on Aug. 17, 1563, he submitted docilely to the authority of his mother. In 1570 he was married to Elizabeth of Austria, daughter of Maximilian II. It was about this time that he dreamed of making a figure in the world. The successes of his brother, the duke of Anjou, at Jarnac and Moncontour had already caused him some jealousy. When Coligny came to court, he received him very warmly, and seemed at first to accept the idea of an intervention in the Netherlands against the Spaniards. For the upshot of this adventure *see* the article ST. BARTHOLOMEW, MASSACRE OF. Charles was in these circumstances no hypocrite, but weak, hesitating and ill-balanced. The terrible events in which he had played a part transformed his character. He became melancholy, severe and taciturn. Undermined by fever, at the age of 20, he was a haunted man. He died on May 30, 1574. By his mistress, Marie Touchet, he had one son, Charles, duke of Angoulême. Charles IX. had a sincere love of letters, himself practised poetry, was the patron of Ronsard and the poets of the Pleiad, and granted privileges to the first academy founded by Antoine de Baïf (afterwards the Académie du Palais). He left a work on hunting, *Traité de la chasse royale,* which was published in 1625, and reprinted in 1859.

BIBLIOGRAPHY.—The principal sources are contemporary memoirs and chronicles, and the published correspondence of Catherine de Medici, Marguerite de Valois and the Venetian ambassadors. *See* also S. Desjardins, *Charles IX., Deux années de règne, 1570–1572* (1873); le comte de la Ferrière, *Le XVIe siècle et les Valois* (1879); J. H. Mariéjol, "La Réforme et la Ligue," in vol. v. of the *Histoire de France* (ed. E. Lavisse, 1904), which contains a bibliography for the reign; L. Batiffol, *Le Siècle de la Renaissance* (1909, Eng. trans. 1916); L. Romier, *Catholiques et Huguenots à la cour de Charles IX.* (1924). *See* also CATHERINE DE MEDICIS, COLIGNY, etc.

CHARLES X. (1757–1836), king of France from 1824 to 1830, was the fourth child of the dauphin Louis, son of Louis XV. and of Marie Josephe of Saxony. He was known before his accession as Charles Philippe, count of Artois. At the age of 16 he married Marie Thérèse of Savoy, sister-in-law of his brother, the count of Provence (Louis XVIII.). His youth was passed in scandalous dissipation, which drew upon himself and his coterie the detestation of the people of Paris. Prior to the revolution he took only a minor part in politics, but when it broke out he soon became, with the queen, the chief of the reactionary party at court. In July 1789 he left France and became leader of the émigrés. In 1795 he attempted to aid the royalist rising of La Vendée, landing at the island of Yeu. But he refused to advance farther and returned to England, settling first in London, then in Holyrood palace at Edinburgh and afterwards at Hartwell. There he remained until 1813, returning to France in Feb. 1814, and entering Paris in April, in the track of the Allies.

During the reign of his brother, Louis XVIII., he was the leader of the ultra-royalists, the party of extreme reaction. On succeeding to the throne in Sept. 1824 he won a passing popularity. But his coronation at Reims, with all the gorgeous ceremonial of the old régime, proclaimed his intention of ruling as the Most Christian King, by divine right. It was soon apparent that the weight of the crown would be consistently thrown into the scale of the reactionary forces. The *émigrés* were awarded a milliard as compensation for their confiscated lands; and Gallicans and Liberals alike were offended by measures which threw increased power into the hands of the Jesuits and Ultramontanes. In a few months there were disquieting signs of the growing unpopularity of the king. The royal princesses were insulted in the streets; and on April 29, 1825 Charles, when reviewing the National Guard, was met with cries from the ranks of "Down with the ministers!" His reply was, next day, a decree disbanding the citizen army.

In 1829 Charles consented unwillingly to try a policy of compromise. Villèle's successor was the vicomte de Martignac, who took Decazes for his model; and in the speech from the throne Charles declared that the happiness of France depended on "the sincere union of the royal authority with the liberties consecrated by the charter." But Charles had none of the patience and common sense which had enabled Louis XVIII. to play with decency the part of a constitutional king. "I would rather hew wood," he exclaimed, "than be a king under the conditions of the king of England;" and when the Liberal opposition obstructed all the measures proposed by a ministry not selected from the parliamentary majority, he lost patience. "I told you," he said, "that there was no coming to terms with these men." Martignac was dismissed; and Prince Jules de Polignac, the very incarnation of clericalism and reaction, was called to the helm of state.

A formidable agitation sprang up, which only served to make the king more obstinate. In opening the session of 1830 he declared that he would "find the power" to overcome the obstacles placed in his path by "culpable manoeuvres." The reply of the chambers was a protest against "the unjust distrust of the sentiment and reason of France"; whereupon they were first prorogued, and on May 16 dissolved. The result of the new elections was a large increase in the opposition; and Charles, on the advice of his ministers, determined on a virtual suspension of the constitution. On July 25 were issued the famous "four ordinances" which were the immediate cause of the revolution.

With singular fatuity Charles had taken no precautions in view of a violent outbreak. Marshal Marmont, who commanded the scattered troops in Paris, had received no orders, beyond a jesting command from the duke of Angoulême to place them under arms "as some windows might be broken." At the beginning of the revolution Charles was at St. Cloud, whence on the news of the fighting he withdrew first to Versailles and then to Rambouillet. On learning of the success of the revolutionaries he abdicated in favour of his grandson, the duke of Bordeaux (comte de Chambord), and appointed Louis Philippe, duke of Orleans, lieutenant-general of the kingdom (July 30). But, on the news of Louis Philippe's acceptance of the crown, he gave up the contest and began a dignified retreat to the sea-coast. Beyond sending a corps of observation to follow his movements, the new government did nothing to arrest his escape. He took ship at Cherbourg for England on Aug. 16. For a time he returned to Holyrood palace

at Edinburgh, which was again placed at his disposal. He died at Göritz, whither he had gone for his health, on Nov. 6, 1836.

The best that can be said of Charles X. is that, if he did not know how to rule, he knew how to cease to rule.

See Alphonse de Lamartine, *Hist. de la restauration* (1851–52); Louis Blanc, *Hist. de dix ans, 1830–1840* (1842–44); G.I. de Montbel, *Dernière Époque de l'hist. de Charles X.*, 5th ed. (1840); Théodore Anne, *Mémoires, souvenirs, et anecdotes sur l'intérieur du palais de Charles X. et les évènements de 1815 à 1830* (1831); *Journal de Saint-Cloud à Cherbourg;* P. Védrenne, *Vie de Charles X.* (1879); Petit, *Charles X.* (1886); P. L. F. Villeneuve, *Charles X. et Louis XIX. en exil Mémoires inédits* (1889); Imbert de Saint-Amand, *La Cour de Charles X.* (1892).

CHARLES I. (1288–1342), king of Hungary, the son of Charles Martell of Naples, and Clemencia, daughter of the emperor Rudolph, was known as Charles Robert before his enthronement as king of Hungary in 1309. He claimed the Hungarian Crown, as the grandson of Stephen V., under the banner of the pope, and was crowned at Esztergom after the death of the last Arpad, Andrew III. (1301), but was forced the same year to surrender the Crown to Wenceslaus II. of Bohemia (1289–1306), who in 1305 transferred his rights to Duke Otto of Bavaria. Duke Otto was taken prisoner by the Hungarians and Charles was enthroned at Budapest on June 15, 1309, though his installation was not regarded as valid till he was crowned with the sacred crown (which was recovered from the robber barons) at Székesfehérvár on Aug. 27, 1310. After three years of warfare Charles at length put down all the elements of rapine and disorder at Rozgony (June 15, 1312). His foreign policy aimed at the aggrandizement of his family, but Hungary also benefited greatly from it. His most successful achievement was the union with Poland for mutual defence against the Habsburgs and the Czechs, which was accomplished by the Convention of Trencsén (1335), confirmed the same year at the brilliant Congress of Visegrád, where all the princes of Central Europe met to compose their differences. The result of the congress was a combined attack by the Magyars and the Poles upon the emperor Louis and his ally Albert of Austria, which was decided in Charles's favour in 1337. Charles wished to unite the kingdoms of Hungary and Naples under his eldest son Louis, but was frustrated by Venice and the pope, who feared that Hungary might become the dominant Adriatic Power. He was, however, compensated for this disappointment by his compact (1339) with his ally and brother-in-law, Casimir of Poland, whereby it was agreed that Louis should succeed to the throne of Poland on the death of the childless Casimir. Charles was a statesman of the first rank, who not only raised Hungary once more to the rank of a great Power, but enriched and civilized her. In character he was pious, courtly and valiant, popular alike with the nobility and the middle classes, whose increasing welfare he did so much to promote, and much beloved by the clergy. His court was famous throughout Europe as a school of chivalry.

Three sons, Louis, Andrew and Stephen survived him. He died on July 16, 1342, and was laid beside the high altar at Székesfehérvár, the ancient burial place of the Arpads.

See Béla Kerékgyartó, *The Hungarian Royal Court under the House of Anjou* (Hung.) (Budapest, 1881); *Rationes Collectorum Pontif. in Hungaria* (Budapest, 1887); *Diplomas of the Angevin Period,* edit. Imre Nagy (Hung. and Lat.) vols. i.–iii. (Budapest, 1878, etc.).

CHARLES I. (1226–1285), king of Naples and Sicily and count of Anjou, was the seventh child of Louis VIII. of France and Blanche of Castile. Louis died a few months after Charles's birth and was succeeded by his son Louis IX. (St. Louis), and on the death in 1232 of the third son, John, count of Anjou and Maine, those fiefs were conferred on Charles. In 1246 he married Beatrice, daughter and heiress of Raymond Bérenger V., the last count of Provence, and after defeating James I. of Aragon and other rivals with the help of his brother, the French king, he took possession of his new county. In 1248 he accompanied Louis in the crusade to Egypt, but on the defeat of the Crusaders he was taken prisoner with his brother. Shortly afterwards he was ransomed, and returned to Provence in 1250. Charles's ambition aimed at wider fields, and he extended his influence by the subjugation of Marseille in 1257, and two years later several communes of Piedmont recognized his suzerainty. In 1262 Pope Urban IV. determined to destroy the power of the Hohenstaufen in Italy, and offered the kingdoms of Naples and Sicily, in consideration of a yearly tribute, to Charles of Anjou. After long negotiations he accepted the Sicilian and Neapolitan crowns, and in 1264 he sent a first expedition of Provençals to Italy; he also collected a large army and navy in Provence and France with the help of King Louis, and by an alliance with the cities of Lombardy was able to send part of his force overland. Pope Clement IV. confirmed the Sicilian agreement on conditions even more favourable to Charles, who sailed in 1265, and conferred on the expedition all the privileges of a crusade. After narrowly escaping capture by Manfred's fleet he reached Rome safely, where he was crowned king of the Two Sicilies. The land army arrived soon afterwards, and on Feb. 26, 1266, Charles encountered his rival Manfred the bastard of the emperor Frederick II., at Benevento (*q.v.*), where after a hard-fought battle Manfred was defeated and killed, and the whole kingdom was soon in Charles's possession. Then Conradin, Frederick's grandson and last legitimate descendant of the Hohenstaufen, came into Italy, where he found many partisans among the Ghibellines of Lombardy and Tuscany, and among Manfred's former adherents in the south. He was totally defeated by Charles at Tagliacozzo (Aug. 23, 1268); taken prisoner, he was tried as a rebel and executed at Naples.

Charles was now one of the most powerful sovereigns of Europe, for besides ruling over Provence and Anjou and the kingdom of the Two Sicilies, he was imperial vicar of Tuscany, lord of many cities of Lombardy and Piedmont, and as the pope's favourite practically arbiter of the papal states, especially during the interregnum between the death of Clement IV. (1268) and the election of Gregory X. (1272). In 1272 he took part with Louis IX. in a crusade to north Africa. The election of Rudolph of Habsburg as German king, and that of Nicholas III. to the Holy See (1277), diminished Charles's power, for the new pope set himself to compose the difference between Guelphs and Ghibellines in the Italian cities, but at his death Charles secured the election of his henchman Martin IV. (1281), who recommenced persecuting the Ghibellines. But the cruelty of the French rulers of Sicily provoked in 1282 the rebellion known as the Sicilian Vespers (*see* VESPERS, SICILIAN). Charles determined to subjugate the island and sailed with his fleet for Messina. The city held out until Peter III. of Aragon arrived in Sicily, and a Sicilian-Catalan fleet under the Calabrese admiral, Roger de Lauria, completely destroyed that of Charles. In May 1284 Roger de Lauria appeared before Naples and destroyed another Angevin fleet commanded by Charles's son, who was taken prisoner. Charles came to Naples with a new fleet from Provence, and was preparing to invade Sicily again, when he died at Foggia on Jan. 7, 1285. An extremely able soldier and a skilful statesman, his inordinate ambition and his cruelty created enemies on all sides, and led to the collapse of the edifice of dominion which he had raised.

CHARLES II. (1250–1309), king of Naples and Sicily, son of Charles I., had been captured by Ruggiero di Lauria in the naval battle at Naples in 1284, and when his father died he was still a prisoner in the hands of Peter of Aragon. In 1288 Charles was liberated on the understanding that he was to retain Naples alone, Sicily being left to the Aragonese, and to induce his cousin Charles of Valois to renounce the kingdom of Aragon given to him by Pope Martin IV. He went to Rieti, where the new pope Nicholas IV. immediately absolved him from all the conditions he had sworn to observe, crowned him king of the Two Sicilies (1289), and excommunicated Alphonso, while Charles of Valois, in alliance with Castile, prepared to take possession of Aragon. Alphonso III., the Aragonese king, being hard pressed, had to promise to withdraw the troops he had sent to help his brother James in Sicily, to renounce all rights over the island, and pay a tribute to the Holy See. But Alphonso died childless in 1291 before the treaty could be carried out, and James took possession of Aragon, leaving the government of Sicily to the third brother Frederick. The new pope Boniface VIII., elected in 1294 at Naples under the auspices of King Charles, mediated between the latter

and James, and a most dishonourable treaty was signed. An attempt was made to bribe Frederick into consenting to the arrangement, but being backed up by his people he refused, and was afterwards crowned king of Sicily. The ensuing war was fought with great fury and peace was not made until 1302 at Caltabellotta, Charles II. giving up all rights to Sicily and agreeing to the marriage of his daughter Leonora to King Frederick; the treaty was ratified by the pope in 1303. Charles died in Aug. 1309, and was succeeded by his son Robert.

BIBLIOGRAPHY.—A. de Saint-Priest, *Histoire de la conquête de Naples par Charles d'Anjou* (4 vols., 1847–49); S. de Sismondi, in *Histoire des républiques italiennes,* vol. ii. (Brussels, 1838), gives a good general sketch; R. Sternfeld, *Karl von Anjou als Graf von Provence* (1888); Charles's connection with north Italy is dealt with in Merkel's *La Dominazione di Carlo d'Angiò in Piemonte e in Lombardia* (Turin, 1891), while the R. Deputazione di Storia Patria Toscana has recently published a *Codice diplomatico delle relazioni di Carlo d'Angiò con la Toscano;* by Durrien, *Archives angevines de Naples* (Toulouse, 1866–1867). M. Amari's *La Guerra del Vespro Siciliano* (8th ed., Florence, 1876) is a valuable history, but is prejudiced and should be compared with L. Cadier's *Essai sur l'administration du royaume de Sicile sous Charles I et Charles II d'Anjou* (1891, *Bibl. des écoles françaises d'Athènes et de Rome,* fasc. 59), which contains many documents.

CHARLES II. (1332–1387), called THE BAD, king of Navarre and count of Evreux, was a son of Jeanne II., queen of Navarre, by her marriage with Philip, count of Evreux. He succeeded his mother in 1349, and in 1352 married Jeanne, daughter of John II. of France. Trouble soon arose between King John and his son-in-law. The promised dowry had not been paid, and the county of Angoulême, formerly belonging to Jeanne of Navarre, was then in the possession of John's favourite, the constable Charles la Cerda. In Jan. 1354 the constable was assassinated, and John was forced to make a treaty at Mantes and to compensate Charles for the loss of Angoulême by a large grant of lands, chiefly in Normandy. In Normandy, Charles was partly responsible for some unrest, and in April 1356 was seized by the French king at Rouen, remaining in captivity until Nov. 1357, after John became a prisoner in England. Charles was then considered by Étienne Marcel and his party as a suitable rival to the dauphin, afterwards King Charles V. Peace was made, but the dauphin's failure to restore to Charles his confiscated estates led to war, quickly followed by a new treaty, after which Charles took part in suppressing the peasant rising known as the *Jacquerie.* However, in June 1358, he returned to Paris, and became captain-general of the city, which was soon besieged by the dauphin. Charles left Paris just before the murder of Marcel in July and continued his alternate policy of war and peace, until the conclusion of the treaty of Brétigny in May 1360, deprived him of the alliance of the English, and compelled him to make peace with King John. When the duchy of Burgundy became vacant in Nov. 1361, Charles made an unsuccessful claim for it.

In July 1362, in alliance with Pedro the Cruel, king of Castile, he invaded Aragon, soon deserting his new ally for Peter IV., king of Aragon. In turn he made treaties with the kings of Castile and Aragon, until he signed a treaty with Edward of England, and then in 1371 he allied himself with Charles V. of France. He was accused of attempting to poison the king of France and other prominent persons, and of other crimes; his French estates were seized and Cherbourg surrendered. After the death of Charles V., in 1380, the king of Navarre did not interfere in the internal affairs of France. His lands in France were handed over to his eldest son Charles, who governed them with the consent of the new king, Charles VI. Charles died on Jan. 1, 1387, and was succeeded by his eldest son Charles; one of his daughters, Jeanne, became the wife of Henry IV. of England.

See D. F. Secousse, *Mémoires pour servir à l'histoire de Charles II. roi de Navarre* (1755–68); Jean Froissart, *Chroniques,* ed. by S. Luce and G. Raynaud (1869–97); E. Meyer, *Charles II. roi de Navarre et la Normandie au XIVe. siècle* (1898); R. Delachenal, *Premières négociations de Charles le Mauvais avec les Anglais* (1900) and E. Lavisse, *Histoire de France,* t. iv. (1902).

CHARLES III. (1361–1425), called THE NOBLE, king of Navarre and count of Evreux, was the eldest son of Charles II. the Bad (*q.v.*), and was married in 1375 to Leonora, daughter of Henry II., king of Castile. He became king of Navarre in 1387, and, in contrast to his father's reign, his was a period of peace and order. In 1393 he regained Cherbourg, which had been handed over by Charles II. to Richard II. of England, and in 1403 exchanged it for certain other lands in France. He was created duke of Nemours and made a peer of France. He died at Olite on Sept. 8, 1425. After the death of his two sons in 1402 the king secured his kingdom for his daughter Blanche (d. 1441), who took for her second husband John, afterwards John II., king of Aragon; and the cortes of Navarre swore to recognize Charles (*q.v.*), prince of Viana, her son by this marriage, as king after his mother's death.

CHARLES (KARL EITEL; in Rum. CAROL), king of Rumania (1839–1914), second son of Prince Karl Anton of Hohenzollern-Sigmaringen, was born on April 20, 1839. He was educated at Dresden (1850–1856), and passed through his university course at Bonn. Entering the Prussian army in 1857, he served in the Danish war of 1864, and received instruction in strategy from General von Moltke. He afterwards travelled in France, Italy, Spain and Algeria. He was a captain in the 2nd regiment of Prussian Dragoon Guards when he was elected *hospodar* or prince of Rumania on April 20, 1866, after the compulsory abdication of Prince Alexander John Cuza. Regarded at first with distrust by Turkey, Russia and Austria, he rapidly gained general recognition; but he had to contend for ten years with fierce party struggles between the Conservatives and the Liberals.

During this period, however, Charles displayed great tact in his dealings with both parties, and kept his country in the path of administrative and economic reform, organizing the army, developing the railways, and establishing commercial relations with foreign powers. The sympathy of Rumania with France in the Franco-Prussian War of 1870, and the consequent interruption of certain commercial undertakings, led to a hostile movement against Prince Charles, which, being fostered by Russia, made him resolve to abdicate; and it was with difficulty that he was persuaded to remain. In the Russo-Turkish War of 1877–78 he joined the Russians before Plevna (*q.v.*), and being placed in command of the combined Russian and Rumanian forces, forced Osman Pasha to surrender. As a consequence of the prince's vigorous action the independence of Rumania, which had been proclaimed in May 1877, was confirmed by various treaties in 1878, and recognized by Great Britain, France and Germany in 1880. On March 26, 1881, he was proclaimed king of Rumania, and, with his consort, was crowned on May 22 following. From that time he pursued a successful career in home and foreign policy, and greatly improved the financial and military position of his country; while his appreciation of the fine arts was shown by his formation of an important collection of paintings of all schools in his palaces at Sinaïa and Bucharest. For an account of the events of his reign, *see* BALKAN WARS and RUMANIA. On Nov. 1 1869 he married Princess Elizabeth (*q.v.*), a daughter of Prince Hermann of Wied, widely known under her literary name of "Carmen Sylva." As the only child of the marriage, a daughter, died in 1874, the succession was finally settled upon the king's nephew, Prince Ferdinand of Hohenzollern-Sigmaringen (*see* FERDINAND I.). He died at the castle of Pelesh, Rumania, on Oct. 10, 1914.

The official life of King Charles, mainly his own composition, *Aus dem Leben König Karls von Rumänien* (Stuttgart, 1894–1900, 4 vols.), deals mainly with political history. *See* for an account of his domestic life, M. Kremnitz, *König Karl von Rumänien: Ein Lebensbild* (Breslau, 1903).

CHARLES II. (1661–1700), king of Spain, the son of Philip IV. by his second marriage with Maria, daughter of the emperor Ferdinand III., was born on Nov. 11, 1661. Weak, indolent and almost imbecile from his birth, Charles was brought up under the tutelage of his Austrian mother, who was later exiled from court by the younger Don John of Austria, a natural son of Philip IV. In 1679, Charles married Maria Louisa of Orleans, thereby satisfying French interests, which were still more advanced by his acceptance of the Treaty of Ratisbon, June 1684. On the death of the French princess in the stifling atmosphere of the Spanish court, Charles married Maria Ana of Neuberg in

1689, and Austrian interests were again promoted. Always decrepit in mind and body, the king, driven wild by the conflict between his wish to transmit his inheritance to "the illustrious house of Austria," his own kin, and the belief instilled into him by the partisans of the French claimant that only the power of Louis XIV. could avert the dismemberment of the empire, was at last reduced to an abject condition. Under pressure from the cardinal archbishop of Toledo, Portocarrero, he finally made a will in favour of Philip, duke of Anjou, grandson of Louis XIV., thereby ending the inglorious line of the Spanish Habsburgs. He died on Nov. 1, 1700.

See M. de Villars, *Lettres* (1868); P. de Villars, *Mémoires de la Cour d'Espagne* (1893); G. Maura Gamaza, *Carlos II. y su Corte*, 2 vols. (1915). (For a genealogical table of the Spanish Habsburgs, *see* HABSBURG.)

CHARLES III. (1716–1788), king of Spain, born on Jan. 20, 1716, was the first son of the second marriage of Philip V. with Elizabeth Farnese of Parma. In 1732 he was sent to rule as duke of Parma by right of his mother, and two years later, 1734, made himself master of Naples and Sicily and began there the work of internal reform which he afterwards continued in Spain. On the death of his half-brother Ferdinand VI. he became king of Spain and resigned the Two Sicilies to his third son, Ferdinand.

As king of Spain his foreign policy was disastrous. His strong family feeling and his detestation of England, which was unchecked after the death of his wife, Maria Amelia, daughter of Frederick Augustus II. of Saxony, in 1760, led him into the Family Compact with France. Spain was entangled in the close of the Seven Years' War, to her great loss. In 1779 he was, somewhat reluctantly, led to join France and the American insurgents against England. His internal government was on the whole beneficial to the country. He improved sanitation, suppressed lawlessness, encouraged trade and industry, and constructed roads and canals. Although a sincere Roman Catholic, he consented to the expulsion of the Jesuits from Spain, reduced the number of idle clergy, and rendered the Inquisition ineffectual. When he died on Dec. 14, 1788, Charles, the greatest of the Spanish Bourbons, left the reputation of an enlightened monarch.

BIBLIOGRAPHY.—*See* M. Danvila y Collado, *Reign of Charles III.* (6 vols.), in the *Historia General de España de la Real Academia de la Historia* (1892, etc.); J. Addison, *Charles the Third of Spain* (1900); F. Rousseau, *Règne de Charles III. d'Espagne* (1907).

CHARLES IV. (1748–1819), king of Spain, second son of Charles III. and his wife Maria Amelia of Saxony, was born on Nov. 11, 1748. The elder brother was set aside as imbecile and epileptic. Charles married Maria Luisa of Parma, his first cousin, who, on his succession to the throne in 1788, directed affairs with the assistance of her lover Godoy (*q.v.*). The king was too slothful to have more than a passive part in the direction of his own Government. If he ever understood that his kingdom was treated as a mere dependence by France, he consoled himself with a belief in his divine right and the sanctity of his person. When he was told that his son Ferdinand was appealing to Napoleon against Godoy, he took the side of the favourite, and when the populace rose at Aranjuez in 1808 he abdicated to save the minister. He took refuge in France, and being imprisoned with his son he was with difficulty restrained from assaulting him. Finally he abdicated in favour of Napoleon and died at Rome on Jan. 20, 1819.

See General Gomez de Arteche (*Historia del Reinado de Carlos IV.*) in the *Historia General de España de la Real Academia de la Historia* (1892, etc.); A. Savine, *L'Abdication de Bayonne.* (1908).

CHARLES IX. (1550–1611), king of Sweden, the youngest son of Gustavus Vasa and Margareto Lejonhufrud, was born on Oct. 4, 1550. By his father's will he received the duchy of Södermanland (Sudermania) in 1560. In 1568 he and his brother John led the rebellion against Eric XIV., but when John became king, as John III., the relations between the two brothers were strained. Duke Charles was the centre of the opposition to John's attempts to romanize Sweden on the one hand, and he resisted all the king's efforts to restrict his authority as duke of Södermanland on the other, though in 1587 he was obliged to resign his claim to autonomy within his own duchy. The religious question came to a crisis on the death of John III. in 1592, when his eldest son, Sigismund, a devoted Catholic who was already king of Poland, succeeded to the throne of Sweden. Duke Charles came forward as the champion of the Protestant majority, who were alarmed lest Sigismund should attempt to re-catholicize Sweden; it was with his assent that they held the famous Synod or "Uppsala-möte" Feb. 1593, which proclaimed Sweden's adherence to the Augsburg Confession; and when Sigismund arrived in Sweden Charles, who had governed jointly with the Estates during his absence, backed by an army, compelled him, before he could be crowned, to guarantee to maintain the Uppsala convention, thereby recognizing that Sweden was essentially a Protestant state. In Aug. 1594 when Sigismund left for Poland, Charles was left in control of affairs, and in 1595 he was elected regent by the *Riksdag* of Söderköping. He ruled firmly, almost despotically. Roman Catholicism was suppressed. In May 1595 the peace of Teusin was concluded with Russia, who recognized Sweden's title to Narva and Estonia. By 1597 however, the country was in a state of civil war. Charles had quarrelled with the council over their refusal to make war on Finland, whose ruler, Klas Fleming, refused to recognize Charles's authority as opposed to that of Sigismund. Sigismund forbade the summoning of the *Riksdag* which supported Charles, and authorized the council to govern alone, but Charles summoned the *Riksdag* when the council was not sitting, and persuaded it to give him all the powers of government. He then sailed to Finland and captured Åbo. Sigismund landed at Kalmar in Sweden with an army, in July 1598, but though large numbers of the nobles flocked to his standards he was regarded as a heretic by the majority of the Swedish nation. Charles defeated him at Stångebro on Sept. 25, 1598, after which he fled for aid to Poland, though he had promised to disband his forces and to abide by the decision of the Estates. He was formally deposed by the *Riksdag* in 1599, and on Feb. 24, 1600, the diet of Linköping declared that he and his posterity had forfeited the Swedish throne, and passing over duke John, the second son of John III., a youth of ten, recognized Duke Charles as king under the title of Charles IX.

Charles proceeded to conquer Finland, and to take cruel vengeance on the nobles who had opposed him. He did not, however, style himself king until March 6, 1604, after Duke John had formally renounced his claim to the throne, and was not crowned until March 15, 1607. His short reign was a period of uninterrupted warfare. In the long war with Poland (1600–60), begun in his reign, he was on the whole unsuccessful, his severest defeat being at Kirkholm (Sept. 1605) (*see* CHODKIEWICZ). Sweden and Poland also supported rival claimants to the tsardom in Russia. In 1610 Charles, who had concluded an alliance with the tsar Basil against Sigismund in 1609 and who aimed at obtaining the county of Keksholm for Sweden, sent an army under Jacob de la Gardie (*q.v.*) to Moscow. After his defeat by the Polish general, Zolkievski, at Klutsjino (June, 1610) and the collapse of Basil, de la Gardie seized Keksholm and Novgorod in 1611. In the same year Christian IV. (*q.v.*) of Denmark declared war on Sweden, partly as a result of Charles's pretensions to Lapland, and his veto on trade with Riga and Kurland and his foundation of the city of Göteborg (Gothenburg), partly from an ambition to conquer Sweden. Christian besieged Kalmar (whence the name "Kalmar War," given to this war). In July, 1611, Charles IX. fought an indecisive battle near that city, and on the 28th the castle of Kalmar was surrendered treacherously. Old and worn out, Charles died on Oct. 30, leaving his son, Gustavus Adolphus, to carry on war with Denmark and Russia. As a ruler Charles IX. is the link between his great father Gustavus Vasa and his still greater son. He consolidated the work of Gustavus Vasa, the creation of a great Protestant state: he prepared the way for the erection of the Protestant empire of Gustavus Adolphus. By his first wife Marie, daughter of the elector palatine Louis VI., he had six children, of whom only one daughter, Catherine, survived; by his second wife, Christina, daughter of Adolphus, duke of Holstein-Gottorp, he had five children, including Gustavus Adolphus and Charles Philip, duke of Finland.

See *Sveriges Historia*, vol. iii. (1878); R. N. Bain, *Scandinavia* (1905); *see* also SWEDEN: *History*. (R. N. B.; X.)

CHARLES X. (CHARLES GUSTAVUS) (1622–1660), king of Sweden, son of John Casimir, count palatine of Zweibrücken, and Catherine, sister of Gustavus Adolphus, was born at Nyköping Castle on Nov. 8, 1622. He learnt the art of war under the great Lennart Torstensson, being present at the second battle of Breitenfeld and at Jankowitz. From 1646 to 1648 he frequented the Swedish court. It was supposed that he would marry the queen regnant, Christina, and to compensate her cousin for a broken half-promise she declared him (1649) her successor, despite the opposition of the senate headed by Axel Oxenstjerna. In 1648 he was appointed generalissimo of the Swedish forces in Germany, and acted as Swedish plenipotentiary at the executive congress of Nuremberg, assembled (1650) to execute the details of the peace of Westphalia. As the recognized heir to the throne, his position on his return to Sweden was a difficult one, in view of the unpopularity of the queen. Charles, therefore, wisely withdrew to the isle of Öland till the abdication of Christina (June 5, 1654) called him to the throne.

The beginning of his reign was devoted to the healing of domestic discords and in preparation for a new policy of conquest. He contracted a political marriage (Oct. 24, 1654) with Hedwig Leonora, the daughter of Frederick III., duke of Holstein-Gottorp, by way of securing a future ally against Denmark. The two great pressing national questions, war and the restitution of the alienated crown lands, were considered at the *Riksdag* which assembled at Stockholm in March 1655. The war question was decided in three days by a secret committee presided over by the king, who easily persuaded the delegates that a war with Poland was necessary and might prove very advantageous; but the consideration of the question of the subsidies due to the crown for military purposes was postponed to the following *Riksdag* (*see* SWEDEN: *History*). On July 15 Charles quitted Sweden to engage in his Polish adventure. By the time war was declared he had at his disposal 50,000 men and 50 warships. Hostilities had already begun with the occupation of Dünaburg (Dvinsk) in Polish Livonia by the Swedes (July 1, 1655), and the Polish army encamped among the marshes of the Netze concluded a convention (July 25) whereby the palatinates of Posen and Kalisz placed themselves under the protection of the Swedish king. The Swedes then entered Warsaw without opposition and occupied the whole of Great Poland. The Polish king, John Casimir, fled to Silesia. Meanwhile Charles pressed on towards Cracow, which was captured after a two months' siege. The fall of Cracow extinguished the last hope of the boldest Pole; but before the end of the year an extraordinary reaction began in Poland itself. On Oct. 18 the Swedes invested the fortress-monastery of Czenstochowa, but the place was heroically defended; and after a seventy days' siege the besiegers were compelled to retire with great loss.

This astounding success elicited an outburst of popular enthusiasm which gave the war a national and religious character. The tactlessness of Charles, the rapacity of his generals, the barbarity of his mercenaries, his refusal to legalize his position by summoning the Polish diet, his negotiations for the partition of the very state he affected to befriend, awoke the long slumbering public spirit of the country. In the beginning of 1656 John Casimir returned from exile and the Polish army was reorganized and increased. By this time Charles had discovered that it was easier to defeat the Poles than to conquer Poland. His chief object, the conquest of Prussia, was still unaccomplished, and a new foe arose in the elector of Brandenburg, alarmed by the ambition of the Swedish king. Charles forced the elector, indeed, at the point of the sword to become his ally and vassal (treaty of Königsberg, Jan. 17, 1656); but the Polish national rising now imperatively demanded his presence in the south. For weeks he scoured the interminable snow-covered plains of Poland in pursuit of the Polish guerillas, penetrating as far south as Jaroslav in Galicia, by which time he had lost two-thirds of his 15,000 men with no apparent result. His retreat from Jaroslav to Warsaw, with the fragments of his host, amidst three converging armies, in a marshy forest region, intersected in every direction by well-guarded rivers, was one of his most brilliant achievements. But his necessities were overwhelming. On June 21 Warsaw was retaken by the Poles, and four days later Charles was obliged to purchase the assistance of Frederick William by the treaty of Marienburg. On July 18–20 the combined Swedes and Brandenburgers, 18,000 strong, after a three days' battle, defeated John Casimir's army of 50,000 at Warsaw and reoccupied the Polish capital; but this brilliant feat of arms was altogether useless, and when the suspicious attitude of Frederick William compelled the Swedish king at last to open negotiations with the Poles, they refused the terms offered, the war was resumed, and Charles concluded an offensive and defensive alliance with the elector of Brandenburg (treaty of Labiau, Nov. 20) whereby it was agreed that Frederick William and his heirs should henceforth possess the full sovereignty of East Prussia. In the meantime the hostile Dutch dominated Danzig, and the tsar started a campaign against the Swedish Baltic provinces.

The alliance of the elector had now become indispensable on almost any terms. So serious, indeed, were the difficulties of Charles X. in Poland, in spite of the assistance of the elector and of George Rákóczy II., prince of Transylvania, that it was with extreme satisfaction that he received the tidings of the Danish declaration of war (June 1, 1657) which enabled him honourably to emerge from the inglorious Polish imbroglio. He had learnt from Torstensson that Denmark was most vulnerable if attacked from the south, and, imitating the strategy of his master, he fell upon her with a velocity which paralyzed resistance. At the end of June 1657, at the head of 6,000 seasoned veterans, he executed a rapid march from the interior of Poland to Stettin, and reached the borders of Holstein on July 18. The Danish army at once dispersed and the duchy of Bremen was recovered by the Swedes, who in the early autumn swarmed over Jutland and firmly established themselves in the duchies. But the fortress of Fredriksodde (Fredericia) on the Little Belt held Charles's little army at bay from mid-August to mid-October, while the fleet of Denmark, after a stubborn two days' battle, compelled the Swedish fleet to abandon its projected attack on the Danish islands. In July an offensive and defensive alliance was concluded between Denmark and Poland. The elector of Brandenburg joined the league against Sweden, and compelled Charles to accept the proffered mediation of Cromwell and Mazarin. The negotiations foundered, however, upon the refusal of Sweden to refer the points in dispute to a general peace-congress, and Charles was still further encouraged by the capture of Fredriksodde (Oct. 23–24). In the middle of December 1657 began the great frost which was to be so fatal to Denmark. On Jan. 28, 1658, Charles X. arrived at Haderslev (Hadersleben) in South Jutland, when it was estimated that in a couple of days the ice of the Little Belt would be firm enough to bear even the passage of a mail-clad host to the island of Fünen. Early in the morning of Jan. 30 the Swedish king gave the order to start, the horsemen dismounting where the ice was weakest, and cautiously leading their horses as far apart as possible, when they swung into their saddles again, closed their ranks and made a dash for the shore. The whole of Fünen was won with the loss of only two companies of cavalry, which disappeared under the ice while fighting with the Danish left wing. Charles, with his eyes fixed steadily on Copenhagen, resolved to cross the frozen Great Belt also. After some hesitation, he accepted the advice of his chief engineer officer Erik Dahlberg, who acted as pioneer throughout, and chose the more circuitous route from Svendborg, by the islands of Langeland, Laaland and Falster, in preference to the direct route from Nyborg to Korsør, which would have been across a broad, almost uninterrupted expanse of ice. On the night of Feb. 5 the transit began, the cavalry leading the way through the snow-covered ice, which quickly thawed beneath the horses' hoofs so that the infantry which followed after had to wade through half an ell of sludge, fearing every moment lest the rotting ice should break beneath their feet. At three o'clock in the afternoon, Dahlberg leading the way, the army reached Grimsted in Laaland without losing a man. On Feb. 8 Charles reached Falster. On the 11th he stood safely on the soil of Sjaelland (Zealand). The medal struck to commemorate "the glorious transit of the Baltic Sea" bore the haughty inscription: *Natura hoc debuit uni.*

The crushing effect of this unheard-of achievement on the Danish Government found expression in the treaties of Taastrup (Feb. 18) and Roskilde (Feb. 26, 1658), whereby Denmark sacrificed nearly half her territory to save the rest (*see* DENMARK: *History*). But even this was not enough for the conqueror. Military ambition and greed of conquest moved Charles X. to what, divested of all its pomp and circumstance, was an outrageous act of political brigandage. At a council held at Gottorp (July 7), Charles X. resolved, without any warning, in defiance of all international equity, to let loose his veterans upon Denmark a second time. For the details of this second struggle, with the concomitant diplomatic intervention of the western powers, who were determined to prevent the closing of the Sound, *see* FREDERICK III., king of Denmark, and DENMARK: *History*. Only after great hesitation would Charles X. consent to reopen negotiations with Denmark direct, at the same time proposing to exercise pressure upon the enemy by a simultaneous winter campaign in Norway. Such an enterprise necessitated fresh subsidies from his already impoverished people, and obliged him in December 1659 to cross over to Sweden to meet the estates, whom he had summoned to Gothenburg. The lower estates murmured at the imposition of fresh burdens; and Charles had need of all his adroitness to persuade them that his demands were reasonable and necessary. At the very beginning of the *Riksdag*, in January 1660, it was noticed that the king was ill; but he spared himself as little in the council-chamber as in the battle-field, till death suddenly overtook him on the night of Feb. 12–13, 1660, in his thirty-eighth year.

See M. Veibull, *Sveriges Storhedstid* (Stockholm, 1881); F. F. Carlson, *Sveriges Historia under Konungarne af Pfalziska Huset* (Stockholm, 1883–85); E. Haumant, *La Guerre du nord et la paix d'Oliva* (1893); G. Jones, *The Diplomatic Relations between Cromwell and Charles X.* (Lincoln, Nebraska, 1897); R. Nisbet Bain, *Scandinavia* (1905); J. Levin-Carlklum, *Karl II. Gustav* (Stockholm, 1912); H. Rosengren, *Karl II. Gustaf före tronkestigingen* (Uppsala, 1913); J. Stefánsson, *Denmark and Sweden* (1916)

CHARLES XI. (1655–1697), king of Sweden, the only son of Charles X. and Hedwig Leonora of Holstein-Gottorp, was born in the palace at Stockholm on Nov. 24, 1655. His father, who died when the child was in his fourth year, appointed a regency of five great ministers of state with the queen as president. For the history of the regency, of the settlement of the Danish and Russian loans, and the later humiliating dependence on France (*see* SWEDEN: *History*). The young king's education was neglected. When he attained his majority, he was ignorant of the very rudiments of state-craft and almost illiterate. It was the disaster of the Scanian war which first called forth his sterling qualities and hardened him into a premature manhood.

In 1675 the Brandenburgers, Pomeranians and Danes had overrun Pomerania and Bremen, and the Danes were preparing to invade Sweden itself. Amidst universal anarchy, the young king, barely twenty years of age, inexperienced, ill-served, snatching at every expedient, worked day and night in his newly-formed camp in Scania (Skåne) to arm the nation for its mortal struggle. The Danes launched invasion from three directions in 1676. The victory of Fyllebro (Aug. 17, 1676), when Charles and his commander-in-chief S. G. Helmfeld routed a Danish division, was the first Swedish success, and on Dec. 4, on the tableland of Helgonabäck, near Lund, the young Swedish monarch defeated Christian V. of Denmark, who also commanded his army in person. After a ferocious contest, the Danes were practically annihilated. The battle of Lund was, relatively to the number engaged, one of the bloodiest engagements of modern times. More than half the combatants (8,357, of whom 3,000 were Swedes) actually perished on the battle-field. All the Swedish commanders, notably John Gyllenstierna, showed remarkable ability, but the chief glory of the day indisputably belongs to Charles XI. This great victory restored to the Swedes their self-confidence and prestige. In the following year, Charles with 9,000 men routed 12,000 Danes near Landskrona (July 15, 1678). This proved to be the last pitched battle of the war, the Danes never again venturing to attack their once more invincible enemy in the open field. In Germany, the Swedes, faced by the Great Elector, lost ground. In 1679 Louis XIV. dictated the terms of a general pacification, and Charles XI., who bitterly resented "the insufferable tutelage" of the French king, acquiesced in a peace which at least left his empire practically intact. Both Christian V. of Denmark and Frederick William, the Great Elector, were forced to restore their conquests (*see* SWEDEN: *History*). Good understanding between Denmark and Sweden followed the peace of Lund, and there relations were cemented by the marriage of Charles with Ulrica Leonora, sister of Christian V. Charles devoted the rest of his life to the gigantic task of rehabilitating Sweden by means of a *reduktion*, or recovery of alienated crown lands, a process which involved the examination of every title deed in the kingdom, and resulted in the complete readjustment of the finances. But vast as it was, the *reduktion* represents only a tithe of Charles XI.'s immense activity. Finance, commerce, the national armaments by sea and land, judicial procedure, church government, education, even art and science—everything, in short—emerged recast from his shaping hand. For the strengthening in his reign of the power of the crown, which left Sweden practically an absolute monarchy (*see* SWEDEN: *History*). Charles XI. died on April 5, 1697, in his forty-first year. He had seven children, of whom only three survived him, a son Charles, and two daughters, Hedwig Sophia, duchess of Holstein, and Ulrica Leonora, who ultimately succeeded her brother on the Swedish throne.

After Gustavus Vasa and Gustavus Adolphus, Charles XI. was, perhaps, the greatest of all the kings of Sweden. His modest, homespun figure has indeed been unduly eclipsed by the brilliant and colossal shapes of his heroic father and his meteoric son; yet in reality Charles XI. is far worthier of admiration than either Charles X. or Charles XII. He was in an eminent degree a great master-builder. He found Sweden in ruins, and devoted his whole life to laying the solid foundations of a new order of things which, in its essential features, has endured to the present day.

See Martin Veibull, *Sveriges Storhedstid* (Stockholm, 1881); Frederick Ferdinand Carlson, *Sveriges Historia under Konungarne af Pfalziska Huset* (Stockholm, 1883–1885); Robert Nisbet Bain, *Scandinavia* (Cambridge, 1905); O. Sjögren, *Karl den Elfte och Svenska Folket* (Stockholm, 1897); S. Jacobsen, *Den nordiske Kriegs Krönicke*, 1675–1679 (Copenhagen, 1897); J. A. de Mesmes d'Avaux, *Négociations du comte d'Avaux*, 1693, 1697, 1698 (Utrecht, 1882, etc.).

CHARLES XII. (1682–1718), king of Sweden, the only surviving son of Charles XI. and Ulrica Leonora, daughter of Frederick III. of Denmark, was born on June 17, 1682. He was carefully educated by excellent tutors under the watchful eyes of his parents. Charles XI. personally supervised his son's physical training. He was taught to ride before he was four and at eight he was quite at home in his saddle.

As he grew older his father took him on all his rounds, reviewing troops, inspecting studs, foundries, dockyards and granaries. Thus the lad was gradually initiated into all the *minutiae* of administration. The influence of Charles XI. over his son was, indeed, far greater than is commonly supposed, and it accounts for much in Charles XII.'s character which is otherwise inexplicable, for instance his precocious reserve and taciturnity, his dislike of everything French, and his inordinate contempt for purely diplomatic methods. On the whole, his early training was admirable; but the young prince was not allowed the opportunity of gradually gaining experience under his guardians. At the *Riksdag* assembled at Stockholm in 1697, the estates, jealous of the influence of the regents, offered full sovereignty to the young monarch, the senate acquiesced, and, after some hesitation, Charles at last declared that he could not resist the urgent appeal of his subjects and would take over the government of the realm "in God's name." The subsequent coronation was marked by portentous novelties, the most significant of which was the king's omission to take the usual coronation oath, which omission was interpreted to mean that he considered himself under no obligation to his subjects. The general opinion of the young king was, however, still favourable. His conduct was evidently regulated by strict principle and not by mere caprice. His intense application to affairs is noted by the English minister, John Robinson (1650–1723).

The coalition formed against Sweden by Johann Reinhold

Patkul, which resulted in the outbreak of the Great Northern War (1699), abruptly put an end to Charles XII.'s political apprenticeship, and forced the sword into his hand. The young king resolved to attack Denmark the nearest of his three enemies—Denmark, Poland and Russia—first. The timidity of the Danish admiral Ulrik C. Gyldenlöve, and the daring of Charles, who forced his nervous and protesting admiral to attempt the passage of the eastern channel of the Sound, the dangerous *flinterend*, hitherto reputed to be unnavigable, enabled the Swedish king to effect a landing at Humleback in Sjaelland (Zealand), a few miles north of Copenhagen (Aug. 4, 1700). He now hoped to accomplish what his grandfather, fifty years before, had vainly attempted —the destruction of the Danish-Norwegian monarchy by capturing its capital. But for once prudential considerations prevailed, and the short and bloodless war was terminated by the peace of Travendal (Aug. 18), whereby Frederick IV. conceded full sovereignty to Charles's ally and kinsman the duke of Gottorp, besides paying him an indemnity of 200,000 rix-dollars and solemnly engaging to commit no hostilities against Sweden in future. From Sjaelland Charles now hastened to Livonia with 8,000 men. On Oct. 6 he had reached Pernau, with the intention of first relieving Riga, but, hearing that Narva was in great straits, he decided to turn northwards against the tsar. He set out for Narva on Nov. 13 against the advice of all his generals, who feared the effect on untried troops of a week's march through a wasted land, along boggy roads guarded by no fewer than three formidable passes which a little engineering skill could easily have made impregnable. Fortunately, the first two passes were unoccupied; and the third, Pyhäjoggi, was captured by Charles, who with 400 horsemen put 6,000 Russian cavalry to flight. On Nov. 19 the little army reached Lagena, a village about 9m. from Narva, whence it signalled its approach to the beleaguered fortress, and early on the following morning it advanced in battle array. The attack on the Russian fortified camp began at two o'clock in the afternoon, in the midst of a violent snowstorm; and by nightfall the whole position was in the hands of the Swedes: the Russian army was annihilated. The triumph was as cheap as it was crushing; it cost Charles less than 2,000 men.

After Narva, Charles XII. stood at the parting of ways. His best advisers urged him to turn all his forces against the panic-stricken Muscovites; to go into winter quarters amongst them and live at their expense; to fan into a flame the smouldering discontent caused by the reforms of Peter the Great; and so disable Russia for some time to come. But Charles was determined to punish the treachery of Augustus of Poland (*see* POLAND: *History*). It is easy from the vantage-point of two centuries to criticize Charles XII. for neglecting the Russians to pursue the Saxons; but at the beginning of the 18th century his decision was natural enough. The real question was, which of the two foes was the more dangerous, and Charles had many reasons to think the civilized and martial Saxons far more formidable than the imbecile Muscovites. Charles also rightly felt that he could never trust the treacherous Augustus to remain quiet, even if he made peace with him. To leave such a foe in his rear, while he plunged into the heart of Russia would have been hazardous indeed. From this point of view Charles's whole Polish policy, which has been blamed so long and so loudly—the policy of placing a nominee of his own on the Polish throne—takes quite another complexion: it was a policy not of overvaulting ambition, but of prudential self-defence.

First, however, Charles cleared Livonia of the invader (July 1701), subsequently occupying the duchy of Courland and converting it into a Swedish governor-generalship. In Jan. 1702 Charles established himself at Bielowice in Lithuania, and, after issuing a proclamation declaring that "the elector of Saxony" had forfeited the Polish crown, set out for Warsaw, which he reached on May 14. The cardinal-primate was then sent for and commanded to summon a diet, for the purpose of deposing Augustus. A fortnight later Charles quitted Warsaw, to seek the elector; on July 2 routed the combined Poles and Saxons at Klissow; and three weeks later, captured the fortress of Cracow by an act of almost fabulous audacity. Thus, within four months of the opening of the campaign, the Polish capital and the coronation city were both in the possession of the Swedes. After Klissow, Augustus made every effort to put an end to the war, but Charles would not even consider his offers. By this time, too, he had conceived a passion for the perils and adventures of warfare. His character was hardening, and he deliberately adopted the most barbarous expedients for converting the Augustan Poles to his views.

The campaign of 1703 was remarkable for Charles's victory at Pultusk (April 21) and the long siege of Thorn, which occupied him eight months but cost him only 50 men. On July 2, 1704, with the assistance of a bribing fund, Charles's ambassador at Warsaw, Count Arvid Bernhard Horn, succeeded in forcing through the election of Charles's candidate to the Polish throne, Stanislaus Leszczynski, who could not be crowned however till Sept. 24, 1705, by which time the Saxons had again been defeated at Punitz. From the autumn of 1705 to the spring of 1706, Charles was occupied in pursuing the Russian auxiliary army under Ogilvie through the forests of Lithuania. On Aug. 5, he recrossed the Vistula and established himself in Saxony, where his presence in the heart of Europe at the very crisis of the war of the Spanish Succession, fluttered all the western diplomats. The allies, in particular, at once suspected that Louis XIV. had bought the Swedes. Marlborough was forthwith sent from the Hague to the castle of Altranstädt near Leipzig, where Charles had fixed his headquarters, "to endeavour to penetrate the designs" of the king of Sweden. He soon convinced himself that western Europe had nothing to fear from Charles, and that no bribes were necessary to turn the Swedish arms from Germany to Russia. Five months later (Sept. 1707) Augustus was forced to sign the peace of Altranstädt, whereby he resigned the Polish throne and renounced every anti-Swedish alliance. Charles's departure from Saxony was delayed for twelve months by a quarrel with the emperor. The court of Vienna had treated the Silesian Protestants with tyrannical severity, in direct contravention of the treaty of Osnabrück, of which Sweden was one of the guarantors; and Charles demanded summary and complete restitution so dictatorially that the emperor prepared for war. But the allies interfered in Charles's favour, lest he might be tempted to aid France, and induced the emperor to satisfy all the Swedish king's demands, the maritime Powers at the same time agreeing to guarantee the provisions of the peace of Altranstädt.

Nothing now prevented Charles from turning his victorious arms against the tsar; and on Aug. 13, 1707, he evacuated Saxony at the head of the largest host he ever commanded, consisting of 24,000 horse and 20,000 foot. Delayed during the autumn months in Poland by the tardy arrival of reinforcements from Pomerania, it was not till Nov. 1707 that Charles was able to take the field. On New Year's Day 1708 he crossed the Vistula, though the ice was in a dangerous condition. On July 4, 1708 he cut in two the line of the Russian army, 6m. long, which barred his progress on the Wabis, near Holowczyn, and compelled it to retreat. The victory of Holowczyn, memorable besides as the last pitched battle won by Charles XII., opened up the way to the Dnieper. The Swedish army now began to suffer severely, bread and fodder running short. The Russians slowly retired before the invader, burning and destroying everything in his path. On Dec. 20 it was plain to Charles himself that Moscow was inaccessible. But the idea of a retreat was intolerable to him, so he determined to march southwards instead of northwards as suggested by his generals, and join his forces with those of the hetman of the Dnieperian Cossacks, Ivan Mazepa, who had 100,000 horsemen and a fresh and fruitful land at his disposal. Short of falling back upon Livonia, it was the best plan adoptable in the circumstances, but it was rendered abortive by Peter's destruction of Mazepa's capital Baturin, so that when Mazepa joined Charles at Horki, on Nov. 8, 1708, it was as a ruined man with little more than 1,300 personal attendants (*see* MAZEPA-KOLEDINSKY). A still more serious blow was the destruction of the relief army which Levenhaupt was bringing to Charles from Livonia, and which, hampered by hundreds of loaded wagons, was overtaken and almost destroyed by Peter at Lyesna after a two days'

battle against fourfold odds (October). The very elements now began to fight against the perishing but still unconquered host. The winter of 1708 was the severest that Europe had known for a century. By Nov. 1 firewood would not ignite in the open air, and the soldiers warmed themselves over big bonfires of straw. By the time the army reached the little Ukranian fortress of Hadjacz in January 1709, wine and spirits froze into solid masses of ice; birds on the wing fell dead.

Never had Charles XII. seemed so superhuman as during these awful days. It is not too much to say that his imperturbable equanimity, his serene *bonhomie* kept the host together. The frost broke at the end of Feb. 1709, and then the spring floods put an end to all active operations till May, when Charles began the siege of the fortress of Poltava, which he wished to make a base for subsequent operations while awaiting reinforcements from Sweden and Poland. On June 7 a bullet wound put Charles *hors de combat,* whereupon Peter threw the greater part of his forces over the river Vorskla, which separated the two armies (June 19–25). On June 26 Charles held a council of war, at which it was resolved to attack the Russians in their entrenchments on the following day. The Swedes joyfully accepted the chances of battle and, advancing with irresistible *élan,* were, at first, successful on both wings. Then one or two tactical blunders were committed; and the tsar, taking courage, enveloped the little band in a vast semicircle bristling with the most modern guns, which fired five times to the Swedes' once, and swept away the guards before they could draw their swords. The Swedish infantry was well nigh annihilated, while the 14,000 cavalry, exhausted and demoralized, surrendered two days later at Perevolochna on Dnieper. Charles himself with 1,500 horsemen took refuge in Turkish territory.

For the first time in his life Charles was now obliged to have recourse to diplomacy; and his pen proved almost as formidable as his sword. He procured the dismissal of four Russophil grand-viziers in succession, and between 1710 and 1712 induced the Porte to declare war against the tsar three times. But after Nov. 1712 the Porte had no more money to spare; and, the tsar making a show of submission, the sultan began to regard Charles as a troublesome guest. On Feb. 1, 1713 he was attacked by the Turks in his camp at Bender, and made prisoner. Charles lingered on in Turkey 15 months longer, in the hope of obtaining a cavalry escort sufficiently strong to enable him to restore his credit in Poland. Disappointed of this last hope, and moved by the despairing appeals of his sister Ulrica and the senate to return to Sweden while there was still a Sweden to return to, he quitted Demotika on Sept. 20, 1714, and attended by a single squire arrived unexpectedly at midnight, on Nov. 11, at Stralsund.

For the diplomatic events of these critical years *see* SWEDEN: *History.* Here it need only be said that Sweden, during the course of the Great Northern War, had innumerable opportunities of obtaining an honourable and even advantageous peace, but they all foundered on the dogged refusal of Charles to consent to the smallest concession to his despoilers. Even now he would listen to no offers of compromise, and after defending Stralsund with desperate courage till it was a mere rubbish heap, returned to Sweden after an absence of 14 years. Here he collected another army of 20,000 men, with which he so strongly entrenched himself on the Scanian coast in 1716 that his combined enemies shrank from attacking him, whereupon he assumed the offensive by attacking Norway in 1717, and again in 1718, in order to conquer sufficient territory to enable him to extort better terms from his enemies. It was during this second adventure that he met his death. On Dec. 11, when the Swedish approaches had come within 280 paces of the fortress of Fredriksten, which the Swedes were closely besieging, Charles looked over the parapet of the foremost trench, and was shot through the head.

(R. N. B.)

BIBLIOGRAPHY.—Charles XII., *Die eigenhändigen Briefe König Karls XII.* (1894); M. Weibull, *Sveriges Storhedstid* (1881); F. F. Carlson, *Sveriges Historia under Konungarne af Pfalziska Huset* (1883–85); Oscar II., *Några bidrag till Sveriges Krigshistoria åren 1711–1713* (1892); D. Krmann, "Historia ablegationis D. Krmann ad regem Sueciae Carolum XII.," in *Monumenta Hungariae Historica* vol. 33, 34 (Budapest, 1894); R. N. Bain, *Charles XII. and the Collapse of the Swedish Empire* (1895); *Bidrag til den Store Nordiske Krigs Historie* (official publ. Copenhagen, 1899–1900); G. Syveton, *Louis XIV. et Charles XII.* (1900); C. Hallendorff, *Karl XII. i Ukraina* (1915); N. Herlitz, *Studier över Carl XII.'s Politik 1703–04* (1916); R. Fåhraens, *Karl XI. och Karl XII.* in "Sverige's Historia" Series (1921); Ballagi Aladár, *XII. Károly és a svédek Atvonulási Magyarországon* (Budapest, 1922); A. Munthe, *Karl XII. och den Ryska Sjömakten* (1924); E. Godley, *Charles XII. of Sweden* (1928).

CHARLES XIII. (1748–1818), king of Sweden and Norway, the second son of Adolphus Frederick, king of Sweden, and Louisa Ulrica, sister of Frederick the Great, was born at Stockholm on Oct. 7, 1748. In 1772 he co-operated in the revolutionary plans of his brother Gustavus III. (*q.v.*). During the Russo-Swedish War of 1788 he served as admiral of the fleet at the battles of Hogland (June 17, 1788) and Öland (July 26, 1789). On the death of Gustavus III., Charles, now duke of Sudermania, acted as regent of Sweden till 1796; but the real ruler of the country was Gustaf Adolf Reuterholm (*q.v.*). These four years may be briefly described as alternations of fantastic Jacobinism and ruthless despotism. On the accession of Gustavus IV. (Nov. 1796), the duke became a mere cipher in politics till March 13, 1809, when those who had dethroned Gustavus IV. appointed him regent, and finally elected him king. But by this time he was prematurely decrepit, and Bernadotte (*see* CHARLES XIV.) took over the government as soon as he landed in Sweden (1810). By the union of 1814 Charles became the first king of Sweden and Norway. He married his cousin Hedwig Elizabeth Charlotte of Holstein-Gottorp (1759–1818), but their only child died in infancy (1798). Charles XIII., who for eight years had been king only in title, died on Feb. 5, 1818.

See *Sveriges Historia* vol. v. (1884); *Drottning Hedwig Charlottes Dagbokshandteckningar* (1898); Robert Nisbet Bain, *Gustavus III. and his Contemporaries* (1895); *ib. Scandinavia* (1905).

CHARLES XIV JOHN (CARL JOHAN; BERNADOTTE) (1763–1844), king of Sweden and Norway, born at Pau in the French province of Béarn, Jan. 26, 1763, was the son of Henri Bernadotte (1711–1780), an *avocat,* and Jeanne St. Jean (1725–1809). Several of the ancestors on each side had been weavers. The family name of Deu Pouey had been changed to Bernadotte in the early 17th century (after the name of a house taken over from the distaff side). He was baptized Jean, known as Jean Baptiste, and later added the name Jules; his regular signature was merely "J. Bernadotte." Of his childhood and youth it is known only that he was repeatedly ill, and that he probably attended a Benedictine school in Pau for at least a short period.

In 1780, five months after his father's death, Bernadotte enlisted in the army of Louis XVI, in the Royal-la-Marine regiment. In varied service he became successively grenadier, corporal, sergeant, quartermaster, sergeant major, and early in 1790 adjutant, the highest rank among noncommissioned officers. The Revolution created difficulties within the army and between army and citizenry, but Bernadotte stood staunchly for maintenance of authority and judicial processes—once leading a group of under-officers in defense of their colonel in a disagreement with revolutionary civil authorities. Soon legislation opened the way for non-nobles to become officers, and early in 1792 Bernadotte was elected a lieutenant (the commission was dated as of Nov. 6, 1791). He was attached to the 36th regiment and went into action along the Rhine with Adam Custine. In the defeat of May 17, 1793, a panic was begun when a group of volunteers fired on their own cavalry; Bernadotte sprang into the midst of the chaos, and with a fiery speech restored order and reorganized the battalion for the fight. Here he was at his best, in one of those fine gestures of self-forgetfulness to be repeated again and again in the crises of campaigns to come. He went through all the ranks, becoming captain in 1793, and in 1794 passing from lieutenant colonel to colonel, on to brigadier general and general of division (Oct. 22). He served in the army of the Sambre and Meuse with General Jean Baptiste Kléber (1794–95), and distinguished himself for his ability to inspire troops in desperate situations. In 1796 he campaigned in north Germany. Here, as in the Low Countries, he was marked as one of the disciplinarians of the

army, trying to save the population from plundering by soldiery and winning an unusual degree of respect from the inhabitants.

In 1797 came the first meeting between Bernadotte and Napoleon, when the general from the army of the Rhine led 20,000 troops to reinforce General Bonaparte in Italy. Both were proud and ambitious, but the Corsican was cool, unscrupulous, eager only for power; Bernadotte showed the characteristics of his Gascon forebears—vain, emotional, loyal, eager chiefly for glory. The two spectacular leaders seemed to sense rivalry and cross-purposes from the first, and the soldiers in their armies were none too friendly; the "citizens' army" of Bonaparte nicknamed the newcomers the "gentlemen" because of their superior smartness and discipline. Nevertheless, at the passage of the Tagliamento and the taking of Gradisca, Bernadotte and his proud division from the Rhine distinguished themselves for valour. After the campaign Bernadotte began a serious reading program, probably roused to do so by Bonaparte's superior knowledge of military science and history.

Though he was next slated to succeed Bonaparte in command of the army of Italy, both Bernadotte and the Austrians were shocked when he was named ambassador to Vienna. He was hardly a proper symbol of diplomatic reconciliation and he had no experience to fit him for the post. From January to April 1798 he did his soldier's best, but the mission ended on April 14 after a Viennese mob rioted against the embassy because of the hanging out of the tricolour.

Back in Paris the general and ambassador was free to enjoy for a time the delights of the salons of Mme. de Staël and Mme. Récamier, where he met the leading political and literary figures of the day. He also renewed acquaintance with the "pretty girl from Marseilles with the gay smile"—Désirée Clary—former fiancée of Joseph Bonaparte, of Napoleon and of Leonard Duphot. Her sister Julie had married Joseph Bonaparte, so that when Bernadotte married Désirée, Aug. 17, 1798, he came into the fringes of the Bonaparte clan.

In the fall of 1798 Bernadotte commanded the army of Mayence and arranged peace with Hesse-Darmstadt. He rejected the offer of command over the army of Italy because he considered the troops insufficient—as events proved them to be. He likewise refused the offer from Paul Barras to lead a *coup d'état* to force reconstitution of the Directory. In July 1799 the directors made him minister of war at a critical point in the fortunes of France. For ten weeks he applied his restless energy to problems of organization, recruiting and supply, but his growing fame and his constitutional scruples irritated Emmanuel-Joseph Sieyès, who engineered his removal. Bernadotte was thus out of office when Bonaparte returned from Egypt. Bonaparte asked his old colleague to join in his coup, but Bernadotte refused, promising only that he would take no initiative in opposition. On the success of the coup d'état of the 18th Brumaire, Bernadotte and Désirée went into brief hiding. He had been the most probable leader of the forces wishing to defend the Directory, but had passed up the chance to act by refusing to assume responsibility. Bernadotte was soon reconciled to the new regime, and from 1800 to 1810 was closely associated with the empire building of Napoleon, active in campaigns and administration, but repeatedly suspect because of his independent attitude and his connections with the opponents of the emperor. Bonaparte "absorbed" the Gascon general, as he did many of the potential opposition, by giving him position and prestige in the new regime.

Bernadotte became a councillor of state, and commander of the army of the west. He expected to defend Brittany from an attack by England, but found his job to be largely suppression of rebellion. Upon returning to Paris in the winter of 1801 he retired to Plombières because of suspicion directed against him on account of the Rennes plot. He was one of two or three generals most likely to be raised to high power if anything happened to Bonaparte; his unwillingness to co-operate in the Brumaire coup was well known; inevitably his name was discussed in connection with each successive plot against first consul or emperor. No evidence has been found to link him with any real plot, though it is clear that he would have favoured constitutional legislative action to limit the power of the first consul or even to overthrow him. Bonaparte was angry and suspicious and in Jan. 1803, in order to get Bernadotte out of the country, appointed him minister to the United States. While waiting to sail Bernadotte got wind of approaching war between France and England, so returned to Paris for an active military post. War was delayed and Bernadotte remained inactive in Paris for a year. Then Napoleon made himself emperor and Bernadotte declared full loyalty to him, having decided that nothing else was possible. He was named one of the 18 marshals of France (May 19, 1804) and early in June left for his new post as governor of Hanover. Here he was both military commander and civil administrative officer; in the combined capacity he showed executive skill and an ability to win the affection and respect of the citizenry. He showered privileges on the University of Göttingen and attempted in tax policy to ease the load of the poor and transfer the burden to the wealthy, including nobility and church. Here he began also to accumulate his small fortune, with "gifts" of 300,000 francs from Hanover and 200,000 francs from Bremen.

In 1805 the war with Austria became active and Bernadotte was ordered in August to lead his forces to Würzburg. He was given command of the I corps, including the Bavarian army. Difficulties with roads and boats and the inefficiency of the Bavarian forces delayed his march toward Vienna and brought reproaches from the emperor. Extraordinary marches brought the I corps to Austerlitz, where it occupied the centre. It played a relatively small role in the battle, partly because its cavalry had been transferred to Murat just before the battle. Bernadotte was annoyed, but Napoleon seemed pleased with him on this occasion. The next task given him (Feb. 19, 1806) was the occupation of Ansbach.

In accord with the imperial policy of naming outstanding generals to the new nobility, Bernadotte was made prince of Ponte Corvo, June 5, 1806. Ponte Corvo was an enclave of 5,600 inhabitants within the territory of the kingdom of Naples.

In October 1806 Bernadotte commanded a strengthened I corps of 15,000 to 21,000 men, including a French division under Pierre Dupont de L'Étang. Bernadotte did not participate actively in the conflicts at Jena or Auerstadt, and was blamed by Napoleon for not being where he should have been. Real responsibility for his absence rests upon Napoleon's unawareness of the Prussian position and upon the vagueness and indirectness of the orders of Marshal Louis Berthier, chief of staff. This in turn may have been caused by Berthier's personal antagonism to Bernadotte. After the battle Napoleon needed a scapegoat and used Bernadotte for the purpose. That he had no fundamental complaint is evidenced by the enlarged responsibility given to Bernadotte two months later—command over three corps which made up the left wing in the Polish campaign. In the meantime Bernadotte showed unusual energy and skill in the pursuit of the Prussians, especially at Halle and in the attack on Lübeck (where some 1,000 Swedish prisoners were taken, and tactful handling of whom was to pay dividends later). By tactics of speed and daring Bernadotte led his troops to a victory over the Russians at Mohrungen (Jan. 25, 1807), but missed the action at Eylau because of the capture of his orders. On June 5 he was wounded by a shot in the neck, and this kept him from the battle of Friedland.

On July 14, 1807, Bernadotte was named governor of the occupied Hanseatic cities. Again he was both administrator and commander, and asssumed the position of a viceroy. Soon he was scheduled to lead a combination of German, French and Spanish troops in an attack on Sweden. The emperor, who may not have intended the threat seriously, required a peculiar distribution of the troops. The total result was that the Spanish contingent deserted en masse and was carried off by English ships (Aug. 1808). The expedition against Sweden was abandoned, and French military power was once more directed against Austria. Bernadotte was ill at the beginning of the campaign with his recurrent blood-spitting. Further difficulties with Chief of Staff Louis Alexandre Berthier, and the inclusion in his IX corps of the ill-prepared Saxon allies combined with his illness to make him beg for release from service. Napoleon disregarded these appeals and Bernadotte organized his forces and proceeded with the campaign, commanding mostly allied troops, with few French. In the decisive battle at Wagram, Dupas' division was withdrawn without Bernadotte's knowledge and the marshal found himself with

depleted strength at the centre of the Austrian attack; in killed, wounded and missing he lost one-third of his soldiers and was forced to retire from the town of Wagram. As compensation for his bitterness and disappointment he issued on July 8, 1809, a bombastic order of the day exaggeratedly praising the skill and courage of the Saxon forces. Shortly before the battle he had stretched his authority to accede to an armistice for the Swedes. On July 10, perhaps partly as a penalty for these acts, the IX corps was dissolved, and Bernadotte was allowed to return to Paris "for reasons of health" but obviously in deep disfavour.

Bernadotte was therefore in Paris when word arrived (July 29, 1809) of the threatening British invasion at Walcheren. He offered his services, but the ministers, not clear as to his status, hesitated to put him in command. A despatch from Napoleon then ordered them to send Bernadotte if he was at hand. It is clear evidence of the emperor's confidence in the ability of the marshal despite their recent differences. Bernadotte went north immediately and ably organized the defense, though disease rather than force of arms proved the undoing of the British expedition. When the danger had disappeared and Bernadotte returned to Paris late in September political suspicions still surrounded him, and the minister of war tried to force him to go at once to a health resort—or presumably anywhere far from Paris. Bernadotte insisted on his right to live where he pleased, but yielded to an order to go to the emperor's headquarters in Vienna, where he remained Oct. 9–21, 1809. He then returned to Paris.

In the midst of this shadow and uncertainty came the dramatic call to a new life as crown prince and heir to the throne of Sweden. In 1809 Sweden had lost Finland to Russia; a palace revolution had overthrown King Gustav IV Adolf, and put on the throne the aged, childless Charles XIII, with the Danish Christian August as elected crown prince. In June 1810 the prince suddenly died, and Sweden, at the nadir of her fortunes, was forced again to seek a man to pilot the state and to be ready to succeed the ruler. It was natural to seek at least the advice of the master of Europe, then at the pinnacle of his power. Hence a delegation was despatched to Napoleon, but the emperor's peculiar reluctance to exert influence in this affair soon placed the initiative in the wholly unauthorized hands of baron Otto Mörner. Mörner was a young Swedish patriot who knew of Bernadotte's military career, his administration of Hanover and the Hansa towns, and his charitable treatment of Swedish prisoners. He contacted the marshal-prince and aroused his interest, then gained support from a few other Swedes in Paris. On his return to Sweden the government arrested him, but the fire had been lighted. The delegates to the special *Riksdag* in Örebro were influenced by the prince's military reputation and by the knowledge that his fortune would bolster the feeble Swedish *Riksbank*. Previous candidates were abandoned at the eleventh hour, and on Aug. 21, 1810, Bernadotte was elected crown prince. On Oct. 20 he accepted the Lutheran faith and landed in Sweden, there to establish the only enduring dynasty of the Napoleonic regime. Continuity in Sweden was maintained by his adoption as son by Charles XIII, and both king and queen were quickly charmed by the new heir, who took the name of Carl Johan (Charles John). The crown prince at once assumed actual leadership of the government and acted officially as regent during the prolonged illnesses of the king.

Foreign policy was of necessity the chief concern of Bernadotte's first years in Sweden. The majority of the people hoped for the reconquest of Finland and expected this to come by alliance with France. But a small group in the government looked instead to an annexation of Norway. Bernadotte himself, with vision undistorted by hereditary hatred of Russia, felt that any attempt to wrest Finland from the vast empire to the east would but perpetuate war and lead to the complete ruin of Sweden. Norway seemed to him a natural geographic and cultural unit with Sweden; he therefore bent every energy to make the Swedes forget Finland and build a peninsular Scandinavian state. He was guided also by three convictions: a belief in the inevitability of Napoleon's collapse; the idea that Sweden's economy demanded close ties with Great Britain and the smashing of the continental system; his personal need to achieve something for Sweden which would establish him and his family in power. Napoleon tried to deprive his ex-marshal of any opportunity to reorient Swedish policy, and on the heels of Bernadotte's departure sent a demand that Sweden declare war on Britain; Swedish Pomerania must cease to serve as a leak in the "continental system." In Nov. 1810 Sweden had no choice, but she declared war with her fingers crossed and fought it with her hands folded, in a tacit understanding with the English that there would be no shooting. Napoleonic annoyance at this state of affairs led at last to the sudden French occupation of Swedish Pomerania in Jan. 1812.

This attack on Swedish territory was all that was needed to disillusion the Francophile Swedes and win approval for Bernadotte's policy. Immediately negotiations began with Alexander of Russia for an alliance against Napoleon. This was concluded in April 1812, and in August Bernadotte and Alexander met in cordial conference at Åbo (Turku), Finland. Alexander pledged to send 35,000 men to help Bernadotte conquer Norway from Denmark, and Bernadotte pledged that as soon as this aim was accomplished he would lead an army to the continent to aid Russia against Napoleon. Russia at the least won the friendship of its age-old enemy at a critical moment, and Sweden won the first ally for her major political shift. Through the coming months, while the French were staggering back from the disaster of the Moscow campaign, Bernadotte tried to gain other allies. His services were so eagerly desired that Britain (March 1813) and Prussia (April 1813) signed the clauses hateful to them guaranteeing Sweden possession of Norway, and Britain granted a generous subsidy. Austria held aloof. The allies then brought combined pressure on Bernadotte to forego his right to get Norway at once and aid in the great campaign against Napoleon. Bernadotte agreed, and an extra war with Denmark was thus postponed. But the crown prince came to distrust the good faith of his allies, and antagonisms grew.

Bernadotte landed 30,000 men at Stralsund in May 1813, but withheld them from action because the promised Russian and Prussian troops had not yet been sent him. Russia and Prussia made a ten weeks' armistice with Napoleon on June 4 and all action was delayed. In the interim misunderstandings were alleviated, and at the general conference at Trachenberg in July Bernadotte mapped out what came to be the basic plan of campaign which led to Leipzig. The foreign contingents were given to Carl Johan, who became commander of all the forces in north Germany, the right wing of the sweeping semicircular offensive. Fighting was resumed on Aug. 17, 1813, and on Aug. 23 he disposed his forces for the defeat of Oudinot at Grossbeeren, Germany. The Prussians bore the brunt of battle and blamed Bernadotte for sparing his Swedes—which he frankly did. He considered the war in north Germany a primarily Prussian concern; he did not share the desire of the Germans to exterminate all Frenchmen; and he felt the need to save his Swedes for the war with Denmark—he therefore would not waste them. Hence at the battle of Dennewitz, Sept. 6, there was the same skilful and successful disposition of troops, and the Prussians again did the lion's share of fighting.

Gradually now the armies converged toward Leipzig, where on Oct. 16–19 was fought the decisive Battle of the Nations. Here again, though his preliminary movements were above reproach, he showed a reluctance to come to direct grips with the French. Obviously he could not afford to risk an allied defeat, yet he hoped that the other armies could accomplish the common object. Though he was not present the first day of the battle, his artillery took a prominent part on the second day (the 18th) and the Swedish infantry joined battle on the 19th.

After the battle at Leipzig Bernadotte decided that French defeat was assured and that he had better collect on the unrealized promises of his allies. On Oct. 29 he turned his armies north and in a rapid but unspectacular campaign forced Denmark to sue for peace. In the treaty of Kiel (Jan. 14, 1814) King Frederick VI of Denmark signed over Norway to the Swedish crown (the transfer did not include the overseas possessions). Swedish control was far from being established in Norway, but the insistence and threats of the allies could be no longer disregarded—Bernadotte had to move toward France.

Nevertheless, the army of the north got only to the Netherlands, and Bernadotte's headquarters were long in Liége. He seemed to move with leaden feet while the Austrians, the Russians and the eager Prussians battered Napoleon into abdication. Natural hesitancy to invade his homeland was heightened in Bernadotte's case by an irresistible ambition: to become king or "protector" in France on the overthrow of the emperor. The tsar encouraged the idea and friends such as Mme. de Stäel and Benjamin Constant urged it; ten years earlier he had been a logical choice for leadership by the opposition —why not now? He failed to realize how completely he was alienated from the French people. He failed to appreciate also that the victorious allies would not tolerate another military man at the head of the French state. Furthermore, he would not risk his comfortable position in Sweden by a bold stroke which might leave him with nothing. Hence his dream faded into thin air, and his brief visit to Paris after the armistice was far from glorious.

Difficulties in the north recalled him to duty. The Norwegians refused to recognize the treaty of Kiel: the king of Denmark was also king of Norway, but he had no right to transfer sovereignty. Some Norwegians desired union with Sweden, but most preferred to attempt independence. An assembly drew up the constitution of Eidsvold (May 17, 1814) and chose the Danish *Statholder* Christian Frederick as king. Bernadotte blamed Danish intrigue for the Norwegian opposition but hastened north determined to conquer the country directly.

With the reluctant but unwavering support of his allies he conducted an efficient and almost bloodless campaign. On Aug. 14 the Norwegians signed the convention of Moss and within the next few weeks arrangements were worked out which preserved the essential liberal principles of the Eidsvold constitution, the only real change being that which required that the king be the king of Sweden. At a time when military force could have established, temporarily at least, any regime it wished, it is significant that Bernadotte insisted on a humane and decidedly democratic settlement. Future conflicts of authority and opinion between parliament and king and between Norway and Sweden were often severe, but obviously 1814 definitely set Norway on the road to the complete independence which it realized in 1905. From the standpoint of Bernadotte and the Swedes much had been accomplished: retirement from Pomerania and from Finland took Sweden out of two areas of conflict; the connection with Norway prevented that land from being used again by Denmark as a place

from which to attack Sweden in the back. The long era of peace in the north from 1814 to 1940 is in itself evidence of the farsightedness of Bernadotte's "policy of 1812."

The 30 years following 1814 were fruitful ones for Bernadotte and for the kingdoms of Sweden and Norway, though they brought the inevitable tensions of a changing social, economic and political life. Bernadotte's ties with his old homeland were gradually cut. Prince Oscar, Bernadotte's only child (born 1799), had come to Sweden with his mother in 1811 (January) and was reared as a Swede. Désirée, however, had returned to Paris and did not come to Sweden to stay until 1823, on the occasion of Prince Oscar's betrothal and marriage (to Princess Josephine, daughter of Eugene de Beauharnais, granddaughter of the king of Bavaria). Through this marriage and its issue the Bernadotte dynasty was destined to continue in Sweden, long-lived and prolific. Though actually the most influential figure in the state from 1810 on, Bernadotte did not acquire the royal title until Feb. 5, 1818, upon the death of Charles XIII.

Having achieved the great goal of his foreign policy, the aim of Bernadotte after 1814 was to retain his position. During the period of the Congress of Vienna there were those who thought that the parvenu prince should be sacrificed to the principle of legitimacy. Prince Clemens W. N. Lothar von Metternich, Louis XVIII, and later Charles X of France were hostile, and the sons of the deposed Gustav IV Adolf were potential troublemakers. But the friendship of Tsars Alexander and Nicholas, and the support of the British government, both based upon recognition of Bernadotte's services and the legality of his position, left his status undisturbed. During the "Hundred Days" of 1815 Bernadotte watched events with keen interest, but avoided involvement.

The dispute with Denmark over the debt settlement and the conflict with Russia over the Norwegian-Russian frontier were arranged by compromise, and relations with Russia were maintained on a basis of mutual respect—plus watchfulness. Toward Britain the former French marshal changed his attitude when he changed his responsibilities, for he recognized the vital importance to Sweden and Norway of British trade and of the British navy.

A man trained for the battlefield and habituated to command inevitably had some difficulties adjusting himself to the procedure of councils and parliaments. His republican ideals and his common sense had many times to check his autocratic tendencies and his feeling that he alone was right. His failure to learn Swedish made his work more difficult and his mind more suspicious. He wanted to control things himself. Hence he tried to strengthen the merely suspensive veto he had over the legislation of the Norwegian *Storting,* and he exercised a conservative influence in Sweden. Yet when the opposition was really strong he knew how to yield or to compromise. His experience, his knowledge and his magnetic personal charm gave him a power in the state far outweighing that of any of the statesmen of the north in his day; his conscientious attention to the duties of kingship gave him a real mastery over the affairs of state, and won him the admiration and love of the common people.

Norway resented the method by which union had been achieved, and bitter internal controversies arose over questions like payment of the national debt, the celebration of May 17 (the Eidsvold constitution) and the abolition of the nobility. On Norway's responsibility to pay the agreed share of the Danish debt Bernadotte was adamant and even threatened the use of the military to force submission. On the questions of May 17 and the abolition of the nobility he yielded with fear and ill grace to the will of the Norwegian people. Again and again in such cases he would defy and threaten, then adapt himself to necessity. His impulsive gasconades led many both then and since to think of him as emotionally unstable. But always, though bold in talk, he was cautious and farsighted in action. Through royal yielding to pressures which were really strong the democratic processes and forces steadily matured.

Bernadotte was keenly interested in the welfare of the people as a whole and provided a stimulating though paternalistic leadership. He encouraged the founding of the Academy of Agriculture in 1811, was largely responsible for the rebuilding of the great library at the University of Uppsala, and for the spread of popular education. When he first went north he feared that "cognac would be the ruin of the Swedish people" and in the 1830s was able to give strong support to Per Wieselgren and the temperance movement. He likewise promoted medical education and the physical education program of P. H. Ling. National finance was one of his primary interests and he vigorously supported such projects as Platen's famous Göta canal.

Opposition to the king's autocratic methods and dominating position in Swedish life led to demands for his abdication in the late 1830s, and to some republican agitation. But he rode out the storm in Sweden as he had already done in Norway, and at the jubilee in 1843 his peoples were united in sincere expressions of admiration and gratitude to the "grand old man" of the north. When he died, aged 81, March 8, 1844, he left two kingdoms vastly stronger, more prosperous and more populous than in 1810, and a new dynasty firmly entrenched.

BIBLIOGRAPHY.—B. Sarrans, Jeune, *Histoire de Bernadotte, Charles XIV Jean* (2 vol., Paris, 1845); B. von Schinkel (ed. by C. W. Bergman and S. J. Boëthius), *Minnen ur Sveriges nyare historia* (12 vol. plus 3, Stockholm and Uppsala, 1855–93); Yngvar Nielsen, *Carl Johan som han virkelig var* (Christiania [Oslo], 1897); J. E. Sars, *Norges politiske historia* (Christiania, 1899); C. Schefer, *Bernadotte roi* (1899); Léonce Pingaud, *Bernadotte, Napoleon et les Bourbons 1797–1844* (Paris, 1901); *Correspondance inédite de l'Empereur Alexandre et de Bernadotte pendant l'année 1812* (1909); Sir Dunbar Plunkett Barton, *Bernadotte, the First Phase* (1914), *Bernadotte and Napoleon 1763–1810* (1921), *Bernadotte, Prince and King* (1925), and *The Amazing Career of Bernadotte* (1929); S. Clason, *Karl XIII och Karl XIV Johan* (vol. XI of *Sveriges Historia,* Stockholm, 1923); F. W. Morén, *Kring 1812 års politik* (Stockholm, 1927); Franklin D. Scott, *Bernadotte and the Fall of Napoleon* (1935); T. T. Höjer, *Carl XIV Johan, den franska tiden* (first of a three volume definitive biography, Stockholm, 1939). (F. D. S.)

CHARLES XV. (1826–1872), king of Sweden and Norway, eldest son of Oscar I., king of Sweden and Norway, and Josephine Beauharnais of Leuchtenberg, was born on May 3, 1826. On June 19, 1850, he married Louisa, daughter of Prince Frederick of the Netherlands. He became regent on Sept. 25, 1857, and king on the death of his father (July 8, 1859). His reign was remarkable for its manifold and far-reaching reforms. Sweden's existing communal law (1862), ecclesiastical law (1863) and criminal law (1864) were enacted. Charles XV. also materially assisted De Geer (*q.v.*) to carry through his memorable reform of the diet in 1865. Charles was a warm advocate of "pan-Scandinavianism" and the political solidarity of the three northern kingdoms, and his enthusiasm led him to give half promises of help to Denmark on the eve of the war of 1864. In view, however, of the unpreparedness of the Swedish army and the absence of support from any of the powers, Charles was forced to observe a strict neutrality. He died at Malmö on Sept. 18, 1872. Charles XV. enjoyed an unusual degree of popularity in both his kingdoms. He was an amateur painter and his *Dikter* show him to have been a true poet. He left one child, a daughter, Louisa Josephina Eugenia, who in 1869 married the crown prince Frederick of Denmark.

See C. Bååth-Holmberg, *Carl XV., som enskild man, konung och konstnär* (Stockholm, 1891); Yngvar Nielsen, *Det norske og svenske Kongehus fra 1818* (Christiania [Oslo], 1883).

CHARLES (KARL ALEXANDER) (1712–1780), prince of Lorraine, the youngest son of Leopold, duke of Lorraine, and grandson of Charles V., duke of Lorraine (*see* p. 289), was born at Lunéville on Dec. 12, 1712. After his elder brother Francis, the duke, had exchanged Lorraine for Tuscany and married Maria Theresa, Charles became an Austrian officer, and he served in the campaigns of 1737 and 1738 against the Turks. At the outbreak of the Silesian wars in 1740 (*see* AUSTRIAN SUCCESSION, WAR OF THE), the queen made her brother-in-law a field marshal, and in 1742 Charles encountered Frederick the Great for the first time at the battle of Chotusitz (May 17). He conducted the successful campaign of 1743 against the French and Bavarians. He married, Jan. 1744, Marianne of Austria (died in 1744), sister of Maria Theresa, who made them jointly governors-general of the Austrian Netherlands. When the war broke out afresh, Charles, at the head of the Austrian army on the Rhine, crossed that river, but on Frederick's resumption of the Silesian war he hurried to Bohemia, whence, aided by the advice of the veteran field marshal Traun, he quickly expelled the Prussians. He took the field again in 1745 in Silesia, but this time without the advice of Traun, and he was twice severely defeated by Frederick, at Hohenfriedberg and at Soor. Subsequently, as commander-in-chief in the Low Countries he received, at Roucoux, a heavy defeat at the hands of Marshal Saxe. His government of the Austrian Netherlands during the peace of 1749–56 was marked by many reforms. After the first reverses of the Seven Years' War (*q.v.*), Maria Theresa called Charles again to the supreme command in the field. The campaign of 1757 opened with Frederick's great victory of Prague, and Prince Charles was shut up with his army in that fortress. In the victory of the relieving army under Daun at Kolin Charles had no part, but he won the battle of Breslau, and great enthusiasm was displayed in Austria over the victory, which seemed to be the final blow to Frederick. But soon afterwards the king of Prussia routed the French at Rossbach, and, swiftly returning to Silesia, he inflicted on Charles the complete and crushing defeat of Leuthen (Dec. 5, 1757). A mere remnant of the Austrian army reassembled after the pursuit, and Charles was relieved of his command. For a year thereafter Prince Charles acted as a military adviser at

Vienna, he then returned to Brussels, where he continued to govern till his death on July 4, 1780, at the castle of Tervueren.

See L. Percy, *Charles de Lorraine et la cour de Bruxelles sous le règne de Marie Thérèse* (1903).

CHARLES (1421–1461), prince of Viana, sometimes called Charles IV., king of Navarre, was the son of John, afterwards John II., king of Aragon, by his marriage with Blanche, daughter of Charles III. of Navarre. Both his grandfather Charles and his mother, who ruled over Navarre, had bequeathed this kingdom to Charles, whose right had also been recognized by the Cortes; but when Blanche died in 1441 her husband John seized the government. The ill-feeling between father and son was increased when in 1447 John took for his second wife Joanna Henriquez, a Castilian princess, who bore him a son, afterwards Ferdinand I., king of Spain. When Joanna began to interfere in the internal affairs of Navarre civil war broke out; and in 1452 Charles, although aided by John II., king of Castile, was taken prisoner. Released upon promising not to take the kingly title until after his father's death, the prince, again unsuccessful in an appeal to arms, took refuge in Italy with Alphonso V., king of Aragon, Naples and Sicily. In 1458 Alphonso died and John became king of Aragon, while Charles was offered Naples and Sicily. He declined these proposals, and having been reconciled with his father returned to Navarre in 1459. Aspiring to marry a Castilian princess, he was thrown into prison by his father; the Catalans rose in his favour, and John was obliged to yield. Charles was recognized as perpetual governor of Catalonia and heir to the kingdom, but he died on Sept. 23, 1461. Charles was a cultured prince; he translated the *Ethics* of Aristotle into Spanish (Saragossa, 1509) and wrote a chronicle of the kings of Navarre, *Crónica de los reyes de Navarra*, an edition of which, edited by J. Yangues y Miranda, was published at Pampeluna (1843).

See G. Desdevises du Dézert, *Carlos d'Aragon* (Paris, 1889).

CHARLES [Karl Ludwig] (1771–1847), archduke of Austria and duke of Teschen, third son of the emperor Leopold II., was born at Florence (his father being then grand-duke of Tuscany) on Sept. 5, 1771. His youth was spent in Tuscany, at Vienna and in the Austrian Netherlands, where he began his career of military service in the war of the French Revolution. He commanded a brigade at Jemappes, and in the campaign of 1793 distinguished himself at the action of Aldenhoven and the battle of Neerwinden. In this year he became *Statthalter* in Belgium and received the army rank of lieutenant field marshal, which promotion was soon followed by that to *Feldzeugmeister* (master of ordnance). In the remainder of the war in the Low Countries he held high commands, and he was present at Fleurus. In 1795 he served on the Rhine, and in the following year was entrusted with the chief control of all the Austrian forces on that river. His conduct of the operations against Jourdan and Moreau in 1796 marked him out at once as one of the greatest generals in Europe. At first falling back carefully and avoiding a decision, he finally marched away, leaving a mere screen in front of Moreau; falling upon Jourdan he beat him in the battles of Amberg and Würzburg, and drove him over the Rhine with great loss. He then turned upon Moreau's army, which he defeated and forced out of Germany. For this campaign, one of the most brilliant in modern history, *see* French Revolutionary Wars. In 1797 he was sent to arrest the victorious march of Gen. Bonaparte in Italy, and he conducted the retreat of the over-matched Austrians with the highest skill. In the campaign of 1799 he was once more opposed to Jourdan, whom he defeated in the battles of Osterach and Stokach, following up his success by invading Switzerland and defeating Masséna in the (first) battle of Zürich, after which he re-entered Germany and drove the French once more over the Rhine. Ill-health, however, forced him to retire to Bohemia, whence he was soon recalled to undertake the task of checking Moreau's advance on Vienna. The result of the battle of Hohenlinden had, however, foredoomed the attempt, and the archduke had to make the armistice of Steyer. His popularity was now such that the diet of Ratisbon, which met in 1802, resolved to erect a statue in his honour and to give him the title of saviour of his country; but Charles refused both distinctions.

In the short and disastrous war of 1805 the archduke Charles commanded what was intended to be the main army, in Italy, but events made Germany the decisive theatre of operations, and the defeats sustained on the Danube neutralized the success obtained by the archduke over Masséna in the desperately fought battle of Caldiero. With the conclusion of peace began his active work of army reorganization, which was first tested on the field in 1809. As generalissimo of the army he had been made field marshal some years before. As president of the Council of War, and supported by the prestige of being the only general who had proved capable of defeating the French, he promptly initiated a far-reaching scheme of reform, which replaced the obsolete methods of the 18th century, the chief characteristics of the new order being the adoption of the "nation in arms" principle and of the French war organization and tactics. The new army was surprised in the process of transition by the war of 1809, of which Charles was commander in chief; yet even so it proved a far more formidable opponent than the old, and, against the now heterogeneous army which Napoleon controlled (*see* Napoleonic Campaigns) it succumbed only after a desperate struggle. Its initial successes were neutralized by the reverses of Abensberg, Landshut and Eckmühl; but, after the evacuation of Vienna, the archduke won the great battle of Aspern-Essling (*q.v.*) and soon afterwards fought the still more desperate battle of Wagram (*q.v.*), at the close of which the Austrians were defeated but not routed; they had inflicted upon Napoleon a loss of over 50,000 men in the two battles. At the end of the campaign the archduke gave up all his military offices, and spent the rest of his life in retirement, except a short time in 1815, when he was governor of Mainz. In 1822 he succeeded to the duchy of Saxe-Teschen. The archduke Charles married, in 1815, Princess Henrietta of Nassau-Weilburg (d. 1829). He had four sons, the eldest of whom, the archduke Albert (*q.v.*) became one of the most celebrated generals in Europe, and two daughters, the elder of whom became queen of Naples. He died at Vienna on April 30, 1847.

The caution which the archduke preached so earnestly in his strategical works, he displayed in practice only when the situation seemed to demand it, though his education certainly prejudiced him in favour of the defensive at all costs. He was at the same time capable of forming and executing the most daring offensive strategy, and his tactical skill in the handling of troops, whether in wide turning movements, as at Würzburg and Zürich, or in masses, as at Aspern and Wagram, was certainly equal to that of any leader of his time, Napoleon only excepted. The campaign of 1796 is considered almost faultless. That he sustained defeat in 1809 was due in part to the great numerical superiority of the French and their allies, and in part to the condition of his newly reorganized troops. His six weeks' inaction after the victory of Aspern is, however, open to unfavourable criticism. As a military writer, his position in the evolution of the art of war is very important, and his doctrines had naturally the greatest weight. Nevertheless they cannot but be considered as antiquated even in 1806. Caution and the importance of "strategic points" are the chief features of his system. The rigidity of his geographical strategy may be gathered from the direction that "this principle is *never* to be departed from." Again and again he repeats the advice that nothing should be hazarded unless one's army is *completely* secure, a rule which he himself neglected with such brilliant results in 1796. In his tactical writings the same spirit is conspicuous. His reserve in battle is designed to "cover a retreat." The baneful influence of these principles was shown in the maintenance of Königgrätz-Josefstadt in 1866 as a "strategic point," which was preferred to the defeat of the separated Prussian armies; in the strange plans produced in Vienna for the campaign of 1859, and in the "almost unintelligible" battle of Montebello in the same year. The theory and the practice of the archduke Charles form one of the most curious contrasts in military history. In the one he is often unreal, in the other he displayed, besides great skill, a vivid activity which made him for long the most formidable opponent of Napoleon.

His writings were edited by the archduke Albert and his brother

the archduke William in the *Ausgewählte Schriften seiner Kgl. Hoheit Erzh. Karl v. Österreich* (1862; reprinted 1893, Vienna and Leipzig), which includes the *Grundsätze der Kriegskunst für die Generäle* (1806), *Grundsätze der Strategie erläutert durch die Darstellung des Feldzugs 1796* (1814), *Gesch. des Feldzugs von 1799* (1819)—the two latter invaluable contributions to the history of the war, and papers "on the higher art of war," etc. *See*, besides the histories of the period, F. J. A. Schneidawind, *Karl, Erzherzog v. Österr. und die österr. Armee* (Vienna, 1840) and *Das Buch vom Erzh. Karl* (1848); Ed. Duller, *Erzh. Karl von Österr.* (1845–47); H. von Zeissberg, *Erzh. Karl von Österr.* (Vienna, 1893); C. von Binder-Krieglstein, *Geist und Stoff im Kriege* (Vienna, 1893); M. E. von Angeli, *Erzherzog Karl als Feldherr und Heere-organisator* (5 vols., Vienna and Leipzig, 1896–97); R. V. Caemmerer, *Development of Strategical Science*, Eng. trans. by Karl von Donat. ch. iv. (1905).

CHARLES (*c.* 1319–1364), duke of Brittany, known as CHARLES OF BLOIS and CHARLES OF CHÂTILLON, was the son of Guy of Châtillon, count of Blois (d. 1342), and of Marguerite of Valois, sister of Philip VI. of France. In 1337 he married Jeanne of Penthièvre (d. 1384), daughter of Guy of Brittany, count of Penthièvre (d. 1331), and thus acquired a right to the succession of the duchy of Brittany. On the death of John III. duke of Brittany, in April 1341, his brother John, count of Montfort-l'Amaury, and his niece Jeanne, wife of Charles of Blois, disputed the succession. Charles of Blois, sustained by Philip VI., captured John of Montfort, who was supported by King Edward III. at Nantes, besieged his wife Jeanne of Flanders at Hennebont, and took Quimper and Guérande (1344). But next year his partisans were defeated at Cadoret, and in June 1347 he was himself wounded and taken prisoner at Roche-Derrien. He was not liberated until 1356, when he continued the war against the young John of Montfort, and perished in the battle of Auray, on Sept. 29, 1364.

See Simeon Luce, *Histoire de Bertrand du Guesclin et de son époque* (1876); also *Monuments du procès de canonization du bienheureux Charles de Blois, duc de Bretagne, 1320–64* (Saint-Brieux, 1921).

CHARLES, called THE BOLD (1433–1477), duke of Burgundy, son of Philip the Good of Burgundy and Isabella of Portugal, was born at Dijon on Nov. 10, 1433. In his father's lifetime he bore the title of count of Charolais. He was brought up under the direction of the seigneur d'Auxy. Although he was on familiar terms with the dauphin (afterwards Louis XI.), when the latter was a refugee at the court of Burgundy, he was annoyed by the repurchase by the king of France of the towns on the Somme, which had been temporarily ceded to Philip the Good by the treaty of Arras; and when he took over the government (which his father abandoned to him completely by an act of April 12, 1465), he entered upon his lifelong struggle against Louis XI., and became one of the principal leaders of the League of the Public Weal. His brilliant bravery at the battle of Montlhéry (July 16, 1465), did not assure a diplomatic victory. He succeeded, however, in forcing upon Louis the treaty of Conflans (1465), by which the king restored to him the towns on the Somme, and promised him the hand of his infant daughter Catherine, with Champagne as dowry. In the meanwhile the count of Charolais obtained the surrender of Ponthieu. The revolt of Liége and Dinant intervened to divert his attention from the affairs of France. On Aug. 25, 1466 Charles took Dinant, which he pillaged and sacked, and then treated with the Liégeois. After the death of Philip the Good (June 15, 1467), the Liégeois renewed hostilities, but Charles defeated them at St. Trond, and made a victorious entry into Liége.

Louis then requested a meeting with Charles and placed himself in his hands at Péronne. In the course of the negotiations the duke was informed of a fresh revolt of the Liégeois secretly fomented by Louis, but Charles decided to respect the parole he had given and to treat with Louis (Oct. 1468), at the same time forcing him to assist in quelling the revolt. The town was carried by assault, and the inhabitants were massacred, Louis not having the courage to intervene on behalf of his ancient allies. At the expiry of the one year's truce which followed the treaty of Péronne, the king accused Charles of treason, cited him to appear before the parlement, and seized some of the towns on the Somme (1471). The duke retaliated by invading France with a large army, taking possession of Nesle and massacring its inhabitants. He failed in an attack on Beauvais, but ravaged the country as far as Rouen.

Since the beginning of his reign Charles had employed himself in reorganizing his army and the administration of his territories. He lost no opportunity to extend his power. In 1469 the archduke of Austria, Sigismund, had sold him the county of Ferrette, and the landgraviate of Alsace and some other towns, reserving to himself the right to repurchase. In 1472–1473 Charles bought the reversion of the duchy of Gelderland from its old duke, Arnold. He conceived the project of forming a kingdom of Burgundy or Arles with himself as independent sovereign, and even persuaded the emperor Frederick to assent to crown him king at Trier. The ceremony, however, did not take place owing to the emperor's precipitate flight by night (Sept. 1473), occasioned by his displeasure at the duke's attitude. In the following year Charles involved himself in a series of quarrels which ultimately brought about his downfall. He embroiled himself successively with Sigismund of Austria, to whom he refused to restore his possessions in Alsace for the stipulated sum; with the Swiss, who supported the free towns of Alsace in their revolt against the tyranny of the ducal governor, Peter von Hagenbach (who was condemned and executed by the rebels in May 1474); and finally, with René of Lorraine, with whom he disputed the succession of Lorraine, the possession of which had united the two principal portions of Charles's territories—Flanders and the duchy and county of Burgundy. All these enemies, incited and supported as they were by Louis, were not long in joining forces against their common adversary. Charles suffered a first rebuff in endeavouring to protect his kinsman, the archbishop of Cologne, against his rebel subjects. He spent ten months (July 1474–June 1475) in besieging the little town of Neuss on the Rhine, but was compelled by the approach of a powerful imperial army to raise the siege. Moreover, the expedition he had persuaded his brother-in-law, Edward IV. of England, to undertake against Louis was stopped by the treaty of Picquigny (Aug. 29, 1475). He was more successful in Lorraine, where he seized Nancy (Nov. 30, 1475). From Nancy he marched against the Swiss, hanging and drowning the garrison of Granson in spite of the capitulation. Some days later, however, he was attacked before Granson by the confederate army and was compelled to fly with a handful of attendants, leaving his artillery and an immense booty in the hands of the allies (Feb. 1476). He succeeded in raising a fresh army of 30,000 men, with which he attacked Morat, but he was again defeated by the Swiss army, assisted by the cavalry of René of Lorraine (June 22, 1476). On Oct. 6th Charles lost Nancy, which was re-entered by René. Making a last effort, Charles formed a new army and arrived in the depth of winter before the walls of Nancy. Having lost many of his troops through the severe cold, it was with only a few thousand men that he met the joint forces of the Lorrainers and the Swiss, who had come to the relief of the town (Jan. 6, 1477). He himself perished in the fight, his mutilated body being discovered some days afterwards.

Charles the Bold has often been regarded as the last representative of the feudal spirit, and accordingly has often been contrasted with his rival Louis XI. as representing modern politics. In reality, he was a prince of wide knowledge and culture and austere morals; and although he cannot be acquitted of occasional harshness, he had the secret of winning the hearts of his subjects, who never refused him their support in times of difficulty. He was thrice married—to Catherine (d. 1446), daughter of Charles VII. of France; to Isabella (d. 1465), daughter of Charles I., duke of Bourbon, by whom he had one daughter, Mary, afterwards the wife of the Emperor Maximilian I.; and to Margaret of York, sister of Edward IV. of England, whom he married in 1468.

See *Mémoires* of Philippe de Comines, and of Olivier de la Marche. *See* also A. Molinier, *Les Sources de l'histoire de France*, tome iv. (1904), and the compendious bibliography in U. Chevalier's *Répertoire des sources historiques*, part iii. (1904); J. F. Kirk, *Charles the Bold* (1863–68); L. M. J. Chaumont, *Charles-le-Hardi* (1904); and R. Putnam, *Charles the Bold* (1908).

CHARLES I. (*c.* 950–*c.* 992), duke of Lower Lorraine, was a younger son of the Frankish king Louis IV., and consequently a member of the Carolingian family. In 977 he received from the emperor Otto II. the duchy of Lower Lorraine, where his authority was nominal; but he aided Otto in his struggle with

Lothair, and on the death of his nephew, Louis V., made an effort to secure the Frankish crown. Hugh Capet, however, was the successful candidate and war broke out. Charles had gained some successes and had captured Reims, when in 991 he was treacherously seized by Adalberon, bishop of Laon, and handed over to Hugh. Imprisoned with his wife and children at Orleans, Charles did not long survive his humiliation. His eldest son Otto, duke of Lower Lorraine, died in 1005.

See F. Lot, *Les derniers Carolingiens, Lothaire, Louis V., Charles de Lorraine 954–991* (1891).

CHARLES II. (d. 1431), duke of Lorraine, called THE BOLD, is sometimes referred to as Charles I. A son of Duke John I., he succeeded his father in 1390; but he neglected his duchy and passed his life in warfare. He died on Jan. 25, 1431, leaving two daughters, one of whom, Isabella (d. 1453) married René I. of Anjou (1409–80), king of Naples, who succeeded his father-in-law as duke of Lorraine.

CHARLES III. or **II.** (1543–1608), called THE GREAT, duke of Lorraine, was a son of Duke Francis I. (d. 1545), and a descendant of René of Anjou. Born at Nancy on Feb. 18, 1543, he was brought up at the court of Henry II. of France, marrying Henry's daughter Claude in 1559. He took part in the wars of religion in France, and was a member of the League. The duke, who was an excellent ruler of Lorraine, died at Nancy on May 14, 1608. He had three sons: Henry (d. 1624) and Francis (d. 1632), who became in turn dukes of Lorraine, and Charles (d. 1607), bishop of Metz and Strasbourg.

CHARLES IV. or **III.** (1604–1675), duke of Lorraine, son of Duke Francis II., was born at Nancy on April 5, 1604. He became duke on the abdication of his father, and obtained the duchy of Bar through his marriage with his cousin Nicole, daughter of Duke Henry II. Mixing in the tortuous politics of his time, he was perpetually intriguing against the crown of France. In 1627 he began negotiations with England against Louis XIII., at the same time giving assistance to Austria against the Swedes. In 1632 Louis XIII. entered his duchy and compelled him to sign the treaty of Liverdun (June 26th) and in the following year a fresh intrigue was punished by the cession of Nancy to France for four years. On Jan. 19, 1634, the duke abdicated in favour of his brother, the cardinal, Francis of Lorraine, and entered the imperial service. He was banished from the kingdom, and the duchy of Bar was confiscated. Charles took part in the battle of Nordlingen in 1634, and fought in Lorraine, Alsace and Artois; on March 29, 1641, by the treaty of Saint-Germain his duchies were restored to him in return for the cession of certain towns to France, but they were seized again, and declared neutral in June, 1644. After this Charles served with the imperialists, and later with Spain. In 1652 he joined Condé in the war of the Fronde, but was arrested by the Spaniards, with whom he had broken faith, and imprisoned at Antwerp and at Toledo. At the peace of the Pyrenees he was restored to liberty and to his duchies, but by the treaty of Montmartre (Feb. 6, 1662), he sold them to Louis XIV. This arrangement was annulled by the treaty of Nomény, in August 1663. In Sept. 1670 Charles was again expelled from his duchy by Marshal Créquy, and in 1673 he joined the second coalition against France. Turenne inflicted a severe defeat on him at Sinzheim in 1674, but on August 11, 1675, Charles was victorious at Konzerbrücke. He died some weeks later at Larbach on Sept. 18, 1675, leaving by his second wife, Béatrix de Cusance, a son, Charles Henry, count of Vaudemont (1642–1723).

See Des Roberts, *Campagnes de Charles IV. duc de Lorraine et de Bar, 1638–48* (2 vols., 1883–88), and *Charles IV. et Mazarin* (1899).

CHARLES V. or **IV.** (1643–1690), duke of Lorraine, nephew of Duke Charles IV., was born on April 3, 1643. He was constantly on active service in the imperial army against the Turks, and later against the French. He was twice (1668 and 1674) an unsuccessful candidate for the elective crown of Poland, being defeated the second time by John Sobieski; in 1678 he married the widowed queen of Poland, Eleonora Maria of Austria. In 1675, on the death of Duke Charles IV., he rode with a cavalry corps into the duchy of Lorraine, then occupied by the French, and secured the adhesion of the Lorraine troops. Soon after this he was made general of the imperial army on the Rhine, and distinguished himself by the capture of Philipsburg in 1676. At the general peace Charles had to accept the hard conditions imposed by Louis XIV., and he never entered into effective possession of his sovereignty. In 1683, at the head of a weak imperial army, he offered resistance to the advance of the Turks on Vienna. At the critical moment, when the Turks finally invested Vienna on July 13, 1683, reinforcements from other powers poured into Charles's camp, and with the aid of John Sobieski and his 27,000 Poles, Charles routed the Turks on Sept. 12, and relieved Vienna. The victors then took the offensive and reconquered part of Hungary; the Germans and Poles went home in the winter, but Charles continued his offensive with the imperial army alone. In 1685 Neuhäusel was taken by storm, and in 1686 he resumed the siege of Ofen (Buda), which he had failed to take in 1684. On Sept. 2, 1686, Ofen was stormed, and in the following campaign the Austrians won a decisive victory on the famous field of Mohacs (Aug. 18, 1687). In 1689 Charles took the field on the Rhine against Louis XIV. Mainz and Bonn were taken in the first campaign, but Charles died suddenly, on his way to the front, at Wels on April 18, 1690. His eldest son, Leopold Joseph (1679–1729), obtained the duchy at the peace of Ryswick in 1697.

CHARLES II. (CHARLES LOUIS DE BOURBON) (1799–1883), duke of Parma, succeeded his mother, Maria Louisa in the duchy of Lucca in 1824. He introduced economy into the administration, increased the schools, and in 1832 became a Protestant. In 1842 he returned to the Catholic Church and made Thomas Ward, an English groom, his prime minister, a man not without ability and tact. In 1847 he declared himself hostile to the reforms introduced by Pius IX. The Lucchesi demanded the constitution of 1805, promised them by the Treaty of Vienna, and a national guard, but the duke, in spite of the warnings of Ward, refused all concessions. A few weeks later he sold his life-interest in the duchy to Tuscany. On Oct. 17 Maria Louisa of Austria, duchess of Parma, died, and Charles Louis succeeded to her throne by the terms of the Florence treaty, assuming the style of Charles II. His administration of Parma was characterized by ruinous finance, debts, disorder and increased taxation, and he concluded an offensive and defensive alliance with Austria. After the outbreak of the revolution in 1848, he abdicated in April and left Parma in the hands of a provisional Government, whereupon the people voted for union with Piedmont. Later Charles II. issued an edict from Weistropp annulling the acts of the provisional Government.

In May 1849 Charles confirmed his abdication, and was succeeded by his son CHARLES III. (1823–1854), who, protected by Austrian troops, placed Parma under martial law, inflicted heavy penalties on the members of the late provisional Government, closed the university and instituted a regular policy of persecution. A violent ruler, a drunkard and a libertine, he was assassinated on March 26, 1854. At his death his widow Maria Louisa, sister of the comte de Chambord, became regent during the minority of his son Robert. The duchess introduced some sort of order into the administration, seemed inclined to rule more mildly and dismissed some of her husband's more obnoxious ministers, but the riots of the Mazzinians in July 1854 were repressed with ruthless severity, and the rest of her reign was characterized by political trials, executions and imprisonments, to which the revolutionists replied with assassinations.

BIBLIOGRAPHY.—Massei, *Storia civile di Lucca,* vol. ii. (Lucca, 1878); Anon., *Y Borboni di Parma . . . del 1847 al 1859* (Parma, 1860); N. Bianchi, *Storia della diplomazia europea in Italia* (Turin, 1865, etc.); C. Tivaroni, *L'Italia sotto il dominio austriaco,* ii. 96–101, i. 590–605 (Turin, 1892) and *L'Italia degli Italiani,* i. (Turin, 1895); S. Lottici and G. Sitti, *Bibliografia generale per la storia parmense* (Parma, 1904).

CHARLES (1270–1325), count of Valois, of Maine, and of Anjou, third son of Philip III., king of France, was born on March 12, 1270. He inherited the four lordships of Crépy, La Ferté-Milon, Pierrefonds and Béthisy, which together formed the countship of Valois. In 1284 Martin IV., having excommunicated Pedro III., king of Aragon, offered that kingdom to Charles. King

Philip failed in an attempt to place his son on this throne, and died on the return of the expedition. In 1290 Charles married Margaret, daughter of Charles II., king of Naples, and renounced his pretensions to Aragon. In 1294, at the beginning of the hostilities against England, he invaded Guienne and took La Réole and Saint-Sever. During the war with Flanders (1300), he took Douai, Béthune and Dam, received the submission of Guy of Dampierre, and aided King Philip IV., the Fair, to gain the battle of Mons-en-Pévèle, on Aug. 18, 1304. Asked by Boniface VIII. for his aid against the Ghibellines, he crossed the Alps in June 1301, entered Florence, and helped Charles II., the Lame, king of Sicily, to reconquer Calabria and Apulia from the house of Aragon, but was defeated in Sicily. As after the death of his first wife Charles had married Catherine de Courtenay, a granddaughter of Baldwin II., the last Latin emperor of Constantinople, he tried to assert his rights to that throne. Philip the Fair also wished to get him elected emperor; but Clement V. quashed his candidature in favour of Henry of Luxemburg, afterwards the emperor Henry VII. Under Louis X. Charles headed the party of feudal reaction, and was among those who compassed the ruin of Enguerrand de Marigny. In the reign of Charles IV., the Fair, he fought yet again in Guienne (1324), and died at Perray (Seine-et-Oise) on Dec. 16, 1325. His second wife died in 1307, and in July 1308 he married a third wife, Mahaut de Châtillon, countess of Saint-Pol. Philip, his eldest son, ascended the French throne in 1328, and from him sprang the royal house of Valois.

See J. Petit, *Charles de Valois* (1900).

CHARLES, ELIZABETH (1828–1896), English author, was born at Tavistock on Jan. 2 1828, the daughter of John Rundle, M.P., and died at Hampstead on March 28 1896. In 1851 she married Andrew Paton Charles. Her best known book, *The Chronicles of the Schönberg-Cotta Family,* was published in 1862, and was translated into most of the European languages, into Arabic, and into many Indian dialects. Mrs. Charles wrote in all some 50 books, the majority of a semi-religious character.

CHARLES, JACQUES ALEXANDRE CÉSAR (1746–1823), French mathematician and physicist, was born at Beaugency, Loiret, on Nov. 12, 1746. From being a clerk in the ministry of finance, he turned to scientific pursuits, and became one of the most acute of physical researchers and inventors. He was the first, in 1783, to employ hydrogen for the inflation of balloons (*see* AERONAUTICS), and about 1787 he anticipated Gay Lussac's law of the dilatation of gases with heat, which on that account is sometimes known by his name. He improved the Gravesand heliostat and the aerometer of Fahrenheit and invented a "thermometric hydrometer," a "goniometer by reflection" and many other ingenious physical devices. In 1785 he was elected to the Academy of Sciences, and subsequently he became professor of physics at the Conservatoire des Arts et Métiers. He died in Paris on April 7, 1823. His published papers are chiefly concerned with mathematical topics.

CHARLES, THOMAS (1755–1814), Welsh Nonconformist divine, was born at Longmoor, Carmarthenshire, on Oct. 14, 1755, and educated at Jesus college, Oxford, for the Church. He was ordained priest in 1782, and held some curacies in Somersetshire, but he resigned these in 1783 and returned to Wales. He had fallen under the influence of the Welsh revivalists before he went to Oxford, and had Methodist connections. He found no pulpit open to him in the Church in Wales, and joined the Calvinistic Methodists in 1784.

He had already begun to provide classes for poor children in Bala; he now held the classes in the chapel, and gradually began the system of Welsh Circulating Schools, on the model devised by Griffith Jones (d. 1761). By 1794 he had 20 travelling masters at work. In 1785 he had become the agent of the Sunday School Society in Wales; he secured supplies of Welsh Bibles from the S.P.C.K. and in 1801 alone nearly 3,000 were distributed. In 1802 he went to London to place Welsh requirements before the Religious Tract Society, and put his case so well that his friends decided to found a society for the publication and distribution of the Scriptures. This was the origin of the British and Foreign Bible Society. He stimulated similar educational movements in Ireland and Scotland. In 1810 he led the movement for the establishing of a regular ordained ministry in the Calvinistic Methodist connection, and, this work accomplished, returned to his task of fostering auxiliary Bible societies. He died on Oct. 5, 1814. Charles compiled the *Geiriadur Ysgrythyrol,* a biblical dictionary (4 vols. 1805–08), which has passed through many editions; he drew up the first definite constitution of the Welsh Methodists, and wrote many Welsh tracts. The first Welsh biography of Charles appeared in 1816. *See* W. Hughes, *Life and Letters of Thomas Charles* (Rhyl 1881), in which some of Charles's minor writings are reprinted.

CHARLES ALBERT (CARLO ALBERTO) (1798–1849), king of Sardinia (Piedmont), son of Prince Charles of Savoy-Carignano and Princess Albertine of Saxe-Courland, was born on Oct. 12, 1798, a few days before the French occupied Piedmont and forced his cousin, King Charles Emmanuel, to take refuge in Sardinia. In 1802 King Charles Emmanuel abdicated in favour of his brother, Victor Emmanuel I. On the fall of Napoleon in 1814 the Piedmontese court returned to Turin, and the king was anxious to secure the succession for Charles Albert, knowing that Austria meditated excluding him from it in favour of an Austrian archduke. He was summoned to Turin, given tutors to instruct him in legitimist principles, and on Oct. 1, 1817, married the archduchess Maria Theresa of Tuscany, who, on March 14, 1820, gave birth to Victor Emmanuel, afterwards king of Italy.

The Piedmontese government at this time was most reactionary, and had made a clean sweep of all French institutions. But there were strong Italian nationalists and anti-Austrian tendencies among the younger nobles and army officers, and the Carbonari and other revolutionary societies had made much progress. Their hopes centred in the young Carignano, whose agreeable manners had endeared him to all, and who had many friends among the Liberals and Carbonari. Early in 1820 a revolutionary movement was set on foot. Charles Albert no doubt was aware of this, but he never actually became a Carbonaro, and was surprised and startled when after the outbreak of the Neapolitan revolution of 1820 some of the leading conspirators in the Piedmontese army informed him that a military rising was ready and that they counted on his help (March 2, 1821). He induced them to delay the outbreak and informed the king, requesting him, however, not to punish anyone. On the 10th the garrison of Alessandria mutinied, and two days later Turin was in the hands of the insurgents, the people demanding the Spanish constitution. The king at once abdicated and appointed Charles Albert regent. The latter, pressed by the revolutionists and abandoned by his ministers, granted the constitution and sent to inform Charles Felix, who was now king, of the occurrence. Charles Felix, who was then at Modena, repudiated the regent's acts, accepted Austrian military assistance, with which the rising was easily quelled, and exiled Charles Albert to Florence. The young prince found himself the most unpopular man in Italy, for while the Liberals looked on him as a traitor, to the king and the Conservatives he was a dangerous revolutionist. At the Congress of Verona (1822) the Austrian chancellor, Prince Metternich, tried to induce Charles Felix to set aside Charles Albert's rights of succession. But the king was piqued by Austria's interference, and as both the grand-duke of Tuscany and the duke of Wellington supported him, Charles Albert's claims were respected. But it was not until he had signed a secret undertaking binding himself, as soon as he ascended the throne, to place himself under the tutelage of a council composed of the higher clergy and the knights of the Annunziata, and to maintain the existing forms of the monarchy (D. Berti, *Cesare Alfieri,* xi. 77, Rome, 1871), that he was allowed to return to Turin and forgiven.

On the death of Charles Felix (April 27, 1831) Charles Albert succeeded; he inherited a kingdom without an army, with an empty treasury, a chaotic administration and mediaeval laws. His first task was to set his house in order; he reorganized the finances, created the army, and started Piedmont on a path which, if not liberalism, was at least progress. In 1833 a conspiracy of the *Giovane Italia* society, organized by Mazzini, was discovered, and a number of its members punished with ruthless severity. The election in 1846 of Pius IX., who appeared to be a Liberal and an

Italian patriot to some extent, reconciled the king to the Liberal movement, for it accorded with his religious views. On Oct. 30 he issued a decree granting wide reforms, and when risings broke out in other parts of Italy early in 1848, and further liberties were demanded, he was at last induced to grant the constitution (Feb. 8).

When the news of the Milanese revolt against the Austrians reached Turin (March 19) public opinion demanded that the Piedmontese should succour their struggling brothers; and after some hesitation the king declared war. But much time had been wasted and many precious opportunities lost. With an army of 60,000 Piedmontese troops and 30,000 men from other parts of Italy the king took the field, and after defeating the Austrians at Pastrengo on April 30, and at Goito on May 30, where he was himself slightly wounded, more time was wasted in useless operations. Radetzky, the Austrian general, having received reinforcements, drove the centre of the extended Italian line back across the Mincio (July 23), and in the two days' fighting at Custozza (July 24–25) the Piedmontese were beaten, forced to retreat and to ask for an armistice. The revolutionary movement throughout Italy was breaking down, but Charles Albert felt that while he possessed an army he could not abandon the Lombards and Venetians, and determined to stake all on a last chance. On March 12, 1849, he denounced the armistice and took the field again with an army of 80,000 men. He gave the chief command to the Polish general Chrzanowski, but he was completely out-generalled and defeated at La Bicocca near Novara on the 23rd. The Piedmontese fought with great bravery, and the unhappy king sought death in vain. After the battle he asked terms of Radetzky, who demanded the occupation by Austria of a large part of Piedmont, and the heir to the throne as a hostage. Thereupon, feeling himself to be the obstacle to better conditions, Charles Albert abdicated in favour of his son Victor Emmanuel. That same night he departed alone and made his way to Oporto, where he retired into a monastery and died on July 28, 1849.

Charles Albert was not a man of first-rate ability; he was of a hopelessly vacillating character. Devout and mystical to an almost morbid degree, hating revolution and distrusting Liberalism, he was a confirmed pessimist, yet he had many noble qualities: he was brave to the verge of foolhardiness, devoted to his country, and ready to risk his crown to free Italy from the foreigner. To him the people of Italy owe a great debt, for if he failed in his object he at least materialized the idea of the Risorgimento in a practical shape, and the charges which the Republicans and demagogues brought against him were monstrously unjust.

BIBLIOGRAPHY.—Besides the general works on modern Italy, *see* the Marquis Costa de Beauregard's interesting volumes *La Jeunesse du roi Charles Albert* (1899) and *Novare et Oporto* (1890), based on the king's letters and the journal of Sylvain Costa, his faithful equerry, though the author's views are those of an old-fashioned Savoyard who dislikes the idea of Italian unity; Ernesto Masi's *Il Segreto del Re Carlo Alberto* (Bologna, 1891) is a very illuminating essay; Domenico Perrero, *Gli Ultimi Reali di Savoia* (Turin, 1889); L. Cappelletti, *Storia di Carlo Alberto* (1891); Nicomede Bianchi, *Storia della diplomazia europea in Italia* (8 vols., Turin, 1865, etc.), a most important work of a general character, and the same author's *Scritti e lettere di Carlo Alberto* (1879) and his *Storia della monarchia piemontese* (Turin, 1877); Count S. della Margherita, *Memorandum storico-politico* (Turin, 1851); A. Luzio, *Carlo Alberto e Giuseppe Mazzini* (1923); he also edited *Le Lettere di Carlo Alberto al Car. Luigi Bianco di Barbania* (Turin, 1924); A. di Saluzzo, *Carlo Alberto della restaurazione all' avvenimento al trono* (1926).

CHARLES AUGUSTUS (KARL AUGUST) (1757–1828), grand-duke of Saxe-Weimar, friend and patron of Goethe, was the son of Constantine, duke of Saxe-Weimar-Eisenach, and Anna Amalia of Brunswick. Educated under the regency of his mother —his father died in 1757—Charles Augustus assumed the reins of government in 1775, in which year he married Princess Louise of Hesse-Darmstadt. In the affairs of Germany and of Europe his character gave him an influence out of all proportion to his position as a sovereign prince. He had early faced the problem presented by the decay of the empire, and began to work for the unity of Germany. The plans of the emperor Joseph II., which threatened to absorb a great part of Germany into the heterogeneous Habsburg monarchy, threw him into the arms of Prussia, and he was the prime mover in the establishment of the league of princes (*Fürstenbund*) in 1785, by which, under the leadership of Frederick the Great, Joseph's intrigues were frustrated. He was, however, under no illusion as to the power of Austria, and he wisely refused the offer of the Hungarian crown, made to him in 1787 by Prussia at the instance of the Magyar malcontents, with the dry remark that he had no desire to be another "Winter King." In 1788 he took service in the Prussian army as major-general in active command of a regiment. As such he was present, with Goethe, at the cannonade of Valmy in 1792, and in 1794 at the siege of Mainz and the battles of Pirmasenz (Sept. 14) and Kaiserslautern (Oct. 28–30). After this, dissatisfied with the attitude of the Powers, he resigned; but rejoined on the accession of his friend King Frederick William III. to the Prussian throne. The disastrous campaign of Jena (1806) followed; on Oct. 14, the day after the battle, Weimar was sacked; and Charles Augustus, to prevent the confiscation of his territories, was forced to join the Confederation of the Rhine. From this time till after the Moscow campaign of 1812 his contingent fought under the French flag in all Napoleon's wars. In 1813, however, he joined the Grand Alliance, and at the beginning of 1814 took the command of a corps of 30,000 men operating in the Netherlands.

At the Congress of Vienna Charles Augustus was present in person and protested vainly against the narrow policy of the Powers in confining their debates to the "rights of the princes" to the exclusion of the "rights of the people." His services in the war of liberation were rewarded with an extension of territory and the title of grand-duke. He was the first of the German princes to grant a liberal constitution to his state under Article XIII. of the Act of Confederation (May 5, 1816); and his concession of full liberty to the press made Weimar for a while the focus of journalistic agitation against the existing order. Metternich dubbed him contemptuously "der grosse Bursche" for his patronage of the "revolutionary" Burschenschaften; and the celebrated "festival" held at the Wartburg by his permission in 1818 brought down upon him the wrath of the Great Powers. Charles Augustus was compelled to yield to the remonstrances of Prussia, Austria and Russia; the liberty of the press was again restricted in the grand-duchy, but, thanks to the good understanding between the grand-duke and his people, the régime of the Carlsbad Decrees pressed less heavily upon Weimar than upon other German States.

Charles Augustus died on June 14, 1828, and left two sons; Charles Frederick (d. 1853), by whom he was succeeded, and Bernhard, duke of Saxe-Weimar (1792–1862), who distinguished himself as commander of the Dutch troops in the Belgian campaign of 1830, and from 1847 to 1850 held the command of the forces in the Dutch East Indies. Bernhard's son, William Augustus Edward, known as Prince Edward of Saxe-Weimar (1823–1902), entered the British army, served with much distinction in the Crimean War, and became colonel of the 1st Life Guards and a field-marshal; in 1851 he contracted a morganatic marriage with Lady Augusta Gordon-Lennox (d. 1904), daughter of the 5th duke of Richmond and Gordon, who in Germany received the title of countess of Dornburg, but was granted the rank of princess in Great Britain by royal decree in 1866.

BIBLIOGRAPHY.—Karl August's Correspondence with Goethe was published in 2 vols. at Weimar in 1863. *See* F. X. Wegele, *Karl August, Grossherzog von Sachsen-Weimar* (Leipzig, 1850); W. Wachsmuth, *Herzog Karl August und Goethe* (Leipzig, 1911); W. Bode, *Karl August von Weimar, Jugendjahre* (1913); H. von Egloffstein, *Karl August während des Krieges von 1813* (1913) and *Karl August auf dem Wiener Kongress* (Jena, 1915).

CHARLES D'ORLÉANS: *see* ORLÉANS, CHARLES, DUKE OF.

CHARLES EDWARD (CHARLES EDWARD LOUIS PHILIP CASIMIR STUART) (1720–1788), English prince, called the "Young Pretender" and also the "Young Chevalier," was born at Rome on Dec. 31, 1720. He was the grandson of King James II. of England and elder son of James, the "Old Pretender," by whom (as James III.) he was created at his birth prince of Wales, the title he bore

among the English Jacobites during his father's lifetime. The young prince was educated at his father's miniature court in Rome, with James Murray, Jacobite earl of Dunbar, for his governor, and under various tutors, amongst whom were the learned Chevalier Ramsay, Sir Thomas Sheridan and the abbé Légoux. He learned the English, French and Italian languages, but his extant letters in English are singularly ill-spelt and illiterate. In 1734 he accompanied his cousin, the duke of Liria, afterwards duke of Berwick, on his expedition in aid of Don Carlos, and the boy of 13 shared with credit the dangers of the successful siege of Gaeta.

The Old Pretender calculated upon foreign aid in his attempts to restore the monarchy of the Stuarts; and the idea of rebellion unassisted by invasion or by support of any kind from abroad, was Charles Edward's own. Jacobite hopes mainly rested in France, and the warm sympathy which Cardinal Tencin, who had succeeded Fleury as French minister, felt for the Old Pretender resulted in a definite scheme for an invasion of England to be timed simultaneously with a prearranged Scottish rebellion. Charles was secretly despatched to Paris in January, 1744. A squadron under Admiral Roquefeuil sailed (Feb. 6) from Brest. Transports for 7,000 troops, to be led by Marshal Saxe, accompanied by the young prince, were in readiness to set sail for England. Meanwhile a strong English fleet appeared in the Downs, and a series of storms provided a probably welcome excuse to the French government for the cancellation of Marshal Saxe's orders. Louis declined to surrender Charles, but no official hospitality was offered him, and he lived in retirement. Charles Edward had made at Rome the acquaintance of Lord Elcho and of John Murray of Broughton; Murray visited him in Paris, and was told that he would come to Scotland in the summer of 1745, even though he came alone. His friends in Scotland saw no chance of success, and messengers, who do not seem to have reached him, were sent expressly to inform him. On July 13, 1745, he sailed from Nantes for Scotland on board the small brig "La Doutelle," which was accompanied by a war frigate, the "Elisabeth," provided by an Irishman at Dunkirk and laden with arms and ammunition. The latter fell in (July 20) with an English man-of-war, the "Lion," and had to return to France; Charles escaped during the engagement, and arrived on Aug. 3 off Erisca, a little island of the Hebrides. Receiving, however, but a cool reception from Macdonald of Boisdale, he set sail again and arrived at the Bay of Loch-na-nuagh on the west coast of Inverness-shire.

The Macdonalds of Clanranald and Kinloch Moidart, along with other chieftains, attempted in vain to dissuade him from the rashness of an unaided rising, but Lochiel and other chieftains, although they had sought to dissuade Charles from coming at all, now called out the clans. On Aug. 19, in the valley of Glenfinnan, the standard of James III. and VIII. was raised. Within a week about 2,000 men, mainly from the Macdonald clan, had joined him. Sir John Cope left Stirling for Inverness on Aug. 20 with 25 companies of foot, leaving the road to the south open to Charles. In the beginning of September the Jacobite army, reinforced by some accessions, notably by Lord George Murray, entered Perth. Crossing the Forth unopposed at the Fords of Frew and passing through Stirling and Linlithgow, he arrived within a few miles of Edinburgh, and on Sept. 16 a body of his skirmishers defeated the dragoons of Colonel Gardiner in what was known as the "Canter of Coltbrig." A few of Cameron's Highlanders having on the following morning, by a happy ruse, forced their way through the Canongate, Charles entered the city at noon. On the 18th he publicly proclaimed James VIII. of Scotland at the Market Cross and occupied Holyrood.

Cope had by this time brought his disappointed forces by sea to Dunbar. On the 20th Charles met and defeated him at Prestonpans, and returned to prosecute the siege of Edinburgh Castle, which, however, he raised on Gen. Guest's threatening to lay the city in ruins. He still hoped for French assistance definitely promised on Oct. 24 by secret treaty. In the beginning of November Charles left Edinburgh to invade England. He was at the head of at least 5,000 men; but the ranks were gradually thinned by the desertion of Highlanders, whose tradition had led them to consider war merely as a raid. Having passed through Kelso, on Nov. 9 he laid siege to Carlisle which capitulated in a week. Manchester provided the prince with 150 recruits under Francis Towneley. On Dec. 4 he had reached Derby. Charles's officers were under no illusions about the strength of English resistance, but hoped that the advance might lead to intervention from France. When they found that the English counties did not rise they advised retreat. Two armies under English leadership were now in the field against Charles, one under Marshal Wade, whom he had evaded by entering England by the west, and the other under William, duke of Cumberland, who had returned from the Continent. On Dec. 6 Charles began his retreat northward. Closely pursued by Cumberland, he marched by way of Carlisle across the border, and at last stopped to invest Stirling Castle. At Falkirk, on Jan. 17, 1746, he defeated Gen. Hawley, who had marched from Edinburgh to intercept his retreat. The Jacobite army had been strengthened by Gordons, Mackintoshes and others, but the accessions were counter-balanced by desertions. A fortnight later, however, Charles raised the siege of Stirling, and after a weary march rested his troops at Inverness. Having taken Forts George and Augustus, and after varying success against the supporters of the government in the north, he at last prepared to face the duke of Cumberland, who had passed the early spring at Aberdeen. On April 8 the duke marched thence to meet Charles, whose little army, exhausted with a futile night march, half-starving, and broken by desertion, was completely worsted at Culloden on April 16, 1746.

This decisive defeat sealed the fate of Charles Edward and the house of Stuart. Hunted hither and thither Charles, upon whose head a reward of £30,000 had a year before been set, was for over five months relentlessly pursued by the troops and spies of the government. Disguised in female attire and aided by a passport obtained by the devoted Flora MacDonald, he passed through Skye, and towards the end of July took refuge in the cave of Coiraghoth in the Braes of Glenmoriston. In August he joined Lochiel and Cluny Macpherson, with whom he remained in hiding until the arrival of two French ships at Loch-na-nuagh, enabled him to sail for France. He reached Roscoff, near Morlaix, on Sept. 29, 1746. He remained in France for two years, but the Treaty of Aix-la-Chapelle entailed his expulsion from France. After his brother Henry's acceptance of a cardinal's hat in July 1747, he broke off communication with his father in Rome (who had approved the step), nor did he ever see him again. The enmity of the British government to Charles Edward made peace with France an impossibility so long as she continued to harbour the young prince. A condition of the Treaty of Aix-la-Chapelle, concluded in October 1748, was that every member of the house of Stuart should be expelled from the French dominions. Charles declared, he would not be bound by its provisions. But his indignation and persistent refusal to leave France were met at last with force; he was apprehended, imprisoned for a week at Vincennes, and on Dec. 17 conducted to the French border. He lingered at Avignon; but Pope Benedict XIV., alarmed by the threat of a bombardment of Civita Vecchia, advised the prince to withdraw. Charles quietly disappeared. For years Europe watched for him in vain. It is now established, almost with certainty, that he returned to the neighbourhood of Paris. In 1750 and again, it is thought, in 1754, he was in London, hatching futile plots and risking his safety for his hopeless cause, and even abjuring the Roman Catholic faith in order to further his political interests.

During the next ten years of his life Charles Edward's illicit connection with Miss Clementina Walkinshaw (d. 1802), whom he had first met at Bannockburn House while conducting the siege of Stirling, his imperious fretful temper, his drunken habits and debauched life, could no longer be concealed. He wandered over Europe in disguise, alienating his friends and crushing the hopes of his party; and in 1766, on returning to Rome at the death of his father, he was treated by Pope Clement XIII. with coldness, and his title as heir to the British throne was openly repudiated by all the great Catholic powers. It was probably through the influence of the French court, still intriguing against England, that the marriage between Charles (now self-styled count of Albany) and Princess Louise of Stolberg was arranged in 1772. The union proved childless and unhappy, and in 1780 the countess fled for

refuge from her husband's drunken violence to a convent in Florence. Later, the countess of Albany (*q.v.*) threw herself on the protection of her brother-in-law Henry, Cardinal York, at Rome, and a formal separation was arranged in 1784. Charles, lonely, ill, and evidently near death, now summoned to Florence his natural daughter, Charlotte Stuart, the child of Clementina Walkinshaw, born at Liége in October 1753 and hitherto neglected by the prince. Charlotte Stuart, who was declared legitimate and created duchess of Albany, tended her father for the remaining years of his life. She contrived to reconcile the two Stuart brothers, so that in 1785 Charles returned to Rome, where he died in the old Palazzo Muti on Jan. 30, 1788. He was buried in his brother's cathedral church at Frascati, but in 1807 his remains were removed to the *Grotte Vaticane* of St. Peter's. His daughter Charlotte died unmarried at Bologna in November, 1789.

See A. C. Ewald, *Life and Times of Charles Stuart, the Young Pretender* (2 vols. 1875); C. S. Terry, *Life of the Young Pretender, and The Rising of 1745; with Bibliography of Jacobite History 1689–1788* (Scott. Hist. fr. Contemp. Writers, iii.) (1900); Earl Stanhope, *History of England* (1836) and *Decline of the Last Stuarts* (1854); Bishop R. Forbes, *The Lyon in Mourning* (1895–96); Andrew Lang, *Pickle, the Spy* (1897), and *Prince Charles Edward* (1900); R. Chambers, *History of the Rebellion in Scotland.*

CHARLES EMMANUEL I. (CARLO EMANUELE) (1562–1630), duke of Savoy, succeeded his father, Emmanuel Philibert, in 1580. His three chief objects were the conquest of Geneva, of Saluzzo and of Monferrato. Saluzzo he succeeded in wresting from France in 1588. In 1590 he sent an expedition to Provence in the interests of the Catholic League, and followed it himself later, but the peace of 1593, by which Henry of Navarre was recognized as king of France, put an end to his ambitions. In the war between France and Spain Charles sided with the latter, with varying success. Finally, by the Peace of Lyons (1601), he gave up all territories beyond the Rhône, but his possession of Saluzzo was confirmed. His attempt to capture Geneva by treachery and with the help of Spain (the famous *escalade*) in 1602, failed completely. On the death in 1612 of Duke Francesco Gonzaga of Mantua, who was lord of Monferrato, Charles Emmanuel made a successful *coup de main* on that district. This arrayed the Venetians, Tuscany, the Empire and Spain against him, and he was obliged to relinquish his conquest. The terms of the peace of 1618 left him more or less in the *status quo ante*. In 1628 he was in alliance with Spain in the war against France and the French invaded the duchy. The duke fought desperately, but was taken ill at Savigliano and died in 1630. He was succeeded by his son Victor Amedeo I., while his third son Tommaso founded the line of Savoy-Carignano from which the present royal house of Italy is descended.

See E. Ricotti, *Storia della monarchia piemontese,* vols. iii. and iv. (Florence, 1865); T. Raulich, *Storia di Carlo Emanuele I.* (Milan, 1896–1902); G. Curti, *Carlo Emanuele I. secondo; più recenti studii* (Milan, 1894).

CHARLES MARTEL, "The Hammer," (*c.* 688–741), Frankish ruler, son of Pippin II., mayor of the palace, and Chalpaïda. Charles was baptized by St. Rigobert, bishop of Reims. At the death of his father in 714, Pippin's widow Plectrude claimed the government in Austrasia and Neustria in the name of her grandchildren, and had Charles thrown into prison. But the Neustrians threw off the Austrasian yoke and entered into an offensive alliance with the Frisians and Saxons. In the general anarchy Charles succeeded in escaping, defeated the Neustrians at Amblève, south of Liége, in 716, and at Vincy, near Cambrai, in 717, and forced them to come to terms. In Austrasia he wrested the power from Plectrude, and took the title of mayor of the palace, thus prejudicing the interests of his nephews. According to the Frankish custom he proclaimed a king in Austrasia in the person of the young Clotaire IV., but in reality Charles was the sole master—the entry in the annals for the year 717 being "Carolus regnare coepit." Once in possession of Austrasia, Charles sought to extend his dominion over Neustria also. In 719 he defeated Ragenfrid, the Neustrian mayor of the palace, at Soissons, and forced him to retreat to Angers. Ragenfrid died in 731, and from that time Charles had no competitor in the western kingdom. He obliged the inhabitants of Burgundy to submit, and disposed of the Burgundian bishoprics and countships to his *leudes*. In Aquitaine Duke Odo (Eudes) exercised independent authority, but in 719 Charles forced him to recognize the suzerainty of northern France, at least nominally. After the alliance between Charles and Odo on the field of Poitiers, the mayor of the palace left Aquitaine to Odo's son Hunald, who paid homage to him. Besides establishing a certain unity in Gaul, Charles saved it from a very great peril. In 711 the Arabs had conquered Spain. In 720 they crossed the Pyrenees, seized Narbonensis, a dependency of the kingdom of the Visigoths, and advanced on Gaul. By his able policy Odo succeeded in arresting their progress for some years; but a new vali, 'Abd-ar-Rahmān, a member of an extremely fanatical sect, resumed the attack, reached Poitiers, and advanced on Tours, the holy town of Gaul. In Oct. 732 (just 100 years after the death of Mohammed) Charles gained a brilliant victory over 'Abd-ar-Rahmān, who was called back to Africa by the revolts of the Berbers and had to give up the struggle. This was the last of the great Arab invasions of Europe. After his victory Charles took the offensive, and endeavoured to wrest Narbonensis from the Muslims. Although he was not successful in his attempt to recover Narbonne (737), he destroyed the fortresses of Agde, Béziers and Maguelonne, and set fire to the amphitheatre at Nîmes. He subdued also the Germanic tribes; annexed Frisia, where Christianity was beginning to make progress; put an end to the duchy of Alemannia; intervened in the internal affairs of the dukes of Bavaria; made expeditions into Saxony; and in 738 compelled some of the Saxon tribes to pay him tribute. He also gave St. Boniface a safe conduct for his missions in Thuringia, Alemannia and Bavaria.

During the government of Charles Martel important changes appear to have been made in the internal administration. Under him began the great assemblies of nobles known as the *champs de Mars*. To attach his *leudes* Charles had to give them church lands as *precarium,* and this had a very great influence in the development of the feudal system. It was from the *precarium,* or ecclesiastical benefice, that the feudal fief originated. Vassalage, too, acquired a greater consistency at this period, and its rules began to crystallize. Under Charles occurred the first attempt at reconciliation between the papacy and the Franks. Pope Gregory III., menaced by the Lombards, invoked the aid of Charles (739), sent him a deputation with the keys of the Holy Sepulchre and the chains of St. Peter, and offered to break with the emperor and Constantinople, and to give Charles the Roman consulate (*ut a partibus imperatoris recederet et Romanum consulatum Carolo sanciret*). This proposal, though unsuccessful, was the starting point of a new papal policy. Since the death of Theuderich IV. in 737 there had been no king of the Franks. In 741 Charles divided the kingdom between his two sons, as though he were himself master of the realm. To the elder, Carloman, he gave Austrasia, Alemannia and Thuringia, with suzerainty over Bavaria; the younger, Pippin, received Neustria, Burgundy and Provence. Shortly after this division of the kingdom Charles died at Quierzy on Oct. 22, 741, and was buried at St. Denis. The characters of Charles Martel and his grandson Charlemagne offer many striking points of resemblance. Both were men of courage and activity, and the two men are often confused in the *chansons de geste.*

See T. Breysig, *Jahrbücher d. fränk. Reichs 714–741; die Zeit Karl Martells* (Leipzig, 1869); A. Beugnot, "Sur la spoliation des biens du clergé attribuée à Charles Martel," in the *Mém. de l'Acad. des Inscr. et Belles-Lettres,* xix. (1853); U. Chevalier, *Bio-bibliographie* (2nd ed. 1904). (C. Pf.)

CHARLES CITY, a city of northern Iowa, U.S.A., on Cedar river; the county seat of Floyd county. It is on Federal highways 18 and 218 and served by the Chicago, Milwaukee, St. Paul and Pacific, Illinois Central, and Charles City Western railways. The population in 1930 federal census was 8,039; in 1940, 8,681.

It is in a rich agricultural region; has abundant water power; manufactures tractors, office equipment and other articles; and has extensive nurseries, specializing in evergreens and roses.

The city was founded in 1850 and incorporated in 1860.

CHARLESTON, a city of eastern Illinois, U.S.A., on the Nickel Plate and the Big Four railways, 45 mi. W. of Terre Haute; the county seat of Coles county. Pop. (1930) 8,012; (1940) 8,197. It has broom and shoe factories and railroad shops. The Eastern Illinois State Teachers college, established in 1895, has an enrolment of about 1,200. In the vicinity are the Lincoln Log Cabin State park and the Fox Ridge State park. Charleston was made the county seat in 1831 and was incorporated in 1839. One of the Lincoln-Douglas debates was held there in 1858.

CHARLESTON, the largest city of South Carolina, U.S.A., and an important south Atlantic seaport, on a narrow peninsula between the Cooper and the Ashley rivers, at the head of the bay formed by their confluence, $7\frac{1}{2}$ mi. from the ocean bar; the county seat of Charleston county, headquarters of the customs district of South Carolina, and the official port of the state. It is on federal highways 17, 52 and 78; and is served by the Atlantic Coast Line, the Seaboard Air Line and the Southern railways, and by coastwise, intercoastal and foreign steamship lines. Has modern municipal airport with daily transport service north and south, and to and from Pacific coast. The population in 1940 was 71,275 by the federal census. The city has a land area of 4.5 sq.mi., highest elevation 16 ft. above datum plane, 9 mi. of water front within the city limits and 11 mi. outside. On islands in the harbour are Forts Sumter, Moultrie (where the U.S. army maintains a unit), Johnson (now the quarantine station), and Castle Pinckney. North of the city, on the west bank of Cooper river, is a first-class navy yard, which has an aviation field and a graving dock 575 ft. long; also destroyer building ways. Still farther north (10·4 mi. above the custom-house) are the port terminals, constructed by the United States during the war of 1914–18 as an army supply base, and repossessed in part for similar purpose. The part owned by the city government was leased to the West Virginia Pulp and Paper Co.

The spacious harbour, almost landlocked, and protected by two converging stone jetties (15,443 and 19,104 ft. long), accommodates vessels with a draught of 30 feet. Its total vessel traffic for 1940 amounted to 2,242,350 tons of cargo, and floated logs and lumber amounted to 19,528 tons. Inbound traffic consists largely of petroleum products, and materials for fertilizer; outbound, of petroleum products, crossties, lumber, coal from Virginia and West Virginia, cotton and cotton goods and tobacco from the Carolinas and Georgia. Trade with foreign countries in 1940 amounted to 173,412 tons in exports, and 480,441 tons in imports. Charleston is an important centre for the distribution of oil, and it has large fertilizer plants. Other leading manufactures are woven asbestos, wood pulp, steel products, creosoted timber, iron work and various articles of wood. The city is a bunkering and repair station for both commercial and naval vessels; headquarters of the 6th and 7th naval districts. It is the site of U.S. Ordnance depot; General hospital and Overseas Discharge and Replacement depot, and a market for the agricultural products (notably vegetables, tobacco and cotton) and the pine and hardwood of the state, and for the oysters, crabs, shrimps and fish caught off the coast.

Charleston has a unique charm and beauty, compounded of natural advantages of situation, historic associations, sub-tropical trees and flowers, marvellous old gardens glimpsed through wrought-iron gates, and numerous survivals of colonial architecture, with balustraded steps, pillared porticos and spacious verandas. A city plan and zoning regulations are in effect which, while providing conveniently for industrial and residential expansion, preserve the picturesque and historic old sections. At the lower end of the peninsula is the Battery, or White Point gardens, planted with live oaks and palmettos. Beach resorts are developed on outlying islands which formerly (until 1718) were the haunts of pirates.

The Magnolia gardens, up the Ashley river, are a monument to the exquisite taste and poetic imagination of the Rev. John Grimké Drayton, who created them when in the 1840s his physician ordered him to lead an outdoor life. At Middleton Place, farther up the river, one wing of the great Tudor mansion still stands, and there are gardens which had renown in England in the 18th century. Other noted garden estates are Cypress Gardens, Runnymede, The Oaks and Mateba. Among the many educational institutions of the city are the College of Charleston, founded in 1770, chartered in 1785 and taken over by the city in 1837 (the first municipal college in the country); the South Carolina medical college, a state institution founded in 1823; and the Citadel, the military college of South Carolina, created by the legislature in 1842. The Charleston library was founded in 1748; the museum in 1773.

The first English settlement in South Carolina, named after the reigning king, was made at Albemarle Point on the west bank of the Ashley in 1670, but in 1672 a new town was begun on the present site, and the seat of government was moved to it in 1680. It soon became the largest and wealthiest settlement south of Philadelphia; the brilliant social and cultural centre of the province and later of the state; the home of the Pinckneys, the Rutledges, the Gadsdens, the Laurenses and many other notable families. Magnificent estates were developed in the surrounding country. The port shipped one specialty after another—rice, indigo, tobacco, lumber, cotton—before entering on its present phase as a more general cargo port. Charleston was the capital of the state until 1790. Until 1783 it was governed by ordinances passed by the legislature and enforced partly by provincial officials and partly by the churchwardens. The city charter of 1783, with many amendments, is still in force. In 1850 the population was 42,985, ranking Charleston 15th among the cities of the United States.

Charleston was attacked by a combined fleet of Spanish and French in 1706; withstood attacks from the British in 1776 and in 1779, but in 1780 was captured from the land side by Sir Henry Clinton and became the base of operations in the Carolinas, remaining under military rule until Dec. 14, 1782. It was the centre of the nullification movement of 1832–33. The bombardment and capture of Ft. Sumter (April 12–13, 1861) by the South Carolinians marked the beginning of the Civil War. From 1862 to 1865 Charleston was almost continually under siege by the Federal naval and military forces, and on Feb. 17, 1865, the Confederates evacuated the city, after burning large stores of cotton and other supplies to keep them from coming into possession of the enemy. Charleston was devastated by hurricanes in 1699, in 1752 and in 1854; by epidemic in 1699 and in 1854; by fire in 1740; and by an earthquake on Aug. 31, 1886, which damaged 90% of the buildings. Since the war of 1914–18 the foreign coastal and intercoastal commerce of the port has increased greatly.

See (for the best history of Charleston) William A. Courtenay, *Charleston, S.C.: The Centennial of Incorporation* (Charleston, 1884). Sketches of many of the historic buildings are included in *Charleston, South Carolina,* edited by Albert Simons and Samuel Lapham, Jr. (Press of the American Institute of Architects, 1927).

CHARLESTON, the capital of West Virginia, U.S.A., on the Kanawha river at the mouth of the Elk, southwest of the centre of the state; the county seat of Kanawha county. It is on U.S. highways 21, 35, 60, 119; and is served by the Baltimore and Ohio, the Chesapeake and Ohio and the New York Central railways, and by river steamers. The population in 1920 was 39,608, of whom 1,354 were foreign-born white and 4,502 were Negroes; and was 67,914 in 1940 federal census. The city has a fine location on high level land above the river. It is an important industrial centre, and a shipping point for the natural resources of the Kanawha valley, including coal, oil, limestone, clays, hardwood and salt. Natural gas in abundance is found in the vicinity. The factory output within the city limits in 1937 (including furniture, steel, glass and base chemicals) was valued at $10,861,622. The U.S. government has armour-plate, gun-forging and projectile plants there, which represent an investment of $100,000,000. The city's assessed valuation of property in 1940 was $116,457,170. A magnificent capitol was completed in 1933 to replace the one built in 1880. Charleston was settled soon after the Revolution, and was incorporated in 1794. It was on the route of migration to the Ohio valley, and became a transfer and shipping centre. Daniel Boone and Simon Kenton, noted frontiersmen, operated in the Charleston area, and Boone represented Kanawha county in the Virginia assembly, 1790–91. In 1870, when it

was chartered as a city, the population was only 3,162. It has been the capital of the state since 1870, except in 1875–85.

CHARLESTOWN, formerly a separate city of Middlesex county, Massachusetts, U.S.A., but since 1874 a part of the city of Boston, with which it had long before been in many respects practically one. It is situated on a small peninsula on Boston harbour, between the mouths of the Mystic and Charles rivers; the first bridge across the Charles, built in 1786, connected Charlestown and Boston. A United States navy yard (1800), occupying about 87ac., and the Massachusetts state prison (1805) are here; the old burying-ground contains the grave of John Harvard and that of Thomas Beecher, the first American member of the famous Beecher family; and there is a soldiers' and sailors' monument (1872), designed by Martin Milmore. Charlestown was founded in 1628 or 1629, being the oldest part of Boston, and soon rose into importance; it was organized as a township in 1630, and was chartered as a city in 1847. Within its limits was fought, on June 17, 1775, the battle of Bunker Hill (*q.v.*), when Charlestown was almost completely destroyed by the British. The Bunker Hill monument commemorates the battle. The original territory of the township was very large, and from parts of it were formed Woburn (1642), Malden (1649), Stoneham (1725), and Somerville (1842); other parts were annexed to Cambridge, to Medford and to Arlington. S. F. B. Morse, the inventor of the electric telegraph, was born here; and Charlestown was the home of Samuel Dexter (1761–1816), an eminent lawyer, secretary of war in the cabinet of President John Adams, and of Oliver Holden (1765–1831), a composer of hymn-tunes, including "Coronation."

See R. Frothingham, *History of Charlestown* (1845), covering 1629–1775; J. F. Hunnewell, *A Century of Town Life . . . 1775–1887* (1888); Timothy T. Sawyer, *Old Charlestown* (1902); and H. H. Sprague, *The Founding of Charlestown by the Sprague*s (1910).

CHARLET, NICOLAS TOUSSAINT (1792–1845), French designer and painter, more especially of military subjects, was born in Paris on Dec. 20, 1792, and died there on Oct. 30, 1845. The son of a dragoon in the Republican army, he was educated at the Lycée Napoléon, and served in the National Guard in 1814. In 1816 Charlet entered the atelier of Gros, and soon began issuing the first of those lithographed designs of subjects drawn from the Napoleonic wars which eventually brought him renown. Lithographs (about 2,000 altogether), water-colours, sepia-drawings, numerous oil sketches, and a few etchings followed one another rapidly, and he exhibited some large canvases. His best work was the "Episode in the Retreat from Russia," exhibited in the salon of 1836.

See De la Combe, *Charlet, sa vie, ses oeuvres* (1856).

CHARLEVILLE, a town of north-eastern France, in the department of Ardennes, 50 mi. N.E. of Reims. Pop. (1936) 22,551. Charleville is situated within a bend of the Meuse on its left bank, opposite Mézières, with which it is united by a suspension bridge. The town was founded in 1606 by Charles III (Gonzaga), duke of Nevers, afterwards duke of Mantua, and is laid out on a definite plan. The Place Ducale is a large square surrounded by old houses. On the right bank of the Meuse is Mont Olympe, with the ruins of a fortress dismantled under Louis XIV. Charleville, which shares with Mézières the administrative institutions of the department of Ardennes, has tribunals of first instance and of commerce, a chamber of commerce, and a board of trade-arbitrators. Its chief industries are metal founding, the manufacture of iron goods and the making of bricks. Brushes and clay pipes are also made.

CHARLEVOIX, PIERRE FRANÇOIS XAVIER DE (1682–1761), French Jesuit traveller and historian, was born at St. Quentin on Oct. 29, 1682. At 16 he entered the Society of Jesus; and at 23 was sent to Canada, where he remained for four years as professor at Quebec. In 1720–22, under orders from the regent, he visited America for the second time, and went along the Great Lakes and down the Mississippi. He died at La Flèche on Feb. 1, 1761.

Among his works are: *Histoire de l'Isle Espagnole ou de Saint Domingue* (1730), based on manuscript memoirs of P. Jean-Baptiste le Pers and original sources; *Histoire de Paraguay* (1756); *Vie de la Mère Marie de l'Incarnation, institutrice et première supérieure des Ursulines de la Nouvelle France* (1724); *Histoire et description générale de la Nouvelle France* (1744; in English 1769; tr. J. G. Shea, 1866–72), a work of capital importance for Canadian history.

CHARLEVOIX, a city of Michigan, U.S.A., on Lake Michigan, with Lake Charlevoix on its eastern boundary and Round lake harbour in the centre of the town; a port of entry and the county seat of Charlevoix county. It is on federal highway 31 and state highway 66, and is served by the Pere Marquette railway, buses and by lake steamers.

The population in 1940 was 2,299. The summer population is more than 10,000. Charlevoix is one of the most popular summer resorts of the state, and has a considerable fishing industry. Charlevoix was platted as a village in 1866, and was incorporated as a city in 1905.

CHARLOTTE (1840–1927), empress of Mexico, only daughter of Leopold I., king of Belgium, and Louise, princess of Orleans, was born at Laeken, near Brussels, on June 7, 1840. She married in 1857 the Archduke Maximilian of Austria, and went with him to Mexico in 1864, when he accepted the Mexican crown. When it became evident in 1866 that Maximilian's position was untenable, she was sent by her husband to Europe to implore the assistance of Napoleon III., who had decided to withdraw the French troops from Mexico. In this mission she failed, and foreseeing a catastrophe (Maximilian was shot in 1867) she went out of her mind (Sept. 1866). Charlotte was placed by her family under care in a Belgian château and survived until January 19, 1927. (*See* also MAXIMILIAN.)

See Count Corti, *Maximilian und Carlotta von Mexico* (1924, 2 vols.).

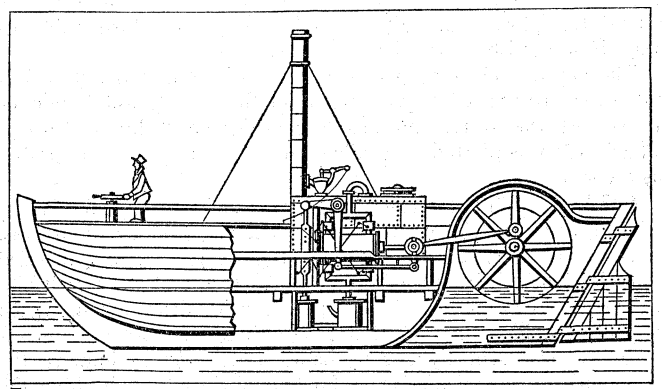
CHARLOTTE, a city of Michigan, U.S.A., 18 mi. S.W. of Lansing; on federal highway 27, and served by the Grand Trunk and the Michigan Central railways; the county seat of Eaton county. The population in 1930 was 5,307; 1940 it was 5,544. It has varied manufacturing industries, and is the trade centre of a rich agricultural and dairying region, which raises large quantities of beans.

CHARLOTTE, a city in southern North Carolina, U.S.A., 175 mi. S.W. of Raleigh; the county seat of Mecklenburg county. It is on federal highways 21, 29 and 74; and is served by the Southern, the Norfolk and Southern, the Piedmont and Northern Electric, and the Seaboard Air Line railways. In 1900 the population was 18,091; in 1920, 46,338 (34·6% Negroes); and in 1940 it was 100,899 by federal census of that year. Cotton, corn, wheat and truck crops are grown in the vicinity. Charlotte is at the heart of the hydro-electric development and the textile industry of the southern Piedmont. Many northern manufacturers of machinery, dyestuffs and other items needed for the equipment of cotton mills have branches there, and it is a distributing point for automobiles and their accessories. Bank clearings for 1940 amounted to $847,446,000. The assessed valuation of property in 1941 was $150,000,000. Within the city limits are large textile mills and knitting mills. The output of the Charlotte factories are some 200 diversified products valued at about $100,000,000. Printing and publishing is an important industry.

Charlotte is the seat of Queens college for women, originally chartered by the colonial legislature in 1771; and of the Johnson C. Smith university for Negroes (formerly Biddle university) founded in 1867. The city was settled about 1750, and incorporated in 1768. It has a commission form of government with mayor, city manager and 11 councilmen. A monument in front of the courthouse commemorates the signing of the "Mecklenburg Declaration of Independence" in May 1775. For a brief period in 1780 the city was occupied by Cornwallis, who nicknamed it "the hornets' nest." Later it became the principal base of Gen. Greene's operations. Andrew Jackson and James K. Polk were born near by and here on April 10, 1865, Jefferson Davis convened his cabinet for its last meeting.

"CHARLOTTE DUNDAS," the name given by her inventor to the first practical steamship. William Symington, in 1802, built the tug "Charlotte Dundas," a paddle-wheel steamer, and successfully tried her on the Forth and Clyde Canal; the name

was a compliment to the family of Lord Dundas, who suggested the experiment, and the boat was built for the Forth and Clyde Canal Company. The motive-power employed was a double-acting condensing engine constructed by James Watt. The engine was fixed horizontally and actuated the crank of a stern-shaft which carried the paddle-wheel. The "Charlotte Dundas" managed to tow two vessels with a burden of 140 tons, in the teeth of a strong



THE "CHARLOTTE DUNDAS," THE FIRST PRACTICAL STEAMBOAT, BUILT IN 1802 BY WILLIAM SYMINGTON AND DRIVEN BY AN ENGINE SUPPLIED BY JAMES WATT

wind, at the rate of 3¼m. an hour. Five years later, the American Robert Fulton, who had witnessed the "Charlotte Dundas" experiment, built the famous "Clermont" on the River Hudson.

CHARLOTTENBURG, a town incorporated in the Greater Berlin scheme of 1912 (which came into full operation in 1920), in the *Land* of Prussia, on the river Spree; its earlier name was Lietzenburg. The central part of the town is connected with Berlin by an avenue, the Charlottenburger Chaussée. The Schloss, built in 1696 for the electress Sophie Charlotte, queen of the elector Frederick, after whom the town was named, contains a collection of antiquities and paintings. In Charlottenburg is the Physikalisch-technische Reichsanstalt, a state institution for the carrying out of scientific experiments and measurements, and for testing instruments of precision, materials, etc. In addition to the famous royal porcelain manufactory, there are many industries, notably iron-works, grouped along the banks of the Spree.

CHARLOTTESVILLE, a city in the beautiful Piedmont region of Virginia, U.S.A., on the Rivanna river, 7om. W.N.W. of Richmond; the county seat of Albemarle county, but administratively independent of it. It is served by the Chesapeake and Ohio, and the Southern railways. The population in 1920 was 10,688, of whom 2,947 were negroes, and was 19,400 in 1940 federal census. It is the seat of the University of Virginia (*q.v.*) and the trade centre of an agricultural district noted for its fine apples and peaches. There is a law-book publishing house, and several manufacturing industries.

On a hill 3m. E., visible from all parts of the city, is Monticello, the home of Thomas Jefferson from 1770 until his death, now a national memorial. The house, in a setting of great beauty, was planned by Jefferson and built under his personal supervision. It is one of the most interesting and picturesque examples of colonial architecture, and embodies many ingenious devices of its versatile designer. His grave is on the estate. Mirador, the girlhood home of Lady Astor, is about 2om. W. of the city. The site of Charlottesville was a part of the Castle Hill estate of Thomas Walker (1715–94). The town (named after Queen Charlotte) was incorporated in 1762. In 1888 it was chartered as a city, independent of the county. It has a commission manager form of government. In 1779–80 about 4,000 of Burgoyne's troops, surrendered under the Convention of Saratoga, were quartered here. In June 1781, Tarleton raided the town and vicinity, destroying the public records and nearly capturing Jefferson. Jefferson owed his escape to the warning brought by a young Virginian soldier, Jack Jouett, who rode 40m. across rough country through the night to outstrip Tarleton, after accidentally getting a clue to his plans through conversation overheard at a tavern.

CHARLOTTETOWN, the capital of the province of Prince Edward Island, Canada, situated in Queen's county, on Hillsborough river. Pop. (1941) 14,821. It has a good harbour, and the river is navigable by large vessels for several miles. The export trade of the island centres here, and the city has regular communication by steamer with the chief American and Canadian ports and with Newfoundland. Besides the Government buildings and the court-house, it contains the Prince of Wales college, supported by the province, the Roman Catholic college of St. Dunstan's and a normal school; among its manufactures are woollen goods, lumber, canned goods and foundry products; its fisheries are extensive and important. The head office and workshops of the Prince Edward Island railway are situated here. The town was founded in 1750 by the French under the name of Port la Joie, but under British rule changed its name in honour of the queen of George III.

CHARM, an incantation, verses sung with supposed magical results, hence anything possessing powers of bringing good luck or averting evil, particularly articles worn with that purpose, such as an amulet. It is thus used of small trinkets attached to bracelets or chains. The word is also used, figuratively, of fascinating qualities of feature, voice or character. It is derived through the Fr. from the Lat. *carmen,* a song.

CHARMES, FRANCIS (1848–1916), French journalist and politician, was born at Aurillac, Cantal, on April 21, 1848. He was educated at Aurillac and at the lycées of Clermont-Ferrand and Poitiers. He was editor of the *Journal des Débats* from 1872 to 1880, and from 1889 to 1907. During the interval he served in the political department of the Foreign office. He sat in the chamber of deputies from 1881 to 1885 and from 1889 to 1898, and in 1900 became a senator. Charmes is, however, best known for his connection with the *Revue des Deux Mondes.* In 1893 he began his famous political writings in the *Revue,* and in 1907 became its editor. His literary and political articles were one of the features of French literary history during the last years of the 19th century. He died in Paris on Jan. 4, 1916.

CHARMEUSE. In textiles, the proprietary name for a silk dress fabric of light and delicate texture suitable for gowns, party wraps, and such like garments for purely dress purposes, and for which strength and durability are not essential qualities. This fabric has a rich and more lustrous appearance on the face side than on the reverse side, which latter is of a more subdued lustre. This difference in lustre results from the particular weave structure of the fabric, and the difference between the character, counts and number of warp and weft threads employed. A typical example of charmeuse consists of a very light texture developed by the 12-end warp-face satin weave, and produced from a grenadine organzine warp, and a two-ply pure schappe silk weft, or else crêpe de Chine twist for the warp, and schappe silk for the weft. Charmeuse is also sometimes developed by employing the warp-face satin weave in combination with a light voile foundation texture. This is produced by introducing two picks of fine and hard-twisted weft alternately with two picks of schappe silk weft. In this structure the fine picks of weft interweave with the warp threads in the plain weave order, that is, under and over successive warp threads, thereby serving to reinforce the satin weave texture which would otherwise be very weak and flimsy. After weaving, the fabric is piece-dyed and finished with the characteristic soft finish to which it owes its good draping qualities. (H. N.)

CHARNAY (CLAUDE JOSEPH), DÉSIRÉ (1828–1915), French traveller and archaeologist, was born in Fleurie (Rhône), studied at the Lycée Charlemagne, and in 1850 became a teacher in New Orleans, Louisiana. He travelled in Mexico under a commission from the French ministry of education, in 1857–61; in Madagascar in 1863; in South America, particularly Chile and Argentina, in 1875; and in Java and Australia in 1878. In 1880–83 he again visited the ruined cities of Mexico. Pierre Lorillard of New York contributed to defray the expense of this expedition, and Charnay named a great ruined city near the Guatemalan boundary line Ville Lorillard in his honour. Charnay went to Yucatan in 1886. His works include: *Le Mexique, souvenirs et impressions de voyage* (1863), and *Les Anciennes Villes*

du Nouveau Monde (1885; Eng. trans. 1887). He elaborated a theory of Toltec migrations and considered the prehistoric Mexican to be of Asiatic origin, because of observed similarities to Japanese architecture, Chinese decoration, Malaysian language and Cambodian dress, etc.

See *Recueil de Voyages,* etc., vol. xix. (1903).

CHARNEL HOUSE. A place for the storage of human bones, specifically that rendered necessary by the fact that many crowded mediaeval cemeteries were used again and again, so that each new burial unearthed the bones of people long dead. Charnel houses were sometimes situated in church crypts, and sometimes as separate buildings in the church yards; chantry chapels were occasionally added. (*See* Viollet-le-Duc, *Dictionnaire raisonné de l'architecture, s.v. ossuaire.*)

CHARNOCK, JOB (d. 1693), English founder of Calcutta, went out to India in 1655 or 1656, apparently not in the East India Company's service, but soon joined it. He was stationed at Cossimbazar, and subsequently at Patna. In 1685 he became chief agent at Hugli. Being besieged there by the Mogul viceroy of Bengal, he put the company's goods and servants on board his light vessels and dropped down the river 27m. to the village of Sutanati, a place well chosen for the purpose of defence, which occupied the site of what is now Calcutta. It was only, however, at the third attempt that Charnock finally settled down at this spot, and the selection of Calcutta as the capital of India was entirely due to his stubborn resolution.

CHARNOCK or **CHERNOCK, ROBERT** (*c.* 1663–1696), English conspirator, was educated at Magdalen college, Oxford, becoming a fellow of his college and a Roman Catholic priest. When in 1687 the dispute arose between James II. and the fellows of Magdalen over the election of a president Charnock favoured the first royal nominee, Anthony Farmer, and also the succeeding one, Samuel Parker, bishop of Oxford. Almost alone among the fellows he was not driven out in Nov. 1687, and he became dean and then vice-president of the college under the new régime, but was expelled in Oct. 1688. Residing at the court of the Stuarts in France, or conspiring in England, Charnock and Sir George Barclay appear to have been implicated in the attempt to kill William III. near Turnham Green, in Feb. 1696. Barclay escaped, but Charnock was arrested, was tried and found guilty, and was hanged on March 18, 1696.

CHARNOCKITE, in petrology a series of igneous rocks (originally described by Sir T. H. Holland) from Madras presidency, southern India, and forming a well-defined petrographic province of Archaean age. The name is derived from that of the founder of Calcutta, Job Charnock, whose tombstone is made of a typical member of the series. The series includes a wide range of rock types from ultrabasic pyroxenites through intermediate types—norites and quartz-hypersthene-diorites—to acid pyroxene-granites. The term charnockite is often specifically reserved for the acid hypersthene-granite. One of the distinguishing features of the series is the recurrence in many members of a strongly pleochroic red-to-green hypersthene. The typical members of the series, however, show other peculiar mineralogical features, namely the development of *schiller* structures, from the presence of minute plate or rod shaped enclosures disposed parallel to definite crystallographic planes or axes. The optical effect of these enclosures is seen in the blue opalescence of the quartz, the milky shimmer of the felspar and the bronzelike lustre of the rhombic pyroxene. Myrmekitic, microperthitic and antiperthitic structures are common in the felspars. In the soda-lime felspars there is a striking tendency to absence of the usual twinning lamellae. The members of the charnockite series frequently show a banded or gneissic structure, now usually interpreted as a flow banding, due to movement during the epoch of crystallization. Chemically the series is distinctly subalkaline, with a dominance of iron oxides over magnesia and lime.

The various members are of widespread distribution and great petrological importance. In southern India they occur in the Nilgiri hills, the Shevaroys and the western Ghats, extending southward to Cape Comorin and reappearing in Ceylon. They occur in the Archaean shield of Western and South Australia and in Adélie Land, Antarctica. Similar rocks are known from the Ivory coast of West Africa, the eastern part of Ellesmere Land; form the Cortlandt series near Peekskill, N. Y., and recur at other localities in the eastern United States and Canada. The most noteworthy occurrences in the northern hemisphere are found in south-western and western Norway, at East Kersund and Soggendal, and over a large area in the Bergen and Jotunheimen districts. The majority of the known occurrences of the charnockite series are of Archaean age, but it is probable that the anorthosite-charnockite series of the Bergen-Jotunheimen districts is of lower Palaeozoic (Caledonian) age. (C. E. T.)

CHARNWOOD FOREST, an upland tract in north Leicestershire (*q.v.*), England, southwest of Loughborough. Much of it is barren, though there are extensive tracts of woodland. More than 6,000 ac. are at a height exceeding 600 ft.; the loftiest point, Bardon Hill, is 912 ft.

CHAROLLES, a town of east-central France, capital of an arrondissement in the department of Saône-et-Loire, at the confluence of the Semence and Arconce, 39 mi. W.N.W. of Mâcon. Pop. (1936) 2,994.

Charolles was the capital of Charolais which from the early 14th century gave the title of count to its possessors. The ruins of their castle are on a hill near the town. In 1327 the countship passed by marriage to the house of Armagnac, and in 1390 it was sold to Philip of Burgundy. After the death of Charles the Bold it was seized by Louis XI. of France, but in 1493 it was ceded by Charles VIII. to Maximilian of Austria. Ultimately passing to the Spanish kings, its possession became disputed, until in 1684 it was assigned to Condé, a creditor of the king of Spain. It was united to the French crown in 1771.

There are stone quarries in the vicinity; the town manufactures pottery, and is the centre for trade in the famous breed of Charolais cattle and has also a timber trade. It has a sub-prefecture and tribunals of primary instance and commerce.

CHARON, in Greek mythology, the son of Erebus and Nyx (Night). It was his duty to ferry over the Styx and Acheron those souls of the deceased who had duly received the rites of burial, in payment for which service he received an obol, which was placed in the mouth of the corpse. He is probably a product of popular belief, not mentioned in Homer or Hesiod. He is represented as a morose and grisly old man. In Etruscan he is called Charun, and appears as a death-demon, armed with a hammer. Finally he came to be regarded as the image of death and the world below. As such he survives in the Charos or Charontas of the modern Greeks.

See the classical dictionaries, especially Roscher's *Lexikon, s.v.*

CHARONDAS, a celebrated lawgiver of Catina in Sicily. His date is uncertain. Some make him a pupil of Pythagoras (*c.* 580–504 B.C.); but all that can be said is that he was earlier than Anaxilaus of Regium (494–476), who abolished his laws, previously in use at Regium. His laws, originally written in verse, were adopted by the other Chalcidic colonies in Sicily and Italy. According to Aristotle there was nothing special about these laws, except that Charondas introduced actions for perjury; but he speaks highly of the precision with which they were drawn up (*Politics,* ii. 12). The legal fragments attributed to him by Stobaeus and Diodorus are of late (neo-Pythagorean) origin.

See Bentley, *On Phalaris,* which (according to B. Niese, *s.v.* in Pauly, *Realencyklopädie*) contains the best account of Charondas; A. Holm, *Geschichte Siciliens,* i.; F. D. Gerlach, *Zaleukos, Charondas, und Pythagoras* (1858); also art. GREEK LAW.

CHARPENTIER, FRANÇOIS (1620–1702), French archaeologist and man of letters, was born in Paris. In his *Excellence de la langue française* (1683) he anticipated Perrault in the famous academical dispute concerning the relative merit of the ancients and moderns. He is credited with a share in the production of the magnificent series of medals that commemorate the principal events of the age of Louis XIV.

CHARRIÈRE, ISABELLE DE (1740–1805), Swiss author, was Dutch by birth, her maiden name being van Tuyll van Seeroskerken van Zuylen. She married in 1771 her brother's tutor, Saint-Hyacinth de Charrière, and settled with him at

Colombier, near Lausanne. Her *Lettres neuchâteloises* (Amsterdam, 1784) offer a simple and attractive picture of French manners. This, with *Caliste, ou lettres écrites de Lausanne* (2 vols. Geneva, 1785–88), was analysed and highly praised by Sainte-Beuve in his *Portraits de femmes* and in vol. iii. of his *Portraits littéraires*. She wrote a number of other novels, and some political tracts; but is perhaps best remembered by her liaison with Benjamin Constant (*q.v.*) between 1787 and 1796.

Her letters to Constant were printed in the *Revue suisse* (April 1844), her *Lettres-Mémoires* by E H. Gaullieur in the same review in 1857, and all the available material is utilized in a monograph on her and her work by P. Godet, the editor of her *Oeuvres complètes* (3 vols. 1907–09), in his *Madame de Charrière et ses amis* (2 vols., Geneva, 1906).

CHARRON, PIERRE (1541–1603), French philosopher, was born in Paris. He entered the Church, and was appointed preacher in ordinary to Marguerite, wife of Henry IV. of Navarre. At Bordeaux he met Montaigne, whose intimate friend he became.

In 1594 Charron published (at first anonymously, afterwards under the name of "Benoit Vaillant, Advocate of the Holy Faith," and also, in 1594, in his own name) *Les Trois Vérités*, in which he seeks to prove that there is a God and a true religion, that the true religion is the Christian, and that the true Church is the Roman Catholic. It is chiefly an answer to the famous Protestant work entitled *Le Traité de l'Église* by Du Plessis Mornay. It was followed in 1600 by *Discours chrestiens*, a book of very eloquent sermons. In 1601 Charron published at Bordeaux the famous *De la sagesse*, a complete popular system of moral philosophy. Usually it is coupled with the Essays of Montaigne, to which the author is under very extensive obligations in it. Charron suddenly stood forth as the representative of the most complete intellectual scepticism. The *De la sagesse* brought upon its author the most violent attacks. It received, however, the warm support of Henry IV. and of the president Pierre Jeannin (1540–1622).

Charron's psychology is sensationalist. With sense all our knowledge commences. The soul, located in the ventricles of the brain, is affected by the temperament of the individual; the dry temperament brings intelligence; the moist, memory; the hot, imagination. The immortality of the soul is the most universal of beliefs, but the most feebly supported by reason. As to man's power of attaining truth, he plainly declares that none of our faculties enable us to distinguish truth from error. On a pessimistic view of human nature Charron founded a moral system that may be summarized as follows: Man comes into the world to endure; let him endure then, and that in silence. Our compassion should be like that of God, who succours the suffering without sharing in their pain. Avoid vulgar errors; cherish universal sympathy. Let no passion or attachment become too powerful for restraint. Follow the customs and laws which surround you. Morality has no connection with religion. Reason is the ultimate criterion.

Charron holds that all religions grow from small beginnings and increase by popular contagion; all teach that God is to be appeased by prayers, presents, vows, but especially, and most irrationally, by human suffering. Each is said by its devotees to have been given by inspiration. In fact, however, a man is a Christian, Jew, or Mohammedan, before he knows he is a man. But while he openly declares religion to be "strange to common sense," the practical result at which Charron arrives is that one is not to sit in judgment on his faith, but to be "simple and obedient," and to allow himself to be led by public authority. Another rule is to avoid superstition, which he defines as the belief that God is like a hard judge, and that therefore He must be flattered and importuned, and won over by pain and sacrifice. True piety is the knowledge of God and of one's self, the latter knowledge being necessary to the former. It leads to spiritual worship; for external ceremony is merely for our advantage, not for His glory. Charron is thus the founder of modern secularism. His political views are neither original nor independent. He pours scorn on the common herd, declares the sovereign to be the source of law, and asserts that popular freedom is dangerous.

A summary and defence of the *Sagesse* appeared in 1606. In 1607 Michel de la Rochemaillet prefixed to an edition of the *Sagesse* a Life. His complete works, with this Life, were published in 1635. An excellent abridgment of the *Sagesse* is given in Tennemann's *Philosophie*, vol. ix.; an edition with notes by A. Duval appeared in 1824.

See H. T. Buckle, *Intro. to History of Civilization in England*, vol. ii. p. 19 (1869); Abbé Lezat, *De la prédication sous Henri IV.* (1871); Liebscher, *Charron u. sein Werk, De la sagesse* (Leipzig, 1890); J. Owen, *Skeptics of the French Renaissance* (1893); W. E. H. Lecky, *Rationalism in Europe* (new ed. 1910); J. B. Sabrié, *De l'humanisme au rationalisme, Pierre Charron* (1913); J. M. Robertson, *A Short History of Free Thought*, vol. i. p. 480 (3rd. ed. 1915).

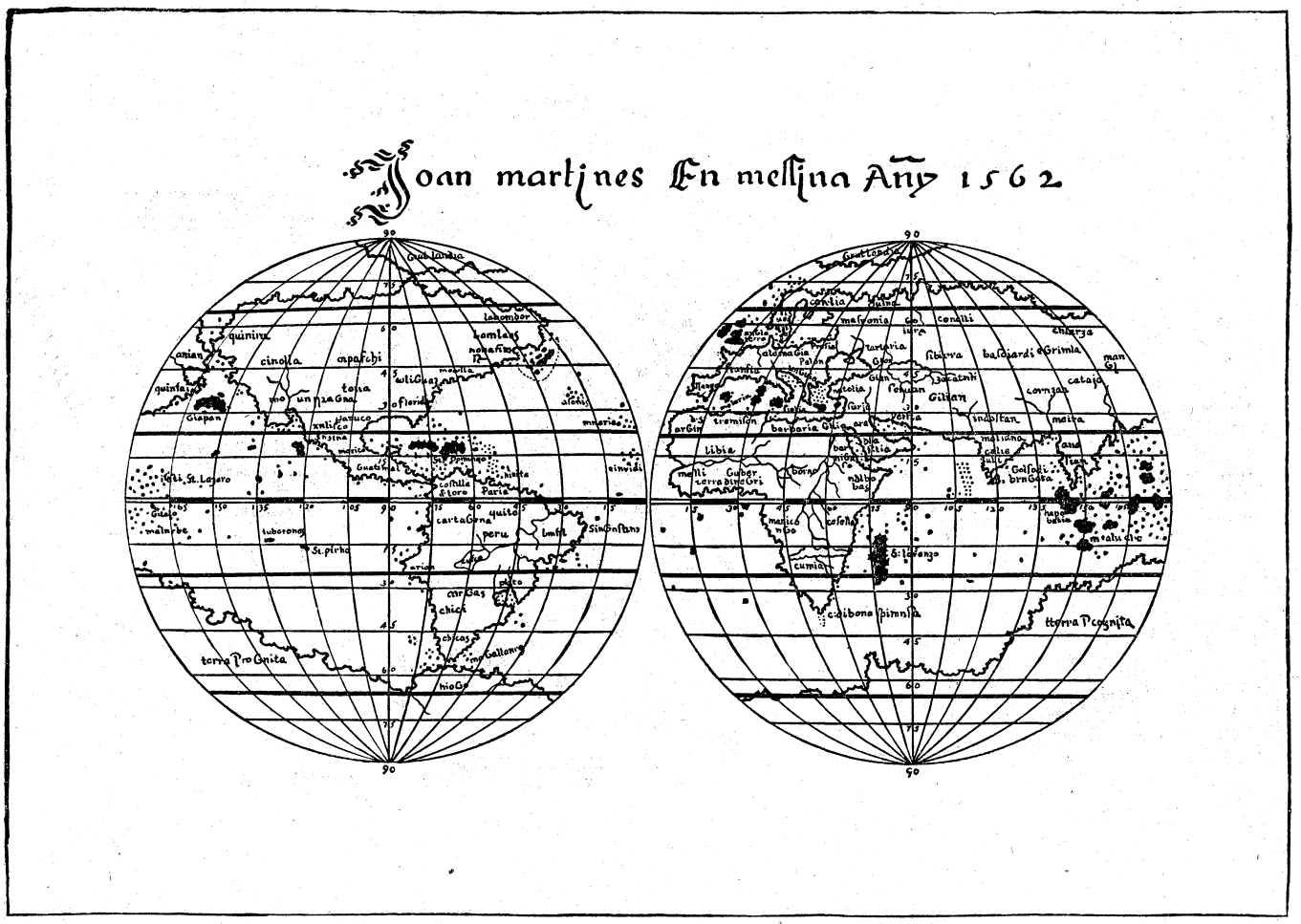
CHARRUA, an almost extinct tribe of South American Indians, wild and warlike, formerly ranging over Uruguay and part of southern Brazil. They were dark and heavily built, fought on horses and used the bolas or weighted lasso.

CHART. A chart is a marine map intended specially for the use of the seaman, to assist him to navigate seas and oceans, to sail from port to port and by its means to ascertain the position of a ship with reference to the land, the direction in which to steer, the distance to sail and the dangers to avoid. The water area on charts is studded with numerous small figures; these are the soundings, indicating in fathoms or in feet or in a combination of the two (as shown in the title of the chart) at mean low water spring tides the depth of water at any particular position. Charts show the nature of the sea bottom, the irregularity in its character and give information of the greatest importance to the mariner. No matter how well the land may be surveyed a chart is practically valueless unless soundings are shown.

The British admiralty charts are compiled, drawn and published by the hydrographic department. This department as established under Earl Spencer by an Order in Council in 1795 consisted of the hydrographer, one assistant and one draughtsman. The first hydrographer was Alexander Dalrymple, a gentleman in the East India Company's service; on his supersession in 1808 the office of hydrographer was filled by Captain Thomas Hurd, R.N., and has since been held by officers of the Royal Navy, amongst whom may be mentioned Admirals Sir Edward Parry, Sir Francis Beaufort and Sir William Wharton. At the present time, 1928, the department consists of the hydrographer, 15 naval assistants, 23 chief cartographers, and cartographers, 57 draughtsmen and 38 clerical staff, apart from the numerous engravers, printers, etc., who are employed in the final stages of preparing the work for publication.

Charts prepared by the hydrographic department and published by order of the Lords Commissioners of the Admiralty are compiled from the labours of British naval officers employed in the surveying service, also from surveys made by the Royal Australian Navy, Royal Indian Marine, South African Naval Service and contributions from officers of the Royal navy and mercantile marine. Generally speaking each maritime nation is considered to be responsible for the charting of its own coastal waters and those of its dependencies; the majority of these have efficient and well-organized hydrographic offices, carry out their own surveys and publish charts for the use of seamen. There is a free interchange of hydrographic information as between nations and foreign government charts are utilized and incorporated in various charts and publications produced by the British Admiralty, acknowledgment of the source of the information being made in the title of the chart. Admiralty charts, which are published with the view of meeting the wants of the seaman in all parts of the world, may be classed under five heads, viz., ocean, general, coastal, harbour and physical charts; they are constructed on either mercator or gnomonic projection according to scale and locality. After preparation at the hydrographic department they are engraved on copper plates which thereafter become the original printing medium and which are in constant correction due to the absolute necessity that the latest information should be available.

The depth of the sea is obtained by sounding line, wire or by sonic methods; all soundings are reduced to mean low water spring tides. The times and heights of the tides with the direction and the velocity of the tidal streams are also ascertained. The original surveys drawn by the surveyors afloat are forwarded to the Admiralty and form the basis of the published charts. The ocean and general charts are compiled and drawn at the hydrographic



BY COURTESY OF THE HISPANIC SOCIETY OF AMERICA

THE WORLD IN TWO HEMISPHERES, FROM THE ATLAS OF 7 CHARTS BY MARTINES OF MESSINA (1562), SHOWING THE EXTENT OF MARITIME DISCOVERY AT THAT DATE. THE AUSTRALIAN CONTINENT WAS STILL "TERRA INCOGNITA."

department; original documents, existing charts, latest surveys and maps have all to be consulted and their compilation requires experience and judgment, for the compiler has to decide what to omit, what to insert, and to arrange the necessary work in such a manner that full information is given to the seaman. A very slight error may lead to great disaster and every symbol on the chart must be delineated with great care. No pains are spared in the effort to lay before the public the labours of the hydrographic surveyors and explorers not only of England, but of all the maritime world, to reduce their various styles into a comprehensive system and to furnish the seaman with a guide of which he may take full advantage. Certain abbreviations are used on charts and are fully described in a special publication.

There are still enormous areas which are unsurveyed or not surveyed in sufficient detail for modern requirements. Charts of these localities are usually drawn in hairline so that the experienced seaman sees at a glance that caution is necessary. The charts issued to the public are correct at the time of publication and are kept corrected for newly reported dangers, changes in character or position of lights and buoys, recent publications of foreign governments, etc., this information being supplied gratis to the public in the Admiralty notices to mariners which are published weekly. Charts are supplemented by the "sailing directions" covering the whole of the navigable portion of the globe, tide tables, light lists, the Admiralty list of wireless time signals, the nautical almanac, distance tables, ocean passages of the world, in which is included information regarding winds and currents, etc.

NAUTICAL SURVEYING

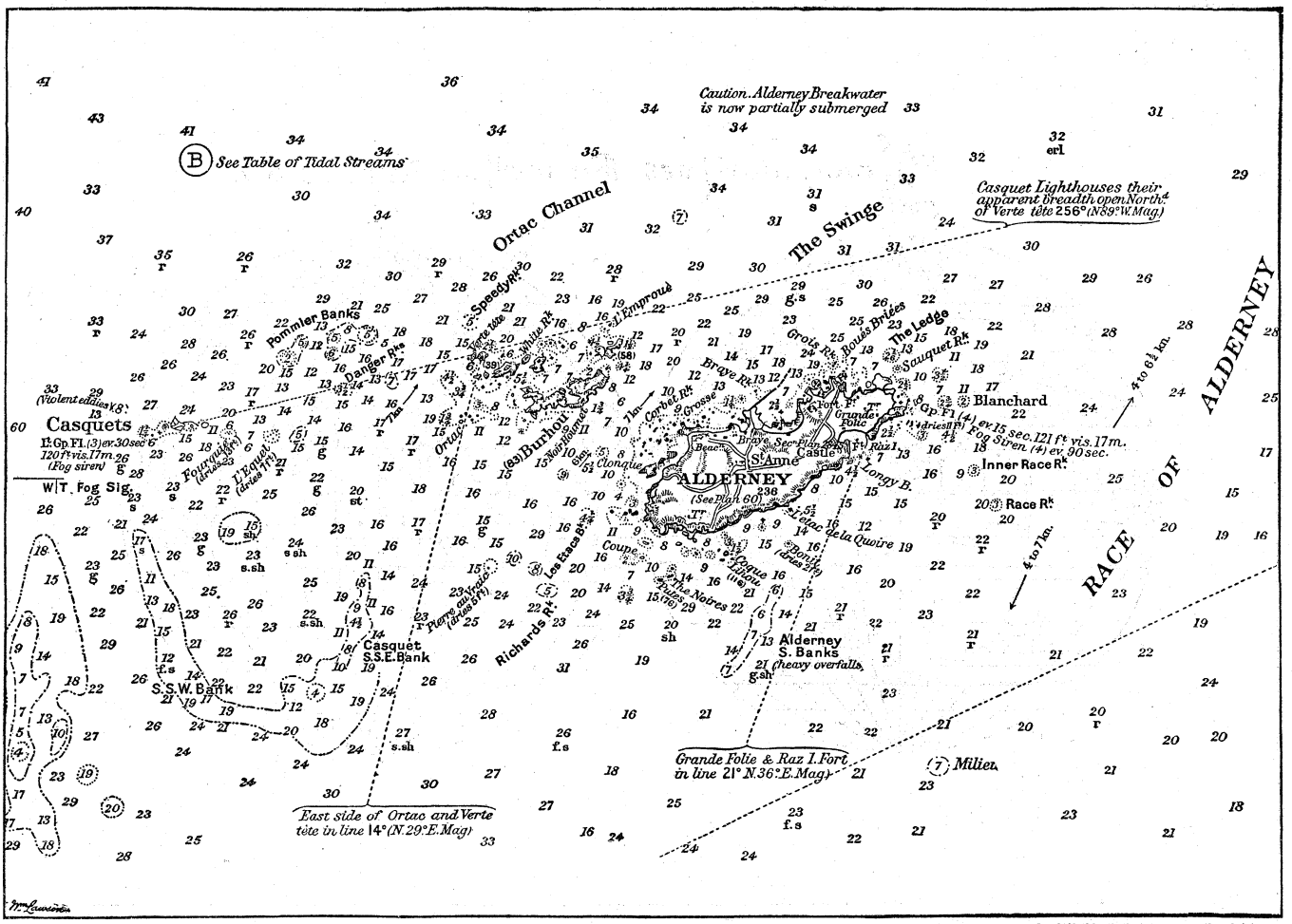
Naval hydrographic surveying has since the termination of the war in 1918 steadily progressed in adopting the latest methods and instruments which have become available to the surveyor ashore and afloat. It is not often realized that the hydrographic surveyor has to combine the work of the land surveyor with his own.

Instruments.—The following are the principal instruments required for use in the field and it should be noted that various scientific inventions of great benefit to the surveyor, and of which full advantage has already been taken, were designed and perfected during the World War, 1914–18.

Theodolites (*q.v.*) in current use (1928) are 4 in., 5 in. and 6 in. The majority of these are micrometer theodolites reading to 10 seconds. The use of the theodolite for astronomical and tacheometer work is now universal.

Sextants for observing with stand and artificial horizon are still supplied and improvements in this instrument have been adopted; amalgamated troughs consisting of gold-covered plates on which a thin film of mercury is floated have superseded the old artificial horizon consisting of a mercury bath; the new pattern is far less sensitive to earth tremors. This instrument for work on shore is now to a great extent superseded by other more precise and compact instruments.

Astrolabe à prisme, a very precise instrument, is one of these. It is used for finding position and enables altitudes of any stars at the altitude of 45° or 60° to be observed. The latest form of astrolabe enables observations of stars to be easily and accurately made as follows with the 60° instrument—one step of $7\frac{1}{2}'$ on either side of 60°, that is 3 observations of 59° $52\frac{1}{2}'$, 60°, 60° $07\frac{1}{2}'$ can be taken of one star. With the 45° instrument—four steps of 5′ on either side of 45°, that is 11 observations of 44° 35′, 44° 40′, 44° 45′, 44° 50′, 44° 55′, 45°, 45° 05′, 45° 10′, 45° 15′, 45° 20′, 45° 25′—can be taken of one star. The great advantage of this instrument is that with one setting up of the instrument and without a number of necessary readjustments, as in a theodolite, both time and latitude can be determined, provided of



CERTAIN HYDROGRAPHIC INFORMATION ON THIS CHART IS REPRODUCED FROM BRITISH ADMIRALTY CHARTS WITH THE PERMISSION OF THE CONTROLLER OF H.M. STATIONERY OFFICE, AND OF THE HYDROGRAPHER OF THE NAVY, WHO ARE IN NO WAY RESPONSIBLE, HOWEVER, FOR THIS CHART

PORTION OF A CHART OF THE CHANNEL ISLANDS, SHOWING THE ISLAND OF ALDERNEY AND THE DANGEROUS ROCKS KNOWN AS THE CASQUETS. THE FIGURES GIVE SOUNDINGS IN FATHOMS

course that the best and latest method of obtaining error of the time used (*i.e.*, wireless time signals) is adopted.

When it is found necessary to measure bases the hydrographic surveyor uses the 500 ft. steel measuring tape and is provided with the Kew standardization certificate. In surveying abroad where no local triangulation exists, the accurate measurement of a base is recognized as a most important step, second only to a satisfactory base extension. Tacheometers and tacheometer staves marked according to the Admiralty pattern are used for measuring distances up to over 2,000 ft. where extreme accuracy is not necessary. One-metre base range-finders are useful in measuring short bases for plans of harbours, etc., when time or circumstances do not permit of a more accurate method.

Sounding Sextants differ from ordinary sextants in being lighter and handier; the arc which is of brass is cut to minutes, reading to large angles of as much as 140° and fitted with a telescope of high power.

Station Pointer is in constant use for all kinds of plotting: it enables the observer's position to be fixed by two angles between three objects suitably placed, the centre of the instrument indicating the observer's position when set and applied to the plotting sheet.

Sun Signals for reflecting the rays of the sun to distance stations for the purpose of obtaining accurate angles and measurements. The most convenient form is Galton's Sun Signal, which is easy to operate, compact and portable.

In addition *pocket aneroid barometers* for topographical purposes, *prismatic compasses, patent logs, Lucas sounding machines,* both large and small, James's *submarine sentry, tacheometer staves,* etc., are also required. For chart room use *graduated brass scales, steel straight edges, beam compasses* of various lengths, *rectangular protractors, circular brass protractors, mathematical drawing instruments, weights, drawing boards* and *paper* are required.

MARKS AND BEACONS

Every survey must have fixed objects which are first plotted on the sheets, technically known as "points." Natural marks of all kinds are utilized, but these must be supplemented by whitewash marks, cairns, flags, etc. On low coasts and islets flag staffs upwards of 100 ft. high made of several spars lashed together must sometimes be erected in order to get the necessary range of vision. A fixed beacon can be erected in shallow water by constructing a tripod of spars about 45 ft. long. The heads of two of them are lashed together and the heels kept open at a fixed distance by a plank nailed at about 5 ft. above the heels of the spars. These are taken out by three boats and the third tripod leg lashed in position on the boats, the heel in the opposite direction to the other two. The first two legs, weighted, are let go together; using the third leg as a prop, the tripod is hauled into position and secured by guys and by additional weights. A vertical pole with bamboo and flag, the heel being weighted, is lashed to the fork.

Floating Beacons.—These as a rule are specially constructed to carry a flag 12 to 16 ft. square on a bamboo from 30 to 35 ft. long. The beacon is secured to an anchor by means of chain or wire moorings and is visible under good conditions for a distance of about 10 miles. A beacon has been moored by sounding wire in depths of 3,000 fathoms with a weight of 100 lb.

Fixing.—In nautical surveying a thorough knowledge of the principles involved in a station-pointer fix is essential. The method of fixing by two angles between three fixed points is generally known as the "two-circle method," but there are really three circles involved. The "station-pointer" is the instrument used for

plotting fixes. Its construction depends upon the fact that angles subtended by the chord of a segment of a circle measured from any point in its circumference are equal. The lines joining three fixed points form the chords of segments of three circles, each of which passes through the observer's position and two of the fixed points. The more rectangular the angle at which the circles intersect each other, and the more sensitive they are, the better will be the fix; one condition is useless without the other. A circle is "sensitive" when the angle between the two objects responds readily to any small movement of the observer towards or away from the centre of the circle passing through the observer's position and the objects. This is most markedly the case when one object is very close to the observer and the other very distant, but not so when *both* objects are distant. In the accompanying diagrams A, B, C are the objects, and X the observer. Fig. 1 shows the circle passing through C, B and X, cutting the circle ABX at a good angle, and therefore fixing X independently of the circle CAX, which is less sensitive, but being nearly tangential they give no cut with each other. The third cuts both at right angles; it is, however, far less sensitive, and for that reason if the right and left hand objects are both distant the fix must be bad. In such a case as this, because the angles CBX, BXA are both so sensitive, and the accuracy of the fix depends on the precision with which the angle CXA is measured, that angle should be observed direct, together with one of the other angles composing it. Fig. 3 represents a case where the points are badly disposed, approaching the condition known as "on the circle," passing through the three points. All three circles cut one another at such a fine angle as to give a very poor fix. The centre of the station-pointer could be moved considerably without materially affecting the coincidence of the legs with the three points. To avoid a bad fix the following rules are safe.

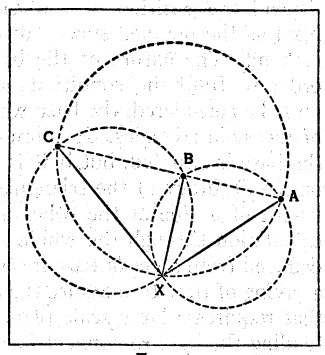


FIG. 1

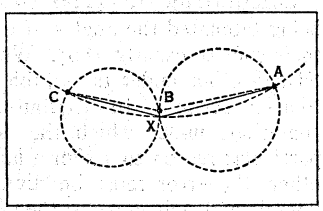


FIG. 2

Choose objects disposed as follows: (a) One outside object distant and the other two near, the angle between the two near objects being not less than 30° or more than 140°. The amount of the angle between the middle and distant object is immaterial. (b) The three objects nearly in a straight line, the angle between any two being not less than 30°. (c) The observer's position being inside the triangle formed by the objects. A fix on the line of two points in transit, with an angle to a third point, becomes more sensitive as the distance between the transit points increases relatively to the distance between the front transit point and the observer; the more nearly the angle to the third point approaches a right angle, and the nearer it is situated to the observer, the better the fix. If the third point is at a long distance, small errors either of observation or plotting will affect the result considerably.

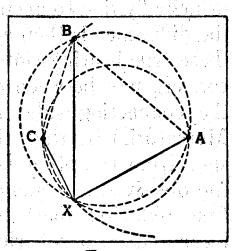


FIG. 3

Tracing-paper answers exactly the same purpose as the station-pointer. The angles are laid off from a centre representing the position, and the lines brought to pass through the points as before. This has often to be used, as when points are close together on a small scale the central part of the station-pointer will often hide them and prevent the use of the instrument. The use of tracing-paper permits any number of angles to different points to be laid down on it, which under certain conditions of fixing is sometimes an advantage.

Bases.—Marine surveys are founded upon triangulation and measured bases of some description, yet when plotted irregularly the system of triangles is not always apparent. The triangulation ranges from the rough triangle of a running survey to the carefully formed triangles of detailed surveys. The measured base for an extended survey is provisional only, the scale resting ultimately mainly upon the astronomical position observed as its extremes. In the case of a plan the base is absolute. The main triangulation establishes a series of points known as main stations, from which and to which angles are taken to fix other stations. A sufficiency of secondary stations enables the detail of the chart to be filled in between them. The points embracing the area to be worked on, having been plotted, are transferred to field boards, upon which the detail of the work in the field is plotted; when complete the work is traced and re-transferred to the plotting sheet, which is then inked in as the finished chart, and is graduated on the gnomonic projection on the astronomical positions of two points situated near opposite corners of the chart.

The kind of base ordinarily used is one measured by a steel tape of 100 or 500 ft. length on flat ground of convenient length, between two points visible from one another and so situated that a triangulation can be extended from them to embrace other points in the survey. The error of the steel tape is noted before leaving the ship, and again on returning, by comparing its length with a standard. The correction so found, also corrections for temperature, sag, etc., are applied to obtain the final result. A masthead angle base is at times useful for small plans, etc., when circumstances do not permit of a base being measured on shore. The height of the masthead to the water line being known the simple calculation necessary to obtain the distance is easily computed.

Astronomical Base.—The difference of latitude between two stations visible from each other and nearly in the same meridian, combined with their true bearings, gives an excellent base for an extended triangulation; the only drawback to it is the effect of local attraction of masses of land in the vicinity on the pendulum, or, in other words, on the mercury in the artificial horizon. The base stations should be as far apart as possible, in order to minimize the effect of any error in the astronomical observations. The observation spots would not necessarily be actually at the base stations, which would probably be situated on summits at some little distance in order to command distant views. In such cases each observation spot would be connected with its corresponding base station by a subsidiary triangulation, a short base being measured for the purpose. If possible, the observation spots should be east or west of the mountain station from which the true bearings are observed.

If the base stations A and B are so situated that by reason of distance or of high land intervening they are invisible from one another, but both visible from some main station C between them, when the main triangulation is completed, the ratio of the sides AC, BC can be determined. From this ratio and the observed angle ACB, the angles ABC, BAC can be found. The true bearing of the lines AC or BC being known, the true bearing of the base stations A and B can be deduced.

Extension of Base.—A base of any description is seldom long enough to plot from directly, and in order to diminish errors of plotting it is necessary to begin on the longest side possible so as to work inwards. A short base measured on flat ground will give a better result than a longer one measured over inequalities, provided that the triangulation is carefully extended by means of judiciously selected triangles, great care being taken to plumb the centre of each station. To facilitate the extension of the base in as few triangles as possible, the base should be placed so that there are two stations, one on each side of it, subtending angles at them of from 30° to 40°, the distances between which, on being calculated in the triangles of the quadrilateral so formed, will constitute the first extension of the base. Similarly, two other stations placed one on each side of the last two will form another quadrilateral, giving a yet longer side, and so on.

Main Triangulation.—The angles to be used in the main triangulation scheme must be very carefully observed and the theodolite placed exactly over the centre of the station. Main

angles are usually repeated several times by resetting the vernier at intervals equidistant along the arc, in order to eliminate instrumental errors as well as errors of observation. The selection of an object suitable for a zero is important. It should, if possible, be another main station at some distance, but not so far or so high as to be easily obscured, well defined, and likely to be permanent. Angles to secondary stations should be repeated. Rough sketches from all stations with angles are of great assistance in identifying objects from different points of view.

False Station.—When the theodolite cannot for any reason be placed over the centre of a station, if the distance be measured and the theodolite reading of it be noted, the observed angles may be reduced to what they would be at the centre of the station. False stations have frequently to be made in practice; a simple rule to meet all cases is of great assistance to avoid the possibility of error in applying the correction with its proper sign It may very easily be found as follows.

Rule.—Put down the theodolite reading which it is required to correct (increased if necessary by 360°), and from it subtract the theodolite reading of the centre of the station. Call this remainder θ. With θ as a "course" and the number of feet from the theodolite to the station as a "distance," enter the traverse table and take out the greater increment if θ lies between 45° and 135°, or between 225° and 315°, and the lesser increment for other angles. The accompanying diagram (fig. 4) will assist the memory. Refer this increment to the "table of subtended angles by various lengths at different distances" (using the distance of the object observed) and find the corresponding correction in arc, which mark + or − according as θ is under or over 180°. Apply this correction to the observed theodolite angle. A "table of subtended angles" is unnecessary if the formula

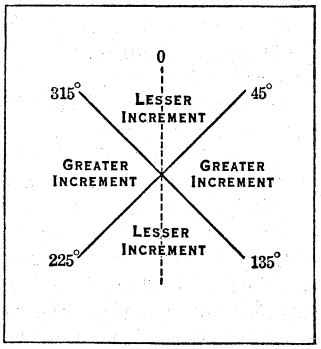


FIG. 4

$$\text{Angle in seconds} = \frac{\text{Number of feet subtended} \times 34}{\text{Distance of object in sea miles}}$$

be used instead.

The difference of the reciprocal true bearings between two stations is called the "convergency." The formula for calculating it is: Conv. in minutes = dist. in sea miles × sin. Merc. bearing × tan. mid. lat. Whenever true bearings are used in triangulation, the effect of convergency must be considered and applied. In north latitudes the southerly bearing is the greater of the two, and in south latitudes the northerly bearing. The Mercatorial bearing between two stations is the mean of their reciprocal true bearings.

Triangulated Coast Survey.—After a preliminary run over the ground to note suitable positions for stations on prominent headlands, islands and summits not too far back from the coast, and, if no former survey exists, to make at the same time a rough plot of them by compass and patent log, a scheme must be formed for the main triangulation with the object of enclosing the whole survey in as few triangles as possible, regard being paid to the limit of vision of each station due to its height, to the existing meteorological conditions, to the limitations imposed by higher land intervening, and to its accessibility. The triangles decided upon should be well-conditioned, taking care not to introduce an angle of less than 30° to 35°, which is only permissible when the two longer sides of such a triangle are of nearly equal length, and when the determination of this length does not depend on the short side. In open country the selection of stations is a comparatively easy matter, but in country densely wooded the time occupied by a triangulation is largely governed by the judicious selection of stations quickly reached, sufficiently elevated to command distant views, and situated on summits capable of being readily cleared of trees in the required directions, an all-round view being, of course, desirable though not always attainable. The positions of secondary stations will also generally be decided upon during the preliminary reconnaissance. The object of these stations is to break up the large primary triangles into triangles of smaller size, dividing up the distances between the primary stations into suitable lengths; they are selected with a view to greater accessibility than the latter, and should therefore usually be near the coast and at no great elevation. Upon angles from these will depend the position of the coastline marks, to be erected and fixed as the detailed survey of each section of the coast is taken in hand. The nature of the base to be used, and its position in order to fulfil the conditions specified under the head of *Bases* must be considered, the base when extended forming a side of one of the main triangles. It is immaterial at what part of the survey the base is situated, but if it is near one end, a satisfactory check on the accuracy of the triangulation is obtained by comparing the length of a side at the other extreme of the survey, derived by calculation through the whole system of triangles with its length deduced from a check base measured in its vicinity. It is generally a saving of time to measure the base at some anchorage or harbour that requires a large scale plan. The triangulation involved in extending the base to connect it with the main triangulation scheme can thus be utilized for both purposes, and while it is being calculated and plotted the survey of the plan can be proceeded with. The bearings are observed at both ends of the survey and at other selected stations and the results subsequently compared. Astronomical observations for latitude and longitude are obtained at observation spots near the extremes of the survey and are connected with the primary triangulation; they are usually disposed at intervals of from 100 to 150 m., and thus errors due to a triangulation carried out with theodolites of moderate diameter do not accumulate to any serious extent.

Calculating the Triangulation.—The triangles as observed being tabulated the angles of each triangle are corrected to bring their sum to exactly 180°. We must expect to find errors in the triangles, but under favourable conditions they will only amount to a few seconds. In distributing the errors we must consider the conditions under which the angles were observed; failing any particular reason to assign a larger error to one angle than to another, the error must be divided equally. The various quadrilaterals and polygons are then adjusted to make the whole triangulation as rigid as possible and bring the whole network into agreement. The length of base being determined, the sides of all the triangles involved are calculated by the ordinary rules of trigonometry. Starting from the true bearing observed at one end of the survey, the bearing of the side of each triangle that forms the immediate line of junction from one to the other is found by applying the angles necessary for the purpose in the respective triangles, not forgetting to apply the convergency between each pair of stations when reversing the bearings. The bearing of the final side is then compared with the bearing obtained by direct observation at that end of the survey. The difference is principally due to accumulated errors in the triangulation; half of the difference is then applied to the bearing of each side. Convert these true bearings into Mercatorial bearings by applying half the convergency between each pair of stations. With the lengths of the connecting sides found from the measured base and their Mercatorial bearing, the Mercatorial bearing of one observation spot from the other is found by middle latitude sailing. Taking the observed astronomical positions of the observation spots and first reducing their true difference longitude to departure, as measured on a spheriod from the formula

$$\text{Dep.} = \text{T.D. long.} \frac{\text{No. ft. in 1 m. of long.}}{\text{No. ft. in 1 m. of lat.}}$$

then with the d. lat. and dep. the Mercatorial true bearing and distance between the observation spots is calculated by middle latitude sailing, and compared with that by triangulation and measured base. To adjust any discrepancy, it is necessary to consider the probable error of the observation for latitude and meridian distance; within those limits the astronomical positions may safely be altered in order to harmonize the results; it is more important to bring the bearings into close agreement than the

distance. From the amended astronomical position the Mercatorial true bearings and distance between them are re-calculated. The difference between this Mercatorial bearing and that found from the triangulation and measured base must be applied to the bearing of each side to get the final corrected bearings, and to the logarithm of each side of the triangulation as originally calculated must be added or subtracted the difference between the logarithms of the distance of the amended positions of the observation spots and the same distance by triangulation.

Calculating Intermediate Astronomical Positions.—The latitude and longitude of any intermediate main station may now be calculated from the finally corrected Mercatorial true bearings and lengths of sides. The difference longitude so found is what it would be if measured on a true sphere, whereas we require it as measured on a spheroid, which is slightly less. The correction $= \text{d. long.} \frac{\cos^2 \text{mid. lat.}}{150}$ must therefore be subtracted; or the true difference longitude may be found direct from the formula $\text{Dep.} \frac{\text{No. ft. in 1 m. of lat.}}{\text{No. ft. in 1 m. of long.}}$. From the foregoing it is seen that in a triangulation for hydrographical purposes both the bearings of the sides and their lengths ultimately depend almost entirely upon the astronomical observations at the extremes of the survey; the observed true bearings and measured base are consequently more in the nature of checks than anything else. It is obvious, therefore, that the nearer together the observation spots, the greater effect will a given error in the astronomical positions have upon the length and direction of the sides of the triangulation, and in such cases the bearings as actually observed must not be altered to any large extent when a trifling change in the astronomical positions might perhaps effect the required harmony. For the reasons given under *Astronomical Base,* high land near observation spots may cause very false results, which may often account for discrepancies when situated on opposite sides of a mountainous country.

Plotting.—Great care is requisite in projecting on paper the points of a survey. The paper should be allowed to stretch and shrink as it pleases until it comes to a stand, being exposed to the air for four or five hours daily, and finally well flattened out by being placed on a table with drawing boards placed over it heavily weighted. If the triangulation and co-ordinates have been calculated beforehand throughout, it is more advantageous to plot by co-ordinates or distances rather than by chords. The main stations are thus got down in less time and with less trouble, but these are only a small proportion of the points to be plotted, and if chords or distances are used long lines must be ruled between the stations as zeros for plotting other points by chords. In ruling these lines care must be taken to draw them exactly through the centre of the pricks denoting the stations, but, however, carefully drawn, there is liability to slight error in any line projected to a point lying beyond the distance of the stations between which the zero line is drawn. In plotting by distances, therefore, all points that will subsequently have to be plotted by chords should lie well within the area covered by the main triangulation. Three distances must be measured to obtain an intersection of the arcs cutting each other at a sufficiently broad angle; the plotting of the main stations once begun must be completed before distortion of the paper can occur from change in the humidity of the atmosphere. Plotting, whether by distance or by chords, must be begun on as long a side as possible, so as to plot inwards, or with decreasing distances. In plotting by chords it is important to remember in the selection of lines of reference (or zero lines), that that should be preferred which makes the smallest angle with the line to be projected from it, and of the angular points those nearest to the object to be projected from them.

Irregular Methods of Plotting.—In surveys for the ordinary purposes of navigation, it may happen that a regular system of triangulation cannot be carried out; the judicious use of the ship in such cases is often essential, and with proper care excellent results may be obtained. A few examples will best illustrate some of the methods used, but circumstances vary in every survey. Fixing a position by means of the "back-angle" is one of the most ordinary expedients. Angles having been observed at A, to the station B, and certain other fixed points of the survey, C and D for instance; if A is shot up from B, at which station angles to the same fixed points have been observed, then it is not necessary to visit those points to fix A. For instance, in the triangle ABC, two of the angles have been observed, and therefore the third angle at C is known (the three angles of a triangle being equal to 180°), and it is called the "calculated or back-angle from C." A necessary condition is that the receiving angle at A, between any two lines (direct or calculated), must give a good cut; also the points from which the "back-angles" are calculated should not be situated at too great distances from A, relatively to the distance between A and B. A station may be plotted by laying down the line to it from one station, and then placing on tracing-paper a number of the angles taken at it, including the angle to the station from which it has been observed. If the points to which angles are taken are well situated, a good position is then obtained. Sometimes the main stations must be carried on with a point plotted by only two angles. An effort must be made to check this subsequently by getting an "angle back" from stations dependent upon it to some old well-fixed point; failing this, two stations being plotted with two angles, pricking one and laying down the line to the other will afford a check. A well-defined mountain peak, far inland and never visited, when once it is well fixed is often invaluable in carrying on an irregular triangulation, as it may remain visible when all other original points of the survey have disappeared, and "back-angles" from it may be continually obtained, or it may be used for plotting on true bearing lines of it. In plotting the true bearing of such a peak, the convergency must be found and applied to get the reversed bearing, which is then laid down from a meridian drawn through it; of the reversed bearing of any other line already drawn through the peak being known, it may simply be laid down with that as a zero. A rough position of the spot from which the true bearing was taken must be assumed in order to calculate the convergency. Fig. 5 will illustrate the foregoing remarks. A and B are astronomical observation spots at the extremes of a survey, from both of which the high inaccessible peak C is visible. D, E, F are intermediate stations; A and D, D and E, E and F, F and B being respectively visible from each other. G is visible from A and D, and C is visible from all stations. The latitudes of A and B and meridian distance between them being determined, and the true bearing of C being observed from both observation spots, angles are observed at all the stations. Calculating the spheroidal correction from the formula, correction = d. long. $\frac{\cos^2 \text{mid. lat.}}{150}$ and adding it to the true (or chronometric) d. long. between A and B to obtain the spherical d. long.; with this spherical d. long. and the d. lat., the Mercatorial true bearing and distance is found by middle latitude sailing (which is an equally correct but shorter method than by spherical trigonometry, and may be safely used when dealing with the distances usual between observation spots in nautical surveys). The convergency is also calculated, and the true bearing of A from B and B from A are thus determined. In the plane triangle ABC the angle A is the difference between the calculated bearing of B and the observed bearing of C from A. The distance AB having been calculated, the side AC is found. Laying down AC on the paper on the required scale, D is plotted on its direct shot from A, and on the angle back from C, calculated in the triangle ACD. G is plotted on the direct shots from A and D, and on the angle back from C, calculated either in the triangle ACG or GCD.

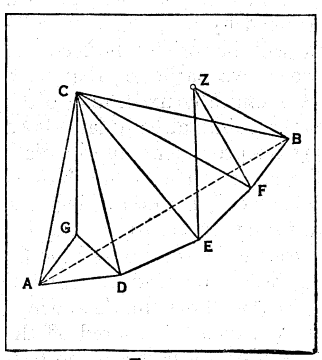


FIG. 5.

The perfect intersection of the three lines at G assures these four points being correct. E, F and B are plotted in a similar manner. The points depend on calculated angles, and except for the first four points we have no check, either on the accuracy of the angles observed in the field or on the plotting. Another well-defined object in such a position, for instance as Z, visible from three or more stations, would afford the necessary check, if lines laid off to it from as many stations as possible gave a good intersection. If no such point, however, exists a certain degree of check on the angles observed is derived by applying the sum of all the calculated angles at C to the true bearing of A from C (found by reversing observed bearing of C from A with convergency applied), which will give the bearing of B from C. Reverse this bearing with convergency applied, and compare it with the observed bearing of C from B. If the discrepancy is but small, it will be a strong presumption in favour of the substantial accuracy of the work. If the calculated true bearing of B from A be now laid down, it is very unlikely that the line will pass through B, but this is due to the discrepancy which must always be expected between astronomical positions and triangulation. If some of the stations between A and B require to be placed somewhat closely to one another, it may be desirable to obtain fresh true bearings of C instead of carrying on the original bearing by means of the calculated angle. In all cases of irregular plotting the ship is very useful, especially if she is moored taut without the swivel, and angles are observed from the bow. Floating beacons also assist an irregular triangulation.

Sketch Surveys.—Surveys of various degrees of accuracy are included among sketch surveys. The roughest description is the running survey, when the work is done by the ship steaming along the coast, fixing points, and sketching in the coast-line by bearings and angles, relying for her position upon her courses and distances as registered by patent log, necessarily regardless of the effect of wind and current and errors of steering. At the other extreme comes the modified running survey, which in point of practical accuracy falls little short of that attained by irregular triangulation. Some of these modifications will be briefly noticed. A running survey of a coast-line between two harbours, that have been surveyed independently and astronomically fixed, may often be carried out by fixing the ship on the points already laid down on the harbour surveys and shooting up prominent intermediate natural objects, assisted by theodolite angles. Theodolite lines to the ship and floating beacons suitably placed, materially increase the value of any such work. A sketch survey of a coast upon which it is impossible to land may be carried out by dropping beacons at intervals of about 8 m., well out from the land and placed abreast prominent natural objects called the "breastmarks," which must be capable of recognition from the beacons anchored off the next "breastmark" on either side. The distance between the beacons is found by running a patent log both ways, noting the time occupied by each run; if the current has remained constant, a tolerably good result can be obtained. At the first beacon, angles are observed between the second beacon and the two "breastmarks," and "intermediate" mark, and any other natural object which will serve as "points." At the second beacon, angles are observed between the first beacon and the same objects as before. Plotting on the line of the two beacons as a base, all the points observed can be pricked in on two shots. At a position about midway between the beacons, simultaneous angles are observed to all the points and laid off on tracing-paper, which will afford the necessary check, and the foundation is thus laid for filling in the detail of coast-line, topography, and soundings off this particular stretch of coast. Each section of coast is complete in itself on its own base; the weak point lies in the junction of the different sections, as the patent log bases will not agree precisely, and the scales of adjacent sections are liable to be slightly different. This is obviated, as far as possible, by fixing on the points of one section and shooting up those of another, which will check any great irregularity of scale creeping in. The bearing is preserved by getting occasional true bearing lines at the beacons of the most distant point visible. In all cases of using angles from the ship under weigh, several assistants are necessary, so that the principal angles may be taken simultaneously, the remainder being connected immediately afterwards with zeros involving the smallest possible error due to the ship not being absolutely stationary, these zeros being included amongst the primary angles. When close to a beacon, if its bearing is noted and the distance in feet obtained from its elevation, the angles are readily reduced to the beacon itself. Astronomical positions by twilight stars keep a check upon the work.

Sketch Surveys by Compass Bearings and Vertical Angles.—In the case of an island culminating in a high, well-defined summit visible from all directions, a useful and accurate method is to steam round it at a sufficient distance to obtain a true horizon, stopping to make as many stations as may be desirable, and fixing by compass bearing of the summit and its vertical angle. The height is roughly obtained by shooting in the summit, from two positions on a patent log whilst approaching it. With this approximate height and Lecky's vertical danger angle tables, each station may be plotted on its bearing of the summit. From these stations the island is shot in by angles between its tangents and the summit, and angles to any other natural features, plotting the work as we go on any convenient scale which must be considered only as provisional. On completing the circuit of the island, the true scale is found by measuring the total distance in inches on the plotting sheet from the first to the last station, and dividing it by the distance in miles between them as shown by patent log. The final height of the summit bears to the rough height used in plotting the direct proportion of the provisional scale to the true scale. This method may be utilized for the sketch survey of a coast where there are well-defined peaks of sufficient height at convenient intervals, and would be superior to an ordinary running survey. From positions of the ship fixed by bearings and elevation of one peak, another farther along the coast is shot in and its height determined; this second peak is then used in its turn to fix a third, and so on. Lecky's tables will show what effect an error of say 1′ in altitude will produce for any given height and distance, and the limits of distance must depend upon this consideration.

Surveys of Banks out of Sight of Land.—On striking shoal soundings unexpectedly, the ship may either be anchored at once and the shoal sounded by boats starring round her, using compass and masthead angle; or if the shoal is of large extent and may be prudently crossed in the ship, it is a good plan to get two beacons laid down on a bearing from one another and patent log distance of 4 or 5 m. With another beacon (or mark-boat, carrying a large black flag on a bamboo 30 ft. high) fixed on this base, forming an equilateral triangle, and the ship anchored as a fourth point, soundings may be carried out by the boats fixing by station-pointer. The ship's position is determined by observations of twilight stars.

Coastlining.—In a detailed survey the coast is sketched in by walking along it, fixing and plotting at intervals. Fixed marks along the shore afford a check on the minor coast-line fixes. When impracticable to fix in the ordinary way subtense methods are used. Greater accuracy is obtained if the work is plotted on the field board at once; this is not always possible but the angles being registered and sketches made of the intervening coast the work may be plotted afterwards. It is with the high water line that the coast-liner is chiefly concerned, delineating its character according to the accepted symbols. The sounder is responsible for the position of the dry line at low water. Heights of cliffs, rocks, islets, etc., must be inserted either from measurement or from the formula,

$$\text{Height in feet} = \frac{\text{Angle of elevation in seconds} \times \text{distance in miles}}{34},$$

and details of topography near the coast, including roads, houses and enclosures must be shown. Rocks above water or on which the sea breaks should be fixed. Coast-line may be sketched from a boat off shore by fixing and shooting up natural objects from selected positions.

Soundings.—The most important feature of a chart is the sounding, and the more complete this is the better is the survey.

Small scale surveys are apt to be misleading; such a survey may appear closely sounded but in reality it sometimes fails to disclose indications of shoal water. Sounding may be commenced as soon as sufficient points are plotted; but off an intricate coast it is better to get the coast-line in first. Lines of soundings are run by the boats perpendicular to the coast, at a distance apart governed by the scale; five lines to the inch is about as close as can be run without overcrowding. The distance apart will vary with the depth of water and the nature of the coast; for instance a rocky coast with shallow water off it will need closer examination than a steep coast. The prolongation of a point under water will require special care to ensure the fathom lines being correct. When soundings begin to decrease to seaward intermediate lines or lines crossing those previously run should be obtained. If possible lines of soundings should be run on transits; these may generally be picked up by fixing when on the required line, noting the angle on the protractor between the line and some fixed mark on the field board, then placing the angle on the sextant and noting what objects intersect at that angle. On large scale surveys it may be necessary to place transit marks in the required positions. The boat is fixed by two angles, with an occasional third angle as a check; the distance between the fixes is dependent upon the scale of the chart and the rapidity with which the depth alters; the 3, 6 and 10 fathom lines should always be fixed, allowing roughly for the tidal reduction. The nature of the bottom must be taken every few casts and recorded. It is best to plot each fix on the sounding board at once, joining the fixes by straight lines and numbering them for identification. The tidal reduction being obtained, the reduced soundings corrected for any lead line error are written in the field-book in red underneath each sounding as originally noted; they are then placed in their proper position on the board between the fixes. Suspicious ground should be closely examined; a small buoy anchored on the shoal is useful to guide the boat while trying for the least depth. Sweeping for a reported pinnacle rock should be resorted to when sounding fails to discover it. Local information from fishermen and others is often of value. Up to depths of about 15 fathoms the hand lead-line is used from the boats, but beyond that depth the Lucas machine for wire effects a great saving of time and labour. The deeper soundings of a survey are usually obtained from the ship, but steamboats with wire sounding machines often assist very materially. By the aid of a steam winch, a 100-lb. lead is hove forward to the end of the lower boom rigged out, from which it is dropped by reversing the winch, soundings of 50 fathoms may be picked up from the sounding platform aft, whilst going at a speed of 5 to 6 knots. In deeper water it is quicker to stop the ship and sound from aft with the wire sounding machine. In running lines of soundings on and off shore, it is essential to be able to fix as far from the land as possible. Angles will be taken from aloft for this purpose, and floating beacons dropped in selected positions will be of assistance. A single fixed point on the land used in conjunction with two beacons suitably placed will give an admirable fix.

Echo Sounding.—This method of obtaining the depth is likely to prove of increasing value as time goes on and its efficiency becomes known. The principle is that an electric impulse is transmitted from the bottom of a ship, strikes the bed of the ocean and is reflected as an echo which is received by a hydrophone. The sound waves are sent out at fixed intervals and the echo is heard in telephone receivers connected with the hydrophone. The velocity of sound in water being known the depth can be calculated provided the time interval is accurately measured. A hand wheel, working a depth scale and connected with the telephonic gear is manipulated until echoes are heard in the receiver; the depth can then be read off the circular scale.

The Admiralty echo sounding apparatus shallow water type is designed to register depths of from 3 to 120 fathoms; for greater depths a modified form of echo gear is utilized. The saving of time is particularly noticeable where great depths are being obtained, the echo gear giving a result in a few seconds, whereas with a wire sounding machine the operation is a lengthy proceeding often occupying more than an hour. The disadvantage of echo sounding is that it is impossible to determine the nature of the bottom by this means and where a survey is in progress this must be obtained with the lead.

Vigias.[1]—A certain percentage of *vigias* which are reported and placed on the charts eventually turn out to have no existence, but before it is possible to expunge them the area has to be examined. Submarine banks rising from great depths necessarily stand on bases many square miles in area. Of recent years our knowledge of the angle of slope that may be expected to occur at different depths has been much extended. From depths upwards of 2,000 fathoms the slope is so gradual that a bank could hardly approach the surface in less than 7 m. from such a sounding; therefore anywhere within an area of at least 150 sq.m. all round a bank rising from these depths, a sounding must show some decided indications of a rise in the bottom. Under such circumstances, soundings at intervals of 7 m., and run in parallel lines 7 m. apart, enclosing areas of only 50 sq.m. between any four adjacent soundings, should clear up the ground and lead to the discovery of any shoal. As the depth decreases the angle of slope rapidly increases, and a shoal might occur within three-quarters of a mile or even half a mile of such a sounding as 500 fathoms. An appreciation of these facts will indicate the distance apart at which it is proper to obtain soundings. Contour lines will show in which direction to prosecute the search. When once a decided indication is found, it is not difficult to follow it up by paying attention to the contour lines as developed by successive soundings. Discoloured water, ripplings, fish jumping or birds hovering about may assist in locating a shoal, but the submarine sentry towed at a depth of 40 fathoms is here most valuable, and may save hours of hunting. Reports being more liable to errors of longitude than of latitude, a greater margin is necessary in that direction. Long parallel lines east and west are preferable, but the necessity of turning the ship more or less head to wind at every sounding makes it desirable to run the lines with the wind abeam, which tends to disturb the dead reckoning least. The current should be allowed for in shaping the course to preserve the parallelism of the lines, but the less frequently the course is altered the better. A good position should be obtained at morning and evening twilight by pairs of stars on opposite bearings, the lines of position of one pair cutting those of another pair nearly at right angles. The dead reckoning should be checked by lines of position from observations of the sun about every two hours throughout the day, preferably whilst a sounding is being obtained and the ship stationary.

Tides.—The datum for reduction of soundings is mean low-water springs, the level of which is referred to a permanent bench mark in order that future surveys may be reduced to the same datum level. Whilst sounding is going on the height of the water above this level is observed by a tide gauge. The time of high-water at full and change, called the "establishment," and the heights to which spring and neap tides respectively rise above the datum are also required. It is seldom that a sufficiently long series of observations can be obtained for their discussion by harmonic analysis, and therefore the graphical method is preferred. A good portable automatic tide gauge suitable for all requirements is much to be desired.

Tidal streams and surface currents are observed from the ship or boats at anchor by means of a current log. An alternative method is to follow a drifting buoy fixing the position at intervals. Tidal streams often run for some hours after high or low water by the shore; it is important to determine whether the change of stream occurs at a regular time of the tide.

Undercurrents are also of importance. A deep-sea current meter devised (1876) by Lieutenant Pillsbury, U.S.N., has been used with success on many occasions, notably in the investigation of the Gulf Stream. More recent developments of deep-sea current meters are the Ekman, Jacobsen, Sverdrup, Woolaston and Carruthers instruments. The instrument is lowered to the required depth and brought into action by a messenger, travelling down the supporting line and operating a lever which sets the instrument

[1]Spanish word meaning "look-out," used of marks on the chart signifying obstruction to navigation.

free, or some similar contrivance. On the completion of the necessary interval the meter is locked whilst still below the surface, hauled up and examined. The time during which the instrument has been working at the required depth is known and the direction and strength of the current can be determined from the mechanical arrangements.

Topography.—Generally speaking the topographical features should be delineated as far back as the skyline viewed from seaward, in order to assist the navigator to recognize the land. Summits of hills, conspicuous spurs, cliffs, etc., are fixed and their heights determined by theodolite elevations or depressions to and from positions where the height above the water is known. The shape is delineated by contour lines sketched by eye, assisted by an aneroid barometer. In wooded country much of the topography may have to be determined from the ship; sketches from different positions at anchor with the necessary angles to fix the features give a fair idea of the general lie of the country.

Latitudes.—Circum-meridian altitudes of stars observed by sextant in the artificial horizon is one of the methods adopted for observations for latitudes. Arranged in pairs of nearly the same altitude north and south of zenith, the mean of each pair give a result from which instrumental and personal errors and errors due to atmospheric conditions are eliminated. The mean of several such pairs should have a probable error of not more than $\pm 1''$. The observations of each star should be confined to within 5 or 6 minutes on either side of the meridian. Two stars selected to "pair" should pass the meridian within an hour of each other, and should not differ in altitude more than 2° or 3°. Artificial horizon roof error is eliminated by always keeping the same end of the roof towards the observer; when observing a single object, as the sun, the roof must be reversed when half way through the observations. The observations are reduced to the meridian by Raper's method. When pairs of stars are not observed, circum-meridian altitudes of the sun may be resorted to, but being observed on one side of the zenith only, none of the errors to which all observations are liable can be eliminated.

Chronometer Errors.—Equal altitudes of sun or stars by sextant and artificial horizon are employed to obtain chronometer errors. Six sets of eleven observations, A.M. and P.M., observing both limbs of the sun, should give a result which, under favourable conditions of latitude and declination, may be expected to vary less than two-tenths of a second from the normal personal equation of the observer. Stars give equally good results. In high latitudes sextant observations diminish in value owing to the slower movement in altitude. In the case of the sun all the chronometers are compared with the "standard" at apparent noon; the comparisons with the chronometer used for the observations on each occasion of landing and returning to the ship are worked up to noon. In the case of stars, the chronometer comparisons on leaving and again on returning are worked up to an intermediate time. A convenient system, which retains the advantage of the equal altitude method, whilst avoiding the necessity of waiting some hours for the P.M. observation, is to observe two stars at equal altitudes on opposite sides of the meridian, and, combining the observations, treat them as relating to an imaginary star having the mean right ascension and mean declination of the two stars selected, which should have nearly the same declination and should differ from 4^h to 8^h in R.A.

Meridian Distances.—The error of chronometer on mean time of place being obtained, the local time is transferred from one observation spot to another by the ship carrying usually eight box chronometers. The best results are found by using travelling rates, which are deduced from the difference of the errors found on leaving an observation spot and returning to it; from this difference is eliminated that portion which may have accumulated during an interval between two determinations of error at the other, or any intermediate, observation spot. A travelling rate may also be obtained from observations at two places, the meridian distance between which is known; this rate may then be used for the meridian distance between places observed during the passage. Failing travelling rates, the mean of the harbour rates at either end must be used. The same observer, using the same instrument, must be employed throughout the observations of a meridian distance.

If the telegraph is available, it should be used. The error on local time at each end of the wire is obtained, and a number of telegraphic signals are exchanged between the observers, an equal number being transmitted and received at either end. The local time of sending a signal from one place being known and the local time of its reception being noted, the difference is the meridian distance. The retardation due to the time occupied by the current in travelling along the wire is eliminated by sending signals in both directions. The relative personal equation of the observers at either end, both in their observations for time, and also in receiving and transmitting signals, is eliminated by changing ends and repeating the operations. If this is impracticable, the personal equations should be determined and applied to the results. Chronometers keeping solar time at one end of the wire, and sidereal time at the other end, materially increase the accuracy with which signals can be exchanged, for the same reason that comparisons between sidereal clocks at an observatory are made through the medium of a solar clock. Time by means of the sextant can be so readily obtained, and within such small limits of error, by skilled observers, that in hydrographic surveys it is often employed; but if transit instruments are available, and sufficient time can be devoted to erecting them properly, the value of the work is greatly enhanced.

True Bearings are obtained on shore by observing with theodolite the horizontal angle between the object selected as the zero and the sun, taking the latter in each quadrant as defined by the cross-wires of the telescope. The altitude may be read on the vertical arc of the theodolite; except in high latitudes, where a second observer with sextant and artificial horizon are necessary, unless the precise errors of the chronometers are known, when the time can be obtained by carrying a pocket chronometer to the station. The sun should be near the prime vertical and at a low altitude; the theodolite must be very carefully levelled, especially in the position with the telescope pointing towards the sun. To eliminate instrumental errors the observations should be repeated with vernier set at intervals equidistant along the arc, and A.M. and P.M. observations should be taken at about equal altitudes.

At sea true bearings are obtained by measuring with a sextant the angle between the sun and some distant well-defined object making an angle of from 100° to 120° and observing the altitude of the sun at the same time, together with that of the terrestrial object. The sun's altitude should be low to get the best results, and both limbs should be observed. The sun's true bearing is calculated from its altitude, the latitude and its declination; the horizontal angle is applied to obtain the true bearing of the zero. On shore the theodolite gives the horizontal angle direct, but with sextant observations it must be deduced from the angular distance and the elevation.

See Wharton and Field, *Hydrographical Surveying* (1920); C. F. Close, *Textbook of Hydrographical Surveying* (1925); John Ball and H. Knox Shaw, *The Handbook of the Prismatic Astrolabe*, Egyptian Government, Cairo Government Press (1919); *Echo Sounding*, H. M. Stationery Office (1926); R. M. Abraham, *Surveying Instruments*, London. (J. A. Ed.)

CHARTER, a written instrument, contract, or convention by which grants of property or of rights and privileges are confirmed and held. The use of the word for any written document is obsolete in England, but is preserved in France, *e.g.*, the École des Chartes at Paris. In feudal times charters of privileges were granted, not only by the Crown, but by mesne lords both lay and ecclesiastical, as well to communities, such as boroughs, gilds and religious foundations, as to individuals. In modern usage grants by charter have become all but obsolete, though in England this form is still used in the incorporation by the Crown of certain public bodies (*see* Chartered Companies).

The grant of the Great Charter by King John in 1215 (*see* Magna Carta), which guaranteed the preservation of English liberties, led to a special association of the word with constitutional privileges, and so in modern times it has been applied to constitutions granted by sovereigns to their subjects, in contradistinction to those based on "the will of the people." Such was

the Charter (*Charte*) granted by Louis XVIII. to France in 1814. In Portugal the constitution granted by Dom Pedro in 1826 was called by the French party the "Charter," while that devised by the Cortes in 1821 was known as the "Constitution." Magna Carta also suggested to the English radicals in 1838 the name "People's Charter," which they gave to their published programme of reforms (*see* CHARTISM). This association of the idea of liberty with the word charter led to its figurative use in the sense of freedom or licence. The common colloquialism "to charter," in the sense of to take, or hire, is derived from the special use of "to charter" as to hire (a ship) by charter-party.

CHARTERED ACCOUNTANT: *see* ACCOUNTANCY AND ACCOUNTANTS.

CHARTERED COMPANIES. A chartered company is a corporation enjoying certain rights and privileges, and bound by certain obligations under a special charter granted to it by the sovereign authority of the State, such charter defining and limiting those rights, privileges and obligations, and the localities in which they are to be exercised. Such companies existed in early times, but have undergone changes and modifications in accordance with the developments which have taken place in the economic history of the States where they have existed. In Great Britain the first charters for foreign trade were granted, not to English companies but to branches of the Hanseatic League (*q.v.*), and it was not till 1598 that England was finally relieved from the presence of a foreign chartered company. In that year Queen Elizabeth closed the steel-yard where Teutons had been established for 700 years.

Of all early English chartered companies, the "Merchant Adventurers" conducted its operations the most widely. Itself a development of very early trading gilds, at the height of its prosperity it employed as many as 50,000 persons in the Netherlands. In the reign of Elizabeth British trade with the Netherlands, reached, in one year, 12,000,000 ducats, and in that of James I. the company's yearly commerce with Germany and the Netherlands was as much as £1,000,000. Hamburg afterwards was its principal depot, and it became known as the "Hamburg company." Here it maintained itself until as late as 1808, when the company was at last dissolved. In the "Merchant Adventurers'" enterprises is to be seen the germ of the trading companies which had so remarkable a development in the 16th and 17th centuries. These old regulated trade gilds passed gradually into joint-stock associations, which were capable of far greater extension in both the number of members and the amount of stock, each member being only accountable for the amount of his own stock, and being able to transfer it at will to any other person.

The discovery of the New World, and the opening out of fresh trading routes to the Indies, gave an extraordinary impulse to shipping, commerce and industrial enterprise throughout western Europe. The English, French and Dutch Governments were ready to assist trade by the granting of charters to trading associations. The Baltic trade had already been the sphere of activities of an English company, since Henry IV. founded one by charter in 1404; and Elizabeth revived this "Eastland company" in 1579. To the "Russia company," which received its first charter in 1553, Great Britain owed its first intercourse with Russia and a direct trade with the Levant and Persia. Later, the Turkey company was founded, which in 1592, after amalgamation with the Venice company, took the name of the Levant company. Like the Muscovy company it was still trading in the 18th century. Both the Russia and Turkey companies had an important effect upon British relations with those empires. They maintained British influence in those countries, and even paid the expenses of the embassies which were sent out by the English Government to their courts.

The chartered companies which were formed during this period for trade with the Indies and the New World have had a more wide-reaching influence in history. The East India company (*q.v.*) is dealt with elsewhere. Charters were given to companies trading to Guiana and the Canaries, but none of these enjoyed a very long or prosperous existence, principally owing to the difficulties caused by foreign competition. It is when we turn to North America that the importance of the chartered company, as a colonizing rather than a trading agency, is seen in its full development. The "Hudson's Bay company," which still exists as a commercial concern, is dealt with under its own heading, but many of the 13 British North American colonies were in their inception chartered companies very much in the modern acceptation of the term. The history of these companies will be found under the heading of the different colonies of which they were the origin. It is necessary, however, to bear in mind that two classes of charters are to be found in force among the early American colonies: (1) Those granted to private individuals or to trading associations, which were often useful when the colony was first founded, but which were later withdrawn when the country had become settled and was looking forward to commercial expansion. The colonies were then brought under the direct control of the Crown, and their trade subject only to regulation by the Government. Thus the Virginia company lost their charter in 1624. The substitution of royal and later of parliamentary control for that of the company was an important factor in the growth of the Navigation Acts. (2) The second class of charters were those granted to the settlers themselves as a guarantee of their system of government. This, for example, was the effect of the charter granted to Massachusetts. In the later 17th century, however, the cancellation or amendment of the charters, and the growth of legislative assemblies tended to produce a uniformity of colonial practice, irrespective of the original character of the colony.

Chartered companies continued to be formed for the development of new trade, *e.g.*, the Royal African company in 1662 and the South Sea company in 1711.

In France and Holland, no less than in England, the institution of chartered companies became a settled principle of the Governments of those countries during the whole of the period in question. In France from 1599 to 1789, more than 70 of such companies came into existence, but after 1770, when the great *Compagnie des Indes orientales* went into liquidation, they were almost abandoned, and finally perished in the general sweeping away of privileges which followed on the outbreak of the Revolution. The monopoly rights granted to such companies were in accordance with the views generally accepted at the time, although there were many critics even in the 17th century. There were serious difficulties in the way of private trade owing to the large capital required to maintain factories and the necessity for their supervision. It was only the need for capital which induced statesmen like Colbert to countenance them, and Montesquieu took the same view (*Esprit des lois*, t. xx.c. 10). John de Witt's view was that such companies were not useful for colonization properly so called, because they wanted quick returns to pay their dividends. So, even in France and Holland, opinion was by no means settled as to their utility. In England historic protests were made against such monopolies, but the chartered companies were less exclusive in England than in either France or Holland. French commercial companies were more privileged, exclusive and artificial than those in Holland and England. Those of Holland may be said to have been national enterprises. French companies were more fettered than their rivals by the royal power and had less initiative of their own, and therefore had less chance of surviving.

During the last 20 years of the 19th century there was a great revival of the system of chartered companies in Great Britain. It was a feature of the general growth of interest in colonial expansion and commercial development which had made itself felt almost universally among European nations. But the modern companies were not like those of the 16th and 17th centuries; they were not monopolists, and were more definitely subject to the control of the Home Government. The charters, in fact, prohibited any monopoly of trade, and prescribed a State control which is their distinguishing feature. It is to be exercised in almost all directions in which the companies may come into contact with matters political; it is inevitable in all disputes of the companies with foreign Powers and is extended over all decrees of the company regarding the administration of its territories, the treatment of natives and mining regulations. In all

cases of dispute between the companies and the natives the secretary of State is *ex officio* the judge, and to the secretary of State (in the case of the British South Africa company) the accounts of administration had to be submitted for approbation. The British character of the company is insisted upon in each case in the charter which calls it into life. The Crown always retains complete control over the company by reserving to itself the power of revoking the charter in case of the neglect of the stipulations. Special clauses were inserted in the charters of the British East Africa and South Africa companies enabling the Government to forfeit their charters if they did not promote the objects alleged as reasons for demanding a charter.

The chartered company of these days is therefore very strongly fixed within limits imposed by law on its political action. As a whole, however, very remarkable results have been achieved. This may be attributed in no small degree to the personality of the men who have had the supreme direction at home and abroad, and who have, by their social position and personal qualities, acquired the confidence of the public. With the exception of the Royal Niger company, it would be incorrect to say that they have been financially successful, but in the domain of Government generally it may be said that they have added vast territories to the British empire (in Africa about 1,700,000 sq.m.), and in these territories they have acted as a civilizing force. They have made roads, opened facilities for trade, enforced peace and laid, at all events, the foundation of settled administration; while anti-slavery and anti-alcohol campaigns have been carried on, the latter certainly being against the immediate pecuniary interests of the companies themselves. The occupation of Uganda certainly, and of the Nigerian territory and Rhodesia probably, will prove to have been rather for the benefit of posterity than of the companies which effected it. In the two cases where the companies have been bought out by the State, they have had no compensation for much that they have expended.

One common characteristic is to be noted in the histories of the old chartered companies and the new. In both periods the company has been used by the English Government as a useful instrument of colonial expansion, but in both periods only for temporary uses. When the colony is settled, or Government established, the State takes the lead. This is well illustrated by the history of the slow decline of the independence of the East India company in the 18th century and of the British South Africa company in the 20th. Both these companies are distinguished for their length of days, but both had to submit to the gradual penetration of State control.

See also BORNEO, NIGERIA, RHODESIA, etc. For the share of the chartered company in the development of the modern trading company, *see* COMPANY.

BIBLIOGRAPHY.—Bonnassieux, *Les Grandes Compagnies de commerce* (1892); Chailly-Bert, *Les Compagnies de colonisation sous l'ancien régime* (1898); Cawston and Keane, *The Early Chartered Companies* (1896); W. Cunningham, *A History of British Industry and Commerce* (1890, 1892); D. Hannay, *The Great Chartered Companies* (1926); J. Scott Keltie, *The Partition of Africa* (1895); Leroy-Beaulieu, *De la colonisation chez les peuples modernes* (1898); *Les Nouvelles Sociétés anglosaxonnes* (1897); Sir C. P. Lucas, *Beginnings of English Overseas Enterprise* (1917); W. MacDonald, *Select Charters illustrative of American History, 1606–1775* (New York, 1899); B. P. Poore, *Federal and State Constitutions*, etc. (Washington, 1877; a more complete collection of American colonial charters); H. L. Osgood, *American Colonies in the 17th Cent.* (1904–07); W. R. Scott, *Joint Stock Companies to 1720* (1910, etc.); Carton de Wiart, *Les Grandes Compagnies coloniales anglaises au 19me siècle* (1899); J. A. Williamson, *Maritime Enterprise, 1485–1558* (1913); "Compagnies de Charte," "Colonies," "Privilege," in *Nouveau Dictionnaire d'économie politique* (1892); and "Companies, Chartered," in *Encyclopaedia of the Laws of England*, edit. A. Wood Renton (1907–09).

CHARTERHOUSE, a corruption of the French *maison chartreuse*, a religious house of the Carthusians (*q.v.*). The name is found in various places in England (*e.g.*, Charterhouse-on-Mendip, Charterhouse Hinton) where the Carthusians were established, but is most familiarly applied to the Charterhouse, London. Near the old city wall, west of the modern thoroughfare of Aldersgate, a Carthusian monastery was founded in 1371 by Sir Walter de Manny. After its dissolution in 1535, the property was occupied for a time by Queen Elizabeth (in 1558) and by James I. In May 1611 the Charterhouse came into the hands of Thomas Sutton (1532–1611) of Snaith, Lincolnshire, who later settled in London. In 1611, the year of his death, he endowed a hospital on the site of the Charterhouse, calling it the hospital of King James and in his will he bequeathed money to maintain a chapel, hospital (almshouse) and school. The will was hotly contested but upheld in court, and the foundation was finally constituted to afford a home for 80 male pensioners and to educate 40 boys.

The school developed, and now ranks as a public school. In 1872 it was removed to new buildings near Godalming in Surrey. The pensioners still occupy the picturesque buildings of mellowed red brick, which include a panelled chapel, in which is the founder's tomb, the fine dining hall—rebuilt by the monks about 1520—the old library and the great staircase. Many of the buildings were ruined in World War II. Of the hall, the chimney piece and some woodwork survive. The master's house and adjacent buildings were burned out, but the chapel was unharmed. The hall (1872) of Merchant Taylors' school was also burned out.

CHARTER-PARTY: *see* AFFREIGHTMENT.

CHARTIER, ALAIN (*c.* 1392–*c.* 1430), French poet and political writer, was born at Bayeux about 1392. His eldest brother, Guillaume, became bishop of Paris; and Thomas became notary to the king. Jean Chartier, a monk of St. Denis, whose history of Charles VII. is printed in vol. iii. of *Les Grands Chroniques de Saint-Denis* (1477), was not, as is sometimes stated, also a brother of the poet. Alain studied, as his elder brother had done, at the University of Paris. His earliest poem is the *Livre des quatre dames,* written after the battle of Agincourt. This was followed by the *Débat du réveille-matin, La Belle Dame sans merci* and others. He was attached to the dauphin, afterwards Charles VII., acting in the triple capacity of clerk, notary and financial secretary. In 1422 he wrote the famous *Quadrilogue-invectif.* The interlocutors in this dialogue are France herself and the three orders of the State. Chartier lays bare the abuses of the feudal army and the sufferings of the peasants. He rendered an immense service to his country by maintaining that the cause of France, though desperate to all appearance, was not yet lost if the contending factions could lay aside their differences in the face of the common enemy. In 1424 Chartier was sent on an embassy to Germany, and three years later he accompanied to Scotland the mission sent to negotiate the marriage of Margaret of Scotland, then not four years old, with the dauphin, afterwards Louis XI. In 1429 he wrote the *Livre d'espérance,* which contains a fierce attack on the nobility and clergy. He was the author of a diatribe on the courtiers of Charles VII., entitled *Le Curial,* translated into English (*Here followeth the copy of a lettre whyche maistre A. Charetier wrote to his brother*) by Caxton about 1484. The story of the famous kiss bestowed by Margaret of Scotland on *la précieuse bouche de laquelle sont issus et sortis tant de bons mots et vertueuses paroles* is mythical, for Margaret did not come to France till 1436, after the poet's death. Jean de Masles, who annotated a portion of his verse, has recorded how the pages and young gentlemen of that epoch were required daily to learn by heart passages of his *Bréviaire des nobles.* John Lydgate studied him affectionately. *La Belle Dame sans merci* was translated into English by Sir Richard Ros about 1640, with an introduction of his own; and Clément Marot and Octavien de Saint-Gelais, writing 50 years after his death, find many fair words for the old poet, their master and predecessor.

See Mancel, *Alain Chartier, étude bibliographique et littéraire,* 8vo (1849); D. Delaunay's *Étude sur Alain Chartier* (1876), with considerable extracts from his writings, and G. Joret-Desclosières, *Alain Chartier* (4th ed., 1899). His works were edited by A. Duchesne (Paris, 1617).

CHARTISM, the name of a revolutionary democratic agitation in Great Britain which came into prominence in 1838 and disappeared after 1850.

The "People's Charter" was the name given to a bill containing the famous six points—equal electoral areas, universal suffrage, payment of members, no property qualifications, vote by ballot, and annual parliaments—all but the last of which have since been secured. These points, which from 1768 had been, partially at

least, the common property of all radical agitation, were first collected into one petition on Feb. 18 1837, by the London Workingmen's Association, founded by William Lovett, as a result of the great disappointment of the Reform Bill of 1832, which enfranchised only the middle class. These six points were drafted into a bill known as the Charter by Lovett, with possibly some assistance from Francis Place, which was published on May 8 1838; and the formal constitution of the Chartist movement is commonly dated from a great meeting held on Aug. 8 on Newhall Hill at which the Charter was approved.

The ultimate aims of the movement were economic—"social equality" or, in the phrase of G. J. Harney's *London Democrat,* (April 27 1839) "that all shall have a good house to live in with a garden back or front, just as the occupier likes; good clothing to keep him warm and to make him look respectable, and plenty of good food and drink to make him look and *feel* happy." The Chartists were not unanimous about the means of securing this social equality, but a provisional agreement on universal suffrage as the necessary first step provided the basis of the movement. The London Workingmen's Association, which launched the campaign by sending out "missionaries" all over Great Britain, consisted of skilled workers mostly above the poverty line; not so the supporters to whom they appealed. The factory workers, colliers and handloom workers of the North and Midlands, who became the chief adherents of Chartism, were passing through a period of extreme misery and degradation, which was not at this time mitigated by any effectively administered Factory Act (except one which limited, in some cases, the working hours of certain children to 12). Two Tory factory reformers, Richard Oastler and the Rev. J. R. Stephens, were, moreover, conducting, in an exceedingly violent manner, a campaign against the provisions of the Poor Law of 1834, which aimed at making poor relief more unpleasant than the most unpleasant means of gaining a livelihood outside. Oastler and Stephens, whose campaign in several areas succeeded in postponing its application, threw their weight into the Chartist movement, and over the whole of the Northern area torchlight meetings were held at night on the moors, in which armed insurrection was freely advocated. Scotland, and the west of England, which was evangelized by Henry Vincent, the most eloquent Chartist orator, were the moderate areas: the Welsh miners were the most revolutionary. Feargus O'Connor (*q.v.*), an Irish squire who had formerly (1832–35) been one of O'Connell's "tail" in Parliament, became rapidly the most popular leader, and rarely made a speech without alluding to physical force.

The new Chartist plan of campaign was, however, provided by a banker, Thos. Attwood, M.P. for Birmingham, who trusted that a Charter parliament would adopt his views on currency. He proposed the election, by the disfranchised, of an anti-Parliament to be called the Convention which would sit as a rival to the House of Commons and present a petition, signed by the mass of the working class, for the enactment of the Charter as the law of the land. If the Commons refused, the Convention would then call a general strike (the "Sacred Month"). This exhilarating programme was enthusiastically taken up; the petition was signed by 1,280,000 people and the members of the Convention, elected by public meetings, held their first sitting in London on Feb. 4 1839. The Convention was at the beginning controlled by the "moral force men" headed by Lovett, but it was not able to prevent frequent violent conflicts with the police (in which the Chartists were not uncommonly victorious) and the moderates entirely lost control when on July 12 the Commons, after long delays, rejected the petition. Post-dated orders for the General Strike were forthwith issued, amid great excitement. Only a few days had passed, however, when the Convention realized that it had behind it no organization and no preparations, and in consequence somewhat ignominiously cancelled the orders on July 22.

What the "moral force men" would not do, others were prepared to attempt. During the Convention a secret military organization had been formed, directed by a committee of five: its plans were completed at a private conference held in the autumn at Heckmondwike. The signal for the insurrection was to be given by the capture of Newport (Mon.) and the release of Vincent from Monmouth Castle. The other centres of revolt appear to have been in Lancashire and Yorkshire. The attack on Newport was led by the ex-mayor and J.P., John Frost, on the morning of Nov. 4. It was to have been in three columns, but owing to mismanagement the columns failed to unite at Risca and Frost attacked alone with about 3,000 men armed with rifles and mandrils (collier's picks). Warning had been given and the Chartists walked into a trap in the square outside the Westgate hotel. They were defeated after a very brief struggle, leaving a considerable number (the figures are disputed) of killed and wounded. The leaders, Frost, Jones and Williams, were sentenced to death, afterwards mitigated to transportation. The police also rounded up nearly every other Chartist leader of importance, and secured sentences of one or two years' imprisonment.

On the release of the leaders in 1840 and 1841 renewed quarrels broke out between the "physical force men" led by O'Connor and his assistant on the *Northern Star,* G. J. Harney, and the "moral force men" led by Lovett and Bronterre O'Brien. The latter considered that the working class had not sufficient strength to achieve reform alone and should now invite the aid of sympathetic middle-class groupings: O'Connor and his allies declared that the middle-class reformers, responsible for the deception of 1832, were also the worst oppressors of the operatives in the factories and mines. O'Connor, with the assistance of his journal the *Star,* which secured a hitherto unparalleled circulation, carried the day and drove the other section out of the movement. His popularity became enormous, due to his hard work, his hatred of the middle class and his remarkable invective, of which the following is a specimen: "You—I was just coming to you when I was describing the materials of which our spurious aristocracy is composed. You, gentlemen, belong to the big-bellied, little-brained, numskull aristocracy. How dare you hiss me, you contemptible set of platterfaced, amphibious politicians?" A national organization, technically illegal, called the National Charter Association, was founded, which gave some coherence to the movement. It secured the allegiance of a number of trade union branches and promoted a second petition which received the startling number of 3,315,752 signatures. The year 1842, when this was presented, marks the high water-mark of Chartism. After its rejection on May 2, the Chartist executive turned an existing small strike at Ashton into a general strike for the Charter (Aug. 12). They brought out Lancashire, Cheshire, the Potteries and several other industrial districts; the strikers marching from town to town knocking the plugs out of the boilers where resistance was offered (hence the name Plug Riots). Owing to inadequate communications, the strike spread slowly, but trades as far north as Aberdeen had decided to come out, when, his nerve failing, O'Connor suddenly declared the strike was a plot of the Anti-Corn Law League. This action broke up the strike which ended almost at once in defeat. Thereafter Chartism entered into a period of decline, in which interest was chiefly directed to a financially unsound scheme for settling Chartists on the land as smallholders, by means of a National Land Company directed by O'Connor. One settlement only (O'Connorville, 1847, Herringsgate, Bucks) was opened. Enthusiasm was revived in 1847 by the election of O'Connor as M.P. for Nottingham, and in 1848 by the sensational series of revolutions on the continent. Fired by the hope of similar victories, O'Connor promoted a petition, which he said had 6,000,000 signatures, and arranged for the calling of a "National Assembly." The petition was to be presented by a procession of Chartists marching from Kennington Common to the House of Commons on April 10 1848. Believing this to be the day fixed for the revolution, the Government garrisoned London so heavily that the procession was abandoned. The petition, further, was announced by the Government to contain under 2,000,000 signatures, and it was also discovered that the Land Company was bankrupt. Under the influence of this series of fiascos, O'Connor became distracted in his mind: his successor, Ernest Jones, endeavoured in vain to revive the legal movement which by about 1854 may be regarded as extinct. The illegal revolutionary organization prepared an insurrection for Whit-Monday 1848, later adjourned to Aug. 15, but as it was carefully

watched and, indeed, partly directed by police informers, its effort was suppressed without difficulty.

The disappearance of Chartism was due not so much to the folly of its leaders as to the increasing comfort of the working class in the period of prosperity following on the Corn Law Repeal (1846), and the enforcement of the factory reforms secured by Lord Shaftesbury (*q.v.*). Working-class interest henceforward was diverted to the co-operative movement and the new craft trade unions, of which the most famous, the Amalgamated Society of Engineers, was founded in 1851.

BIBLIOGRAPHY.—There are two *Histories of the Chartist Movement*, both unfinished, by Mark Hovell (1917) and Julius West (1920). *See* also M. Beer, *History of British Socialism* 2 vols. (1919, 1920). For original authorities *see* R. W. Postgate, *Revolution from 1789 to 1906* (1920); R. G. Gammage, *History of Chartism* (1854); W. Lovett, *Life and Struggles of William Lovett* (republished 1920); *Trial of John Frost under a special Commission of Oyer and Terminer* (1840); Francis Place's mss. (Brit. Mus., Add mss. 27,819–21), and the file of the *Northern Star*. (R. W. P.)

CHARTRES, a city of north-western France, capital of the department of Eure-et-Loir, 55 m. south-west of Paris on the railway to Le Mans. Pop. (1936) 26,747. Chartres is on the left bank of the Eure, on a hill crowned by its famous cathedral, the spires of which are a landmark on the plain of Beauce, "the granary of France." The Eure, which divides into three branches, is crossed by several bridges, some ancient, and is fringed by remains of fortifications, notably the Porte Guillaume (14th century) flanked by towers. The steep, narrow streets of the old town contrast with the boulevards which encircle it and divide it from the suburbs. The cathedral of Notre-Dame (*see* ARCHITECTURE: *Gothic Architecture;* STAINED GLASS; SCULPTURE), was founded by Bishop Fulbert (11th century) on the site of a church which had been destroyed by fire. In 1194 another fire made new building necessary and the present church was finished by 1240; there have been minor additions and alterations since that time. A fire in 1836 destroyed the upper woodwork. The statuary of the portals, the stained glass of the 13th century, and the choir-screen of the Renaissance are all unique. The south spire, the Clocher Vieux (351 ft. high), dates from the 12th century; the Clocher Neuf (377 ft.) was not completed till the 16th century. The cathedral is 440 ft. long, its choir measures 150 ft. across, and the vaulting is 121 ft. high. The abbey church of St. Pierre, chiefly 13th century, contains fine stained glass and twelve representations of the apostles in enamel (1547) by Léonard Limosin. St. Martin-au-Val is a 12th century church. The hôtel de ville (17th century) contains a museum and library, an older hôtel de ville is of the 13th century, and there are mediaeval and Renaissance houses.

Chartres was one of the principal towns of the Carnutes, and by the Romans was called *Autricum,* from the river *Autura* (Eure), and afterwards *civitas Carnutum.* It was burnt by the Normans in 858, and unsuccessfully besieged by them in 911. It was in English hands 1417–32. It was attacked unsuccessfully by the Protestants in 1568, and was taken in 1591 by Henry IV., who was crowned there three years afterwards. It was seized by the Germans on Oct. 21, 1870, and used as a centre of operations. During the middle ages it gave its name to a countship held by the counts of Blois and Champagne and afterwards by the house of Châtillon, a member of which in 1286 sold it to the crown. It was raised to the rank of a duchy in 1528 by Francis I.

The town is the seat of a bishop, a prefecture, a court of assizes, and has tribunals of first instance and of commerce and a chamber of commerce. It is a market-town for Beauce. Game-pies of Chartres are well known, and industries include flour milling, timber sawing, brewing, distilling, iron founding, leather manufacture, dyeing, and the manufacture of stained glass, billiard requisites, hosiery, machinery, etc.

See M. T. Bulteau, *Monographie de la cathédrale de Chartres* (1887). A. Plerval, *Chartres, sa cathédrale, ses monuments* (1896); H. J. L. J Massé, *Chartres: its Cathedral and Churches* (1900); E. Houvet, *Cathédrale de Chartres* (1922).

CHARTREUSE. A celebrated liqueur, green and yellow, with a distinctive flavouring of angelica root. It is made at La Grande Chartreuse, the old Carthusian monastery near Grenoble. The Carthusian order of monks was founded by Saint Bruno of Cologne in 1084. In 1607 the Maréchal d'Estrées gave to the Carthusian Fathers the recipe of the elixir. It was supposed to be concocted from a distillation of herbs, culled on the slopes of the Dauphiné valley, and the finest brandy. In 1757 Brother Gérôme Maubec, "a very clever apothecary," perfected the formula, the secret of which, however, was never divulged nor discovered by analysis. Although in the Revolution of 1793 the Carthusians were despoiled of their property, they retained the secrets of their formula. In 1816 they were allowed to return to their monastery, but in 1901 were in trouble again owing to the decree for the expulsion of the religious orders from France. They locked themselves in their monastery, but were eventually expelled and their distillery at Fourvoire was sold, including their trade-mark. The monks emigrated to Farneta, near Lucca, in Italy, and later acquired a distillery at Tarragona in Spain, taking their famous recipe with them. Meantime, the new French owners of the monastery near Grenoble began to sell an imitation liqueur under the original trade-mark. Thereupon the monks adopted *Les Pères Chartreux* as their new trade-mark and registered it in many countries. In London, the high court of justice decided that the French "Chartreuse" could not lawfully be sold in the United Kingdom as being the monks' product. This decision was qualified by the fact that certain stocks of the original liqueur remained in existence and it was ruled that these might be sold lawfully. If bottles are merely labelled "Chartreuse" it is certain that the liqueur was made by the monks before their expulsion from France. The only guarantee of their origin is the printer's name, Alier, on the label, but stocks bearing this label were virtually exhausted by 1944. In 1938 the Carthusian monks were allowed to return to their property at Grenoble and the distillation of the liqueur was being revived there. (J. V. M.; F. W. D.)

CHARTREUSE, LA GRANDE, the mother house of the order of Carthusian monks (*see* CARTHUSIANS). It is situated in the French department of the Isère, about 12½ m. N. of Grenoble, at a height of 3,205 ft. above the sea, in the heart of a group of limestone mountains, and not far from the source of the Guiers Mort. The original settlement here was founded by St. Bruno in 1084, and derived its name from the small village to the southeast, formerly known as Cartusia, and now as St. Pierre de Chartreuse. The first convent on the present site was built between 1132 and 1137, but the actual buildings date only from about 1676, the older ones often having been burned. One of the most famous of the early Carthusian monks was St. Hugh of Lincoln, who lived here from 1160 to 1181, when he went to England as prior of the first Carthusian house at Witham, Somerset; in 1181 he became bishop of Lincoln, and before his death in 1200 had built the angel choir and other portions of the cathedral there.

The monks were expelled in 1792, but were allowed to return in 1816, when they had to pay rent for the use of the buildings and the forests around. They were again expelled in 1903, and were dispersed in various houses in England, at Pinerolo (Italy) and at Tarragona (Spain). The high roofs of dark slate, the cross-surmounted turrets and the lofty clock-tower are the chief features of the buildings of the convent, which are not very striking. Women were formerly lodged in the old infirmary, close to the main gate, which is now a hotel. Within the conventual buildings are four halls formerly used for the reception of the priors of various branch houses in France, Italy, Burgundy and Germany. The very plain and unadorned chapel dates from the 15th century, but the cloisters, around which cluster the 36 small houses for the fully professed monks, are of later date. The library contained before the Revolution a very fine collection of books and mss., most of them now in the town library at Grenoble.

CHARWOMAN. A word of interesting origin, meaning one who is hired to do occasional household work. "Char" or "chare," which forms the first part of the word, is common, in many forms, to Teutonic languages, meaning a "turn," and, in this original sense, is seen in "ajar," properly "on char," of a door "on the turn" in the act of closing. It is thus applied to a "turn of work," an odd

job, and is so used, in the form "chore," in the United States, and in dialects of the south-west of England.

CHASE, SALMON PORTLAND (1808–1873), American statesman and jurist, was born in Cornish, N.H., on Jan. 13, 1808. His father died in 1817, and the son passed several years (1820–24) in Ohio with his uncle, Bishop Philander Chase (1775–1852), the foremost pioneer of the Protestant Episcopal Church in the West. He graduated at Dartmouth college in 1826, and after studying law under William Wirt, attorney-general of the United States, in Washington, D.C., was admitted to the bar in 1829, and removed to Cincinnati, O., in 1830. Here he soon gained a position of prominence at the bar.

At a time when public opinion in Cincinnati was largely dominated by Southern business connections, Chase, influenced probably by James G. Birney, associated himself after about 1836 with the anti-slavery movement, and became recognized as the leader of the political reformers as opposed to the Garrisonian abolitionists. To the cause he freely gave his services as a lawyer, and was particularly conspicuous as counsel for fugitive slaves seized in Ohio for rendition to slavery under the Fugitive Slave law of 1793 —indeed, he came to be known as the "attorney-general of fugitive slaves." His argument (1847) in the famous Van Zandt case before the United States Supreme Court attracted particular attention, though in this as in other cases of the kind the judgment was against him. In brief he contended that slavery was "local, not national," that it could exist only by virtue of positive State law, that the Federal Government was not empowered by the Constitution to create slavery anywhere, and that "when a slave leaves the jurisdiction of a State he ceases to be a slave, because he continues to be a man and leaves behind him the law which made him a slave."

In 1841 he abandoned the Whig Party, with which he had previously been affiliated, and for seven years was the undisputed leader of the Liberty Party in Ohio; he was remarkably skilful in drafting platforms and addresses, and it was he who prepared the national Liberty platform of 1843 and the Liberty address of 1845. Realizing in time that a third-party movement could not succeed, he took the lead during the campaign of 1848 in combining the Liberty Party with the Barnburners or Van Buren Democrats of New York to form the Free-Soilers. He drafted the famous Free-Soil platform, and it was largely through his influence that Van Buren was nominated for the presidency. His object, however, was not to establish a permanent new party organization, but to bring pressure to bear upon Northern Democrats to force them to adopt a policy opposed to the further extension of slavery.

In 1849 he was elected to the United States Senate as the result of a coalition between the Democrats and a small group of Free-Soilers in the State legislature; and for some years thereafter, except in 1852, when he rejoined the Free-Soilers, he classed himself as an Independent Democrat, though he was out of harmony with the leaders of the Democratic Party. During his service in the Senate (1849–55) he was pre-eminently the champion of anti-slavery in that body, and no one spoke more ably than he did against the Compromise Measures of 1850 and the Kansas-Nebraska bill of 1854. The Kansas-Nebraska legislation, and the subsequent troubles in Kansas, having convinced him of the futility of trying to influence the Democrats, he assumed the leadership in the North-west of the movement to form a new party to oppose the extension of slavery. The "Appeal of the Independent Democrats in Congress to the People of the United States," written by Chase and Giddings, and published in the New York *Times* of Jan. 24, 1854, may be regarded as the earliest draft of the Republican Party creed. He was the first Republican governor of Ohio, serving from 1855 to 1859.

Although, with the exception of Seward, he was the most prominent Republican in the country, and had done more against slavery than any other Republican, he failed to secure the nomination for the presidency in 1860, partly because his views on the question of protection were not orthodox from a Republican point of view, and partly because the old line Whig element could not forgive his coalition with the Democrats in the senatorial campaign of 1849; his uncompromising and conspicuous anti-slavery record, too, was against him from the point of view of "availability." As secretary of the Treasury in President Lincoln's cabinet in 1861–64, during the first three years of the Civil War, he rendered services of the greatest value. That period of crisis witnessed two great changes in American financial policy, the establishment of a national banking system and the issue of a legal tender paper currency. The former was Chase's own particular measure. He suggested the idea, worked out all of the important principles and many of the details, and induced Congress to accept them. The success of that system alone warrants his being placed in the first rank of American financiers. It not only secured an immediate market for Government bonds, but it also provided a stable uniform national currency.

Perhaps Chase's chief defect as a statesman was an insatiable desire for supreme office. It was partly this ambition, and also temperamental differences from the president, which led him to retire from the cabinet in June 1864. A few months later (Dec. 6, 1864) he was appointed chief justice of the United States Supreme Court to succeed Judge Taney, a position which he held until his death. Toward the end of his life he gradually drifted back toward his old Democratic position, and made an unsuccessful effort to secure the nomination of the Democratic Party for the presidency in 1872. He died in New York city on May 7, 1873. Chase was one of the ablest political leaders of the Civil War period, and deserves to be placed in the front rank of American statesmen.

The standard biography is A. B. Hart's *Salmon Portland Chase* in the "American Statesmen Series" (1899). Less philosophical, but containing a greater wealth of detail, is J. W. Shuckers' *Life and Public Services of Salmon Portland Chase* (1874). R. B. Warden's *Account of the Private Life and Public Services of Salmon Portland Chase* (Cincinnati, 1874) deals more fully with Chase's private life. *See* also Floyd Pershing Gates, *Salmon P. Chase and the Independent Democrats* (1918); and Arthur M. Schlesinger, *Salmon Portland Chase, Undergraduate and Pedagogue* (1919).

CHASE, SAMUEL (1741–1811), American jurist, was born in Somerset county (Md.), April 17, 1741. He was admitted to the bar at Annapolis in 1761, and for more than 20 years was a member of the Maryland legislature. He took an active part in the resistance to the Stamp Act, and from 1774 to 1778 and 1784 to 1785 was a member of the Continental Congress. He did much to persuade Maryland to advocate a formal separation of the 13 colonies from Great Britain, and signed the Declaration of Independence on Aug. 2, 1776. In 1791 he became chief judge of the Maryland general court, but resigned in 1796 to become associate justice of the U.S. Supreme Court. Because of his activities on behalf of the Federalist party, the House of Representatives adopted a resolution of impeachment in March, 1804, and on Dec. 7, 1804, the House managers, chief among whom were John Randolph, Joseph H. Nicholson (1770–1817), and Caesar A. Rodney (1772–1824), laid their articles of impeachment before the Senate. The trial, which lasted from Jan. 2 to March 1, 1805, ensued on an indictment of eight articles, dealing with his conduct in the Fries and Callender trials, with his treatment of a Delaware grand jury, and (in article viii.) with his making "highly indecent, extrajudicial" reflections upon the national administration. On only three articles was there a majority against Judge Chase, the largest, on article viii., being four short of the necessary two-thirds to convict.

"The case," says Henry Adams, "proved impeachment to be an impracticable thing for partisan purposes, and it decided the permanence of those lines of constitutional development which were a reflection of the common law." Judge Chase resumed his seat on the bench, and occupied it until his death, June 19, 1811.

See *The Trial of Samuel Chase* (2 vols., Washington, 1805), reported by Samuel H. Smith and Thomas Lloyd; an article in *The American Law Review*, vol. xxxiii. (St. Louis, 1899); and Henry Adams's *History of the United States*, vol. ii. (1889). *See* also J. H. Hazelton, *The Declaration of Independence* (1906); and *The Maryland Signers of the Declaration of Independence* (Baltimore, 1912).

CHASE, WILLIAM MERRITT (1849–1916), American painter, was born at Franklin, Ind., on Nov. 1, 1849. He was a pupil of B. F. Hays in Indianapolis, of J. O. Eaton in New York and of A. Wagner and Piloty in Munich. In New York he established a school of his own, after having taught with success for

some years at the Art Students' League. A worker in all mediums —oils, water-colour, pastel and etching—painting with distinction the figure, landscape and still life, he is perhaps best known by his portraits, his sitters numbering some of the most important men and women of his time.

Chase won many honours at home and abroad, became a member of the National Academy of Design, New York, and for ten years was president of the Society of American Artists. In 1912 he was awarded the Proctor Prize by the National Academy of Design for his "Portrait of Mrs. H." At the Panama Pacific Exposition (1915) a special room was assigned to his works. Among his most important canvases are "Ready for the Ride" (Union League Club, N.Y.), "The Apprentice," "Court Jester," and portraits of the painters, Whistler and Duveneck; of General Webb and of Peter Cooper.

See J. Walker McSpadden, *Famous Painters of America* (1916).

CHASE. (1) The pursuit of wild animals for food or sport (Fr. *chasse,* Lat. *capere,* to take), and so the pursuit of anything. (*See* HUNTING.) The word was also applied to park land reserved for the breeding and hunting of wild animals; *cf.* various place-names in England, as Cannock Chase. It is also a term for a stroke in tennis. (*See* LAWN TENNIS AND TENNIS.) (2) An enclosure (Fr. *châsse,* Lat. *capsa,* a box), such as the muzzle-end of a gun in front of the trunnions, or, in typography (*q.v.*) the frame enclosing the page of type. (*See* PRINTING.)

CHASE NATIONAL BANK, THE, of the city of New York was founded on Sept. 12, 1877. Its first published balance sheet (Dec. 27, 1877) showed total resources of $1,042,009.25. The statement for March 30, 1940, showed total resources of $3,345,528,389.43; common capital stock of $100,270,000.00 and surplus and undivided profits of $136,486,918.24. On the same date, the bank had 35 branches in greater New York, and branches in London, Havana, San Juan, Panama, Colon, Cristobal and Balboa. An affiliate, The Chase Bank (organized under the Edge Act), had branches in Paris, Shanghai, Hongkong and Tientsin. The Chase National Bank occupies a prominent position in the field of both domestic and foreign commercial banking, acts as New York correspondent for thousands of other banks in the United States and abroad, and maintains a large trust department.

Principal executive officers in 1940 were Winthrop W. Aldrich, chairman, board of directors, and H. Donald Campbell, president. Mergers with three other large New York banks and a number of smaller institutions were consummated between 1921 and 1931, as follows:

Nov. 23, 1921, Metropolitan Bank; April 12, 1926, Mechanics & Metals National Bank; Dec. 28, 1927, Mutual Bank; Jan. 26, 1929, Garfield National Bank; Aug. 24, 1929, National Park Bank; June 2, 1930, Equitable Trust Company and Interstate Trust Company; Dec. 19, 1931, American Express Bank & Trust Co.

CHASING, the art of producing figures and ornamental patterns, either raised or indented, on metallic surfaces by means of steel tools or punches. (*See* SILVERSMITHS' AND GOLDSMITHS' WORK.) The chaser first outlines the pattern on the surface he is to ornament, after which, if the work requires bold or high embossments, this is blocked out by a process called "snarling." The snarling iron is a long iron tool turned up at the end, and made so that when securely fastened in a vice the upturned end can reach and press against any portion of the interior of the vase or object to be chased. The part to be raised being held firmly against the upturned point of the snarling iron, the workman gives the shoulder or opposite end a sharp blow which raises the surface of the metal held against the tool. When the blocking out from the interior is finished, the object to be chased is filled with molten pitch, which is allowed to harden. It is then fastened to a sandbag, and with hammer and a multitude of small punches of different outline the details of the pattern (lined, smooth or "mat") are worked out. Embossing and stamping from steel dies and rolled ornaments have taken the place of chased ornamentations in the cheaper kinds of plated works. (*See* EMBOSSING.)

CHASLES, MICHEL (1793–1880), French mathematician, was born on Nov. 15, 1793, at Epernon. He was educated at Paris, and engaged in business, which he later gave up for the study of mathematics. Chasles was made professor of geodesy and mechanics at the Polytechnic school and later professor of higher geometry at the Sorbonne. He and Steiner independently elaborated modern projective geometry, but the interchange of scientific ideas was so poor that the former did not know of the work of the latter. Chasles used his "method of characteristics" and his "principle of correspondence" to solve many problems; the solutions were published in a series of papers in *Comptes Rendus.* The problem of the attraction of an ellipsoid on an external point was solved by him in 1846. Many of his original memoirs were later published in the *Journal de l'École Polytechnique.* Chasles wrote two text-books, *Higher Geometry* (1852) and *Conic Sections* (1865). His *Aperçu historique sur l'origine et la développement des méthodes en géometrie* (1837) is a standard work, the subject being continued in *Rapport sur le progrès de la géometrie* (1870). Chasles died in Paris on Dec. 18, 1880.

CHASLES, PHILARÈTE (1798–1873), French critic and man of letters, was born at Mainvilliers (Eure et Loir). His father, P. J. M. Chasles (1754–1826), was a member of the Convention, and brought up his son according to the principles of Rousseau's *Émile.* Philarète, after a régime of outdoor life, followed by some years of classical study, was apprenticed to a printer. He contributed to the *Revue des deux mondes,* until he had a violent quarrel, terminating in a lawsuit, with François Buloz, who won his case. He became librarian of the Bibliothèque Mazarine, and from 1841 was professor of comparative literature at the Collège de France. During his active life he produced some 50 volumes of literary history and criticism and of social history.

Among his best critical works is *Dix-huitième Siècle en Angleterre . . .* (1846), one of a series of 20 vols. of *Études de littérature comparée* (1846–75), which he called later *Trente ans de critique.* An account of his strenuous boyhood is given in his *Maison de mon père.* His *Mémoires* (1876–77) did not fulfil the expectations based on his brilliant talk.

CHASSÉ, a gliding step in dancing, so called since one foot is brought up behind, or chases, the other. The *chassé croisé* is a double variety of the step.

CHASSELOUP-LAUBAT, FRANÇOIS, MARQUIS DE (1754–1833), French general and military engineer, was born at St. Sernin (Lower Charente), and entered the French engineers in 1774. In 1791 he was promoted captain, and his ability was recognized in the campaigns of 1792. After serving as chief engineer at the siege of Mainz (1796), he was sent to Italy, where he conducted the first siege of Mantua, and afterwards to the new Rhine frontier of France. He was chief of engineers in the army of Italy in 1799, and Napoleon's engineer general in 1800; and he was afterwards employed in reconstructing the defences of the famous Quadrilateral in northern Italy (1801–05). His *chef-d'oeuvre* was the great fortress of Alessandria on the Tanaro. Chasseloup served in Napoleon's campaign of 1806–07, directing the sieges of Colberg, Danzig and Stralsund; and again in 1809, in Italy. Soon after his last campaign, in Russia (1812), he retired from active service, and was made a peer of France and a knight of St. Louis by Louis XVIII. He voted in the chamber of peers against the condemnation of Marshal Ney. In politics he belonged to the constitutional party.

As an engineer Chasseloup was an adherent, though of advanced views, of the old bastioned system. His front was applied to Alessandria, as has been stated, and contains many elaborations of the bastion trace, with, in particular, masked flanks in the tenaille, which served as extra flanks of the bastions. The bastion itself was carefully and minutely retrenched. The ordinary ravelin he replaced by a heavy casemated caponier after the example of Montalembert, and, like Bousmard's, his own ravelin was a large and powerful work pushed out beyond the glacis.

Chasseloup's only published works were, *Correspondance d'un général français avec un général autrichien.* (1801; republ. 1803 or 1809 as *Correspondance de deux généraux . . .*) and *Extraits de Mémoires sur quelques parties de l'artillerie et de fortifications* (Milan, 1805; republ. 1811 as *Essais sur quelques parties . . .*). The most important of his papers are in ms. in the Depôt of Fortifications, Paris.

CHASSEPOT, officially "fusil modèle 1866," a military breech-loading rifle, famous as the arm of the French forces in

the Franco-German War of 1870–71. It was called after its inventor, Antoine Alphonse Chassepot (1833–1905), who had previously constructed a series of experimental forms of breech-loader, and it became the French service weapon in 1866. In the following year it made its first appearance on the battlefield at Mentana, where it inflicted severe losses upon Garibaldi's troops. In the war of 1870 it proved very greatly superior to the German needle-gun. The breech was closed by a bolt very similar to those of more modern rifles, and amongst the technical features of interest were the method of obturation and the retention of the paper cartridge. It was sighted to 1,312yd. (1,200 metres).

CHASSÉRIAU, THÉODORE (1819–1856), French painter, was born in the Antilles on Sept. 20, 1819, and died in Paris on Oct. 8, 1856. He studied under Ingres at Paris and at Rome, subsequently falling under the influence of Paul Delaroche. In his short life he produced little. There are decorative paintings by him in the church of St. Méry and the Salle des Comptes in the Palais d'Orsay, and some characteristic lithographs, imaginative in character and original in execution, which link him with the artists of the '70s and '80s rather than with his contemporaries or predecessors.

CHASSEURS, light infantry or cavalry regiments in the French army (from Fr. *chasser,* to hunt). The first light infantry (*chasseurs à pied*) units were raised in 1743, and by 1794 their number had increased to 21 battalions. The name then disappeared until 1840, but by 1870 they had again increased to their original figure, and by the outbreak of the World War to 30 battalions, of which 12 were known as *Chasseurs Alpins,* and were specially equipped and trained for mountain warfare. Under the existing French army organization these 30 battalions of *chasseurs* are formed as independent units for administrative purposes, but are grouped into demi-brigades of three battalions for war. They are distinguished from line infantry by their dark blue uniform.

The light cavalry (*chasseurs à cheval*) regiments, which were first instituted in 1779, and had a distinguished record of service down to the close of the World War, are now represented only by the five regiments of *Chasseurs d'Afrique,* which were originally recruited for service in Algeria, but performed notable service in the European campaigns of the Second Empire. The peace and war organization of these *Chasseurs d'Afrique* regiments corresponds in general to that of a line cavalry unit. The corps of *chasseurs forestiers* is a semi-military body of gamekeepers and forest guards, intended to act as guides and intelligence agents in time of war.

CHASSIS. Properly, a window-frame. The word is French, meaning a frame, from which is derived "sash." It is in general use for that part of a motor-vehicle consisting of the wheels, frame and machinery, on which the body or carriage part rests. The word has passed into aeronautics, and is also used for the movable traversing frame of a gun.

CHASTELARD, PIERRE DE BOCSOZEL DE (1540–1563), French poet, was born in Dauphiné, a scion of the house of Bayard. His name is inseparably connected with Mary, Queen of Scots. From the service of the Constable Montmorency, Chastelard, then a page, passed to the household of Marshal Damville, whom he accompanied on his journey to Scotland in escort of Mary (1561). He returned to Paris in the marshal's train, but left for Scotland again shortly afterwards, bearing letters of recommendation to Mary from his old protector, Montmorency, and the *Regrets* addressed to the ex-queen of France by Pierre Ronsard, his master in the art of song. He undertook to transmit to the poet the service of plate with which Mary rewarded him. But he had fallen in love with the queen, who is said to have encouraged his passion. The young man hid himself under her bed, where he was discovered by her maids of honour. Mary pardoned the offence, but Chastelard was so rash as again to violate her privacy. He was discovered a second time, seized, sentenced and hanged the next morning. He met his fate valiantly and consistently, reading, on his way to the scaffold, his master's noble *Hymne de la mort,* and turning at the instant of doom towards the palace of Holyrood, to address to his unseen mistress the famous farewell—"Adieu, toi si belle et si cruelle, qui me tues et que je ne puis cesser d'aimer." This at least is the version of the *Mémoires* of Brantôme.

CHASTELLAIN, GEORGES (*c.* 1415–1475), Burgundian poet and chronicler, was a native of Alost, in Flanders. He saw active service in the Anglo-French Wars and elsewhere. In 1434 he received a gift from Philip the Good, duke of Burgundy, for his military service. After the peace of Arras (1435) he abandoned soldiering for diplomacy. The next ten years were spent in France, where he was connected with Georges de la Trémoille, and afterwards entered the household of Pierre de Brézé, at that time seneschal of Poitou, by whom he was employed on missions to the duke of Burgundy, in an attempt to establish better relations between Charles VII. and the duke. On the further breach between the two princes, Chastellain left the French service to enter Philip's household, and in 1457 he became a member of the ducal council. He was continually employed on diplomatic errands until 1455, when he was made Burgundian historiographer. He worked at his *Chronique,* with occasional interruptions in his retreat to fulfil missions in France, or to visit the Burgundian court. He was assisted, from about 1463 onwards, by his disciple and continuator, Jean Molinet, whose rhetorical and redundant style may be fairly traced in some passages of the *Chronique.* Chastellain died at Valenciennes on Feb. 13 (according to the treasury accounts), or on March 20 (according to his epitaph), 1475. Only about one-third of the whole *Chronique,* which extended from 1419 to 1474, is extant.

Among his contemporaries Chastellain acquired a reputation by his poems and occasional pieces. He was no mere annalist, but proposed to fuse and shape his vast material to his own conclusions, in accordance with his political experience. The most interesting feature of his work is the skill with which he pictures the leading figures of his time.

The known extant fragments of Chastellain's *Chroniques* with his other works were edited by Kervyn de Lettenhove for the Brussels Academy in 1863–66 (Brussels) as *Oeuvres de Georges Chastellain.* This edition includes three volumes of minor pieces of considerable interest, especially *Le Temple de Boccace,* dedicated to Margaret of Anjou, and the *Déprécation* for Pierre Brézé, imprisoned by Louis XI. The attribution to Chastellain is in some cases erroneous, notably in the case of the *Livre des faits de Jacques de Lalaing,* which is probably the work of Lefèbvre de Saint-Remi, herald of the Golden Fleece. In the allegorical *Oultré d'amour* it has been thought a real romance between Brézé and a lady of the royal house is concealed.

See A. Molinier, *Les Sources de l'histoire de France;* notices by Kervyn de Lettenhove prefixed to the *Oeuvres* and in the *Biographie nationale de Belgique;* and an article by Vallet de Viriville in the *Journal des savants* (1867).

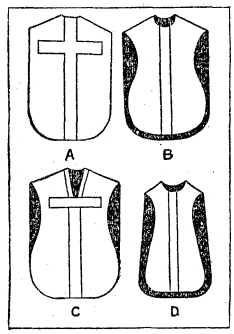
CHASUBLE, a liturgical vestment of the Catholic Church, being the outermost garment worn by bishops and priests when celebrating the Mass. The word is derived, through the French, from the Latin *casula,* a little house or hut. Since the chasuble (or *planeta,* as it is also called in the Roman Missal) is only used at the Mass, or rarely for functions intimately connected with the sacrament of the altar, it may be regarded as the Mass vestment *par excellence.* According to the prevailing model in the Roman Catholic Church it is a scapular-like cloak, with a hole in the middle for the head, falling down over breast and back, and leaving the arms uncovered at the sides. Its shape and size, however, differ considerably in various countries (*see* fig.), while some churches—*e.g.,* those of certain monastic orders—have retained or reverted to the earlier "Gothic" forms to be described later. According to the decisions of the Congregation of Rites, chasubles must not be of linen, cotton or woollen stuffs, but of silk; though a mixture of wool (or linen and cotton) and silk is allowed if the silk completely cover the other material on the outer side.

The chasuble, like the kindred vestments in the Eastern Churches, is derived from the Roman *paenula* or *planeta,* a cloak worn by all classes and both sexes in the Graeco-Roman world (*see* VESTMENTS).

At the Reformation the chasuble was rejected with the other vestments by the more extreme Protestants. Its use, however,

survived in the Lutheran churches; and though in those of Germany it is no longer worn, it still forms part of the liturgical costume of the Scandinavian Evangelical churches. In the Church of England, though it was prescribed alternatively with the cope in the first prayer-Book of Edward VI., it was ultimately discarded with the other "Mass vestments." (*See* VESTMENTS.)

Form.—The chasuble was originally a tent-like robe which fell in loose folds below the knee of the wearer. Its inconvenience, however, was obvious, and a process of cutting away at the sides began, which continued until the tent-shaped chasuble of the 12th century had developed in the 16th into the present scapular–like vestment. This process was, moreover, hastened by the substitution of costly and elaborately embroidered materials for the simple stuffs of which the vestment had originally been composed: for, as it became heavier and stiffer, it had to be made smaller.



FROM BRAUN, "DIE LITURGISCHE GEWANDUNG IM OCCIDENT UND ORIENT" (HERDER, FREIBURG IM BREISGAU)

COMPARATIVE SIZES AND SHAPES OF CHASUBLES AS NOW IN USE IN VARIOUS COUNTRIES (A & B) GERMAN, (C) ROMAN, (D) SPANISH

Decoration.—Chasubles were until the 10th century generally quite plain, and even at the close of this century, when the custom of decorating the chasuble with orphreys had become common, there was no definite rule as to their disposition. From this time onward, the embroidery became ever more and more elaborate, and the orphreys were broadened to allow of their being decorated with figures. About the middle of the 13th century, the cross with horizontal arms begins to appear on the back of the vestment, and by the 15th this had become the most usual form. Sometimes the back of the chasuble has no cross, but only a vertical orphrey, and in this case the front, besides the vertical stripe, has a horizontal orphrey just below the neck opening. This latter is the type used in the local Roman Church, which has been adopted in certain dioceses in South Germany and Switzerland, and of late years in the Roman Catholic churches in England, *e.g.*, Westminster cathedral.

The earlier decoration of the forked cross, *i.e.*, a vertical orphrey with two arms turned upwards over the shoulders, was commonly retained in England and has thus been largely adopted by the "Anglo-Catholic" clergy in modern times. Father Braun gives proof that this decoration was not even originally conceived as a cross at all, citing early instances of its having been worn by laymen and even by non-Christians. It was not until the 13th century that the symbolical meaning of the cross began to be elaborated, and this was accentuated from the 14th century onward by the custom of adding to it the figure of the crucified Christ and other symbols of the Passion. This, however, did not represent any definite rule; and the orphreys of chasubles were decorated with a great variety of pictorial subjects. The local Roman Church, true to its ancient traditions, adhered to the simpler forms. The modern Roman chasuble, besides the conventional arabesque pattern, is decorated, according to rule, with the arms of the archbishop and his see.

The Eastern Church.—The original equivalent of the chasuble is the phelonion, from the Lat. *paenula*. It is a vestment of the type of the Western bell chasuble; but, instead of being cut away at the sides, it is either gathered up or cut short in front. In the Armenian, Syrian, Chaldaean and Coptic rites it is cope-shaped. The phelonion is not in the East so specifically a eucharistic vestment as in the West, but is worn at other solemn functions besides the liturgy, *e.g.*, marriages, processions. The Greek and Greek Melchite metropolitans now wear the *sakkos* instead of the phelonion; and in the Russian, Ruthenian, Bulgarian and Italo-Greek churches this vestment has superseded the phelonion in the case of all bishops (*see* DALMATIC and VESTMENTS).

See J. BRAUN, S. J., *Die liturgische Gewandung* (1907), pp. 149–247, Dom H. Leclerq, in Cabrol, *Dict. d'Archéol. Chrét. et de Liturgie*, and the bibliography to the article VESTMENTS.

CHATALJA LINES, a fortified position 25m. W. of and covering Constantinople, extending from the Black sea at Karaburnu to the Sea of Marmara at Buyuk Chekmedje. They form a very strong position, covered in part by lakes and marshes, and commanding all the country to the west. They were first constructed during the Russo-Turkish war of 1877–78, but were not at that time the scene of fighting. During the Balkan war of 1912, however, they afforded a secure refuge to the Turkish armies defeated in the open field by the Bulgarians, and when the latter attacked them in mid-November of that year, with insufficient artillery preparation, they were repulsed with heavy loss. In the World War the lines were once more reconditioned in expectation of an Allied attack on Constantinople.

CHÂTEAU, the French word for castle (*q.v.*). The development of the castle in the 15th and 16th centuries into houses arranged rather for residence than defence led to a corresponding widening of the meaning of the term *château,* which came to be applied to any seigniorial residence and so generally to all country houses of any pretensions (*cf.* the Germ. *Schloss*). The French distinguish the fortified from the residential type by describing the former as the *château fort,* the latter as the *château de plaisance.* The development of the one into the other is admirably illustrated by the *châteaux* scattered along the Loire. Of these, Langeais, still in perfect preservation, is a fine type of the *château fort,* with its 10th century keep and 13th century walls. Amboise (1490), Blois (1500–40), Chambord (begun 1526), Chenonceaux (1515–60), Azay-le-Rideau (1521), may be taken as typical examples of the *château de plaisance* of the transition period, all retaining some of the architectural characteristics of the mediaeval castle In English the word *château* is often used to translate foreign words, *e.g., Schloss,* meaning country house or mansion.

See RENAISSANCE ARCHITECTURE. For the Loire *châteaux see* Theodore Andrea Cook, *Old Touraine* (1892). (T. F. H.)

CHATEAUBRIAND, FRANÇOIS RENÉ, VICOMTE DE (1768–1848), French author, youngest son of René Auguste de Chateaubriand, comte de Combourg, was born at St. Malo on Sept. 4, 1768. He was a brilliant representative of the reaction against the ideas of the French Revolution, and the most conspicuous figure in French literature during the First Empire. His naturally poetical temperament was fostered in childhood by picturesque influences, the mysterious reserve of his morose father, the ardent piety of his mother, the traditions of his ancient family, the legends and antiquated customs of the sequestered Breton district, above all, the vagueness and solemnity of the neighbouring ocean. His closest friend was his sister Lucille,[1] a passionate-hearted girl, divided between her devotion to him and to religion. François received his education at Dol and Rennes. From Rennes he proceeded to the College of Dinan, to prepare for the priesthood, but decided, after a year's holiday at the family château of Combourg (1786) to enter the army. In 1788 he received the tonsure in order to enter the order of the Knights of Malta. In Paris (1787–89) he met La Harpe, Évariste Parny, "Pindare" Lebrun, Nicolas Chamfort, Pierre Louis Ginguené, and others, of whom he has left portraits in his memoirs. In 1791 he departed for America to take part in a romantic scheme for the discovery of the North-West Passage. The passage was not found or even attempted, but the adventurer returned from his seven months' stay in America enriched with new ideas and new imagery. In 1792 he married Mlle. Céleste Buisson de Lavigne, a girl of 17, who brought him a small fortune. He then joined the *émigrés,* and after many vicissitudes reached London, where he lived in great poverty.

From his English exile (1794–99) dates the *Natchez* (first printed in his *Oeuvres complètes,* 1826–31), a prose epic portraying the life of the Red Indians. Two brilliant episodes originally designed for this work, *Atala* and *René,* are famous. Chateaubriand's first publication, however, was the *Essai historique, politique et moral sur les révolutions . . .* (London, 1797), which the author subsequently retracted, but did not suppress. In this volume he appears as a mediator between royalist and revolution-

[1]Her *Oeuvres* were edited in 1879, with a memoir, by Anatole France.

ary ideas, a free-thinker in religion, and a disciple of Rousseau. A great change in his views was, however, at hand, induced, if we accept his own statement, by a letter from his sister Julie (Mme. de Farcy), telling him of the grief his views had caused his mother, who had died soon after her release from the Conciergerie in the same year. His brother had perished on the scaffold in April 1794, and both his sisters, Lucile and Julie, and his wife had been imprisoned at Rennes. Mme. de Farcy did not long survive her imprisonment.

On Chateaubriand's return to France in 1800 the *Génie du christianisme* was already in an advanced state. Chateaubriand's favourite resort in Paris was the salon of Pauline de Beaumont, who was to fill a great place in his life, and gave him some help in the preparation of his book. *Atala, ou les amours de deux sauvages dans le désert,* used as an episode in the *Génie du christianisme,* appeared separately in 1801 and immediately made his reputation. Alike in its merits and defects the piece is a more emphatic and highly coloured *Paul et Virginie.* The *Génie du christianisme, ou beautés de la religion chrétienne,* appeared in 1802, upon the eve of Napoleon's re-establishment of the Catholic religion in France. No coincidence could have been more opportune, and Chateaubriand esteemed himself the counterpart of Napoleon in the intellectual order. The work is not to be judged by its apologetics, but as a masterpiece of literary art. Its influence in French literature was immense. The *Éloa* of Alfred de Vigny, the *Harmonies* of Lamartine and even the *Légende des siècles* of Victor Hugo may be said to have been inspired by the *Génie du christianisme.* At the moment of publication it admirably subserved the statecraft of Napoleon, and Talleyrand in 1803 appointed the writer *attaché* to the French legation at Rome, whither he was followed by Mme. de Beaumont, who died there.

When his insubordinate and intriguing spirit compelled his recall he was transferred as envoy to the canton of the Valais. The murder of the duke of Enghien (March 21, 1804) took place before he took up this appointment. Chateaubriand immediately resigned his post. In 1807 he offended Napoleon by an article in the *Mercure de France* (July 4), containing allusions to Nero which were rightly taken to refer to the emperor. The *Mercure,* of which he had become proprietor, was temporarily suppressed, and was in the next year amalgamated with the *Décade.* In 1806, he had made a pilgrimage to Jerusalem, undertaken in quest of new imagery. He returned by way of Tunis, Carthage, Cadiz and Granada. At Granada he met Mme. de Mouchy, and the place and the meeting apparently suggested the romantic tale of *Le Dernier Abencérage,* which, for political reasons, remained unprinted until the publication of the *Oeuvres complètes* (1826–31). The journey also produced *L'Itinéraire de Paris à Jérusalem . . .* (3 vols., 1811), and inspired his prose epic, *Les Martyrs, ou le triomphe de la religion chrétienne* (2 vols., 1809). *René* had appeared in 1802 as an episode of the *Génie du christianisme,* and a separate unauthorized edition appeared at Leipzig. The tale forms a connecting link in European literature between *Werther* and *Childe Harold;* it paints the misery of a morbid and dissatisfied soul. Chateaubriand betrayed amazing egotism in describing his sister Lucile in the Amélie of the story, and much is obviously descriptive of his own early surroundings. With *Les Natchez* his career as an imaginative writer is closed. In 1831 he published his *Études ou discours historiques . . .* (4 vols.) dealing with the fall of the Roman empire.

Chateaubriand's vanity and ambition made him dangerous and untrustworthy as a political associate. He was forbidden to deliver the address he had prepared (1811) for his reception to the Academy on M. J. Chénier on account of the bitter allusions to Napoleon contained in it. From this date until 1814 Chateaubriand lived in seclusion at the Vallée-aux-loups, an estate he had bought in 1807 at Aulnay. His pamphlet *De Bonaparte, des Bourbons, et de la nécessité de se rallier à nos princes légitimes,* appeared on March 31, 1814, the day of the entrance of the allies into Paris. Louis XVIII. declared that it had been worth a hundred thousand men to him. Chateaubriand, as minister of the interior, accompanied him to Ghent during the Hundred Days, and for a time associated himself with the excesses of the royalist reaction. But he rapidly drifted into liberalism and opposition, and was disgraced in Sept. 1816 for his pamphlet *De la monarchie selon la charte.* He had to sell his library and his house of the Vallée-aux-loups.

After the fall of his opponent, the duc Decazes, Chateaubriand obtained the Berlin embassy (1821), from which he was transferred to London (1822), and he also acted as French plenipotentiary at the Congress of Verona (1822). He here made himself mainly responsible for the iniquitous invasion of Spain. He was foreign minister for a brief period, and then, after another interlude of effective pamphleteering in opposition, accepted the embassy to Rome in 1827, under the Martignac administration, but resigned it at Prince Polignac's accession to office.

During the first half of Louis Philippe's reign he wrote a *Mémoire sur la captivité de madame la duchesse de Berry* (1833) and other legitimist pamphlets; but as the prospect of his again performing a conspicuous part diminished, he relapsed into an attitude of complete discouragement. His *Congrès de Vérone* (1838), *Vie de Rancé* (1844), and his translation of Milton, *Le Paradis perdu de Milton* (1836), belong to the writings of these later days. He died on July 4, 1848, affectionately tended by his old friend Madame Récamier, herself deprived of sight. For the last 15 years of his life he had been engaged on his *Mémoires,* and his chief distraction had been his daily visit to Madame Récamier, at whose house he met the European celebrities. He was buried in the Grand Bé, an islet in the bay of St. Malo. Shortly after his death appeared his celebrated *Mémoires d'outre-tombe* (12 vols., 1849–50). These memoirs undoubtedly reveal his vanity, his egotism, the frequent hollowness of his professed convictions, and his incapacity for sincere attachment, except, perhaps, in the case of Madame Récamier. Though the book must be read with the greatest caution where others are concerned, it is perhaps now the most read of all his works.

Chateaubriand is chiefly significant as marking the transition from the old classical to the modern romantic school. The fertility of ideas, vehemence of expression and luxury of natural description, which he shares with the romanticists, are controlled by a discipline learnt in the school of their predecessors. His palette, always brilliant, is never gaudy; he is not merely a painter but an artist. He is a master of epigrammatic and incisive sayings. Perhaps, however, the most truly characteristic feature of his genius is the peculiar magical touch which Matthew Arnold indicated as a note of Celtic extraction, which supplies an element of sincerity to Chateaubriand's declamation. Egotism was his master-passion. He is a signal instance of the compatibility of genuine poetic emotion, of sympathy with the grander aspects both of man and nature, and of munificence in pecuniary matters, with absorption in self and general sterility of heart.

BIBLIOGRAPHY.—The *Oeuvres complètes* of Chateaubriand were printed in 28 vols., 1826–31; in 20 vols., 1829–31; and in many later editions, notably in 1858–61, in 20 vols., with an introductory study by Sainte-Beuve. The principal authority for Chateaubriand's biography is the *Mémoires d'outre-tombe* (1849–50), of which there is an English translation, *The Memoirs of . . . Chateaubriand* (6 vols., 1902), by A. Teixeira de Mattos, based on the edition (4 vols., 1899–1901) of Edmond Biré. This work should be supplemented by the *Souvenirs et correspondances tirés des papiers de Mme. Recamier* (2 vols., 1859, ed. Mme. Ch. Lenormant). *See* also Comte de Marcellus, *Chateaubriand et son temps* (1859); the same editor's *Souvenirs diplomatiques; correspondance intime de Chateaubriand* (1858); C. A. Sainte-Beuve, *Chateaubriand et son groupe littéraire sous l'empire* (2 vols., 1861, new and revised ed., 3 vols., 1872); other articles by Sainte-Beuve, who was in this case a somewhat prejudiced critic, in the *Portraits contemporains,* vols. i. and ii.; *Causeries du lundi,* vols. i., ii. and x.; *Nouveaux Lundis,* vol. iii.; *Premiers Lundis,* vol. iii.; A. Vinet, *Études sur la litt. française au XIXe siècle* (1849); M. de Lescure, *Chateaubriand* (1892) in the *Grands écrivains français;* Émile Faguet, *Études littéraires sur le XIXe siècle* (1887); and *Essai d'une bio-bibliographie de Chateaubriand et de sa famille* (Vannes, 1896), by René Kerviler. Joseph Bédier, in *Études critiques* (1903), deals with the American writings, and there is an admirable criticism of the *Génie du christianisme* in F. Brunetière's *Hist. de la litt. française* vol. iv. (1917). Some correspondence with Sainte-Beuve was edited by Louis Thomas in 1904, and some letters to Mme. de Staël appeared in the *Revue des deux mondes* (Oct. 1903).

CHÂTEAUBRIANT, a town of western France, capital of an arrondissement in the department of Loire-Inférieure, on the

left bank of the Chère, 40m. N.N.E. of Nantes by rail. Pop. (1936) 7,444. It takes its name from a castle founded in the 11th century by Brient, count of Penthièvre, remains of which still exist though it was shattered in 1488. The new castle, begun in 1524 by Jean de Laval, and famous in history as the residence of Françoise de Foix, mistress of Francis I., has a beautiful colonnade running at right angles to the main building. It was presented to the department by the duc d'Aumale in 1852. The interesting Romanesque church is dedicated to St. Jean de Béré. Châteaubriant is the seat of a subprefect and has a tribunal of first instance. It is an important centre on the Ouest-État railway, and has lime-kilns and agricultural trade.

CHÂTEAU-D'OEX, resort, Switzerland, 20½ mi. from Montreux, in the Sarine valley, 3,182 feet above sea-level, below the north-west end of the Bernese Oberland. Pop. 3,840. The castle has been replaced by a church and the village has many attractive chalets scattered on the hillside, which are enriched with pine woods. The village is much frequented both in summer and in winter, and summer and winter sports are well developed.

CHÂTEAUDUN, a town of north central France, capital of an arrondissement in the department of Eure-et-Loir, 28 m. S.S.W. of Chartres. Pop. (1936) 6,447. It stands on high ground near the left bank of the Loir. The streets radiate from a central square, the town being replanned after fires in 1723 and 1870.

Châteaudun (*Castrodunum*), which dates from the Gallo-Roman period, was in the middle ages the capital of the countship of Dunois. The château was built in great part by Count Jean and his descendants. Founded in the 10th and rebuilt in the 12th and 15th centuries, it consists of a principal wing adjoined by a chapel. To the left of the courtyard rises a 12th century lofty keep. The church of La Madeleine dates from the 12th century; the buildings of the abbey to which it belonged are occupied by the subprefecture, the law court and the hospital. St. Valérien, St. Jean and the ruined chapel of Notre-Dame du Champdé are mediaeval in date. There is a tribunal of first instance. Flour-milling, tanning and leather-dressing, and the manufacture of silver jewellery and machinery are carried on. Trade is in cattle, grain, wool and hemp.

CHÂTEAU-GONTIER, a town of western France in the arrondissement of Laval in the department of Mayenne on the Mayenne, 18 mi. S. by E. of Laval. Pop. (1936) 6,307. Château-Gontier owes its origin and its name to a castle erected in the first half of the 11th century by Gunther, the steward of Fulk Nerra of Anjou, on the site of a farm belonging to the monks of St. Aubin d'Angers. On the extinction of the family, the lordship was assigned by Louis XI to Philippe de Comines. The church of St. Jean, a relic of the castle, dates from the 11th–12th centuries. The town suffered severely during the wars of the League. In 1793 it was occupied by the Vendeans. It manufactures serge and flannel and is an agricultural market.

CHÂTEAU-RENAULT, FRANÇOIS LOUIS DE ROUSSELET, MARQUIS DE (1637–1716), French admiral, entered the army in 1658, but in 1661 was transferred to the navy. His early services were mostly performed in cruises against the Barbary pirates (1672). When war broke out between England and France after the Revolution of 1688, he was in command at Brest, and was chosen to carry the troops and stores sent by the French king to the aid of James II. in Ireland. Although he was watched by Admiral Herbert (Lord Torrington, *q.v.*), with whom he fought an indecisive action in Bantry bay, he executed his mission with success. Château-Renault commanded a squadron under Tourville at the battle of Beachy Head in 1690. He was with Tourville in the attack on the Smyrna convoy in 1693.

On the death of Tourville in 1701 he was named to the vacant post of vice-admiral of France. On the outbreak of the War of the Spanish Succession he was charged with the protection of the Spanish ships which were to bring the treasure from America. His fleet of 15 French and three Spanish warships, having under their care 12 galleons, had anchored on Sept. 22 in Vigo bay. Official obstacles were placed in the way of landing the treasure. At last the order came, and the bullion was landed under the care of the Galician militia which was ordered to escort it to Lugo. The bulk of the merchandise was on board the galleons when the allied fleet appeared outside of the bay on Oct. 22, 1702. Sir George Rooke and his colleagues resolved to attack. The fleet was carrying a body of troops which had been sent out to make a landing at Cadiz, and had been beaten off. The fortifications of Vigo were weak on the sea side, and on the land side there were none. The fleet of 24 sail was steered at the boom which Château-Renault had erected and broke through it, while the troops turned the forts and scattered the Galician militia. In the bay the action was utterly disastrous to the French and Spaniards. The booty was far less than the allies hoped, but the damage to the French and Spanish Governments was great.

The king considered Château-Renault free from blame, and must indeed have known that the admiral had been trusted with too many secrets to make it safe to inflict a public rebuke. The Spanish Government declined to give him the rank of grandee which was to have been the reward for bringing the bullion safely home. But in 1703 he was made a marshal of France, and shortly afterwards lieutenant-general of Brittany. In 1708 on the death of his nephew he inherited the marquisate, and on Nov. 15, 1716, he died in Paris.

A life of Château-Renault was published in 1903 by J. J. R. Calmon-Maison. There is a French as well as an English account of the part played by him at Bantry bay and Beachy Head, and the controversy still continues. For the French history of the navy under Louis XIV. *see* Léon Guérin, *Les Marins illustres* (1861), and *Histoire maritime de la France,* vols. iii., iv. (1863).

CHÂTEAUROUX, MARIE ANNE DE MAILLY-NESLE, DUCHESSE DE (1717–1744), mistress of Louis XV. of France, was the fourth daughter of Louis, marquis de Nesle. In 1740, upon the death of her husband, the marquis de la Tournelle, she supplanted her sister, Madame de Mailly, as titular mistress in 1742. Directed by the duc de Richelieu, she tried to arouse the king, dragging him off to the armies, and negotiated the alliance with Frederick II. of Prussia in 1744. Her political rôle, however, has been exaggerated.

See Ed. and J. de Goncourt, *La Duchesse de Châteauroux et ses soeurs* (new ed. 1889); *Histoire de Madame de Châteauroux tirée des mémoires de la Duchesse de Brancas* (1919).

CHÂTEAUROUX, a town of central France, capital of the department of Indre, situated on the left bank of the Indre, 88 m. S. of Orléans on the main line of the Orléans railway. Pop. (1936) 26,318. The old town, close to the river, forms a nucleus round which a newer and more extensive quarter, bordered by boulevards, has grown up; the suburbs of St. Christophe and Déols (*q.v.*) lie on the right bank of the river. Châteauroux owes its name and origin to the castle founded about the middle of the 10th century by Raoul, prince of Déols, which later passed to Henry II. of England, falling eventually to the Condé family (1612). The present Château-Raoul dates from the 14th and 15th centuries and forms part of a charming river-side landscape. The old Église des Cordeliers (13th century) contains a museum and a library with the oldest extant ms. of the "Chanson de Roland." The modern church of St. André is very tastefully planned in the Gothic style. Châteauroux is the seat of a prefect and of a court of assizes. It has tribunals of first instance and of commerce and a board of trade-arbitrators and a chamber of commerce. The manufacture of textiles and machinery is actively carried on and there is a state tobacco factory.

CHÂTEAU-THIERRY, a town of northern France, in the department of Aisne, 59 m. E.N.E. of Paris on the Eastern railway to Nancy. Pop. (1936) 7,600. Château-Thierry is built on rising ground on the right bank of the Marne, over which a fine stone bridge leads to the suburb of Marne. On the top of a hill are the ruins of a castle, said to have been built by Charles Martel for the Frankish king, Thierry IV., whence the name of the town. The chief relic is a gateway flanked by massive round towers, known as the Porte Saint-Pierre. A belfry of the 15th century and the church of St. Crépin (Crispin) of the same period are of some interest.

Château-Thierry was formerly the capital of the district of Brie Pouilleuse, and received the title of duchy from Charles IX in 1566. It was captured by the English in 1421, by Charles V in 1544, and sacked by the Spanish in 1591. During the wars of the Fronde it was pillaged in 1652; and in the campaign of 1814 it suffered severely, under Blücher, the Russo-Prussian forces being beaten by Napoleon in the neighbourhood. It was the farthest point reached by the Germans in their offensive of May 27, 1918. The 2nd and 3rd divisions of the American Expeditionary force were sent to the Marne in the Château-Thierry region to assist the hard-pressed French forces. At Château-Thierry itself a U.S. machine-gun battalion took part in the successful defense of the river-crossing, while to the west of the town the 2nd division, under General Omar Bundy, fought the fiercely contested engagement of Belleau Wood.

(*See* GERMAN OFFENSIVE, 1918; MARNE, SECOND BATTLE OF THE.)

La Fontaine was born in the town in 1621. His house is still preserved in the street that bears his name.

The distinctive industry is the manufacture of mathematical and musical instruments. There is trade in the white wine of the neighbourhood, and in agricultural products. Gypsum, millstone and paving-stone are quarried in the vicinity.

CHÂTELAIN, in France originally merely the equivalent of the English castellan, *i.e.*, the commander of a castle. With the growth of the feudal system, however, the title gained in France a special significance which it never acquired in England, as implying the jurisdiction of which the castle became the centre.

The *châtelain* was originally, in Carolingian times, an official of the count; with the development of feudalism the office became a fief, and so ultimately hereditary. In this as in other respects the *châtelain* was the equivalent of the viscount (*q.v.*); sometimes the two titles were combined, but more usually in those provinces where there were *châtelains* there were no viscounts, and vice versa.

The title *châtelain* continued also to be applied to the inferior officer, or *concierge châtelain,* who was merely a castellan in the English sense. The power and status of *châtelains* necessarily varied greatly at different periods and places; occasionally they were great nobles with an extensive jurisdiction, as in the Low Countries (*see* BURGRAVE). The *châtellenie* (*castellania*), or jurisdiction of the *châtelain,* as a territorial division for certain judicial and administrative purposes, survived the disappearance of the title and office of the *châtelain* in France, and continued till the Revolution.

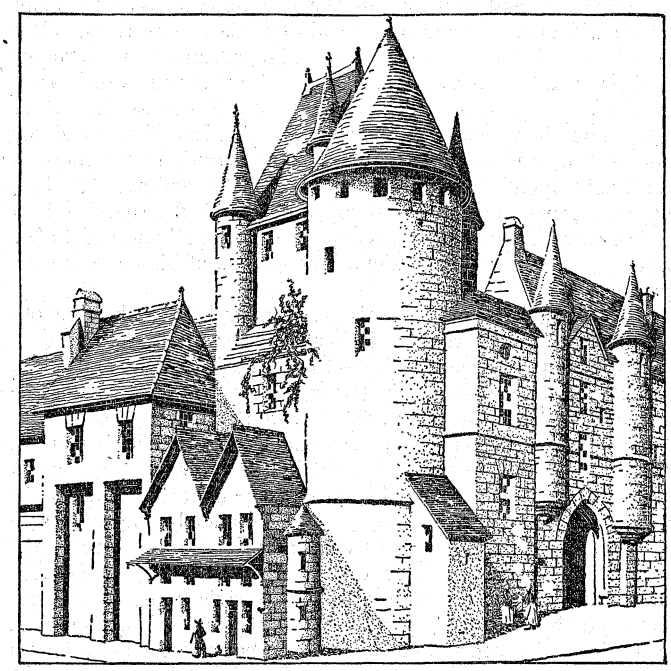
See Achille Luchaire, *Manuel des institutions françaises* (1892); Du Cange, *Glossarium, s.* "Castellanus."

CHATELAINE, the mistress of a castle. From the custom of a chatelaine of carrying the keys of the castle suspended from her girdle, the word was applied in the late 19th century to the collection of short chains, worn by ladies, to which keys, penknife, needlecase, scissors, etc., were attached.

CHÂTELET, the word used in France for a building designed for the defense of an outwork or gate, sometimes of great strength, but distinguished from the *château,* or castle proper, in being purely defensive and not residential (from Med. Lat. *castella*).

In Paris, before the Revolution, this word was applied both to a particular building and to the jurisdiction of which it was the seat. This building had been first a castle defending the approach to the Cité. Tradition traced its existence back to Roman times, and in the 18th century one of the rooms in the great tower was still called *Caesar's room.* The jurisdiction was that of the provostship (prévôté) and viscountship of Paris, which was of feudal origin, probably going back to the counts of Paris.

It was not till the time of St. Louis that, with the appointment of Étienne Boileau, the provostship of Paris became a public office no longer put up to sale (*prévôté en garde*). When the *baillis* (*see* BAILIFF AND BAILIE) were created, the provost of Paris discharged the functions of a *bailli,* in which capacity he heard appeals from the seigniorial and inferior judges of the city and its neighbourhood, keeping, however, his title of provost. When under Henry II certain *bailliages* became presidial jurisdictions (*présidiaux*), *i.e.,* received the right of judging without appeal, the Châtelet was made a presidial court. Finally, various tribunals peculiar to the city of Paris, *i.e.,* courts exercising jurisdictions outside the common law or corresponding to certain *cours d'exception* which existed in the provinces, were united with the Châtelet, of which they became divisions (*chambres*). Thus the lieutenant-general of the police made it the seat of his jurisdiction, and the provost of the Île de France, who had the same criminal jurisdiction as the provosts of the marshals of France in other provinces, sat there also. As to the *personnel* of the Châtelet, it was originally the same as in the *bailliages,* except that after the 14th century it had some special officials, the auditors and the examiners of inquests. Like the *baillis,* the provost had lieutenants who were deputies for him, and in addition gradually acquired a considerable body of *ex officio* councillors. This last staff, however, was not yet in existence at the end of the 14th century, for it is not mentioned in the *Registre criminel du Châtelet* (1389–92). In 1674 the whole *personnel* was doubled at the time when the new Châtelet was established side by side with the old, the two being soon after amalgamated. On the eve of the Revolution it comprised, beside the provost whose office had become honorary, the *lieutenant civil* who presided over the *chambre de prévôté au parc civil* or court of first instance; the *lieutenant criminel,* who presided over the criminal court; two *lieutenants particuliers,* who presided in turn over the *chambre du présidial* or court of appeal; a *juge auditeur;* 64 councillors (*conseillers*); the *procureur du roi,* four *avocats du roi,* and eight *substituts, i.e.* deputies of the *procureur* (*see* PROCURATOR), beside a host of minor officials. Under the Revolution the Constituent Assembly empowered the Châtelet to try cases of *lèse-nation.* It was before this court that was opened the inquiry following on the events of Oct. 5 and 6, 1789 (Louis' removal to Paris). It was suppressed by the law of Aug. 16, 1790, together with the other tribunals of the *ancien régime.* The site of the building still bears the name of Châtelet. (J. P. E.; X.)



THE CHÂTELET, PARIS, ORIGINALLY A FORTRESS, LATER A PRISON AND COURTHOUSE, AS IT LOOKED BEFORE ITS DESTRUCTION IN 1802

CHÂTELLERAULT, a town of western France, capital of an arrondissement in the department of Vienne, 19 mi. N.N.E. of Poitiers on the Orleans railway. Pop. (1936) 16,032. It is situated on the right bank of the Vienne and is connected with the suburb of Châteauneuf by a stone bridge of the 16th and 17th centuries. Châtellerault (or Châtelherault: *Castellum Airaldi*) derives its name from a fortress built in the 10th century by

Airaud, viscount of its territory. In 1515 it was made a duchy in favour of François de Bourbon, but was soon reunited to the crown. In 1548 it was bestowed on James Hamilton, 2nd earl of Arran (*see* HAMILTON). The manufacture of cutlery dates from the 14th century and is carried on in villages along the banks of the Clain. The most important industrial establishment is the national small-arms factory, established in 1819.

CHATHAM, EARL OF, WILLIAM PITT (1708–1778), was born at Golden square, Westminster, on Nov. 15, 1708. His father was Robert, son of the famous governor Pitt of Madras, who sold to the Regent Orleans his great diamond still to be seen in the Louvre; his mother Harriet Villiers, daughter of Viscountess Grandison, a notable character in her day. He was the fourth child of a family of six, of whom his elder brother Thomas inherited the governor's Cornish property, Beconnoc, and the youngest, his favourite sister Ann, attained some note in the world that Horace Walpole adorned. At the age of ten or 11 he was sent to Eton and in Jan. 1727 to Trinity college, Oxford. He showed no remarkable genius at either place, but obtained a sound classical education and came to know many of those with whom he was afterwards associated: Lyttelton, the Grenvilles, two Foxes, Hanbury Williams, Pratt and Henry Fielding at Eton, while Henley, the Wesleys, Samuel Johnson and Murray were his contemporaries at Oxford. But after a year he had to leave Oxford owing to the persistent gout which had already got hold of him and he spent some months studying law at the university of Utrecht. By this time, when he was barely 20 most of his natural protectors were dead, including his father, his uncle, the soldier-statesman Lord Stanhope, who used to delight in his nephew's martial spirit and call him the "young marshal," and the grim old governor who loved the boy and said of him "he is a hopeful lad and doubt not he will answer yours and all his friends expectations." But he had good friends in the Grenvilles, who procured him a cornetcy in their uncle Lord Cobham's regiment of Horse, which later became the 1st Dragoon Guards. In spite of a small income of little more than £200 and though he took his military training more seriously than most, he made many friends in the political world and found time and money to make another, his last, journey abroad, in the course of which he had a passing love affair and at Lyons saw the confluence of the Rhone and Saône which, 20 years later, gave him a hint for one of his most famous speeches.

A Commoner.—In 1735 his real career began when he obtained a seat in the House of Commons for Old Sarum, one of his brother's pocket-boroughs. Naturally he joined the opposition to Walpole, to which all his young friends belonged, under the leadership of Carteret, Chesterfield, Wyndham and Pulteney, with the prince of Wales as their patron and Bolingbroke their mentor. Pitt's maiden speech was delivered in the following year on an address moved by the opposition to congratulate the king on the prince's marriage. Except for some back-handed compliments to the king and covert allusions to the notorious dissensions in the royal family, the speech as reported hardly seems to account for its results. "We must muzzle this terrible cornet of horse," exclaimed Walpole and forthwith deprived him of his commission. At any rate this deprivation did Pitt no harm, for he obtained a better post in the prince's household: and his fame was made. Walpole too lived to regret it, for no speeches made from the opposition benches during the last years of his administration on the commercial disputes with Spain and on the conduct of the war, into which Walpole was finally goaded, were so pointed, so bitter and so damaging as Pitt's. Pitt, indeed, with that engaging frankness characteristic of his public utterances, subsequently admitted that on the main object of Walpole's policy, an accommodation with Spain on the vexed question of the right of search, he was wrong and Walpole right. But this his first duel with a great parliamentary leader is chiefly remarkable for the revelation of his power of giving expression to the opinions of important sections of the community, such as the commercial men and even the colonists beyond the sea, hardly represented in the close oligarchy of parliament. In one of his speeches, for example, he called on the House to remember "the two millions of people in your American colonies," so apt to be forgotten, and to condemn Walpole's policy because "the complaints of your despairing merchants,—the voice of England has condemned it." Thus early he showed the source of his strength and of his influence as the Great Commoner by seeking for the national will and the national policy, not within the walls of a corrupt and unrepresentative House of Commons, but in the hearts of the people of England itself.

On Walpole's fall in 1742 the new ministry was constituted, largely owing to Walpole's influence behind the curtain, chiefly of men not prepared to carry the vendetta against him to extremes. It included his old colleagues Newcastle and Hardwicke; Carteret was appeased by the post of Secretary of State; Pulteney was silenced by a peerage; and Cobham's Boy Patriots, of whom Pitt was now the leading figure, were excluded. Pitt indeed secured a committee to enquire into Walpole's conduct during his ministry, but got little satisfaction from its half-hearted proceedings. For the next two years he devoted himself to compassing Carteret's downfall.

Growing Influence.—Carteret, that downright and arresting figure of the 18th century with his genius for foreign affairs, had one principle in common with Pitt, a determination to overthrow the exorbitant power of the Bourbons in Europe, which both regarded as the standing menace to England. But they differed essentially in their methods. In the confusing war of the Austrian Succession (1741–48) Carteret could only see a purely continental issue and though, like Pitt, he was anxious to secure Frederick's support, he was mainly concerned in forming a great coalition of German states under the leadership of England and Hanover to support Maria Theresa in her struggle with France; in this aim he found support from George II., who was always preoccupied with the safety of his German electorate. Pitt on the other hand thought we were wasting our efforts in forming German alliances, always onerous and expensive, and made the most of the popular prejudice against the king's German dominions, maintaining that our true policy was to devote ourselves entirely to the duel with France in our proper sphere at sea and in attacks on France's colonial possessions, which threatened English enterprise and expansion both in America and in India. Hence he attacked Carteret even more bitterly than he had Walpole in a series of philippics in which full rein was given to his unrivalled power of invective. "A desperate rhodomontading minister," "An infamous minister, who seems to have renounced the name of an Englishman," "A Hanover troop minister, a flagitious taskmaster, whose only party are the 16,000 Hanoverians, the placemen by whose means he has conquered the cabinet,"—such are some of the gems of invective which abound in Pitt's attacks on Carteret's policy of continental alliances and Hanoverian subsidies. Even more in keeping with Pitt's lifelong views was his denunciation of Carteret's secret methods and his refusal to "gain the confidence of the people" for his measures. This secrecy, more than anything else, proved Carteret's undoing, for he was as secret with his colleagues as with parliament and people; in 1744, finding that the cabinet refused any longer to honour his blank cheques, he resigned.

The way now seemed open to Pitt; for the Pelhams, now in the ascendant, felt they could no longer dispense with so formidable an orator. But unfortunately Pitt had grievously wounded the king's tenderest feelings by his attacks on Hanover, "a despicable electorate," as he called it, and by derogatory remarks about the battle of Dettingen; the king absolutely refused to have him in his closet. It required a further exhibition of Pitt's power over the House and in the country and of his patriotic spirit during the '45, when he was consulted by all and looked up to as almost the only effective and vigourous statesman; it required too the resignation of the Pelham ministry in 1746 before the king recalled them a few days later on their own terms, which included a post for Pitt, first as Vice-Treasurer for Ireland, and shortly afterwards as Paymaster.

A Disinterested Paymaster.—The duties of Paymaster then, as now, were not onerous, but the pickings were not to be despised. It was the custom for the Paymaster to put out at interest on his own account the large lump sums paid over to him at the

beginning of a year for subsequent disbursement; as he had not to hand over any surplus balances he might have accumulated till the end of his term of office, the profits from this source were very large. It was also customary for the Paymaster to accept a commission of ¼% on every subsidy to a foreign prince, of which there were many at that time. Pitt resolutely set his face against these practices and after holding the office for nine years left it a poor man but with a resounding reputation for disinterestedness among his countrymen. He also introduced some useful reforms for the benefit of the recipients of pay and pensions.

Domestic Life.—He had leisure during the next seven years, two of them in war-time and the remainder uneasy years of preparation for the Seven Years' War, to give a general support to the Pelham administration. He could also afford to indulge in his passion for landscape gardening, both on his friends' estates and in the grounds of South Lodge, Enfield, that he purchased for himself, to seek at various spas mitigation for his almost incessant attacks of gout, and to allow himself the grandiose scale of expenditure that he affected especially in generosity to his friends. For, in addition to his salary of about £4,000, in 1744 he had received a legacy of £10,000 from the old duchess of Marlborough "upon account of his merit in the noble defence he has made of the laws of England, and to prevent the ruin of his country." But though he had many warm friends bound to him, says a contemporary, by his "private good qualities, friendship beyond professions, industry and ability to oblige," yet he was essentially a solitary man, especially after a rift in the affection of himself and his favourite sister Ann. Fortunately in the autumn of 1754 he suddenly woke up to his love for Hester, the one sister of his five Grenville friends; and at one of their places, Wotton, with its "deep shades of oak, softening lawns and tranquil waters, like a lively smile lightening up a thoughtful countenance," discovered his love to her and received the admission of hers. On Nov. 16 following they were quietly married in London; and so began one of the happiest unions that it has ever befallen the fate of a great statesman to find, blessed as it was with a perfect understanding between the two and soon with the added joys of happy parenthood. Pitt was especially fortunate in finding a home where he could be certain of abiding trust and sympathy at this time, for he was on the eve of his most arduous struggle as a prelude to those wonderful five years when he bore the whole weight of a decisive war upon his shoulders.

The Great Commoner.—Until Pelham's death during the year 1754, though not always entirely approving of the ministry's policy, he had supported it in war and peace, without surrendering his right of protest against measures which ran counter to his fundamental principles. He strove vainly to give the last period of the war a colonial and maritime bias, away from the futile campaigns on the continent; and during the years of peace set his face against Pelham's too drastic economies on the navy, which he always regarded as our chief weapon of offence and defence; he also protested against Newcastle's expensive and pusillanimous policy of seeking protection by subsidy treaties with a crowd of German princelings. But on Pelham's death he was driven to more forcible measures. Newcastle, on whom Pelham's mantle fell, though unrivalled as a parliamentary manager, was no statesman and had the weak man's jealousy of eminence in that line. Pitt was incontestably the greatest leader in the House of Commons, but for that very reason Newcastle feared to put the leadership in his hands. His only possible rival was Henry Fox, but Newcastle forced Pitt and Fox into temporary alliance against him by placing over them Robinson, a worthy nonentity. The two great orators baited poor Robinson beyond endurance and forced him to resign whereupon Newcastle was reduced to taking Fox, as the less eminent of the two, to fill his place. Pitt naturally felt himself betrayed by Fox's desertion and transferred his attacks to him, being inspired in one debate to compare the junction of the feeble Newcastle and the vehement Fox with his recollection of "the conflux at Lyons of the Rhone and the Saône: this a feeble, languid stream, and, though languid, of no depth—the other a boisterous and overbearing torrent—but they meet at last; and long may they continue united, to the comfort of each other, and to the glory, honour and happiness of this nation." This jibe cost Pitt the Pay Office.

But it would not do. The war began with the defeat of Braddock on the Monongahela and the loss of Minorca, while the old German muddle seemed likely to be repeated with the proposals to hire troops from Hesse, Brunswick and Saxony and a treaty with Russia for an invasion of Germany in defence of Hanover and a few months later another with Prussia to prevent any foreign power entering on German soil. The popular demand for Pitt became irresistible and Pitt was ready to respond to the demand. "I know," he said, "that I can save this country and that no one else can." In Nov. 1756 he formed a ministry without Newcastle and with Devonshire as its nominal head: but even a Pitt with the whole country at his back could not stand against Newcastle's parliamentary legions, so in June 1757 the ministry was reconstituted on the understanding that Newcastle should wield all the patronage and Pitt bend his whole mind to the war. Never was division of labour more effectual.

America and India.—Pitt was determined that this should be a national war. He got rid of German mercenaries who had been sent over to resist invasion and revived the ancient militia, which he made a serviceable defence force; he saw to it that England "should put herself on board her fleet," by finding her the necessary ships and men; he united all parties not only in the House but throughout the country by appeals "captivating of the people" and above all gave them confidence by enunciating a courageous and intelligible war policy. America and India he fastened upon as the main objects of our strategy, so to the first he sent out his main expeditions and gave his chief thoughts to elaborating the campaigns for the conquest of Canada; and to the East India Company and their "heaven-born general" Clive he lent invaluable support in their struggle against the French East India Company. But not content with these main fields of operation he saw that a colonial empire could best be won by also distracting France in other parts of the world. He attacked her on her own coasts, in Africa, in the West Indies and above all kept her main armies and resources engaged in the duel with our ally Frederick by subsidizing him and sending a British force to guard his flank. He was of course accused of inconsistency in thus supporting a German war, but the essential difference between his policy and that of Carteret and Newcastle was that Germany was no longer the main object but subsidiary in the sense that he could boast that he had won America in Germany.

Not the least of his services was the new spirit he infused into his chosen generals, Wolfe, Amherst, Forbes; his admirals, Boscawen, Hawke, Saunders, Pocock, Watson; the American levies and assemblies who fought and paid for the common cause as they had never been willing to do before; and even the Highland levies, rebels ten years before, whom he had the courage to seek out "in their mountains of the north." Against such a minister directing so determined a national effort the Bourbon powers, even when they were united in 1761, were helpless. At the treaty of Paris in 1763, which consolidated the victories, England found herself supreme in North America and in India, had her Mediterranean base, Minorca, restored and gained territory both in Africa and the West Indies; but above all she had learned that she could fight best when she relied on herself.

Before the end of the war, however, Pitt had been forced to resign. George III., on his accession in 1760, at once showed his determination to bring the war to an end as speedily as possible in order to gain control of the government machinery monopolized by Newcastle and the Whigs, and to become himself head of the administration as the Patriot King. In his first speech to the Council he gave Pitt a taste of what was coming by describing the war as "bloody and expensive" and practically ignoring Frederick, the faithful ally to whom Pitt was committed. The introduction of Bute into the cabinet and its refusal in Oct. 1761 to forestall Spain's entry into hostilities by an immediate declaration of war, as Pitt advocated, led to his resignation and even to the momentary eclipse of his popularity by his acceptance of a pension and of a peerage for his wife.

But though the king had brought the war to an end in 1763,

by the Treaty of Paris, which Pitt had attacked in the House as an inadequate recognition of England's worldwide successes in the war, and by the resignation of Newcastle had obtained control of the government machinery of patronage and bribery, yet he was not happy in his ministers. Bute resigned after the Treaty of Paris, his successor George Grenville still thought he could lecture and dictate to the king as in the old halcyon days of Whig supremacy. Indeed the king soon came to the conclusion that the superficial resemblance between Pitt's principle of "measures not men" and his own desire for non-party government with individual ministers subservient to himself indicated Pitt as the most satisfactory refuge from his difficulties. Pitt had indeed opposed the measures promoted by the king against Wilkes and the use of general warrants as an infringement of the liberty of the subject and was known to disapprove of the Stamp Act passed by Grenville with the king's full approval; but he would have accepted office in 1765 had it not been for difficulties with his own followers. Thereupon the king was driven to accept the old Whig party under Rockingham.

The Earl of Chatham.—In the following year, however, when the Stamp Act had been repealed, and the Rockingham ministry found its position untenable owing to the intrigues of George III.'s creature Northington, Pitt consented to form a ministry drawn from all sections of the House. The only chance for the success of such an experiment would have been complete control by Pitt himself: unfortunately his strength was waning and he chose the comparative ease of the House of Lords, being created earl of Chatham, and of the almost sinecure post of Lord Privy Seal. Even so he might have guided his heterogeneous team on the right lines had he been able to remain at his post. But a few months after assuming office his great mind temporarily gave way and he remained in retirement for close on two years, almost dead to the world and refusing even at the king's reiterated requests to see him or take any part in government. At the end of 1768 he roused himself, on some slights to his own personal followers, to resign the Privy Seal, but did not appear in the House of Lords till 1770, when for the first time he gave his peers a taste of that wonderful eloquence that had held the lower house spell-bound for so many years and had helped to earn for him the title of the Great Commoner. His principal subject of attack was on the conduct of the House of Commons in giving up its own privileges at the bidding of the king in the Wilkes case and in declaring that Luttrell, the candidate with a minority of votes, had been elected for Middlesex over Wilkes who headed the poll. He pressed for a dissolution to get rid of a corrupt and subservient House of Commons; he supported the City in its protests on behalf of civil liberty; and he once more dealt with the invasion of civil liberties through general warrants. In 1770 Chatham proposed to "infuse new health into the constitution" and neutralize its "rotten parts," the boroughs, by permitting "every county to elect one member more in addition to their present representation. The knights of the shire approach nearest to the constitutional representation of the country": and in the following year declared himself a convert to triennial parliaments, as a method of bringing parliament more into touch with the people. On foreign policy he sounded the alarm against the Bourbons as exemplified by Spain's high-handed seizure of the Falkland islands. But all his eloquence was to no purpose. He could not, nor was he perhaps, with his dictatorial disposition the man to unite the opposition, and, as his speeches were unreported to the nation, where lay his strength, they made little immediate impression on his apathetic colleagues.

America.—But the chief care of his last years was America. Though the Stamp Act had been repealed, largely as a result of a speech from Pitt, yet his own chancellor of the exchequer, Townshend, during Chatham's illness, had imposed other trifling duties, which brought in little revenue to England but irritated the Americans just as much as if they had been a serious financial burden. Attempts to enforce the obnoxious taxes led to violence in America, and repressive measures were adopted by the English government; by 1775 it had come to war.

Chatham from the outset laid down the principle that while the imperial parliament might legitimately impose duties for the regulation of imperial trade, any tax levied solely on the Americans should only be voted by the Americans themselves. But Chatham's pleas against the government policy went far beyond legal distinctions. He loved the Americans for their British independence of spirit and he knew from his own experience in the war that they only needed appeals to their sense of justice and to their patriotism to become a "willing, giving people." "I rejoice that America has resisted," he told the House of Commons at the time of the Stamp Act: at this graver crisis, he told the Peers that "it is not repealing this act of parliament, it is not repealing a piece of parchment, that can restore America to our bosom; you must repeal her fears and her resentments; and you may then hope for her love and gratitude."

But he broke away from the Whigs when they were prepared to recognize the independence of America, even when she had cast in her lot with England's secular enemy, France; and he made his dying speech in the House of Lords in protest against any such diminution of an empire based on freedom, which he had done more than any living man to exalt. A few days later, after his collapse in the House of Lords, he died at his beloved country house at Hayes in Kent on May 11, 1778.

Broken by illness as he was during the last 15 years of his life and often almost despairing of his country, at least he was supremely happy in his private life, whether at Hayes in Kent, the house that he bought in 1756, sold ten years later, and bought again in 1767, or at Burton Pynsent in Somersetshire, left to him with an estate worth some £3,000 a year by Sir William Pynsent, a man who admired his services to the country but whom he had never seen. Here he was never too busy to train his five children to his own standard of love and service to England, finding in "the young statesman" William a readiness to follow in his own footsteps,—or to enter into their childish games or more dignified amusements such as private theatricals on classical subjects.

As an orator he was perhaps the greatest that England has produced, as one may guess even from the indistinct fragments that have come down to us by surreptitious reporting. Even in reading them one can understand something of what Charles Butler meant when he said that "every hearer was impressed with the conviction that there was something in him even finer than his words, that the man was infinitely greater than the orator"; while Grattan said of him: "He lightened upon the subject and reached the point by the flashings of his mind, which, like those of the eye, were felt but could not be followed." As a statesman his greatness was not only in the executive ability and clear vision of objectives which he manifested in his glorious five years as Secretary of State; but even more in the lessons he taught his countrymen, unheeding though they were at the time, of the spirit in which this empire of theirs was to be governed if it was to survive.

BIBLIOGRAPHY.—J. Almon, *Anecdotes of Chatham* 3 vols. (1798, 6th ed.) chiefly inspired by Grenvilles; Rev. F. Thackeray, *Life of Chatham,* 2 vols. (1827) dull, but useful documents; *Chatham Correspondence,* ed. W. S. Taylor and J. H. Pringle, 4 vols. (1839) selection from Chatham mss. now in Record Office; *Correspondence of W. Pitt w. Colonial Governors,* ed. J. S. Kimball, 2 vols., N.Y. (1900) invaluable for understanding Pitt's work as Secretary of State; A. von Ruville, *William Pitt Graf von Chatham* 3 vols. (Stuttgart, 1905), English trs., 3 vols. (1907), admirable for discovery of facts, but wrongheaded in judgment; Lord Rosebery, *Chatham, Early Life and Connections* (1910) has early letters not found elsewhere; D. A. Winstanley, *Personal and Party Government* and *Lord Chatham and the Whig Opposition* (1912). Basil Williams, *Life of Wm. Pitt, E. of Chatham,* 2 vols. (1913) containing bibliography of further books and mss. (B. WI.)

CHATHAM or **MIRAMICHI,** an incorporated town and port of entry in Northumberland county, New Brunswick, Canada, on the Miramichi river, 24 mi. from its mouth and on the Canadian National railway. Pop. (1941) 4,082. The town contains a Roman Catholic pro-cathedral, many saw-mills, pulp-mills, and establishments for curing and exporting fish. The lumber trade, fisheries and the manufacture of pulp are the chief industries.

CHATHAM, a city and port of entry of Ontario, Canada, and the capital of Kent county, 64 mi. S.W. of London and 11 mi. N. of Lake Erie, on the Thames river and the Canadian Na-

tional, Canadian Pacific and Pere Marquette railways. Pop. (1941) 17,369. It has steamboat connection with Detroit and the cities on Lakes Huron and Erie. It is situated in a rich agricultural and fruit-growing district, and carries on a large export trade. It contains a large wagon factory, planing and flour mills, manufactories of fanning mills, binder-twine, woven-wire goods, engines and windmills.

CHATHAM, a port and municipal borough comprising the Chatham parliamentary division of Rochester, Kent, England, on the right bank of the Medway, 34 mi. E.S.E. of London by the Southern railway. Pop. (1938) 44,940. Area 6.8 sq.mi. Though a distinct borough, it is continuous on the west with Rochester, and forms with it and New Brompton, on the east, one large town. The site on Chatham hill controlling the river entrance yielded human remains in the tumuli; also pottery and coins.

Chatham (*Ceteham, Chetham*) belonged at the time of Domesday to Odo, bishop of Bayeux. It later formed a suburb of Rochester, but Henry VIII and Elizabeth established dockyards; and Elizabeth, an arsenal here. The dockyard was altered and improved by Charles I and Charles II, and became the chief naval station of England. In 1708 an act was passed for extending the fortifications of Chatham. Henceforward the dockyard became the centre of attraction around which the town grew.

The Dockyard.—This covers an area of 516 ac. and has a river frontage of over three miles. It was brought into its present state by the extensive works begun about 1867. Before that time there was no basin or wet-dock, though the river Medway to some extent answered the same purpose, but a portion of the adjoining salt-marshes was then taken in, and three basins have been constructed, communicating with each other by means of large locks, so that ships can pass from the bend of the Medway at Gillingham to that at Upnor. Subsequent improvements included dredging operations in the Medway to improve the approach, and the provision of extra dry-dock accommodation under the Naval Works acts. There are in all nine dry docks, one of which now takes first-class cruisers. The yard is equipped for building light class cruisers and refitting ships of all classes and for building submarines. There is a chapel within the yard.

St. Mary's church was opened in 1903, but occupies a site in use since Saxon times. Stephen Borough (d. 1584), discoverer of the northern passage to Archangel in Russia (1553), is commemorated there. St. Bartholomew's chapel, originally attached to the hospital for lepers founded by Gundulph, bishop of Rochester, in 1070, is in part Norman. The funds for the maintenance of the hospital were appropriated to the hospital of St. Bartholomew, erected in 1863 within the boundaries of Rochester. The almshouse established in 1592 by Sir John Hawkins for seamen and shipwrights is still extant; the building was re-erected in the 19th century, while the fund called the Chatham Chest, originated by Hawkins and Drake in 1588, was incorporated with Greenwich hospital in 1802. The Naval hospital was opened in 1907 and replaces the old Melville hospital which was situated in Old Brompton. The Naval barracks were opened in 1897 on a site previously used as a convict prison. There are numerous brickyards, limekilns and flour mills in the district neighbouring to Chatham, and the town carries on a large retail trade, in great measure owing to the presence of the garrison. There is a considerable traffic on the Medway. Chatham was constituted a parliamentary borough by the Reform bill of 1832. In 1918 the municipal boroughs of Chatham, Gillingham and Rochester combined to return two members. The town was incorporated in 1890. It includes the suburb (an ecclesiastical parish) of Luton, in which are the waterworks of Chatham and district.

CHATHAM ISLANDS, a small group of islands in the Pacific ocean forming part of New Zealand, 450 mi. due E. of Lyttleton, in South Island, in about 44° S., 177° W. It consists of three islands, a large one called Whairikauri, or Chatham Island, a small one, Rangihaute, or Pitt Island, and a third, Rangatira, or South-East Island. There are also several rocky islets. Whairikauri, of which the highest point reaches about 1,000 ft., is remarkable for the number of small lakes it contains. Its form is irregular, being about 38 mi. in length and 25 mi. in extreme breadth, with an area of 321 sq. miles. The geological structure (mainly volcanic rocks with schists and Tertiary limestone) indicates that the islands were once part of New Zealand. In general, the soil is extremely fertile, and where it is naturally drained a rich vegetation of fern and flax occurs. On the southwestern side is Petre bay, on which, at the mouth of the river Mantagu, is Waitangi, the main settlement.

The islands were discovered in 1791 by Lieutenant W. R. Broughton (1762–1821) who gave them the name of Chatham after the earl of Chatham. He called the natives Morioris or Maiorioris. In 1831 they were conquered by 800 Maori who were landed from a European vessel. The natives were almost exterminated, and disease killed off most of the remainder. Their language was akin to that of the Maori of New Zealand, though they differed from them physically. Cattle and sheep are bred. At one period whalers visiting these seas used to call at the Chathams for supplies. The chief exports are wool and fishery products, particularly frozen fish. The area of the group is 372 sq.mi. In 1936 the population on all islands totalled only 702 (399 Europeans and 303 Maori).

There are no indigenous mammals; the reptiles belong to New Zealand species. The birds—the largest factor in the fauna—have become very greatly reduced through the introduction of cats, dogs and pigs, as well as by constant destruction. The larger bellbird is now scarce, the fruit-pigeon and the two endemic rails are extinct. The fossil avian forms are very important, especially from the point of view of the geographical distribution of species and the survival of the older forms in these remote corners. There have been discovered the remains of a species of swan belonging to the South American genus *Chenopis*, and of the tuatara (*Hatteria*) lizard, the unique species of an ancient family now surviving only in New Zealand. One of the finest of the endemic flowering plants of the group is the boraginaceous "Chatham Island lily" (*Myositidium nobile*), and a gigantic forget-me-not, growing near the high-water mark on the shores. Dracophyllums, leucopogous, and arborescent ragworts are characteristic forms in the vegetation.

CHÂTILLON-SUR-SEINE, a town of eastern France, in the department of Côte-d'Or, on the Eastern and P.L.M. railways, 67 mi. N.N.W. of Dijon. Pop. (1936), 4,690. It is situated on the upper Seine, which is here joined by the Douix, the source of which is much visited. Châtillon, an old feudal town, anciently consisted of two parts, Chaumont, belonging to the duchy of Burgundy, and Bourg, ruled by the bishop of Langres; they did not coalesce till the end of the 16th century. It was taken by the English in 1360 and by Louis XI in 1475, during his struggle with Charles the Bold. Châtillon was one of the first cities to adhere to the League, but suffered severely from the oppression of its garrisons and governors. It is associated with the abortive conference of 1814 between the representatives of Napoleon and the Allies. The ruined 13th century castle of the dukes of Burgundy lies above the town. Near by stands the church of St. Vorles, begun in the 10th century, but with many additions; it contains a sculptured Holy Sepulchre of the 16th century and a number of frescoes. Marshal Marmont, duke of Ragusa was born at Châtillon in 1774, and built a château here. Its industries include iron-founding and the manufacture of agricultural machinery.

CHATSWORTH, a parish of Derbyshire, England, containing a famous seat belonging to the duke of Devonshire. Chatsworth House is situated close to the left bank of the river Derwent, 2¾m. E.N.E. of Bakewell. It is Ionic in style, built foursquare, and enclosing a large open courtyard, with a fountain in the centre. In front, a beautiful stretch of lawn slopes gradually down to the riverside. The celebrated gardens are adorned with sculptures by Gabriel Cibber; the fountains are said to be surpassed only by those at Versailles. The great conservatory, unrivalled in Europe, which covered nearly an acre, was demolished in 1920. The house contains a famous library and a fine collection of pictures by Reynolds, Holbein, Dürer, Murillo, Jan van Eyck, Dolci, Veronese, Titian, Michelangelo, Leonardo da Vinci, Raffaelle, Correggio; and sculptures by Canova, Thorwaldsen, Chantrey and R. J. Wyatt. Chatsworth Park is upwards of 11m.

in circuit. Beyond the river, and immediately opposite the house, stands the model village of Edensor, erected by order of the 6th duke. The parish church contains an old brass in memory of John Beaton, confidential servant to Mary, queen of Scots. In the churchyard are the graves of Lord Frederick Cavendish, murdered in 1882 in Phoenix Park, Dublin, and of Sir Joseph Paxton, the designer of the great conservatory.

Chatsworth (*Chetsvorde, Chetelsvorde,* "the court of Chetel") took its name from Chetel, one of its Saxon owners. It was entrusted by the Conqueror to the custody of William Peverel. Chatsworth afterwards belonged for many generations to the family of Leech, and was purchased in the reign of Elizabeth by Sir William Cavendish, husband of the famous Bess of Hardwick. In 1557 he began to build Chatsworth House, and it was completed after his death by his widow, then countess of Shrewsbury. Here Mary, queen of Scots, spent several years of her imprisonment under the care of the earl of Shrewsbury. During the Civil War, Chatsworth was occupied as a fortress by both parties. It was pulled down, and the present house begun by William, 1st duke of Devonshire in 1688.

CHATTANOOGA, a city of Tennessee, U.S.A., on the Tennessee river, at the southern boundary of the state adjoining Georgia; a port of entry and the county seat of Hamilton county. It is at the intersection of federal highways 11, 27, 41 and 64; has a municipal airport, Lovell field, and is served by the Eastern and the Pennsylvania-Central airlines.

It is also served by the following railroads: Southern (five main divisions), Nashville, Chattanooga and St. Louis (two main divisions), the Central of Georgia and the Tennessee, Alabama and Georgia.

The Tennessee river is navigable all year round, and river steamers and barges supplement the city's transportation requirements.

The land area of the incorporated city is 27.4 sq.mi. The population by the 1940 federal census was 128,163.

In 1930 the metropolitan population was 168,589 and in 1940, 193,215.

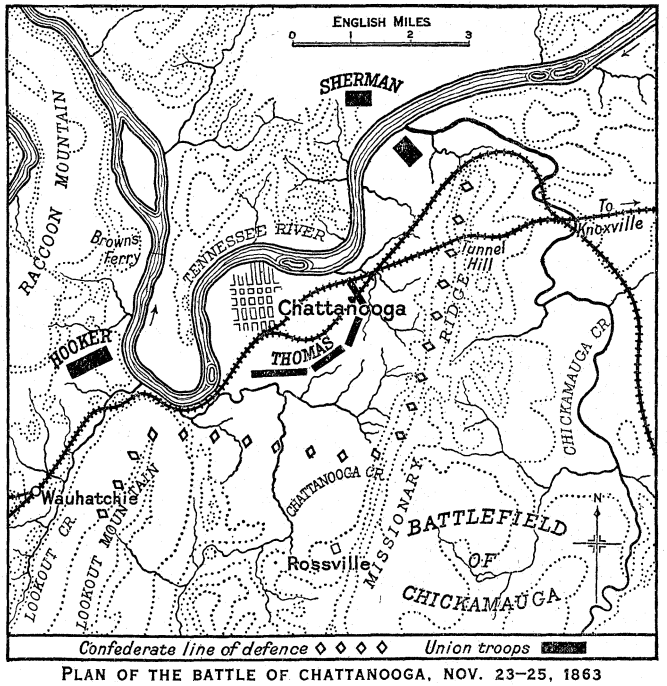
Chattanooga is the geographic centre and largest city of the Tennessee Valley authority's development program.

The mile-long $36,000,000 Chickamauga dam is in the northern outskirts of the city; the Watts Bar dam and Hales Bar dam are near by. Manufacturing is the principal industry. The more than 440 factories produce upward of 1,500 articles. Chief among these are: textiles, farm implements, steam boilers, gas, coal and electric stoves and ranges, plumbing supplies, machinery, bathtubs, soil pipe, structural steel, furniture, chemicals, paper, glass bottles, ceramic products, beverages, medicines, cement, candy and electrically treated iron ore. Its educational institutions include: University of Chattanooga (coeducational); two private military schools for boys, Baylor school and McCallie school; one private school for girls, Girls' Preparatory school; and two private grammar-kindergarten schools, Bright school and Wert school; Chattanooga College of Law; and Cadek Conservatory of Music.

A large municipal auditorium, built as a memorial to men of Chattanooga who served in the World War of 1914–18, houses all types of indoor performances.

In 1817 missionaries came to the Cherokee Indians on the Chickamauga, 6m. E. of Chattanooga. In 1834 a Cherokee chief, John Ross, built a house (still standing) within the present limits of the city, and the place was long called Ross's Landing. It was incorporated as Chattanooga in 1851, and received a city charter in 1866. Since 1911 it has had a commission form of government. In 1860 the population was 2,545; in 1880, 12,892; in 1900, 30,154. The iron industry was well established even before the development of hydro-electric power, because of the proximity of coal-fields and iron mines. The city and its environs were the scene of important engagements in the Civil War, notably the battles of Chickamauga, on Sept. 19–20, 1863; and of Missionary Ridge and Lookout mountain ("the battle above the clouds"), on Nov. 24–25, 1863. The national cemetery in the city contains 14,248 graves (5,059 marked "unknown"), and there is also a Confederate cemetery. Chickamauga battlefield, ten miles S. of Chattanooga, in Georgia, has been a national military park since 1895. In both the Spanish-American and the World War it was used for the mobilization and training of troops. Its 5,563 acres are dotted with over 2,000 monuments, and many others are scattered over Missionary Ridge, Lookout mountain and other historic spots. Ft. Oglethorpe, just north of the battlefield, is a regimental cavalry post.

Military.—From the end of September to November 24 the Army of the Cumberland was invested in Chattanooga by the Confederates, whose position lay along Missionary Ridge from its north end near the river towards Rossville, whence their entrenchments extended westwards to Lookout Mountain, which dominates the whole ground, the Tennessee running directly beneath it. Thus Rosecrans was confined to a semi-circle of low ground around Chattanooga itself, and his supplies had to make a long and difficult *détour* from Bridgeport, the main road being under fire from the Confederate position on Lookout and in the Wauhatchie valley adjacent. Bragg indeed expected that Rosecrans would be starved into retreat. But the Federals once more, and this time on a far larger scale, concentrated in the face of the enemy. The XI. and XII. corps from Virginia, under Hooker, were transferred by rail to reinforce Rosecrans; other troops were called up from the Mississippi, and on Oct. 16 the Federal government reconstituted the western armies under the supreme command of General Grant. The XV. corps of the Army of the Tennessee, under Sherman, was on the march from the Mississippi. Hooker's troops had already arrived when Grant reached Chattanooga on Oct. 23. The Army of the Cumberland was now under Thomas, Rosecrans having been recalled. The first action was fought at Brown's Ferry in the Wauhatchie valley, where Hooker executed with complete precision a plan for the revictualling of Chattanooga, established



PLAN OF THE BATTLE OF CHATTANOOGA, NOV. 23–25, 1863
In this battle of the American Civil War the armies of Hooker, Thomas and Sherman, under the supreme command of Gen. Grant, in successive assaults against the fortified heights of Lookout mountain and Missionary ridge won a decisive victory for the Union cause

himself near Wauhatchie on the 28th, and repulsed a determined attack on the same night. But Sherman was still far distant, and the Federal forces at Knoxville, against which a large detachment of Bragg's army under Longstreet was now sent, were in grave danger. Grant waited for Sherman's four divisions, but prepared everything for battle in the meantime. His plan was that Thomas, in the Chattanooga lines, should contain the Confederate centre on Missionary Ridge, while Hooker on the right, at Wauhatchie, was to attack Lookout Mountain, and Sherman, farther up the river, was to carry out the decisive attack against Bragg's extreme

right wing at the end of Missionary Ridge. The last marches of the XV. corps were delayed by stormy weather, Bragg reinforced Longstreet, and telegraphic communication between Grant and the Federals at Knoxville had already ceased. But Grant would not move forward without Sherman, and the battle of Chattanooga was fought more than two months after Chickamauga. On Nov. 23 a forward move of Thomas's army, intended as a demonstration, developed into a serious and successful action, whereby the first line of the Confederate centre was driven in for some distance. Bragg was now much weakened by successive detachments having been sent to Knoxville, and on the 24th the real battle began. Sherman's corps was gradually brought over the river near the mouth of Chickamauga Creek and formed up on the east side.

The attack began at 1 P.M. and was locally a complete success. The heights attacked were in Sherman's hands, and fortified against counter-attack, before nightfall. Hooker in the meanwhile had fought the "Battle above the Clouds" on the steep face of Lookout Mountain, and though opposed by an equal force of Confederates, had completely driven the enemy from the mountain. The 24th then had been a day of success for the Federals, and the decisive attack of the three armies in concert was to take place on the 25th. But the maps deceived Grant and Sherman as they had previously deceived Rosecrans. Sherman had captured, not the north point of Missionary Ridge, but a detached hill, and a new and more serious action had to be fought for the possession of Tunnel Hill, where Bragg's right now lay strongly entrenched. The Confederates used every effort to hold the position and all Sherman's efforts were made in vain. Hooker, who was moving on Rossville, had not progressed far, and Bragg was still free to reinforce his right. Grant therefore directed Thomas to move forward on the centre to relieve the pressure on Sherman. The Army of the Cumberland was, after all, to strike the decisive blow. About 3.30 P.M. the centre advanced on the Confederate's trenches at the foot of Missionary Ridge. These were carried at the first rush, and the troops were ordered to lie down and await orders. Then occurred one of the most dramatic episodes of the war. Suddenly, and without orders either from Grant or the officers at the front, the whole line of the Army of the Cumberland rose and rushed up the ridge. Two successive lines of entrenchments were carried at once. In a short time the crest was stormed, and after a last attempt at resistance the enemy's centre fled in the wildest confusion. The pursuit was pressed home by the divisional generals, notably by Sheridan. Hooker now advanced in earnest on Rossville, and by nightfall the whole Confederate army, except the troops on Tunnel Hill, was retreating in disorder. These too were withdrawn in the night, and the victory of the Federals was complete. Bragg lost 8,684 men killed, wounded and prisoners out of perhaps 34,000 men engaged; Grant, with 60,000 men, lost about 6,000.

CHATTEL, a term used in English law as equivalent to "personal property," that is, property which, on the death of the owner, devolves on his executor or administrator to be distributed (unless disposed of by will) among the next of kin according to the Statutes of Distributions. Chattels are divided into *chattels real* and *chattels personal.* Chattels real are those interests in land for which no "real action" (*see* PRACTICE AND PROCEDURE) lies; estates which are less than freehold (estates for years, at will, or by sufferance) are chattels real. Chattels personal are such things as belong immediately to the person of the owner, and for which, if they are injuriously withheld from him, he has no remedy other than by a personal action. Chattels personal are divided into *choses in possession* and *choses in action* (*see* CHOSE).

CHATTEL MORTGAGE, a transaction by which an owner of personal property transfers the property to a creditor for the purpose of securing payment of the debt. The chattel mortgage differs from a pledge in that the latter requires transfer of possession and control of the goods to the creditor, whereas in the typical chattel mortgage full possession and use of the goods remain in the mortgagor. And precisely here lie both the great economic advantage and the social danger of the device. For, having possession, use and control, the mortgagor retains the economic use of goods which he is vastly better able to utilize than is his lender; indeed, out of such use he may realize the wherewithal to pay off the very debt secured by the mortgage. So in the case of a chattel mortgage on crops to be sown or grown, the advances of the country banker are intended to finance the growing of those crops, and will normally be repaid out of its sale. And so with live stock mortgages and mortgages on the equipment of a factory, of a small plant, etc. On the other hand, the continued and unrestricted possession of the goods by the mortgagor is likely to mislead his other creditors, present or prospective, into the belief that his assets are greater than they are; and in the event of trouble, the mortgagee's prior claim, if sustained, may come in to cut them off from any possibility of realizing their debts. Out of this double need has arisen legislation in all American States except Pennsylvania (which does not recognize the chattel mortgage) limiting the validity of the transaction unless the mortgagee takes possession, or unless the mortgage instrument is filed for public information in some prescribed public office. But the details of the legislation are amazingly diverse. In some States the filing is required to be in the county where the mortgagor resides; in others, in that where the goods are located, in still others, in both. In some States possession or filing must occur at once, to be effective; in others, within a fixed period, such as ten days; in still others it is effective as soon as it occurs, whenever that may be. Everywhere, persons purchasing the goods from the mortgagor in possession take free of the mortgage if it has not been filed, and if they are ignorant of it. Everywhere, some of the mortgagor's creditors can disregard the mortgage, if it remains unfiled; but the precise classes of creditors protected vary widely. It may be safely stated, however, that a mortgagee who does not comply with the statute nowhere acquires a satisfactory security.

The requirements of form are equally diverse. The form of apparently outright bill of sale (*q.v.*) is permissible, but not widely used, to evidence chattel mortgages in the United States. In States where no form is required, save a paper signed by the mortgagor, the object is to allow business to be done simply and quickly. But some States attempt to avoid fraudulent practices of mortgagees by requiring the mortgagor to receive, and give a receipt for, a copy of the mortgage; the purpose is to make fraudulent alteration easy to detect. Others fear dishonest practices of mortgagors, and require witnesses or formal acknowledgment to make the document valid. Here the attempt is, in part, to prevent the mortgagor from later denying that he gave the mortgage. Others require, in addition, affidavits by the mortgagor, or by the mortgagee, or by both, that the debt secured is in truth owed, and the transaction *bona fide.* This last requirement arises out of the apparently not uncommon practice of debtors—especially merchants—when approaching insolvency, of creating fictitious debts to their friends, and attempting to divert their assets by colourable mortgages to secure such debts. And because of a similar fear of creditors being misled, a mortgage on a merchant's floating stock in trade has been hedged about by the courts with so many restrictions as to make it worthless as a continuing security to-day. That chattel mortgages are regarded—at least where merchants are the mortgagors—as signs of serious financial difficulty, sufficient to cause suspension of credit, is partly due to this fact, partly to their evil odour because of much attempted fraudulent use, and partly to the fact that in open-credit selling the sellers properly insist on the stock of goods continuing unencumbered: they have supplied the goods; they do not want those same goods to be diverted to paying debts to others.

Almost everywhere a chattel mortgage is good between mortgagor and mortgagee, despite non-compliance with such formalities or with the filing provisions of the local statute. The mortgagee can take possession and foreclose on default in payment of the debt, or in any other of the terms of the transaction—common requirements being that the mortgagor shall keep the goods on the premises, shall not attempt to sell them, nor suffer attachment of the goods by other creditors, and so on. The risk of loss by fire or theft lies, always, on the mortgagor; and often, too, he is required by the mortgage to keep the goods insured for the mortgagee's benefit.

Chattel mortgages are in wide use. Crop mortgages are a major

basis for financing current farm operations throughout the country. The same is true of live stock raising; save that here the mortgages are commonly taken in the first instance by specialized mortgage companies rather than by banks or local merchants. The wide-spread instalment selling business makes considerable use of the device, though more of the conditional sale (*see* INSTALMENT PURCHASE). In the shape of mortgages on articles of personal use such as automobiles, and on household furniture, chattel mortgages underlie many of the small consumption loans of needy borrowers—often with serious abuses. And they are becoming increasingly important in corporate mortgage-bond issues, since a mortgage on plant is obviously seriously impaired unless it can be made to cover the plant's equipment as well. In this last field serious discrepancy is beginning to be felt between the real estate portion of the security, as to which recording, once effected, is good forever, and the chattel portion, as to which periodical refiling is necessary. Finally, the chattel mortgage, in the peculiar form of the trust receipt, is used in the financing of imports, and of the sale of automobiles. In this form—an exception carved by the courts out of general statutes—it is good as against the mortgagor's creditors irrespective of filing or possession; but not as against purchasers without notice.

In the United States the chattel mortgage takes the place of the bill of sale, the latter term being there applied to a signed document describing goods and evidencing their sale, which a seller gives to a buyer who for some reason requires evidence of his ownership. Of late years the prevalence of automobile thefts has led generally to legislation requiring a bill of sale to be made out in the case of sales of second hand cars, and filed with the licensing authorities of the State. (K. N. L.)

See L. A. Jones, *Chattel Mortgages* (Indianapolis, 1908); *Hubbell's Legal Directory* (annual); Karl T. Frederick (1922), 22 *Col. L. Rev.*, 395, 546; C. Eliot, *The Farmer's Campaign for Credit* (N.Y., 1927).

CHATTERER, the general name applied to the members of two families of birds. The South American chatterers are the Cotingidae, woodland birds, feeding mainly on fruit; the best known are the cocks of the rock, umbrella and bellbirds (*qq.v.*). Chatterer was once inappropriately applied to the waxwing (*q.v.*), originally wrongly placed in a genus of jays, *Garrulus,* which was rendered *chatterer* in an early book on ornithology.

CHATTERIS, urban district and market town in the Isle of Ely, Cambridgeshire, England, 25½ mi. N. by W. of Cambridge by the L.N.E.R. Pop. (1938) 5,085. Area 21 sq.mi. St. Peter's church is principally Decorated. Parts remain of a Benedictine convent founded in the 10th century and rebuilt after fire in the early 14th.

To the north runs the great Forty-foot Drain, also called Vermuyden's, after the Dutch engineer, whose name is associated with the fen drainage works of the mid 17th century.

CHATTERJI, BANKIM CHANDRA (BANKIMACHANDRA CHATTOPADHYAYĀ) (1838–1894), Indian novelist, was born in the district of the Twenty-four Parganas in Bengal on June 27, 1838, and was by caste a Brahman. He was educated at the Hugli college, at the Presidency college in Calcutta, and at Calcutta university, where he was the first to take the degree of B.A. (1858). He entered the Indian civil service, and served as deputy magistrate in various districts of Bengal, his official services being recognized, on his retirement in 1891, by the title of rai bahadur and the C.I.E. He died April 8, 1894. Bankim Chandra was the greatest novelist of India during the 19th century, whether judged by the amount and quality of his writings, or by the influence which they have continued to exercise. He created in India a school of fiction on the European model. His novels include *Durges-Nandini, Kapala-Kundala, Mrinalini,* and *Bisha-Brikkha.* His outstanding work however is the *Ananda Math,* a story of the Sannyasi rebellion of 1772. The rebels gained a crushing victory over the British and Mohammedan forces. This success was, however, not followed up as a mysterious "physician," speaking as a divinely-inspired prophet, advised Satyananda to abandon further resistance, as, for the time, British rule was the only alternative to Mohammedan oppression. This book contains the famous song *Bande Mataram.*

Although the *Bande Mataram* was not used during Chatterji's life time as a party war-cry, it became, during the agitation which followed the partition of Bengal, the recognized patriotic song of the revolutionary party. The words *Bande Mataram,* "Hail to thee; Mother" are usually held to be an invocation to Kali, the goddess of death and destruction. The Sanyassi rebels are represented as having erected, in addition to the dark image of Kali "The Mother who has been," a *white* marble statue of the "Mother that shall be": the poet sings the praise of the "Mother"

> as Lachmi bowered in the flower
> that in the water grows,

but he also praises her as "Durga, bearing ten weapons." Other passages, too, are susceptible of revolutionary interpretation. Whatever Chatterji's original intention (it is sometimes held that it is merely an invocation of the Motherland) the story of the Sanyassis, the ingenious language and its stirring air, the *Mallar-Kawali-Tal,* all have a strong appeal to the Hindu mind and the *Bande Mataram* has become a powerful influence in political agitation and the accepted hymn of the extremist party.

In his earlier years Bankim Chandra served his apprenticeship in literature under Ishwar Chandra Gupta, the chief poet and satirist of Bengal during the earlier half of the 19th century. Bankim Chandra's friend and colleague, Dina Bandhu Mitra, was virtually the founder of the modern Bengali drama. Among the younger men who venerated Bankim Chandra, and benefited by his example and advice, may be mentioned two distinguished poets, Nabin Chandra Sen and Rabindranath Tagore.

CHATTERTON, THOMAS (1752–1770), English poet, was born at Bristol on Nov. 20, 1752, three months after the death of his father, who had been master of the Pile street free school, at Bristol. In 1760 Chatterton was sent to the Colston free school where he stayed for eight years. But this Bristol blue-coat school had little share in the education of its marvellous pupil. The office of sexton at the church St. Mary Redcliffe had been held for nearly two centuries by the Chatterton family, and under the guidance of his uncle, the child found his favourite haunt in the beautiful old church, deriving a fresh interest, when he was able to read, in certain quaint old chests, where parchment deeds, old as the Wars of the Roses, lay unheeded and forgotten. In 1763 a beautiful cross of curious workmanship, which had adorned the churchyard of St. Mary Redcliffe for upwards of three centuries, was destroyed by a churchwarden, and the boy sent to the local journal on Jan. 7, 1764, a clever satire on the parish vandal. His delight was to lock himself in a little attic, where, with books, cherished parchments, saved from the loot of the muniment room of St. Mary Redcliffe, and drawing materials, he lived in thought with his 15th century heroes and heroines. The first of his literary mystifications, the duologue of "Elinoure and Juga," was written before he was twelve years old, and he showed it to the usher at Colston's hospital, T. Phillips, as the work of a 15th century poet.

His "Rowleian" jargon appears to have been chiefly the result of the study of John Kersey's *Dictionarium Anglo-Britannicum,* and Prof. W. W. Skeat seems to think his knowledge even of Chaucer was very slight. He had already conceived the romance of Thomas Rowley, an imaginary monk of the 15th century, and lived for the most part in an ideal world of his own, in that elder time when Edward IV. was England's king, and Master William Canynge—familiar to him among the recumbent effigies in Redcliffe church—still ruled in Bristol's civic chair. Canynge is represented as an enlightened patron of literature, and Rowley's dramatic interludes were written for performance at his house. In order to escape a marriage urged by the king, Canynge retired to the college of Westbury in Gloucestershire, where he enjoyed the society of Rowley, and eventually became dean of the institution. The literary masquerade which thus constituted the life-dream of the boy was wrought out by him in fragments of prose and verse into a coherent romance, until the credulous scholars and antiquaries of his day were persuaded into the belief that there had lain in the parish chest of Redcliffe church for upwards of three centuries, a collection of mss. of rare merit, the work of Thomas Rowley, an unknown priest of Bristol in the days

of Henry VI., and his poet laureate, John Lydgate.

Among the Bristol patrons of Chatterton were two pewterers, George Catcott and his partner Henry Burgum. Catcott was one of the most zealous believers in Rowley, and continued to collect his reputed writings long after the death of their real author. On Burgum, who had risen in life by his own exertions, the blue-coat boy palmed off the de Bergham pedigree, and other equally apocryphal evidences of the pewterer's descent from an ancestry old as the Norman Conquest. The de Bergham quartering, blazoned on a piece of parchment doubtless recovered from the Redcliffe muniment chest, was itself supposed to have lain for centuries in that ancient depository. The pedigree was professedly collected by Chatterton from original records, including "The Rowley mss." The pedigree still exists in Chatterton's own handwriting, copied into a book in which he had previously transcribed portions of antique verse, under the title of "Poems by Thomas Rowley, priest of St. John's, in the city of Bristol"; and in one of these, "The Tournament," Syrr Johan de Berghamme plays a conspicuous part. The ennobled pewterer rewarded Chatterton with five shillings, and was satirized for this valuation of a noble pedigree in some of Chatterton's latest verse.

On July 1, 1767, Chatterton was transferred to the office of John Lambert, attorney, to whom he was bound apprentice as a clerk. There he found leisure for his own favourite pursuits. An ancient stone bridge on the Avon, built in the reign of Henry II., had been displaced by a new bridge opened in 1768. Shortly afterwards the editor of *Felix Farley's Journal* received from a correspondent, signing himself *Dunelmus Bristoliensis,* a "description of the mayor's first passing over the old bridge," professedly derived from an ancient ms. The original manuscript is now preserved in the British Museum, along with other Chatterton mss., most of which were ultimately incorporated by William Barrett in his *History and Antiquities of the city of Bristol,* published nearly 20 years after the poet's death. It was at this time that the definite story made its appearance—over which critics and antiquaries wrangled for nearly a century—of numerous ancient poems and other mss. taken by the elder Chatterton from a coffer in the muniment room of Redcliffe church, and transcribed, and so rescued from oblivion, by his son. The pieces include the "Bristowe Tragedie, or the Dethe of Syr Charles Bawdin," a ballad celebrating the death of the Lancastrian knight, Charles Baldwin; "Ælla," a "Tragycal Enterlude," as Chatterton styles it, but in reality a dramatic poem of sustained power; "Goddwyn," a dramatic fragment; "Tournament," "Battle of Hastings," "The Parliament of Sprites," "Balade of Charitie," with numerous shorter pieces, forming altogether a volume of poetry, the rare merit of which is indisputable, wholly apart from the fact that it was the production of a mere boy.

In Dec., 1768, in his seventeenth year, he wrote to Dodsley, the London publisher, offering to procure for him "copies of several ancient poems, and an interlude, perhaps the oldest dramatic piece extant, wrote by one Rowley, a priest in Bristol, who lived in the reigns of Henry VI. and Edward IV." To this letter, as well as to another letter enclosing an extract from the tragedy of "Ælla," no answer appears to have been returned. Chatterton then bethought him of Horace Walpole, who not only indulged in a mediaeval renaissance of his own, but was the reputed author of a spurious antique in the *Castle of Otranto.* He wrote to him offering him a document entitled "The Ryse of Peyncteyne yn Englande, wroten by T. Rowleie, 1469, for Mastre Canynge," accompanied by notes which included specimens of Rowley's poetry. To this Walpole replied with courteous acknowledgments. He characterized the verses as "wonderful for their harmony and spirit," and added, "Give me leave to ask you where Rowley's poems are to be had? I should not be sorry to print them; or at least a specimen of them, if they have never been printed." Chatterton replied, enclosing additional specimens of antique verse, and telling Walpole that he was the son of a poor widow, and clerk to an attorney, and he hinted a wish that he might help him to some more congenial occupation. Walpole's manner underwent an abrupt change. The specimens of verse had been submitted to his friends, Gray and Mason, and pronounced modern. He now coldly advised the boy to stick to the attorney's office, and "when he should have made a fortune," he might betake himself to more favourite studies. Chatterton had to write three times before he recovered his mss. Walpole has been loaded with more than his just share of responsibility for the fate of the unhappy poet, of whom he admitted when too late, "I do not believe there ever existed so masterly a genius."

Chatterton now began to contribute to the *Town and County Magazine* and other London periodicals. Assuming the vein of Junius—then in the full blaze of his triumph—he turned his pen against the duke of Grafton, the earl of Bute, and the princess of Wales. He had just despatched one of his political diatribes to the *Middlesex Journal,* when he sat down on Easter Eve, April 17, 1770, and penned his "Last Will and Testament," a strange satirical compound of jest and earnest, in which he intimated his intention of putting an end to his life the following evening. Among his satirical bequests, such as his "humility" to the Rev. Mr. Camplin, his "religion" to Dean Barton, and his "modesty" along with his "prosody and grammar" to Mr. Burgum, he leaves "to Bristol all his spirit and disinterestedness, parcels of goods unknown on its quay since the days of Canynge and Rowley." In more genuine earnestness he recalls the name of Michael Clayfield, a friend to whom he owed intelligent sympathy. The will was probably purposely prepared in order to frighten his master into letting him go. Lambert cancelled his indentures, his friends made him up a purse, and on the 25th or 26th of the month he arrived in London.

Chatterton was already known to the readers of the *Middlesex Journal* as a rival of Junius, under the *nom de plume* of Decimus. He had also been a contributor to Hamilton's *Town and County Magazine,* and speedily found access to the *Freeholder's Magazine,* another political miscellany strong for Wilkes and liberty. Wilkes himself had noted his trenchant style, "and expressed a desire to know the author"; and Lord Mayor Beckford graciously acknowledged a political address of his, and greeted him "as politely as a citizen could." But of actual money he received little. He was extremely abstemious, but his diligence was great, and his versatility wonderful. He could assume the style of Junius or Smollett, reproduce the satiric bitterness of Churchhill, parody Macpherson's Ossian, or write in the manner of Pope, or with the polished grace of Gray and Collins. He wrote political letters, eclogues, lyrics, operas and satires, both in prose and verse. In June, 1770—after Chatterton had been some nine weeks in London—he removed from Shoreditch, where he had hitherto lodged with a relative, to an attic in Brook street, Holborn, where, for the first time, he enjoyed uninterrupted solitude. The romance of his earlier years revived, and he transcribed from an imaginary parchment of the old priest Rowley his "Excelente Balade of Charitie." This fine poem, perversely disguised in archaic language, he sent to the editor of the *Town and County Magazine,* and had it rejected.

The high hopes of the sanguine boy had begun to fade. He had not yet completed his second month in London, and already failure and starvation stared him in the face. The note of his actual receipts, found in his pocket-book after his death, shows that Hamilton, Fell and other editors who had been so liberal in flattery had paid him at the rate of a shilling for an article, and somewhat less than eightpence each for his songs; while much which had been accepted was held in reserve, and still unpaid for. The beginning of a new month revealed to him the indefinite postponement of the publication and payment of his work. He had wished, according to his foster-mother, to study medicine with Barrett; in his desperation he now reverted to this, and wrote to Barrett for a letter to help him to an opening as a surgeon's assistant on board an African trader. He appealed also to Mr. Catcott to forward his plan, but in vain. On Aug. 24, 1770, he retired for the last time to his attic in Brook street, carrying with him the arsenic which he there drank, after tearing into fragments whatever literary remains were at hand.

He was only seventeen years and nine months old; but the best of his numerous productions, both in prose and verse, require no allowance to be made for the immature years of their author. He pictures Lydgate, the monk of Bury St. Edmund's, challenging Rowley to a trial at versemaking, and under cover of this fiction, produces his "Songe of Ælla," a piece of rare lyrical beauty, worthy of comparison with any antique or modern production of its class. Again, in his "Tragedy of Goddwyn," of which only a fragment has been preserved, the "Ode to Liberty," with which it abruptly closes, may claim a place among the finest martial lyrics in the language. The death of Chatterton attracted little notice at the time; for the few who then entertained any appreciative estimate of the Rowley poems regarded him as their mere transcriber. He was interred in a burying-ground attached to Shoe Lane Workhouse. A monument has since been erected to his memory in Redcliffe churchyard, Bristol, with the appropriate inscription, borrowed from his "Will," and so supplied by the poet's own pen—"To the memory of Thomas Chatterton. Reader! judge not. If thou art a Christian, believe that he shall be judged by a Superior Power. To that Power only is he now answerable."

BIBLIOGRAPHY.—*Poems supposed to have been written at Bristol by Thomas Rowley and others, in the Fifteenth Century* (1777) was edited by Thomas Tyrwhitt; Thomas Warton, in his *History of English Poetry* (1778); vol. ii., section viii., gives Rowley a place among the 15th century poets; but neither of these critics believed in the antiquity of the poems. In 1782 a new edition of Rowley's poems appeared, with a "Commentary, in which the antiquity of them is considered and defended," by Jeremiah Milles, dean of Exeter. The controversy which raged round the Rowley poems is discussed in A. Kippis *Biographia Britannica* (vol. iv., 1789), where there is a detailed account by G. Gregory of Chatterton's life (pp. 573–619). This was reprinted in the edition (1803) of Chatterton's *Works* by R. Southey and J. Cottle, published for the benefit of the poet's sister. The neglected condition of the study of earlier English in the 18th century alone accounts for the temporary success of Chatterton's mystification. It has long been agreed that Chatterton was solely responsible for the Rowley Poems, but the language and style are analysed in confirmation of this view by Prof. W. W. Skeat in an introductory essay prefaced to vol. ii. of *The Poetical Works of Thomas Chatterton* (1871) in the "Aldine Edition of the British Poets." This, which is the most convenient edition, also contains a memoir of the poet by Edward Bell. The spelling of the Rowley poems is there modernized, and many of the archaic words are replaced by modern equivalents provided in many cases from Chatterton's own notes, the theory being that Chatterton usually composed in modern English, and inserted his peculiar words and his complicated orthography afterwards. *See* also H. B. Forman, *Thomas Chatterton and his latest Editor* (1874). The Chatterton mss., originally in the possession of William Barrett of Bristol, were left by his heir to the British Museum in 1800. Others are preserved in the Bristol library.

Chatterton's genius and his tragic death are commemorated by Shelley in *Adonais,* by Wordsworth in "Resolution and Independence," by Coleridge in "A Monody on the Death of Chatterton," by D. G. Rossetti in "Five English Poets"; John Keats inscribed *Endymion* "to the memory of Thomas Chatterton." Alfred de Vigny's drama of *Chatterton* gives an altogether fictitious account of the poet. Sir Herbert Croft, in his *Love and Madness,* interpolated a long and valuable account of Chatterton, giving many of the poet's letters, and much information obtained from his family and friends (pp. 125–244, letter li.). There is a valuable collection of "Chattertoniana" in the British Museum, consisting of separate works by Chatterton, newspaper cuttings, articles, dealing with the Rowley controversy and other subjects, with ms. notes by Joseph Haslewood, and several autograph letters. F. A. Hyatt and W. Bazeley, *Chattertoniana* (Gloucester, 1914), a catalogue of printed matter.

Among biographies of Chatterton may be mentioned Daniel Wilson, *Chatterton: A Biographical Study* (1869); D. Masson, *Chatterton: A Biography* (1899); Helene Richter, "Thomas Chatterton" (1900), in *Wiener Beitrage zur engl. Philologie;* C. E. Russell, *Chatterton,* (1909); J. H. Ingram, *The True Chatterton* (1910); Sir E. Clarke, *New Lights on Chatterton* (1916), a paper read before the Bibliographical Society, London.

CHATTI, an ancient German tribe inhabiting the upper reaches of the rivers Weser, Eder, Fulda and Werra, a district approximately corresponding to Hesse-Cassel, though probably somewhat more extensive. They frequently came into conflict with the Romans during the early years of the 1st century A.D. Eventually they formed a portion of the Franks and were incorporated in the kingdom of Clovis at the beginning of the 6th century.

See Tacitus, *Annals,* i., ii., xi., xii. and xiii.; *Germania,* 30–31.

CHAUCER, GEOFFREY (1340?–1400), English poet, was born, about 1340, of a family which had been settled in London for at least two generations, but probably came from the eastern counties. His father, John Chaucer, lived at one time in Cordwainer street, the quarter of the shoemakers, with which the name Chaucer (a French form of the Latin *Calcearius*) connects the family. But John Chaucer, his father Robert, and a stepfather Richard, were vintners, and Robert and John held offices connected with the customs on wine. Geoffrey was probably born at Thames street, where his father is found living somewhat later, with a wife, Agnes, niece of Hamo de Compton, probably the poet's mother. In 1357 Geoffrey is found, apparently as a lad, in the service of Elizabeth, countess of Ulster, wife of Lionel, duke of Clarence. In 1359 he went to the war in France and is heard of at Retters, *i.e.,* Rethel, near Reims, and as being taken prisoner. The king contributed £16 to his ransom and it is probable that after his return he was for some time at the Inner Temple, where, at a considerable cost, an education was given likely to help suitable men for civil employment under the Crown. By June 20, 1367, he had been long enough in the king's service to be granted a pension of 20 marks, probably in connection with his marriage with a Philippa, one of two daughters of Sir Payne Roet, who in the previous September had been granted a pension of ten marks for her services to the queen as one of her *domicellae.* Philippa's sister, Katherine, after the death of her husband, Sir Hugh de Swynford, in 1372, became governess to John of Gaunt's children, and subsequently his mistress, and (in 1396) his wife. The marriage with Philippa thus helps to account for the favour subsequently shown to Chaucer by John of Gaunt.

In the grant of his pension Chaucer is called "dilectus vallectus noster," our beloved yeoman; before the end of 1368 he had risen to one of the king's esquires. In September of the following year John of Gaunt's wife, the duchess Blanche, died at the age of 29, and Chaucer wrote in her honour *The Book of the Duchesse,* a poem of 1,334 lines in octosyllabic couplets. In June 1370 he went abroad on the king's service, on an unknown errand, returning probably some time before Michaelmas. On Dec. 1, 1372, he started, with an advance of 100 marks in his pocket, for Italy, as one of three commissioners to treat with the Genoese as to an English port where they might have special facilities for trade. His accounts, delivered on May 23, 1373, show that he had also visited Florence on the king's business, and he possibly went also to Padua and there made the acquaintance of Petrarch.

In the second quarter of 1374, Chaucer lived in a whirl of prosperity. On April 23 the king granted him a pitcher of wine daily, subsequently commuted for an annuity of 20 marks. From John of Gaunt, who in Aug. 1372 had granted Philippa Chaucer £10 a year, he himself now received (June 13) a like annuity. On June 8 he was appointed (with a salary of £10 and an annual gratuity of £6 13s.4d.) comptroller of the Custom and Subsidy of Wools, Hides and Woodfells and also of the Petty Customs of Wine in the Port of London. Probably in anticipation of this appointment he had taken, on May 10, a lease for life from the city of London of the dwelling-house above the gate of Aldgate, and here he lived for the next 12 years. In 1375–76 two large windfalls came to him, the first being two wardships of Kentish heirs, one of whom paid him £104, the second a grant of £71 4s.6d. the value of some confiscated wool. In Dec. 1376 he was sent abroad on the king's service in the retinue of Sir John Burley; in Feb. 1377 he was sent to Paris and Montreuil in connection probably with the peace negotiations between England and France, and at the end of April (after a reward of £20 for his good services) he was again despatched to France. It is generally considered that this diplomatic period of his life was unprolific in poetry.

On the accession of Richard II., Chaucer was confirmed in his offices and pensions. In Jan. 1378 he seems to have been in France in connection with a proposed marriage between Richard and the daughter of the French king; and on May 28 of the same year he was sent (his last diplomatic journey) with Sir Edward de Berkeley to the lord of Milan and Sir John Hawkwood to treat for help in the king's wars, returning on Sept. 19. In April 1382 a new comptrollership, that of the petty customs in the Port of London,

was given him, and shortly after he was allowed to exercise it by deputy, a similar licence being given him in Feb. 1385, at the instance of the earl of Oxford, as regards the comptrollership of wool. In Oct. 1385 he was made a justice of the peace for Kent. In Feb. 1386 we catch a glimpse of his wife, Philippa, being admitted to the fraternity of Lincoln cathedral in the company of Henry, earl of Derby (afterwards Henry IV.), Sir Thomas de Swynford and other distinguished persons. In Aug. 1386 he was elected one of the two knights of the shire for Kent, and with this dignity (one not much appreciated in those days) his good fortune reached its climax. In December he was superseded in both his comptrollerships, probably as a result of the absence of his patron, John of Gaunt, in Spain, and the supremacy of the duke of Gloucester. In the following year the cessation of Philippa's pension suggests that she died between midsummer and Michaelmas. In May 1388 Chaucer surrendered to the king his two pensions of 20 marks each, and they were regranted at his request to one John Scalby, an unusual transaction, pointing to a pressing need for ready money.

In July 1389, after John of Gaunt had returned to England, and the king had taken the government into his own hands, Chaucer was appointed clerk of works at various royal palaces at a salary of two shillings a day. To this post was subsequently added the charge of some repairs at St. George's chapel, Windsor. He was also made a commissioner to maintain the banks of the Thames between Woolwich and Greenwich, and was given by the earl of March (grandson of Lionel, duke of Clarence, his first patron) a sub-forestership at North Petherton, Devon; obviously a sinecure. While on the king's business, in Sept. 1390, Chaucer was twice robbed by highwaymen, losing £20 of the king's money. In June 1391 he was superseded as clerk of the works, and seems to have suffered another spell of misfortune, of which the first alleviation came in Jan. 1393, when the king made him a gift of £10. In Feb. 1394 he was granted a new pension of £20. In 1397 he received from King Richard a grant of a butt of wine yearly. For this he appears to have asked in terms that suggested poverty, and in May 1398 he obtained letters of protection against his creditors. On the accession of Henry IV. a new pension of 40 marks was granted him (Oct. 13, 1399) and Richard II.'s grants were formally confirmed. Though no instalment of the new pension was paid, on the strength of his expectations (Dec. 24, 1399), Chaucer leased a tenement in the garden of St. Mary's chapel, Westminster, and it was probably here that he died on the following Oct. 25. He was buried in Westminster Abbey, and his tomb became the nucleus of what is now known as Poets' Corner.

The portrait of Chaucer, which the affection of his disciple, Thomas Hoccleve, caused to be painted in a copy of the latter's *Regement of Princes* (now Harleian ms. 4,866 in the British Museum), shows him an old man with white hair; he has a fresh complexion, grey eyes, a straight nose, a grey moustache and a small double-pointed beard. His dress and hood are black, and he carries in his hands a string of beads.

Works.—Henry IV.'s promise of an additional pension was doubtless elicited by the *Compleynt to his Purs,* in the envoy to which Chaucer addresses him as the "conquerour of Brutes Albioun." Thus within the last year of his life the poet was still writing. Nevertheless, as early as 1393–94, in lines to his friend Scogan, he had written as if his day for poetry were past, and it seems probable that his longer poems were all composed before this date. In the preceding 15—or, if another view be taken, 20—years, his literary activity was very great, and with the aid of the lists of his works which he gives in the *Legende of Good Women* (lines 414–431), and the talk on the road which precedes the "Man of Lawe's Tale" (*Canterbury Tales,* B. 46–76), the order in which his main works were written can be traced with approximate certainty.

The development of Chaucer's genius has been attractively summed up as comprised in three stages, French, Italian and English, and there is a rough approximation to the truth in this formula, since his earliest poems are translated from the French or based on French models, and the two great works of his middle period are borrowed from the Italian, while his latest stories have no such obvious and direct originals, and in their humour and freedom anticipate the typically English temper of Henry Fielding. But Chaucer's indebtedness to French poetry was no passing phase. He knew the *Roman de la rose* as modern English poets know Shakespeare, and the full extent of his debt to his French contemporaries, not merely in 1369, but in 1385, and in 1393 (the dates are approximate), has only gradually been discovered. To this continuing French influence it was his good fortune to add lessons in plot and construction derived from Boccaccio's *Filostrato* and *Teseide,* as well as some glimpses of the higher art of the *Divina Commedia.* He shows acquaintance also with one of Petrarch's sonnets. His study of Italian models was thus an episode of unique importance in his literary life, but before it began he had already been making his own artistic experiments, and it is noteworthy that while he learnt much from Boccaccio he improved on his originals as he translated them. Doubtless his busy life in the service of the Crown had taught him self-confidence, and he uses his Italian models in his own way and with the most triumphant and assured success. When he had no more Italian poems to adapt he had learnt his lesson. In his "English" period we find him taking what might be little more than an anecdote and lending it body and life and colour with a skill never surpassed.

Early Period.—The most direct example of Chaucer's French studies is his translation of *Le Roman de la rose,* a poem written in some 4,000 lines by Guillaume de Lorris about 1237 and extended to over 22,000 by Jean Clopinel, better known as Jean de Meun, 40 years later. We know from Chaucer himself that he translated this poem, and the extant English fragment of 7,698 lines was generally assigned to him from 1532, when it was first printed, till its authorship was challenged in the early years of the Chaucer Society. The ground of this challenge was its wide divergence from Chaucer's practice in his undoubtedly genuine works as to certain niceties of rhyme, notable as to not rhyming words ending in *-y* with others ending *-ye.* It was subsequently contended, however, that the whole fragment is divisible linguistically into three portions, of which the first and second end respectively at lines 1,705 and 5,810, and that in the first of these three sections the variations from Chaucer's accepted practice are insignificant. Lines 1–1,705 have therefore been provisionally accepted as Chaucer's and the other two fragments as the work of unknown translators which somehow came to be pieced together. A rival theory proposed by Dr. Brusendorf assigns the whole fragment to a professional reciter writing down what he remembered of the parts of Chaucer's translation he was accustomed to recite, and varying when his memory failed.

While our knowledge of Chaucer's *Romaunt of the Rose* is in this unsatisfactory state, another translation of his from the French, the *Book of the Lyon* (alluded to in the "Retraction" found, in some manuscripts, at the end of the *Canterbury Tales*), which must certainly have been taken from Guillaume Michault's *Le Dit du lion,* has perished altogether. The strength of French influence on Chaucer's early work may, however, be amply illustrated from the first of his poems with which we are on sure ground, the *Book of the Duchesse,* or, as it is alternatively called, the *Deth of Blaunche.* Here not only are individual passages closely imitated from Machault and Froissart, but the dream, the May morning, and the whole machinery of the poem are taken over from contemporary French conventions. But even at this stage, Chaucer could prove his right to borrow by the skill with which he makes his materials serve his own purpose, and some of the lines in the *Deth of Blaunche* are among the most tender and charming he ever wrote.

Chaucer's *A.B.C.,* a poem in honour of the Blessed Virgin, of which the stanzas begin with the successive letters of the alphabet, is another example of French influence. It is taken from the *Pèlerinage de la vie humaine,* written by Guillaume de Deguilleville about 1330. The occurrence of some magnificent lines in Chaucer's version, combined with evidence that he did not yet possess the skill to translate at all literally as soon as rhymes had to be considered, accounts for this poem having been dated sometimes earlier than the *Book of the Duchesse,* and sometimes sev-

eral years later. With it is usually moved up and down, though it should surely be placed in the '70s, the *Compleynt to Pity,* a fine poem which yet, from its slight obscurity and absence of Chaucer's usual ease, may very well some day prove to be a translation from the French.

Middle Period.—While Chaucer thus sought to reproduce both the matter and the style of French poetry in England, he found other materials in popular Latin books. Among his lost works are renderings of "Origenes upon the Maudeleyne," and of Pope Innocent III. on "The Wrecced Engendring of Mankinde" (*De miseria conditionis humanae*). He must have begun his attempts at straightforward narrative with the *Lyf of Seynt Cecyle* (the weakest of all his works, the second Nun's Tale in the Canterbury series) from the *Legenda Aurea* of Jacobus de Voragine, and the story of the patience of Grisilde, taken from Petrarch's Latin version of a tale by Boccaccio. In both of these he condenses a little, but ventures on very few changes, though he lets his readers see his impatience with his originals. In his story of Constance (afterwards ascribed to the Man of Lawe), taken from the Anglo-Norman chronicle of Nicholas Trivet, written about 1334, we find him strengthening another weak tale, but still without the courage to remedy its radical faults, though here, as with Grisilde, he does as much for his heroine as the conventional exaltation of one virtue at a time permitted. It is possible that other tales which now stand in the Canterbury series were written originally at this period. What is certain is that at some time in the '70s, independently of any glimpses he may have obtained of the *Divina Commedia* and of Petrarch's sonnets, two notable Italian poems by Boccaccio passed into Chaucer's possession and that the turning of the *Filostrato* into *Troilus and Criseyde* and the *Teseide* into "al the storye of Palamon and Arcyte" was his main poetic business during the next few years and vitally affected his development. He did not, however, work on these masterpieces uninterruptedly. Almost at the outset two court poems had to be written in connection with the betrothal and marriage of Richard II. to Anne of Bohemia, the *Hous of Fame* and *The Parlement of Foules.* The former begins with a dream on a certain tenth of December and Dr. Aage Brusendorf is almost certainly right in linking this with the formal appointment on Dec. 12, 1380, of an English embassy to treat for the marriage and the conception of the poem with Froissart's *Le Temple d'Honneur* in which a marriage is guardedly forecast. Unhappily, one or more leaves at the end of the archetype manuscript of Chaucer's poem were lost before other copies were made from it, so that the conjecture cannot be finally verified, but it offers a much needed clue to the meaning, which had previously been rashly connected with Dante's *Divina Commedia.* Written in octosyllabic couplets, like the *Romaunt of the Rose,* it shows Chaucer already possessed of the conversational ease which marks his later work, but the ease tempted him to extend the poem to a length out of keeping with his subject, and it is best known by the few lines in which he talks about himself. *The Parlement of Foules,* written in seven-line stanzas, commemorating the delay of over a year in the celebration of the marriage, and full of gaiety and humour, is in much better proportion.

Besides these two poems Chaucer about this time produced his most important prose work, the translation of the *De Consolatione Philosophiae* of Boethius. Reminiscences of this helped to enrich many of his subsequent poems and inspired five of his shorter pieces (*The Former Age, Fortune, Truth, Gentilesse* and *Lak of Stidfastnesse*), but the translation itself cannot be counted a success. To borrow Chaucer's own phrase, his "English was insufficient" to reproduce such difficult Latin. The translation is often barely intelligible without the original, and it is only here and there that it flows with any ease or rhythm.

Troilus and Criseyde.—A snatch of abuse of his scrivener shows that the translation of Boethius and *Troilus and Criseyde* were being copied for circulation at the same time and in the *Troilus,* after a good many half-successes, Chaucer achieved a great artistic triumph. He follows Boccaccio's *Filostrato* step by step, but he does not follow it as a mere translator. He had done his duty manfully for St. Cecyle, Grisilde and Constance, whom he was forbidden by the conventions of his originals to clothe with complete flesh and blood. In this great story of love and betrayal there were no such restrictions, and the characters, which Boccaccio's treatment left thin and conventional, became in Chaucer's hands convincingly human. No other English poem is so instinct with the glory and tragedy of youth, and in the details of the story Chaucer's gifts of vivid colouring, of humour and pity, are all at their highest. *Troilus and Criseyde* is written in seven-line stanzas; for re-telling from the *Teseide* the story of *Palamon and Arcyte* Chaucer used for the first time decasyllabic couplets, for which Guillaume Machault had provided him with a French model, with a great gain in swiftness and compression. The story has not the poignant interest of the *Troilus* (it is probably the "comedye" which in the epilogue to the earlier poems Chaucer promised to write), but Chaucer's skill is again at its highest. This time, while he takes Boccaccio's plot, he takes only as much of it as he wants, and what he takes he heightens and humanizes with the same skill as he had shown in transforming the *Filostrato.* Of the individual characters Theseus himself, the arbiter of the story, is developed as notably as Sir Pandarus in the *Troilus,* while the fair Emilye and her two lovers-at-first-sight receive just as much individuality as they can be given without burdening the story with a greater intensity than it will bear. With what revision we know not, the story was fitted into the *Canterbury Tales* and assigned to the chivalrous Knight; but that it was written soon after *Troilus* and the translation of Boethius, and before the *Legende of Good Women* (in which it is mentioned), should not be doubted, though other theories have been proposed.

When the *Teseide* had been used, Chaucer had no more Italian stories to translate and he turned to his Latin materials to compile a lectionary of Cupid's Saints for presentation to the queen. To atone for his portrayal of the disloyalty of Criseyde he accepted as a penance the painting of 19 women faithful to love, with Alcestis as their queen, enriching his scheme with a delightful prologue (extant in two rather widely differing forms) into which he introduces touches about his worship of the Deity and the controversy between the partisans of the Flower and the Leaf from his French friends, Froissart and Deschamps. Of the stories of constant women, those of Dido and Cleopatra are fully worthy of him. When, however, he had written eight and part of a ninth he wearied of the monotony of his theme, which he was beginning to treat with scant respect, and broke off.

Canterbury Tales.—Chaucer's failure to complete the scheme of the *Legende of Good Women* may have been partly due to the attractions of the *Canterbury Tales,* which were probably taken up in immediate succession to it. His guardianship of two Kentish wards, his justiceship of the peace, his representing the county in the parliament of 1386, his commissionership of the river-bank between Greenwich and Woolwich, all make it easy to understand his dramatic use of the merry crowds he saw on the Canterbury road, without supposing him to have had recourse to Boccaccio's *Decameron,* a book which there is no proof of his having seen. The pilgrims whom he imagines to have assembled at the Tabard inn in Southwark, where Harry Bailey was host, are said to have numbered "wel nyne and twenty in a company," and the Prologue gives full-length sketches (at least some of which Prof. Manly, in his *New Light on Chaucer,* has shown to have been drawn from life) of a Knight, a Squire (his son), and their Yeoman; of a Prioress, Monk, Friar, Oxford Clerk, and Parson, with two disreputable hangers-on of the church, a Summoner, and a Pardoner; of a Serjeant-at-Law and a Doctor of Physic, and of a Franklin, or country gentleman, Merchant, Shipman, Miller, Cook, Manciple, Reeve, Ploughman (the Parson's brother) and the ever-famous Wife of Bath. Five London burgesses are described in a group, and a Nun and Priest (altered possibly in a moment of hopefulness by Chaucer himself, to "priestes three") are mentioned as in attendance on the Prioress. Each of these, with Chaucer himself making the 29th, was pledged to tell two tales, but including one second attempt and a tale told by the Yeoman of a Canon, who overtakes the pilgrims on the road, we have only 20 finished stories, two unfinished and two interrupted ones.

As in the case of the *Legende of Good Women,* our loss is not so much that of the additional stories as of the completed framework. The wonderful character sketches of the Prologue are carried yet farther by the Talks on the Road which link the different tales, and two of these Talks, in which the Wife of Bath and the Pardoner respectively edify the company, have the importance of separate Tales, but between the Tales that have come down to us there are seven links missing, and it was left to a later and weaker hand to narrate, in the "Tale of Beryn," the adventures of the pilgrims at Canterbury.

The reference to the *Lyf of Seynt Cecyle* in the prologue to the *Legende of Good Women* gives external proof that Chaucer included earlier work in the scheme of the *Canterbury Tales,* and mention has been made of other stories which are indisputably early, while in the case of at least two, the Clerk's tale of Grisilde and the Monk's tragedies, there is evidence of early work being revised and supplemented. It is fortunately impossible to separate the prologue to the charmingly told story of "yonge Hugh of Lincoln" from the tale itself, and with the "quod sche" in the second line as proof that Chaucer was here writing specially for his Prioress we are forbidden to limit the new stories to any one metre or tone. There can be no doubt, however, that what may be called the Tales of the Churls (Miller, Reeve, Summoner, Friar, etc.), and the conversational outpourings of the Pardoner and Wife of Bath, form, with the immortal Prologue, the most important and distinctive additions to the older work. In these, and in the Pardoner's story of Death and the Three Revellers, and the Nun's Priest's masterly handling of the fable of the Cock and Fox, both of them free from the grossness which marks the others, Chaucer takes stories which could have been told in a short page of prose and elaborates them with all the skill in narration which he had sedulously cultivated. The conjugal reminiscences of the Wife of Bath and the Reeve's Tale with its abominable climax (lightened a little by Aleyn's farewell, lines 316–319) are among the great things in Chaucer, as surely as *Troilus* and *Palamon and Arcyte* and the *Prologue.* They help notably to give him the width of range which may certainly be claimed for him.

In or soon after 1391 Chaucer wrote in prose for an 11-year-old reader, whom he addresses as "Litel Lowis my son," a treatise on the use of the Astrolabe, its short prologue being the prettiest specimen of his prose. The wearisome tale of "Melibee and his wyf Prudence," which was perhaps as much admired in English as it had been in Latin and French, may have been translated at any time. The sermon on Penitence, used as the Parson's Tale, was probably the work of his old age. "Envoys" to his friends Scogan and Bukton, a translation of some balades by Sir Otes de Granson, and the *Compleynt to his Purs* complete the record of his minor poetry. We have his own statement that in his youth he had written many Balades, Roundels and Virelayes in honour of Love, and the two songs embedded respectively in the *Parlement of Foules* and the Prologue to the *Legende of Good Women* are charming and musical. His extant shorter poems, however, whether early or late, offer no excuse for claiming high rank for him as a lyrist. He had very little sheer singing power, and though there are fine lines in his short poems, witness the famous "Flee fro the prees and dwell with soothfastnesse," they lack the sustained concentration of great work. From the drama, again, Chaucer was cut off, and it is idle to argue from the innumerable dramatic touches in his poems and his gift of characterization as to what he might have done had he lived two centuries later. His own age delighted in stories, and he gave it the stories it demanded invested with a humanity, a grace and strength which place him among the world's greatest narrative poets, and which bring the England of his own day, with all the colour and warmth of life, wonderfully near to his readers.

The part played by Chaucer in the development of the English language has often been overrated. He neither corrupted it, as used to be said, by introducing French words which it would otherwise have avoided, nor bore any such part in fixing it as was afterwards played by the translators of the Bible. The practical identity of Chaucer's language with that of Gower shows that both merely used the best English of their day with the care and slightly conservative tendency which befitted poets. Chaucer's service to the English language lies in his decisive success having made it impossible for any later English poet to attain fame, as Gower had done, by writing alternatively in Latin and French.

Chaucer borrowed both his stanza forms and his "decasyllabic" couplets (mostly with an extra syllable at the end of the line) from Guillaume Machault, and his music, like that of his French master and his successors, depends very largely on assigning to every syllable its full value, and more especially on the due pronunciation of the final *-e.* The slower movement of change in Scotland allowed time for Chaucer to exercise a potent influence on Scottish poetry, but in England this final *-e,* to which most of the earlier grammatical forms by Chaucer's time had been reduced, itself fell rapidly into disuse during the 15th century, his disciples, Hoccleve and Lidgate, quickly lost touch with his rhythms and successive copyists reduced his text to a state in which it was only by accident that lines could be scanned correctly. For fully three centuries his reputation was sustained solely by his narrative power, his warmest panegyrists betraying no consciousness that they were praising one of the greatest technical masters of poetry. Even when thus maimed, however, his works found readers and lovers in every generation, and every improvement in his text has set his fame on a surer basis.

BIBLIOGRAPHY.—The *Canterbury Tales* have always been Chaucer's most popular work, and, including fragments, upwards of 60 15th century manuscripts of it still survive. Two thin volumes of his minor poems were among the little quartos which Caxton printed by way of advertisement immediately on his return to England; the *Canterbury Tales* and *Boethius* followed in 1478, *Troilus* and a second edition of the *Tales* in 1483, the *Hous of Fame* in 1484. The *Canterbury Tales* were subsequently printed in 1492 (Pynson), 1498 (de Worde) and 1526 (Pynson); *Troilus* in 1517 (de Worde) and 1526 (Pynson); the *Hous of Fame* in 1526 (Pynson); the *Parlement of Foules* in 1526 (Pynson) and 1530 (de Worde), and the *Mars, Venus* and *Envoy to Bukton* by Julyan Notary about 1500. Pynson's three issues in 1526 almost amounted to a collected edition, but the first to which the title *The Workes of Geffray Chaucer* was given was that edited by William Thynne in 1532 for Thomas Godfray. Of this there was a new edition in 1542 for John Reynes and William Bonham, and an undated reprint a few years later for Bonham, Kele, Petit and Toye, each of whom put his name on part of the edition. In 1561 a reprint, with numerous additions, edited by John Stowe, was printed by J. Kyngston for J. Wight, and this was re-edited, with fresh additions by Thomas Speght, in 1598 for G. Bishop and again in 1602 for Adam Islip. In 1687 there was an anonymous reprint, and in 1721 John Urry produced the last and worst of the folios. By this time the paraphrasers were already at work, Dryden rewriting the tales of the Knight, the Nun's Priest and the Wife of Bath, and Pope the Merchant's. In 1737 (reprinted in 1740) the Prologue and Knight's Tale were edited (anonymously) by Thomas Morell "from the most authentic manuscripts," and here, though by dint of much violence and with many mistakes, Chaucer's lines were for the first time in print given in a form in which they could be scanned. This promise of better things was fulfilled by a fine edition of the *Canterbury Tales* (1775–78), in which Thomas Tyrwhitt's scholarly instincts produced a comparatively good text from second-rate manuscripts and accompanied it with valuable illustrative notes. The next edition of any importance was that edited by Thomas Wright for the Percy Society in 1848–51, based on the erratic but valuable British Museum manuscript Harley 7,334. In 1866 Richard Morris re-edited this text in a more scholarly manner for the Aldine edition of the British Poets.

In 1868 the foundation of the Chaucer Society, with Dr. Furnivall as its director and chief worker, and Henry Bradshaw as a leading spirit, led to the publication of a six-text edition of the *Canterbury Tales,* and the consequent discovery that a manuscript belonging to the earl of Ellesmere, though undoubtedly "edited," contained the best available text. The Chaucer Society also printed the best manuscripts of *Troilus and Criseyde* and of all the minor poems, and thus cleared the way for the "Oxford" Chaucer, edited by Prof. Skeat, with a wealth of annotation, for the Clarendon Press in 1894, the text of which was used for the splendid folio printed two years later by William Morris at the Kelmscott Press, with illustrations by Sir Edward Burne-Jones. A supplementary volume of the Oxford edition, entitled *Chaucerian and other Pieces,* issued by Prof. Skeat in 1897, contains the prose and verse which his early publishers and editors, from Pynson and Thynne onwards, included among his Works by way of illustration, but which had gradually come to be regarded as forming part of his text. Many of these pieces have now been traced to other authors, and their exclusion has helped to clear not only Chaucer's text but also his biography, which used (as in the "Life" published by William Godwin in two

quarto volumes in 1803) to be encumbered with inferences from works now known not to be Chaucer's, notably the *Testament of Love* written by Thomas Usk. *See* Eleanor P. Hammond, *Chaucer; a Bibliographical Manual* (1909); J. S. P. Tatlock and A. G. Kennedy, *A Concordance to the Complete Works of Geoffrey Chaucer and to the Romaunt of the Rose* (Carnegie Institute, 1927). (A. W. P.)

CHAUDESAIGUES, a village of central France, in the department of Cantal, at the foot of the mountains of Aubrac, 19 mi. S.S.W. of St. Flour. Pop. (1936) 953. It has hot mineral springs, which at their maximum rank as the hottest in France. The water, which contains bicarbonate of soda, is employed medicinally, and also for washing fleeces, incubating eggs and various other economic purposes; and it furnishes a ready means of heating the houses of the town during winter. In the immediate neighbourhood is the cold chalybeate spring of Condamine. The warm springs were known to the Romans, and are mentioned by Sidonius Apollinaris.

CHAUFFEUR. In its anglicized sense, the common name for a professional driver of a motor vehicle. The word is French (from *chauffer,* to heat) and, primarily used for a man in charge of a forge or furnace, came to describe a stoker on a locomotive or steamship.

CHAULIAC, GUY DE (GUIDO DE CAULIACO) (*c.* 1300–1368), French surgeon, was born at Chauliac (Auvergne). He took holy orders and studied at Toulouse, Montpellier and Paris, and then went to Bologna to study anatomy under Nicolo Bertuccio. Chauliac was one of the most learned men of his time, and his book, *Chirurgia magna* (1363), passed through many translations and was for a long time the standard work on the subject, though it tended to retard progress in surgery by advocating meddlesome treatment of wounds. It was first printed in French at Lyons in 1478. In his *Capitulum singulare* he qualifies as an important medical historian. Guy died on July 25, 1368, at Avignon, where he was physician to the pope. He operated for hernia and cataract, which had hitherto been treated mainly by charlatans, and has left a description of the narcotic inhalation given to patients.

See Fielding H. Garrison, *History of Medicine,* p. 156–158 (1929); Arturo Castiglioni, ed. by E. B. Krumbhaar, *History of Medicine,* p. 345–347 (1941).

CHAULIEU, GUILLAUME AMFRYE DE (1639–1720), French poet and wit, was born at Fontenay, Normandy. His father, *maître des comptes* of Rouen, sent him to study at the Collège de Navarre. Louis Joseph, duke of Vendôme, and his brother Philippe, grand prior of the Knights of Malta in France, at that time had a joint establishment at the temple, where they gathered round them a very gay and reckless circle. Chaulieu received the abbey of Aumate and other benefices from the duke; and became the constant companion and adviser of the two princes. He made an expedition to Poland in the suite of the marquis de Béthune, but returned to Paris without securing any advancement. In his later years Chaulieu spent much time at the little court of the duchesse du Maine at Sceaux. There he became the trusted and devoted friend of Mdlle. Delaunay. Among his poems the best known are "Fontenay" and "La Retraite."

Chaulieu's works were edited, with those of his friend the marquis de la Fare, in 1714, 1750 and 1774. *See* also C. A. Sainte-Beuve, *Causeries du lundi,* vol. i; and *Lettres inédites* (1850), with a notice by Raymond, marquis de Berenger.

CHAUMETTE, PIERRE GASPARD (1763–1794), French revolutionary, was born at Nevers on May 24, 1763. Until the revolution he lived a somewhat wandering life, interesting himself particularly in botany. He was a student of medicine at Paris in 1790, became one of the orators of the club of the Cordeliers, and contributed anonymously to the *Révolutions de Paris.* As member of the insurrectionary Commune of Aug. 10, 1792, he was delegated to visit the prisons, with full power to arrest suspects. He was elected president of the Commune, defending the municipality in that capacity at the bar of the convention on Oct. 31, 1792. Chaumette was one of the ringleaders in the attacks of May 31 and of June 2, 1793, on the Girondists, towards whom he showed himself relentless. He was one of the promoters of the worship of reason, and on Nov. 10, 1793, he presented the goddess to the convention in the guise of an actress. On the 23rd he obtained a decree closing all the churches of Paris, and placing the priests under strict surveillance; but on the 25th he retraced his steps and obtained from the commune the free exercise of worship. Robespierre had him accused with the Hébertists; he was arrested, imprisoned in the Luxembourg, condemned by the revolutionary tribunal and executed on April 13, 1794. Chaumette was an ardent social reformer; he secured the abolition of corporal punishment in the schools, the suppression of lotteries, of houses of ill-fame and of obscene literature; he instituted reforms in the hospitals, and insisted on the honours of public burial for the poor.

CHAUMONT, a town of eastern France, capital of the department of Haute-Marne, a railway junction 163 mi. E.S.E. of Paris on the main line of the Eastern railway to Belfort. Pop. (1936) 17,389. Chaumont is situated on high ground at the confluence of the Marne and Suize. It received a charter from the counts of Champagne in 1190. The church of St. Jean-Baptiste dates from the 13th century, the choir and lateral chapels belonging to the 15th and 16th. The sculptured triforium (15th century), the spiral staircase in the transept and a Holy Sepulchre are of interest. The Tour Hautefeuille (a keep of the 11th century) is the principal relic of a château of the counts of Champagne; the rest of the site is occupied by the law courts. In 1814 Great Britain, Austria, Russia and Prussia concluded at Chaumont the treaty by which they bound themselves not to conclude a separate peace and to prosecute the Napoleonic war to a successful issue. Chaumont is the seat of a prefect and of a court of assizes, and has tribunals of first instance and of commerce. The main industries are glovemaking and leather dressing. The town has trade in grain, iron (mined in the vicinity) and leather.

CHAUNCEY, ISAAC (1772–1840), U.S. naval commander, was born at Black Rock, Conn., Feb. 20, 1772. He was brought up in the merchant service, and entered the U.S. navy as a lieutenant in 1798. The most active period of his life was that of his command on the Great Lakes during the War of 1812. He took the command at Sackett's harbour on Lake Ontario in Oct. 1812. Commodore Chauncey brought from 400 to 500 officers and men with him, and local resources for building being abundant, he had by November formed a squadron of ten vessels, with which he attacked the Canadian port, York, taking it in April 1813. The Americans had the advantage of commanding greater resources for shipbuilding. Sir James Yeo began by blockading Sackett's harbour early in 1814, but when the U.S. squadron was ready he was compelled to retire by the disparity of the forces. Commodore Chauncey was now able to blockade the British flotilla at Kingston. During his later years he served as commissioner of the navy, and was president of the board of naval commissioners from 1833 till his death at Washington, Feb. 27, 1840.

See Roosevelt's *War of 1812* (1882); and A. T. Mahan, *Sea Power in its Relations to the War of 1812* (1905); also *see* E. Channing, *History of the United States,* vol. iv (1926).

CHAUNCY, CHARLES (1592–1672), president of Harvard college, was born at Yardley-Bury, England, in Nov. 1592, and attended Trinity college, Cambridge. He was in turn vicar at Ware and at Marston St. Lawrence, but twice incurred censure from the authorities for nonconformity. His formal recantation in Feb. 1637 caused him lasting self-reproach. In this same year he emigrated to America, where he was an associate pastor at Plymouth, then pastor at Scituate (Mass.), and, from 1654 until his death, president of Harvard college. He died on Feb. 19, 1672. According to Mather, he was "a most incomparable scholar." His writings include: *The Plain Doctrine of the Justification of a Sinner in the Sight of God* (1659) and *Antisynodalia Scripta Americana* (1662).

His great-grandson, CHARLES CHAUNCY (1705–1787), a prominent U.S. theologian, was born in Boston (Mass.), on Jan. 1, 1705, and graduated at Harvard in 1721. In 1727 he was chosen as the colleague of Thomas Foxcroft in the First Church of Boston, continuing as pastor until his death. He condemned

the "Great Awakening" as an outbreak of emotional extravagance in his sermon *Enthusiasm,* and in his *Seasonable Thoughts on the State of Religion in New England* (1743), written in answer to Jonathan Edwards' *Some Thoughts Concerning the Present Revival of Religion in New England* (1742). Before and during the War of Independence he ardently supported the patriot party. He died in Boston on Feb. 10, 1787. His publications include: *Salvation of All Men, Illustrated and Vindicated as a Scripture Doctrine* (1782) and *Five Dissertations on the Fall and its Consequences* (1785).

For Charles Chauncy *see* Cotton Mather's *Magnalia Christi Americana* (1702) and W. C. Fowler's *Memorials of the Chauncys* (1858). For the younger Chauncy *see* P. L. Ford's privately printed *Bibliotheca Chaunciana* (1884), and Williston Walker's *Ten New England Leaders* (1901).

CHAUNY, a town of northern France in the department of Aisne, 19 mi. S. by W. of St. Quentin by rail. Pop. (1936) 9,061. The town is situated on the Oise (which here becomes navigable) and at the junction of the canal of St. Quentin with the lateral canal of the Oise. It contains mirror-polishing works, chemical works and metal foundries. It was the scene of much fighting in the Hundred Years' War.

CHAUSSES. Mediaeval protective leg-harness or mail hose. Modern French *chausse:* stocking, hose. The term also refers to light pantaloons covering the hips, legs and feet.

CHAUTAUQUA, an unincorporated village of Chautauqua county, New York, U.S.A., in a township of the same name, on the west shore of Chautauqua lake, a beautiful body of water 1,300 ft. above sea level, 17 mi. long and 3 mi. across at its greatest width. It is served by motor coach and electric lines, connecting with railways at Westfield and Jamestown, at either end of the lake. The resident population of the town in 1940 federal census was 300. The village contains the campus and equipment of the Chautauqua institution. (*See* LYCEUMS AND CHAUTAUQUAS.)

CHAUVIGNY, a town of western France in the department of Vienne, 20 mi. E. of Poitiers by rail. Pop. (1936) 2,591. The town is finely situated overlooking the Vienne, and has two interesting Romanesque churches, both restored in modern times. It was a strong fortress in the middle ages, and still possesses the ruins of no less than five castles, the chief of which is the Château Baronnial (11th and 15th centuries) the old seat of the bishops of Poitiers, who were lords of Chauvigny.

CHAUVINISM, a term for unreasonable and exaggerated patriotism, the French equivalent of "Jingoism." The word originally signified idolatry of Napoleon, being taken from a much-wounded veteran, Nicholas Chauvin, who, by his adoration of the emperor, became the type of blind enthusiasm for military glory.

CHAUX DE FONDS, LA, an industrial town in the Swiss canton of Neuchâtel, about 19m. by rail N.W. of Neuchâtel, at a height of about 3,250ft. in a valley of the same name in the Jura. Pop. (1930) 35,252; mainly Protestant (27,306) and French-speaking; of the Catholic faith, the majority are "Old Catholics." It is a centre of the watch-making industry. There are schools of watch-making and of industrial art.

See *Dict. hist. et biogr. de la Suisse,* ii.

CHAVANTEAN, a small independent linguistic stock of South American Indians, so called from the Chavantes or Caingangs, its most important tribe. The Chavantean tribes are found to-day on the upper Parana and Lower Paranapanema rivers, in the state of São Paulo, Brazil. They formerly occupied a somewhat larger territory. These Chavantes are to be carefully distinguished from the tribe of the same name in the States of Goyaz and Matto Grosso, who belong to the Ges stock. The Chavantes are quite dark-skinned, rather timid hunting folk, of very primitive culture. They are very little known. Both sexes wear small bast breech-clouts, but no other clothing. Their dwellings are tiny thatched huts, and their weapons the bow and spear. They have no pottery or textiles.

See H. von Ihering, *The Anthropology of the State of S. Paulo, Brazil* (2nd ed. S. Paulo, 1906).

CHAVASSE, FRANCIS JAMES (1846–1928), the son of Thomas Chavasse, of Sutton Coldfield, and brother of Sir Thomas Chavasse, the Birmingham surgeon, was born on Sept. 27, 1846. He was educated privately, and later at Corpus Christi college, Oxford. He was ordained in 1870, and in 1878 became vicar of St. Peter-le-Bailey, Oxford, and a year later principal of Wycliffe hall. In 1900, on the resignation of Dr. J. C. Ryle, the first bishop of Liverpool, Chavasse was appointed to the vacant see. He was remarkable for his ability in finding common interests for people of very different types and holding very different views, and in bringing them together to work for a common purpose. This gift proved invaluable in the execution of the great scheme for the building of Liverpool cathedral (on the plans designed by Sir Giles Gilbert Scott, R.A.) with which his name will always be associated. He resigned his bishopric in 1923, owing to his advanced years, and died on March 11, 1928.

CHAVES, a town of northern Portugal, in the district of Vila Real, 8 mi. S. of the Spanish frontier. Pop. (1940), 8,822. Chaves is the ancient *Aquae Flaviae,* famous for its hot saline springs, which are still in use. A fine Roman bridge of 18 arches spans the Tamega. Chaves was long one of the principal frontier fortresses, and may derive its present name from the position which makes it the "keys" (*chaves*) of the north. One of its churches contains the tomb of Alphonso I. of Portugal (1139–85).

CHEADLE, a small town in the urban district of Cheadle and Gatley (pop. 1938, 26,220), in Cheshire, England, 6m. S. of Manchester. The name occurs in the formerly separate villages of Cheadle Hulme, Cheadle Bulkeley and Cheadle Moseley. Cheadle is one of the numerous townships of modern growth which fringe the southern boundaries of Manchester, and practically form suburbs of that city. Stockport lies immediately to the east. There are cotton printing and bleaching works in the locality.

CHEADLE, market town of north Staffordshire, England, 10 mi. E. of Stoke, on the L.M.S.R. Pop. civil parish (1931) 6,754. The Roman Catholic church of St. Giles, with a lofty spire, was designed by Pugin and erected in 1846. There are three collieries in the neighbourhood, and a large textile manufactory in the town. Metal-working is also carried on.

CHEATING, "the fraudulently obtaining the property of another by any deceitful practice not amounting to felony, which practice is of such a nature that it directly affects, or may directly affect, the public at large" (Stephen, *Digest of Criminal Law*). Cheating is either a common law or statutory offence, and is punishable as a misdemeanour. An indictment for cheating at common law is of comparatively rare occurrence, and the statutory crime usually presents itself in the form of obtaining money by false pretences (*q.v.*).

CHEBICHEV, PAFNUTIY LVOVICH (1821–1894), after N. I. Lobachevskiy, the most distinguished of Russian mathematicians, was born at Borovsk on May 26, 1821. Educated at the University of Moscow in 1859, he became professor of mathematics in the University of St. Petersburg, a position from which he retired in 1880. He became a correspondent in 1860, and in 1874 *associé étranger* of the Institute of France. He was also a foreign member of the Royal Society of London. In 1841 he published a valuable paper, "Sur la convergence de la série de Taylor," in *Crelle's Journal.* He wrote much on prime numbers; in one paper ("Sur les nombres premiers," 1850) he established the existence of limits within which must be comprised the sum of the logarithms of the primes inferior to a given number. He devoted much attention to the problem of obtaining rectilinear motion by linkage. The "Chebichev's parallel motion" is a three-bar linkage, which gives a very close approximation to exact rectilinear motion, but he failed to devise one producing true rectilinear motion. Such a linkage was discovered by one of his pupils, Lipkin, who, however, had been anticipated by A. Peaucellier. His mathematical writings cover a wide range of subjects, such as the theory of probabilities, quadratic forms, theory of integrals, gearings, the construction of geographical maps, etc. He also published a *Traité de la théorie des nombres.* He died at St. Petersburg on Dec. 8, 1894.

CHEBOYGAN, a city of Michigan, U.S.A., on south channel of the Strait of Mackinac, at the mouth of the Cheboygan river; a port of entry and the county seat of Cheboygan county. It is on

Federal highways 23 and 27, and is served by the Michigan Central and the Detroit and Mackinac railways, and by lake steamers during the navigation season. The population in 1940 was 5,673. Cheboygan is in the heart of the summer resort region of northern Michigan, and is surrounded by a farming, stock-raising and fruit-growing country.

The city has sundry manufacturing industries, and is an important fishing port. There are large apple orchards and an apple juice factory.

The commerce of the port has declined. Cheboygan (at first called Duncan and later Inverness) was settled in 1846, and chartered as a city in 1889.

CHECHENO-INGUSHETIA. This autonomous republic in the North Caucasian area of the Russian Soviet Federated Socialist Republic was created an autonomous republic in Dec. 1936. Area, 6,062 sq.mi. Pop. (1939) 697,408; 498,739 rural, 198,669 urban. It consists mainly of the densely wooded slopes of the Northern Caucasus, and extends from the Caucasus to the Terek river, and from North Ossetian A.S.S.R. and Kabardino-Balkaria to Daghestan. In the north the forest thins out and its place is taken by steppe with chestnut brown soil, less fertile than the black earth, but suitable for agriculture in years of good rainfall. The latter varies in quantity in the north, but is more abundant on the southern hill slopes. The density of population is about 115 per sq.mi.; the Chechens are the most numerous of the native hill tribes in the North Caucasian area, forming 58.4% of the total population. The Ingush represent only about 12.4% of the total population. The Chechen, Tchetchen (or Khists [Kisti], as they are called by the Georgians) call themselves "Nakhtche" (people). They fought fiercely against Russian aggression under Daûd Beg, Oman Khan and Shamyl, in the 18th century, and under Khazi-Mollah in the 19th century. Many of them migrated to Armenia in 1859, after the surrender of their chieftain Shamyl. They are Mohammedans, and they are governed by popular assembly in each commune, every man considering himself free and equal to his neighbour. Towards the north settled agriculture has been introduced by Russian immigrants and winter wheat, millet, oats and barley are grown. Working cattle are used in preference to horses. But, in the southern hill oak, beech, birch and pine forest and alpine pasture area, the Chechens are hunters or nomad herdsmen, taking their goats and sheep to the high meadows in the spring, and descending in autumn to the lower, more sheltered areas. They sow oats and barley under great difficulties, often having to remove the stones brought down by the spring floods from their tiny cultivated patches, and even in summer snow may fall.

Their goats supply them with milk, and their sheep with meat, leather and wool; koustar (peasant) industries include spinning, weaving, preparing leather and the making of knives and daggers. Bees are kept and a sawmilling industry is being developed.

Cultural life is at a low level: there is a high percentage of illiteracy, and this, combined with the absence of roads and the impossibility of using the mountain streams (the Sunzha and Argun and their tributaries) for passenger navigation, makes cultural and economic progress difficult. Many mountain Chechens and Ingush alike live in windowless hovels of mud and stone in the winter, and, in the summer, on the Alpine pastures, improvise shelters from boughs.

The two main roads are from Grozny to Shatoi on the Argun river, and a road farther east almost parallel to it, passing south into Daghestan. There is telegraphic communication along these roads.

From Gydermes junction a loop of the Caspian-Black sea railway passes through Grozny to Beslan, from which a branch goes to Orjonikidze (Vladikavkaz).

CHECKERS, the name by which the British game of draughts is known in the United States.

See DRAUGHTS OR CHECKERS.

CHEDDAR, town, Somersetshire, England, 22 mi. S.W. of Bristol by G.W.R. Pop. (1931) 2,154. To the west lies the low Axe valley, to the east rise immediately southwest the Mendip cliffs (600–800 ft.) of Cheddar gorge, with beautiful stalactitic caverns, of which Cox's and Gough's are best known. The remains discovered in the caves (particularly Gough's after 1928) and elsewhere in the neighbourhood give evidence of prehistoric and Roman settlements at Cheddar (*Cedre, Chedare*), which was a convenient trade centre. The manor of Cheddar was a royal demesne in Saxon times, and the witenagemot was held there in 966 and 968. It was granted by John in 1204 to Hugh, archdeacon of Wells. The bishop of Bath and Wells granted it to the king in 1553. It is now owned by the marquess of Bath. By a charter of 1231 extensive liberties in the manor of Cheddar were granted to Bishop Joceline, who in 1235 obtained the right to hold a weekly market and fair. By a charter of Edward III (1337) Cheddar was removed from the king's forest of Mendip. The market and stock fairs have long been discontinued, the former in about 1690. The name of Cheddar is given to a well-known species of cheese, the manufacture of which began in the 17th century in the town and neighbourhood.

CHEDUBA or **MAN-AUNG,** an island in the Bay of Bengal, situated 10 mi. from the coast of Arakan, between 18° 40′ and 18° 56′ N., and between 93° 31′ and 93° 50′ E. It forms part of the Kyaukpyu district of Arakan. It extends about 20 mi. in length from north to south, and 17 mi. from east to west, and its area of 220 sq.mi. supports a population of nearly 30,000. The channel between the island and the mainland is navigable for boats, but not for large vessels. The surface of the interior is richly diversified by hill and dale, and in the southern portion some of the heights exceed 1,000 ft. in elevation. There are various indications of former volcanic activity, and along the coast are earthy cones covered with green-sward, from which issue springs of muddy water emitting bubbles of gas. Copper, iron and silver ore have been discovered; but the island is chiefly noted for its petroleum wells. The inhabitants of the island are mainly Maghs. Cheduba fell to the Burmese in the latter part of the 18th century, and was taken by the British in 1824.

CHEERING, the uttering or making of sounds encouraging, stimulating or exciting to action, indicating approval or acclaiming or welcoming persons, announcements of events and the like. The word "cheer" meant originally face, countenance, expression (Low Lat. *cara*), and was at first qualified with epithets, both of joy and sorrow; compare "She thanked Dyomede for alle . . . his gode chere" (Chaucer, *Troylus*) with "If they sing . . . 'tis with so dull a cheere" (Shakespeare, *Sonnets,* xcvii.). An early transference in meaning was to hospitality or entertainment, and hence to food and drink, "good cheer." The sense of a shout of encouragement or applause is a late use.

Of the different words or sounds that are used in cheering, "hurrah," though now generally looked on as the typical British form of cheer, is found in various forms in German, Scandinavian, Russian (*urá*), French (*houra*); it is probably onomatopoeic in origin. The German *hoch,* the French *vive,* Italian and Spanish *viva, evviva,* are cries rather of acclamation than encouragement. The Japanese shout, *banzai,* became familiar during the Russo-Japanese War. In reports of parliamentary debates "cheers" indicates that approval was shown by emphatic utterances of "hear hear." Cheering may be tumultuous or it may be conducted rhythmically by prearrangement, as in the case of the "Hip-hip-hip" by way of introduction to a simultaneous "hurrah."

Rhythmical cheering has been developed to its greatest extent in America in the college yells, which may be regarded as a development of the primitive war-cry. The original yells of Harvard and Yale are identical in form, being composed of *rah* (abbreviation of *hurrah*) nine times repeated, shouted in unison with the name of the university at the end. The Yale cheer is given faster than that of Harvard. Many institutions have several different yells; the best known of these variants is the Yale cheer, partly taken from the *Frogs* of Aristophanes:

Brekekekéx, ko-áx, ko-áx,
Brekekekéx, ko-áx, ko-áx,
O-óp, O-óp, parabaloú,
Yale, Yale, Yale,
Rah, rah, rah, rah, rah, rah,
rah, rah, rah,
Yale! Yale! Yale!

The "triple cheer" of Princeton is:

H'ray, h'ray, h'ray,
Tiger, tiger, tiger,
Siss, siss, siss,
Boom, boom, boom,
Ah, ah, ah,
Princetón, Princetón, Princetón!

The "railroad cheer" is like the foregoing, but begun very slowly and broadly, and gradually accelerated to the end, which is enunciated as fast as possible. Many cheers are formed like that of Toronto university:

Varsitý, varsitý,
V-a-r-s-i-t-y (spelled)
VARSIT-Y (spelled *staccato*)
Vár-si-tý,
Rah, rah, rah!

The cheer of the United States Naval academy is an imitation of a nautical syren. The Amherst cheer is:

Amherst! Amherst! Amherst! Rah! Rah!
Amherst! Rah! Rah!
Rah! Rah! Rah! Rah! Rah! Rah! Amherst!

Besides the cheers of individual institutions there are some common to all, generally used to compliment some successful athlete or popular professor. One of the oldest examples of these personal cheers is:

Who was George Washington?
First in war,
First in peace,
First in the heárts of his countrymén,

followed by a stamping on the floor in the same rhythm.

College yells are used particularly at athletic contests. In any large college there are several leaders, chosen by the students, who stand in front and call for the different songs and cheers, directing with their arms in the fashion of an orchestral conductor. Cheering and singing form one of the distinctive features of inter-collegiate and scholastic athletic contests in America.

CHEESE, a food product made from the milk of many different kinds of animals: it is the earliest form of dairy manufacturing. In general cheese consists of the essential food nutrients of the milk, which have been collected into a coagulum or curd, either by natural souring or by the addition of rennet, and separated from the "whey" or watery portion of the milk. In making most forms of cheese, the curd is subject to the curing or ripening action of moulds or bacteria to develop characteristic flavours. Cheese contains nearly all the fat, casein, calcium, vitamin A, and a part of the milk-sugar and salts, of the milk from which it was made. Cheese therefore preserves much of the food value of milk for consumption over longer periods than milk.

Naturally, the earliest husbandmen must have observed the souring or curdling of milk, and also that the sour-milk curd was not only good to eat but that it was also a way in which to preserve the milk for later use. Such widely known sour-milk cheeses as cottage cheese probably represent the earliest form of cheese-making. Coagulating milk with rennet, and curing the curd to develop characteristic flavours and keeping qualities, as is done in making such cheeses as Cheddar, Roquefort and Swiss, likewise dates back to ancient times. There are no records of the beginning of cheese-making as it is known today, but the principal of coagulation—with rennet extract obtained from the stomachs of young calves, pigs, or goats—on which modern cheese-making depends, is believed to have been discovered quite by accident. Ancient peoples used the skins and stomachs of animals as containers for various materials, and tradition credits the discovery of coagulation to some ancient herdsman who is supposed to have observed the "phenomenon" in the milk that he carried in a container made of a calf's stomach. The ripening and curing of cheese by various micro-organisms is also believed to have originated in some early observation of the changes that occurred in sour milk curd that was accidentally stored in caves or under other conditions favourable for bacterial action.

History relates the use of cheese by many early peoples, and the Old Testament contains a number of references to it. The Greeks and Romans are supposed to have had cheese as a staple food at least a thousand years before the beginning of the Christian era. The Jews and the Romans are said to have recognized the strength-giving properties of cheese and to have fed it to their armies because of its convenient concentrated form, and the Greeks gave it to their wrestlers to give them endurance.

Today cheese is made and eaten the world over, being made from the milk of many different animals—the cow, sheep, goat, mare, llama, reindeer, buffalo, zebu, etc., depending on the country and the kind of milk-producing animal identified with the industry in the particular country.

Cheese-making began as an art rather than as a science, and in many countries the bulk of the cheese is still made by "rule of thumb" methods handed down from preceding generations. Long before science had explained the complex chemistry of milk or the nature of fermentation and bacterial action, methods of making and handling cheese had developed more or less independently in widely separated regions. In many instances the practices were closely associated with local conditions of climate, agriculture, and habits of the people, which not only resulted in characteristic differences in cheeses made in the different regions, but also gave rise to a vast number of names. Apparently it was the custom of the earliest cheese-making peoples to name their product after the village or country in which it was made.

Cheese is now made and sold under perhaps 400 or 500 different names, but many of these so-called varieties are unknown outside of the locality or the country in which they are made. In many instances local and regional names represent no real difference in type from that of cheese made under other names elsewhere, although the cheeses made in the various localities and countries may have certain distinguishing characteristics. Frequently these differences may be only in the shape or size of the cheese, or they may be in the flavour and texture due to different methods of cooking the curd or curing the cheese. Differences in ripening practices may give rise to considerable differences in quality even in cheese made from the same curd.

There are several possible ways of classifying cheeses, no one of which seems satisfactory for all purposes. For one purpose it may be more desirable to classify them according to methods of making, for another purpose the characteristics of the cheese may be a more satisfactory basis. One common classification recognizes three groups,—soft cheeses, semi-hard cheeses, and hard cheeses. This grouping, however, is almost entirely on the texture of the product when it is ready for consumption. In general the soft cheeses are those made by souring the milk with lactic acid and eaten within a few days after making. The hard cheeses are those made by coagulating the protein with rennet, cooking and pressing the curd, and ripening with moulds or bacteria for several months or several years before they are ready to be eaten. Semi-hard cheeses fall in between these two groups, and the making process may have features in common with both.

All these types of cheese are known as the "natural" cheeses. Many of them frequently are subjected to further treatment or processing which has the effect of producing an entirely new or different product, known as "processed cheese." In making processed cheese, one or more lots of a natural cheese or of several kinds of natural cheese, or of cheeses of different ripeness or inferior texture and flavour, may be ground up, melted and blended with various seasoning materials. The liquid is then forced into forms of the shape desired and cooled, and packaged in attractive containers for direct sale to consumers. The manufacture of processed cheese is a comparatively new phase of the cheese industry, but one that has become of considerable economic importance.

Although cheese is marketed throughout the world under 400 or 500 different names, there are probably only about 18 distinct varieties. Matheson (K. J. Matheson, *Varieties of Cheese: Descriptions and Analyses.* U. S. Dept. Agr. Bull. 608, 68 pp. 1932.) lists the best-known names of distinct varieties or groups as follows: Brick, Caciocavallo, Camembert, Cheddar, Cottage, Cream, Edam, Emmenthaler, Gorgonzola, Gouda, Hand, Limburg, Neufchâtel, Parmeson, Pecorino, Roquefort, Sapsago, and Trappist.

Some of the distinctive differences in these varieties as briefed from Matheson's descriptions are as follows:

Brick Cheese is strictly an American product. Its name is supposed to have come from its shape or from the practice of using bricks to weight down the curd in the moulds. The curd is pressed in the small moulds—about 3 by 6 by 10 inches—for 24 hours, after which the prints are removed, salted, and taken to the curing cellar where the cheese ripens in 2 or 3 months. Brick cheese has a strong sweetish taste somewhat like Emmenthaler, or Swiss cheese, and an aroma mildly resembling Limburg. The body of the cheese is rather elastic and contains numerous small, round holes or eyes. Brick cheese is made in about 400 factories in 14 American states, but at least 90 percent of the 30 million pounds made annually is made in Wisconsin.

Caciocavallo Cheese is a peculiar kind of cheese made from either whole or partly skimmed milk of cows. It originated in Italy several centuries ago. One explanation of the name, which means literally horse cheese, is that the cheese was first made in the region of Monte Cavallo, another is that the imprint of a horse's head appeared on each cheese as a trade mark of the original maker. The curd is moulded into any desired shape or size, usually about 3 pounds, and after the moulded shapes have been immersed in brine for several days, they are suspended in pairs from the ceiling and smoked. The most common shape resembles a beet, the constriction at the top being due to string by which it hangs. This cheese is sometimes eaten while comparatively fresh, but is more frequently kept for months, then grated and used in soups, or macaroni and similar foods. A small quantity is imported into the United States, and some is made in Wisconsin, Michigan, and Pennsylvania.

Camembert Cheese is a soft, rennet cheese made from cow's milk. A typical cheese is about $4\frac{1}{4}$ inches in diameter and 1 inch thick, and as marketed in the United States is usually found wrapped in paper and enclosed in a wooden box of the same shape. The cheese usually has a rind about $\frac{1}{8}$-inch thick, which is composed of moulds and dried cheese. The interior is yellowish in color and waxy, creamy, or almost fluid in consistency, depending largely upon the degree of ripeness. The flavour is similar to Limburg, but not as strong. Four to six weeks of ripening is required before this cheese is in condition for the market. Camembert cheese is said to have originated in 1791 in the locality from which it derives its name in the northwestern part of France. Cheese of the same type, however, is made in other parts of France and also in other countries, including New York and Wisconsin in the United States. Similar types are known as Brie, Coulommiers, Robbiola, and Ripened Neufchâtel.

Cheddar Cheese gets its name from the village of Cheddar in Somersetshire, England, where it was first made many years ago. It is very popular as a food product both in England and in the United States. It was exported from the United States as early as 1790, and is today the most important variety made in that country, its manufacture accounting for more than 75 per cent of the total cheese production. The cheese is made from whole milk of cows, or from skim milk or partly skimmed milk. The term "Cheddar" as known and used today refers principally to a phase of the making process. The finished cheese may be white or yellow, and it may be used after only 3 or 4 months of ripening, when it has a very mild flavour, or after 1 or 2 years of curing to develop a sharp or snappy flavour. American Cheddar Cheese is frequently known and retailed merely as American or "store" cheese, "cream," "Yankee," "Wisconsin," and "New York" cheese. In California, this cheese is known as Jack or Monterey cheese. It is made in several sizes and shapes with more or less distinguishing names, such as Long Horns, Daisies, Twins, Flats, and Cheddars or Exports. These sizes range from 5 to 16 inches in diameter, and 4 to 16 inches in height, and 10 to 100 pounds in weight. Within the last few years this variety has been packaged and cured in cans, to afford a convenient and attractive form in which to merchandise it. A one-way valve on the can permits ripening gases to escape and excludes air: thus curing in the can is possible.

Cottage Cheese is an unripened, soft, sour-milk cheese made extensively in the United States, where it is often called Dutch cheese, or smearcase. It is made both in the home and in the factory, from skim milk, with or without the addition of rennet. It is highly nutritious and palatable, contains all the food value of milk except the cream, and may be used as the main part of the meal or in salads, desserts, or cooked dishes. Properly made, it has a clean, mild, acid flavour and smooth texture. Factory production increased markedly during and after the World War as a result of educational campaigns directed toward the utilization of skim milk to conserve meats and other foods. The cheese is perishable and must be kept at low temperatures until consumed.

Cream Cheese of the genuine kind is made from rich cream thickened by souring or from sweet cream thickened with rennet. The thickened cream is put into a cloth and allowed to drain, this requiring about four days. It is then placed on a board, salted, and turned occasionally. It is ready for consumption in from 5 to 10 days. Modifications of this process are now common. A cheese common on the American markets is known as "Philadelphia Cream Cheese." The cream is thickened with rennet and drained for several days, when it is salted and worked into a paste by special mixing machines, and placed in tin foil packages of the desired size and weight. This cheese has a mild, rich flavour and is used principally as a spread for bread.

Edam Cheese is a hard, rennet cheese produced in the Netherlands; it is also known as Katzenkopf, Tete de Maure, and Manbollen. Formerly Edam cheese was made from whole milk on the farms in North Holland, but today it is usually made of skimmed milk. The genuine Edam cheese contains at least 40 percent fat, although many creameries make a cheese of the same shape with only 20 to 30 percent fat. All Edam cheese for export bears the Government guarantee of the fat content. The cheese is round, but flattened at the top and bottom, and the outside is coloured red; or the cheese is packed in tin foil and, for export to hot countries, in bladders or tins. When the cheeses are a few weeks old they are marketed and the ripening process continues in the warehouses of the cheese merchants. Some is made in Wisconsin, and the imported product is well known in all large markets.

Emmenthaler Cheese is a hard, rennet cheese made from cow's milk, and is somewhat sweetish in flavour. It is characterized by holes or eyes about the size of a cent, about 1 to three inches apart throughout the cheese. This cheese originated in the Emmenthal Valley of Switzerland, and is a very old variety, reported as early as the middle of the fifteenth century in the Canton of Emmenthal. Its manufacture in France in 1722 under the name of Gruyere is recorded. It is now made in every civilized country. That made in the United States is known as Domestic Swiss, and that in the region of Lake Constance is called Algau Emmenthaler. Other local names are Bellunese, Formaggio Dolce, Fontine d'Aosta, and Thraanen. The United States has about 300 factories in 11 states, but the bulk of the 40 million pounds made annually in this country is made in Wisconsin, Ohio, and Illinois. Only the best grades are imported into the United States. The cheeses are like massive solid wheels, 6 inches thick and sometimes 4 feet in diameter, and weigh from 60 to 220 pounds each. Ripening requires 3 to 6 months. Scientific studies by the U. S. Bureau of Dairy Industry have established a controlled procedure in many factories, which facilitates the manufacture of a uniformly good quality cheese. Whereas the original makers depended on nature to introduce the necessary bacteria into the milk, modern makers now introduce "pure cultures" to bring about the desired action as follows: (1) The *lactobacillus bulgaricus* to check undesirable fermentation and to aid in controlling ripening, and (2) the use of an eye and flavour culture to aid in the development of eyes and flavour.

Gorgonzola Cheese, known also as Stracchino di Gorgonzola, is a rennet, Italian cheese made from whole milk of cows. Its name comes from Gorgonzola, near Milan, but very little of the cheese is now made there. The interior of the cheese is mottled or veined with a penicillium much like Roquefort. As seen on the markets of the United States the surface of the cheese is covered with a thin coat resembling clay, said to be prepared by mixing barite or gypsum, lard or tallow, and colouring matter. These cheeses are cylindrical, being about 12 inches in diameter and 6 inches in height. As marketed they are packed with straw in

wicker baskets. Well-made cheeses may be kept a year or longer, but much is consumed fresh in the region where it is made. In England a similar type of cheese, known as Stilton, is made from cows' milk, and is imported in quantities into the United States.

Gouda Cheese is a sweet-curd Netherlands cheese made from cows' milk. The full-cream Gouda is mainly a farm product made chiefly in the Provinces of Zuidholland and Utrecht, with an average fat content of 50 percent. Gouda made in creameries from partly skimmed milk has a fat content of 20 to 40 percent. The fat content is guaranteed by the Government mark on the cheese. In shape Gouda cheese is cylindrical with the sharp edges rounded off. The cheeses weigh from 6½ to 44 pounds. Ripening requires 6 to 8 weeks. This cheese is commonly found on the larger markets in the United States.

Hand Cheese is so named because originally it was moulded by hand into its final shape. It is a sour-milk cheese, very popular among German races, and made in many countries. The process varies in different localities, but in general the curd is cooled in moulds, then ground fine in a curd mill (in some kinds caraway seed is added), then ripened on shelves in the curing room. The cheese has a very sharp, pungent odour and taste, which is very disagreeable to most people unaccustomed to it. It is known by such local names as Thuringia Caraway cheese; Ihlefeld, in Mecklenburg; and Livlander in Russia.

Limburg Cheese is a soft, rennet cheese made from cows' milk which may contain all the butterfat or may be partly or entirely skimmed. The best Limburg is undoubtedly made from the whole milk. This cheese has a very strong and characteristic odour and taste, weighs about 2 pounds, and is about 6 by 3 inches in size. It requires about 2 months to ripen. The most common synonyms of Limburg are Backstein and Hervé. It has, however, many local names, such as Algau, Lanark, Marianhof, Morin, Saint Michels, Schutzen, Tanzenberg, Carinthian, Grottenhof, Emmersdorf, Briol, and Lindenhof. Limburg cheese originated in the Province of Lüttich, Belgium, in the neighbourhood of Hervé. Its manufacture has spread to Germany and Austria, where it is very popular, and to the United States, where large quantities are made, mostly in New York and Wisconsin. Contrary to popular belief, Limburg is no longer imported into the United States, since the domestic product is of good quality and is made cheaply.

Neufchâtel Cheese is a soft rennet cheese made extensively in France, from either whole or skim milk of cows. Bondon, Malakoff, Petit Carre, and Petit Suisse are essentially the same as Neufchâtel but have slightly different shapes. Neufchâtel cheese is made in the same manner as cream cheese, except that a little less rennet is used. The standard package, wrapped in tin foil, is round and weighs 2½ to 3 ounces, its dimensions being 1½ by 2½ inches. Factories in the United States make a variation of the Neufchâtel cheese, which is probably as good as the French variety. American makers attempt to vary this cheese by the use of condiments. Pimento, or Pepper Cream, is a Neufchâtel cheese in which 1 pound of red peppers is used for every 10 pounds of cheese. The peppers are ground very fine and thoroughly mixed; the whole is then moulded and kept in a cold place.

Parmesan Cheese is the name in common use outside of Italy for the cheese made and known in that country for centuries as Grana, the term "grana" or "granona" referring to its granular appearance when broken, which is necessary on account of the hardness of the cheese, cutting being practically impossible. There are two quite distinct kinds of cheese—one made in Lombardy and the other in Emilia. Parma, situated in Emilia, has long been an important commercial centre for both kinds, and to this fact the name of Parmesan is due. The use of the term "Parmesan," however, is sometimes restricted to the cheese made in Lombardy, the term "Reggian" being used to designate that made in Emilia. The cheeses are ripened in a cool, well-ventilated room, where they may be stored for years, the surface being rubbed with oil from time to time. The exterior of the cheese is dark green or black, due to colouring matter rubbed on the surface. A greenish colour in the interior has been attributed to the contamination with copper from the vessels in which the milk is allowed to stand before skimming. Parmesan cheese when well made may be broken and grated easily and may be kept for an indefinite number of years. It is grated and used largely for soups and with macaroni. A considerable quantity of this cheese is imported into the United States and sells for a very high price.

Pecorino Cheese is a sheep's-milk cheese made in Italy and there are numerous more or less clearly defined kinds. The most common sort is the one designated Cacio Pecorino Romano, or merely Romano. This varies considerably in size and shape. A cheese of ordinary size is about 10 inches in diameter and 6 inches in thickness and weighs from 2 to 25 pounds. The interior is slightly greenish in colour, somewhat granular, and devoid of eyes or holes. Ripening requires eight months or longer. The Pecorino Dolce is artificially coloured with annatto and subjected to considerable pressure in the process of manufacture. Pecorino Tuscano is a smaller cheese than the Romano, measuring usually 6 inches in diameter and 2 or 4 inches in thickness and weighing from 2 to 5 pounds. Among the sheep's-milk cheeses bearing local names are the following: Ancona, Cotrone, Iglesias, Leonessa, Puglia, and Viterbo. In the manufacture of Viterbo cheese the milk is curdled by means of a wild artichoke *Cynara scolymus*.

Roquefort Cheese is a soft, rennet cheese made principally from sheep's milk, although some cows' milk and goats' milk may be added. Numerous imitations, such as Gex and Septmoncel, are made from cows' milk. One of the most striking characteristics is the mottled or marbled appearance of the interior of the cheese, due to the development of a penicillium, which is the principal ripening agent. The manufacture of Roquefort has been carried on in the southeastern part of France for at least two centuries, and is particularly important in the village of Roquefort, from which the cheese derives its name. One interesting phase of the making process is the sifting of mouldy bread crumbs between layers of curd as it is placed in the forms or hoops, to bring about the desired ripening. Formerly the manufacture of the cheese up to curing time was carried on by the shepherds themselves, but in recent years centralized factories collect the milk and make the cheese, which is still cured in the natural caves near Roquefort. The cheese may be sold after from 30 to 40 days or may remain in the caves as long as five months, depending on the degree of ripening desired. This type of cheese is made from cows' milk in Denmark. In the United States this type has been made since 1918, from cows' milk and with artificial curing conditions. Recently such American-made cheese has been ripened in natural caves along the Mississippi River in Minnesota and in an abandoned shaft of a coal mine in Pennsylvania.

Sapsago Cheese is made principally in Glarus, Switzerland, from sour, skim milk of cows. It is also known as Schabzieger, Glarnerkäse, Grünerkäse, and Kräuterkäse. It is claimed that it was made in the thirteenth century; its authentic history at least dates back to the fifteenth century. Sapsago is a small, hard, green cheese flavoured with the leaves of an aromatic clover grown for the purpose. It is shaped like a truncated cone, 4 inches high, 3 inches in diameter at the base and 2 inches at the top. A comparatively small quantity is shipped into the United States under the name of Sap Sago, where it usually sells at a low price and is used as a grated cheese.

Trappist Cheese originated with the Trappists in 1885 in the monastery of Mariastern, near Banjaluka, in Bosnia. The fresh milk is used and rennet is added. The ripening period of the smaller cheeses is from 5 to 6 weeks in summer, but the cheese is usually shipped at the end of 4 or 5 weeks. It is pale yellow in colour and has a remarkably mild taste. The smallest size of the cheese made in the monastery referred to has a diameter of 6 inches, a height of 2 inches, and weighs 2 or 3 pounds. A larger size measures 9 inches in diameter, 2½ inches in height, and weighs about 10 pounds. There is also a still larger size. The cheese is exported to a large extent to Austria and Hungary, the most important centres of the trade in these regions being Gratz and Budapest. It is, however, found in all large cities of Austria, and the demand appears to be constantly increasing. This cheese is very probably the same as Port du Salut. A cheese which is probably identical with the Trappist, or Port du Salut, is made in the Trappist monastery at Oka, Canada, and is known as Oka cheese.

CHEESE INDUSTRY IN THE UNITED STATES

There are no definite records of when or where cheese was first made in the United States, but it was probably very early in the development of colonial agriculture. Cheese-making was well established in European countries when the new settlers came to America, and it is evident the practices and methods they established were those with which they were familiar in their native countries. Thus Cheddar cheese became the first variety of importance in New England, where the English colonists settled, and Swiss cheese has since become an important variety in Wisconsin where immigrants from Switzerland established a settlement.

Originally, cheese was made only on the farm, both in Europe and in America. The earliest records indicating the growth and importance of cheese-making in America are the export statistics of 1790, in which year the New England states, New York, and Pennsylvania, exported 145,000 pounds of farm-made cheese. Farm cheese production reached its peak about 1850, when factory production began. It is generally believed that Jesse Williams of Oneida County, New York, was the first to operate under a factory system, in 1851. By 1870, the factory production of cheese made up more than half of the total cheese made. Farm cheese production gradually declined, and has almost completely disappeared.

New York was the leading cheese-producing state for a long period, but as population increased and cities grew, cheese-making declined because of the greater profitableness of the fluid milk industry. Wisconsin now makes 10 times as much cheese as New York, and more than two-thirds of all the cheese made in this country. New York makes about half of the remaining third. Other states ranking well up in cheese production are Indiana, Illinois, Oregon, Minnesota, Michigan, and California. From $3\frac{1}{2}$ to 5 percent of the milk produced annually in the United States is made into cheese.

Many of the so-called foreign types of cheese could be made in the United States and would be made if the demand were sufficient. Cheddar cheese is by far the most important of the hard varieties made and consumed in this country, with Swiss cheese next. Cottage cheese and cream cheese make up about a fifth of the total.

Factory production of cheese in the United States, exclusive of cottage, pot, and bakers' cheese, now totals about 621 million pounds annually, about 6 times the highest figure ever reached by cheese made on farms. The varieties made in the United States, and the production for 1935, are shown in the following table:

	Thousand pounds
American Cheddar:	
Whole milk	468,999
Part skim	6,564
Full skim	225
Swiss cheese (including block)	42,622
Münster cheese	7,617
Brick cheese	29,905
Limburg cheese	9,535
All Italian varieties	10,628
Neufchâtel cheese	727
Cream cheese	38,244
All other varieties	5,890
Cottage, pot and bakers' cheese	109,579

In 1881, the United States was the largest cheese exporting country in the world, with a peak of nearly 148 million pounds that year never equalled since. Exports have gradually decreased until the amount is less than 2 million pounds annually. Seventeen countries export more cheese now than the United States. Imports of cheese into the United States reached a peak of 81 million pounds in 1928, but have since gradually declined, making this country about the fifth largest importer. The kinds of cheese imported, together with the amount, 1935, are as follows:

	(Pounds)
Emmenthaler	6,258,907
Romano or Pecorino	15,814,253
Reggiano or Parmesan	2,679,569
Procoloni or Procolette	6,319,052
Roquefort	1,995,769
All other types	15,865,093

Consumption of cheese in the United States has varied from 3·8 to 4·8 pounds per capita for the last 25 years, until in 1935 when consumption reached its peak of 5·2 pounds. The comparative consumption in various countries is as follows:

	Pounds per capita
United States (1935)	5·2
Canada (1934)	3·6
Australia (1933)	4·0
New Zealand (av. 1930–1932)	7·0
Great Britain (1931)	9·6
Norway (1932)	10·2
Germany (1933)	* 7·1
Sweden (1932)	11·5
France (1933)	16·6
Italy (1933)	11·0
Netherlands (1933)	15·4
Denmark (1934)	11·4
Switzerland (1932)	19·2

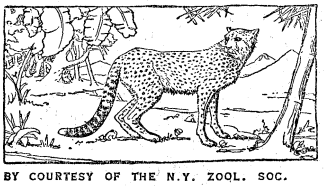
*Factory cheese

The quantity of cheese imported by England from various countries in 1935 is shown in the following table:

Country	Cwt. (112 pounds)
Australia	134,249
New Zealand	1,763,090
Canada	469,331
Other British countries	30,394
Netherlands	199,204
Switzerland	14,712
Italy	79,893
Other foreign countries	22,449
Total	2,713,322

(O. E. R.)

CHEETA, Cheetah, Chita or Hunting Leopard (*Acinonyx jubata*), a member of the family Felidae, distinguished by its claws being only partially retractile (*see* Carnivora). The cheeta attains a length of 3 to 4 ft.; it is of a pale fulvous colour, marked with numerous spots of black on the upper surface and sides, and is nearly white beneath. The fur is crisp, lacking the sleekness which characterizes the typical cats, and the tail is long and bushy at the tip. The cheeta is found on the plains of Africa and Southern Asia, and has been employed for centuries in India and Persia in hunting antelopes and other game. It is taken to the field hooded and chained in a low car without sides. When the game is within about 200 yards, the cheeta is loosed. Over short distances, the cheeta can probably outrun any other animal. In India the name cheeta is applied also to the leopard.



BY COURTESY OF THE N.Y. ZOOL. SOC.
THE CHEETA, OR HUNTING LEOPARD

CHEF, in French, a chief or head person; in English-speaking usage, the head-cook in a club or large private establishment, or the head of the kitchen department in a large hotel or commercial catering organization. In general a chef is responsible for the conduct and operation of the food preparation in a large kitchen. He directs the staff of cooks, bakers and others required to prepare food for serving. He plans meals, prepares menus and sees that sanitary practices are observed. If a chef-steward, he may be given complete control of kitchen, pantries and ice-boxes including all purchasing, and be expected to figure prices. If only a supervising chef, he is only responsible for the preparation of the food supplied to him from the stores department on requisition. He is usually expected to devise new recipes for preparing foods and more attractive ways for arranging them for service.

Every establishment preparing food on a large scale usually has a chef in charge of cooking operations. The constant growth of the hotel business and the commercial preparation of foods gives employment each year to a still larger number of chefs, though the requirements tend to become greater due to the demand for men having a more thorough knowledge of nutrition and food chemistry. For the most part, chefs are a product of an apprentice system. Young men start as assistant vegetable

man, or even lower in the culinary scale, pass through a long line of specialized cooking positions such as vegetable cook, fry cook, roast cook (*rossetier*), roundsman, at times as baker or butcher, pastry man, cold meat chef (*garde manger*), until finally they become chefs, a process requiring from 4 to 8 years and frequent changes of employment. Schools for chefs and cooks are practically non-existent in the U.S.A., though not unknown in Great Britain. The leading chefs in English-speaking countries have usually served an apprenticeship in central Europe or in France, whence they depart after completing their service. In some commercial establishments trained chemists and graduates from university schools of home economics often serve as chefs, though usually under a different title.

CHEFOO, former treaty port on the rocky north coast of the Shantung peninsula in northeast China (37° 33′ N., 121° 22′ E). The port is naturally sheltered by outlying islands and in recent years these have been linked up by breakwaters to form a fully protected harbour. The port is more properly Yentai, Chefoo being a village across the harbour. Population (1931) 131,661. The tangled hill country of Shantung rises immediately behind Chefoo and its communications with the interior are only by pack-mule trails. A branch line of the Tsingtao-Tsinan railway was once projected. Chefoo was opened to foreign trade in 1863. It retained 10th place among Chinese ports until 1907, but decreased in importance after that year. It was the market for the tussore silk industry of the Shantung hills and raw silk constituted its staple export. A special trade had grown up between Chefoo in Shantung and the port of Antung across the Po Hai. After the Japanese occupation in 1938 the trade between Chefoo and Japan-controlled territory increased. The total value of imports in 1940 was $10,948,565 (U.S.) and that of the exports was $7,003,944 (U.S.). Of this $2,819,055 (U.S.) entered Chefoo from Japan and $4,254,042 (U.S.) from Kwantung-leased territory, while the largest part of the export, $2,795,756 (U.S.), went to the U.S.A. The treaty port status of Chefoo was ended as a result of the English and U.S. treaties with China, Jan. 11, 1943, in which the foreign rights and privileges in China were given up.

CHEHALIS, a city of Washington, U.S.A., 33 mi. S. by W. of Olympia, 4m. S. of Centralia (*q.v.*); the county seat of Lewis county. It is on Federal highway 99, and is served by the four trans-Continental railways which serve Centralia, and also by the Cowlitz, Chehalis and Cascade railway. Its manufacturing industries include saw and shingle mills, brick and tile works, a cannery, fern packing and condensed-milk plants. The population in 1940 was 4,857.

CHEKE, SIR JOHN (1514–1557), English classical scholar, was one of the founders of Greek learning at Oxford. At St. John's college, Cambridge, where he became a fellow in 1529, he adopted the principles of the Reformation. In 1540, on Henry VIII.'s foundation of the regius professorships, he was elected to the chair of Greek. In a letter on the state of Greek learning at Cambridge to a fellow of St. John's college, Oxford, in 1542, his pupil, Roger Ascham, describes how Demosthenes had become as familiar as Cicero, and that Herodotus, Thucydides and Xenophon were more conned than Livy was in his student days. With Sir Thomas Smith, who shares with him the major part of the credit for the establishment of Greek studies at Cambridge, he introduced the "Erasmian" pronunciation of Greek in his lectures, rejecting the Italian and modern Greek method of giving various vowels and diphthongs the same sound, which the first western students had learned from Greek and Italian humanists. It was strenuously opposed in the university, where the "Reuchlinian" method favoured by Melancthon prevailed, and Bishop Gardiner, as chancellor, issued a decree against it (June 1542); but Cheke ultimately triumphed. On July 10, 1544, he was chosen tutor to Prince Edward, who retained him in that capacity after his accession to the throne. Cheke sat, as member for Bletchingly, for the parliaments in 1547 and 1552–1553; he was made provost of King's college, Cambridge (April 1, 1548), was one of the commissioners for visiting that university as well as Oxford and Eton, and was appointed with seven divines to draw up a body of laws for the governance of the church. On Oct. 11, 1551, he was knighted; in 1553 he was made one of the secretaries of State, and sworn of the privy council. He filled the office of secretary of State for Lady Jane Grey during her nine days' reign. In consequence Mary threw him into the Tower (July 27, 1553), and confiscated his wealth. He was released on Sept. 13, 1554, and granted permission to travel abroad. He went first to Basle, then visited Italy, giving lectures in Greek at Padua, and finally settled at Strasbourg, teaching Greek for his living. In the spring of 1556 he visited Brussels to see his wife; on his way back, between Brussels and Antwerp, he and Sir Peter Carew were treacherously seized (May 15) by order of Philip of Spain, hurried over to England, and imprisoned in the Tower. Cheke was terrified by a threat of the stake, and giving way, was received into the Church of Rome by Cardinal Pole, being cruelly forced to make two public recantations. He died in London on Sept. 13, 1557.

Thomas Wilson, in the epistle prefixed to his translation of the Olynthiacs of Demosthenes (1570), has a long and most interesting eulogy of Cheke; and Thomas Nash, in *To the Gentlemen Students,* prefixed to Robert Greene's *Menaphon* (1589), calls him "the Exchequer of eloquence, Sir Ihon Cheke, a man of men, supernaturally traded in all tongues." Many of Cheke's works are still in ms., some have been lost altogether. One of the most interesting from an historical point of view is the *Hurt of Sedition how greueous it is to a Communewelth* (1549), written on the occasion of Ket's rebellion, republished in 1569, 1576 and 1641, on the last occasion with a life of the author by Gerard Langbaine. Others are *D. Joannis Chrysostomi homiliae duae* (1543), *D. Joannis Chrysostomi de providentia Dei* (1545), *The Gospel according to St. Matthew . . . translated* (*c.* 1550; ed. James Goodwin, 1843), *De obitu Martini Buceri* (1551), (Leo VI.'s) *de Apparatu bellico* (Basel, 1554; but dedicated to Henry VIII., 1544), *Carmen Heroicum, aut epitaphium in Antonium Dencium* (1551), *De pronuntiatione Graecae . . . linguae* (Basel, 1555). He also translated several Greek works, and lectured admirably upon Demosthenes.

His *Life* was written by John Strype (London 1705, Oxford 1821); additions by J. Gough Nichols in *Archaeologia* (1860), xxxviii. 98, 127.

CHEKHOV, ANTON PAVLOVICH (1860–1904), Russian dramatist and story-writer, born on Jan. 17, 1860, in Taganrog on the Sea of Azov. This name is also spelled Tchekhov, Tchehov and Chehov. His father was a tradesman and the son of a serf. The writer was educated at the *gymnasium* of his native town, and in 1879 went to the University of Moscow, where he studied medicine. He took his degree in 1884 but practised very little (except during the cholera epidemic of 1892–93). He began his literary career while yet a student, and soon became one of the most welcome contributors to the comic papers. His early stories appeared over the signature Antosha Chekhonte. In 1886 some of his stories were published in book form (*Particoloured Stories*). The book had a great success and attracted the attention of the publisher and editor Suvorin, who became his friend.

In 1887 he produced his first play *Ivanov.* In 1890 he travelled to the convict island of Sakhalin and the result of his journey was *Saghalien Island* (1891), which had a considerable effect on the mitigation of the penal régime. From 1891 to 1897 he lived with his parents on a small estate he had acquired not far from Moscow. After 1897, as he was threatened with tuberculosis, he was forced to live the greater part of the year in the Crimea and abroad. In 1896 he produced his second play, *The Seagull,* which was a complete failure in St. Petersburg (Leningrad). But in 1898 it was revived by the Moscow Art theatre of Stanislavsky and proved a great success. Henceforward Chekhov's connection with that theatre became very close. *Uncle Vanya* (1899), *The Three Sisters* (1901) and *The Cherry Orchard* (1904) were produced there. In 1901 he married the actress Olga Knipper. In 1900 he was elected an honorary fellow of the Academy of Science, but resigned his fellowship when the election of Maxim Gorky was cancelled by the Government. He died on July 2, 1904, at Badenweiler in the Black Forest.

Early Work.—The early stories of Chekhov, up to about 1886, are chiefly humorous. They are, in Russia, the most widely popular part of his work, and more people know him by them than by *My Life* or *The Three Sisters.* Chekhov's humour is not strikingly above the level of the papers he wrote for. But very early he began to lay the foundations of that manner which is the essential Chekhov. Such a story as *The Chorus Girl* (1884) is almost

a mature masterpiece. It was, however, only after 1886 that he found the necessary leisure and independence to give definite expression to his imaginative experience. The years 1886–88 are a period of transition during which he experimented in various directions. To these years belong a series of stories of atmosphere against a background of nature (*The Steppe, Happiness, Easter Eve*) where the lyrical element of his genius received its fullest expression, and short stories of morbid experience in which the knowledge of the doctor is balanced by the sense of form of the artist. By 1889, however, he had attained perfection in his style. To this and the following years belong a succession of masterpieces, the principal of which are *A Dreary Story* (1889), *The Duel, Ward No. 6* (1892), *The Teacher of Literature* (1894), *Three Years: An Artist's Story,* in Russian *The House with the Maisonette* (1895), *Peasants* (1897), *The Darling, Ionitch, The Lady with the Dog* (1898), *The New Villa* (1899), *The Bishop* (1902).

Chekhov's art has been described as psychological, but his psychology ignores the individual. His characters are not persons but just men and women, the genus *homo,* an indifferentiated mass of humanity, divided into watertight compartments by the phenomenon of individuality, which does not make one being different from another but only inaccessible to him. A typical story by Chekhov is the life-story of a "mood," of a state of mind, usually of the relation of one person to another and the gradual transformation of that state of mind under the action of the incessant infinitesimal and unforeseen pinpricks of life. Sensitiveness to these pinpricks is the main feature of Chekhov's people, of those at least who are made to kindle the reader's sympathy, and the standard by which Chekhov gauges the worth of a human being. Those who suffer and succumb are the higher race, those who do not are unfeeling brutes. Hence a deep-rooted aversion (present in pre-Chekhov Russian literature, especially in Turgenev, but enormously magnified by Chekhov) for the strong and efficient man. None but "Hamlets" may receive sympathy.

The construction of Chekhov's stories may be described as musical or infinitesimal. It is at once fluid and precise. They are built along exactly calculated curves, of which only certain points are marked in the story, but each two points are sufficient to calculate the whole curve. The curve is the mood which begins as almost a straight line, then under the influence of "pinpricks" begins to deviate and at last shoots out in an entirely opposite direction. By far the greater number of Chekhov's stories end on a minor note, "not with a bang but a whimper." A story where the direction is in the opposite way, as in *The Lady with the Dog* (where the hero begins by regarding his love for the lady as a mere insignificant intrigue and ends in self-forgetful passion), is an exception. The "pessimistic," destructive, descendant tendency of the Russian novelists of the mid and later 19th century reaches its extreme expression in Chekhov, all the more extreme as it is so consistently muffled and "understated." To him, better than to anyone, the words of Albert Thibaudet apply, that a Russian story is always the story of the undoing of a life.

Somewhat apart from the other stories of Chekhov stand, what are perhaps his two masterpieces, *My Life* (1895) and *In the Ravine* (1900). They have a clearer and harder outline; they are free from the atmospheric, autumnal haze that pervades the others, and animated by a more active sense of moral and human values. *My Life,* especially, is a creation of vast and pregnant significance, with a symbolical grasp that gives it an almost religious character.

Chekhov's dramatic work consists of the same element as his narrative work. It includes numerous one-act plays which were extremely popular in Russia. Belonging to a later period than the comic stories, they are also on a higher artistic level. The serious plays are five in number—*Ivanov, The Seagull, Uncle Vanya, The Three Sisters, The Cherry Orchard.* They have many points in common with his stories; one main difference is that while the stories invariably centre round a single person from whose standpoint the situation is developed, the dramas have no such central figure, and all the characters have more or less equal rights on the stage. The plays are, as it were, symphonies for an orchestra of parts, and the resultant is arrived at by the complex interaction of the various voices. They are plays of "atmosphere," the English word that comes nearest to the Russian *nastroenie* (Stimmung). The principal thing in them is not the action but the emotional accompaniment of the action. In the "de-theatricalisation" of the theatre, in the complete avoidance of all traditional stage effects (though he introduced a new kind of "atmospheric" effect, as the famous string bursting at the end of *The Cherry Orchard*), Chekhov is the logical limit of the preceding development of the Russian drama. He did not go much further in this respect than Turgenev or Ostrovsky, but he built a more consistent dramatic system with a completely adequate technique.

The Novelist's Influence.—The influence of Chekhov on Russian literature has not been extensive. The last realists (Andreyev, Gorky, Bunin, etc.) learned little from him, and soon after his death the rise of an entirely new movement put an end to all possibility of continuing in his tradition. His plays were imitated by Gorky, Andreyev and others, but they invariably missed the constructive principle without which the whole system is stultified. To the Russia of to-day Chekhov is perhaps more alien than any other Russian writer of his rank.

On the other hand, his vogue and his influence outside Russia have of recent years grown immensely and were in 1927 probably near their zenith. England has proved particularly sensitive to his charm. He is almost universally regarded as the greatest Russian writer and as the greatest story-teller and dramatist of modern times. (D. S. M.)

BIBLIOGRAPHY.—*The Tales of Tchehov* (13 vols., trans. C. Garnett, 1916–22); *Letters of A. Tchehov* (trans. C. Garnett, 1920); *The Notebooks of A. Tchehov, together with Reminiscences of Tchehov by Maxim Gorky* (trans. S. S. Koteliansky and L. Woolf, 1921); *The Plays of Tchehov* (2 vols. trans. C. Garnett, 1923, etc.); *Letters on Literary Topics* (trans. Louis Friedland, 1924); *The Life and Letters of A. Tchehov* (trans. S. S. Koteliansky and P. Tomlinson, 1925); *Letters of A. P. Tchehov to O. L. Knipper* (trans. C. Garnett, 1926); some hitherto unpublished letters have been edited by N. K. Piksanov at Moscow under the title of *Nesobrannye Pisma* (1928). *See* also L. Shestov, *Anton Tchehov* (1916); W. Gerhardi, *Anton Chehov* (1923); S. S. Koteliansky, *Anton Tchekhov, Literary and Theatrical Reminiscences* (1927).

CHEKIANG, the smallest but one of the most famous and densely peopled provinces of China. Area 40,169 sq.mi.; pop. 21,776,045 (1940). It is the most northerly of the coastal provinces of south China and is situated where the southwest to northeast ridges, so characteristic of southeast China, begin to sink beneath the alluvial plains of the delta of the Yangtze Kiang. The province falls naturally into two physiographic regions demarcated by the Tayu-ling, the northernmost ridge, which runs out to sea in the Chusan archipelago. The southern region consists of ridges and troughs parallel to the Tayu-ling and cut across by a number of transverse rivers. At the mouth of the largest of these, the Wu-kiang, lies Wenchow, the chief port of southern Chekiang. The northern region, drained for the most part by a single river, the Tsien-tang, with its outlet in Hangchow bay, consists essentially of the alluvial plains round the bay and of the foothills of the highlands. These northern plains are the most densely peopled part of the province participating in the life of the Yangtze delta and containing the well-known seaport of Ningpo and the beautiful capital city of Hangchow. This northern part of the province therefore resembles southern Kiangsu, while the rest is essentially similar to Fukien, which succeeds it on the south. Away from the plains around Hangchow bay flat land is rare and terraces stretch far up the mountain slopes.

The crops—wheat and beans, rice and cotton, tea and silk—are typical of mid-China, where the products characteristic of north and south overlap. On the slopes of the maritime ranges some of the best tea grown in the country is produced. The historical role of the province and many aspects of its culture reflect the pivotal position of Chekiang. Before the consolidation of China in the 3rd century B.C. north Chekiang was the core of the maritime state of Yüeh, which finally gained the mastery over the whole Yangtze delta. During the 12th and 13th centuries A.D. it had a larger significance, for Hangchow was then the capital of what remained of China to the Sung dynasty, retreating south-

wards before the Kin Tatars, and, after the Mongol conquest, it remained the acknowledged centre of Mangi. (*See* CATHAY.)

The province suffered severely through the Japanese invasion. After the fall of Hangchow, Christmas 1937, the Tsientang river temporarily formed the military line. Early in 1942 the Japanese attacked the airfields in western Chekiang and remained in possession of part of the territory. The occupation combined with deliberate destruction of Chinese sericulture brought great economic distress, little compensated by government sponsored development in the free part of the province.

Chekiang is linguistically divided. In the north, Wu dialects prevail, as in southern Kiang-su. The southwest speaks Mandarin as does neighbouring Kiangsi. In the south, Fukien dialects transgress the border.

CHELLEAN, the name given by the French anthropologist G. de Mortillet to the first epoch of the Quaternary period when the earliest human remains are discoverable. The word is derived from the French town Chelles in the department of Seine-et-Marne. The Chellean epoch was interglacial, warm and humid as evidenced by the wild growth of fig-trees and laurels. The animals characteristic of the epoch are the *Elephas antiquus,* the rhinoceros, the cave-bear, the hippopotamus and the striped hyaena. Man existed and belonged to the Neanderthal type. The implements characteristic of the period are flints chipped into leaf-shaped forms and held in the hand when used. There is clear evidence of phases of Chellean industry—both in a simple and an advanced stage.

See Gabriel de Mortillet, *Le Préhistorique* (1900); M. C. Burkitt, *Prehistory* (1925); H. Peake and H. J. Fleure, *Apes and Men* (1927).

CHELM (Russian *Kholm*), a town of Poland, in the province of Lublin, 45 mi. by rail E.S.E. of Lublin. Pop. (1931) 29,224. It was founded in 1223 by Prince Daniel of Volhynia. Germany occupied Chelm during World War II.

CHELMNO (German *Kulm*), a small town of Poland, in the province of Pomorze (Pomerania), 1 mi. E. of the Vistula. Pop. (1931) 12,533. It is surrounded by 13th century walls, and contains two Roman Catholic and two Protestant churches and a mediaeval town-hall. There are large oil mills and an important trade in agricultural produce, including fruit and vegetables. Granted in 1226 by Conrad of Mazovia to the Teutonic Order, it became the base for their conquest of Prussia and the seat of the first Prussian bishopric. It always retained a large Polish population, which revolted against the Order and was re-annexed to Poland by the peace of Thorn in 1466. It was part of Prussia from 1773 to 1918, and Germany occupied it again during World War II. It was a prominent member of the Hanseatic League.

CHELMSFORD, FREDERICK JOHN NAPIER THESIGER, 1ST VISCOUNT (1868–1933), British administrator, born on Aug. 12, 1868, was the eldest son of Frederick Augustus, 2nd Baron Chelmsford. He was educated at Winchester and Magdalen college, Oxford, and held a fellowship at All Souls from 1892 to 1899. Having been called to the bar he was a member of the London school board for four years, and in 1904–5 served on the London county council. In the latter year, when he succeeded his father as Baron Chelmsford, he was appointed governor of Queensland and he held that office till 1909. These years saw the inauguration of the new policy of replacing the repatriated Kanakas by white labour. It was also a period of bitter political conflict. Chelmsford's action in granting the request of the premier, Philp, for a dissolution of parliament led to widespread agitation for the appointment of local governors in Australia. In Aug. 1909 Chelmsford left Queensland for New South Wales, of which State he was governor till 1913. It was a period of great development for the colony, and also of great labour unrest.

Chelmsford, who was created G.C.M.G. in 1912, served in India with the Dorset regiment in the early part of the World War. From April 1916 to the spring of 1921 he was viceroy of India. During this period the system of dyarchy, founded upon the joint report of the viceroy and the secretary of State, E. S. Montagu, was introduced. A considerable measure of autonomy was accorded to the provinces. The council of State and legislative assembly were to be elected, and the annual budget, with some reservations, submitted to the latter. Indians were given representation on the viceroy's council, and India was given the same power over tariffs as the Dominions.

But the new reforms were opposed by a combination of Hindus and Muslims under Gandhi, and a system of non-co-operation adopted, whilst the repressive legislation recommended by Mr. Justice Rowlatt's committee to deal with sedition provoked serious riots in Guzerat and the Punjab, culminating in the Amritsar disturbances (April 1919). However, an amnesty for political offences accompanied the promulgation of the reforms which were gradually accepted by moderate opinion. Meanwhile the viceroy had also to meet a Mohammedan agitation directed against British policy toward Turkey. This was actively supported by an Afghan army, after whose defeat the subsidy was withdrawn from the Amir, together with the privilege of importing arms from India. The new institutions were inaugurated by the duke of Connaught early in 1921. On his retirement Chelmsford was created a viscount and received Indian orders. He was first lord of the admiralty in Ramsay MacDonald's Labour Ministry of 1924. He died April 1, 1933. (G. LE G. N.)

CHELMSFORD, FREDERIC THESIGER, 1ST BARON (1794–1878), lord chancellor of England, was the third son of Charles Thesiger, and was born in London on April 15, 1794. Young Frederic Thesiger was originally destined for a naval career, and he served as a midshipman on board the "Cambrian" frigate in 1807 at the second bombardment of Copenhagen. About this time he succeeded to a valuable estate in the West Indies, so he left the navy and studied law, with a view to practising in the West Indies, and eventually managing his property in person. But a volcano destroyed the family estate, and he was thrown back upon his prospect of a legal practice in the West Indies. He entered Gray's Inn in 1813, and was called on Nov. 18, 1818. Godfrey Sykes, whose pupil he was, advised him to try his fortunes in England. He accordingly joined the home circuit and practised at the Surrey sessions, also buying the right to appear at the old palace court (*see* LORD STEWARD).

In 1824 he distinguished himself by his defence of Joseph Hunt when on his trial at Hertford with John Thurtell for the murder of William Weare; and eight years later at Chelmsford assizes he won a hard-fought action in an ejectment case after three trials, to which he attributed so much of his subsequent success that when he was raised to the peerage he assumed the title Lord Chelmsford. In 1834 he was made king's counsel, and in 1835 was briefed in the Dublin election inquiry which unseated Daniel O'Connell. In 1840 he was elected M.P. for Woodstock. In 1844 he became solicitor-general, but having ceased to enjoy the favour of the duke of Marlborough, lost his seat for Woodstock and had to find another at Abingdon. In 1845 he became attorney-general, holding the post until the fall of the Peel administration on July 3, 1846. Thus by three days Thesiger missed being chief justice of the common pleas, for on July 6 Sir Nicholas Tindal died, and the seat on the bench, which would have been Thesiger's as of right, fell to the Liberal attorney-general, Sir Thomas Wilde. In 1852 he became M.P. for Stamford. On Lord Derby coming into office for the second time in 1858, Sir Frederic Thesiger was raised straight from the bar to the lord chancellorship (as were Lord Brougham, Lord Selborne, and Lord Halsbury). In the following year Lord Derby resigned. Again in 1866, on Lord Derby coming into office for the third time, Lord Chelmsford became lord chancellor for a short period. In 1868 Lord Derby retired, and Disraeli, who took his place as prime minister, wished for Lord Cairns as lord chancellor. Lord Chelmsford died in London on Oct. 5, 1878. He had married in 1822 Anna Maria Tinling, and left four sons and three daughters, of whom the eldest, Frederick Augustus, 2nd Baron Chelmsford (1827–1905), earned distinction as a soldier, while the third, Alfred Henry Thesiger (1838–80), was made a lord justice of appeal and a privy councillor in 1877, at the age of 39, but died only three years later.

See *Lives of the Chancellors* (1908), by J. B. Atlay, who had the advantage of access to an unpublished autobiography of Lord Chelmsford.

CHELMSFORD, market town and municipal borough, and the county town of Essex, England, 30 mi. E.N.E. from London by the L.N.E.R. Pop. (1938) 31,400. Area 7.4 sq.mi. It lies in the Chelmer valley at the confluence of the Cann, and has communication by river with Maldon and the Blackwater estuary 11 mi. east. Chelmsford (*Chilmersford, Chelmeresford, Chelmesford*) owed its mediaeval importance to its position on the road from London to Colchester. It consisted of two manors: that of Moulsham, which remained in the possession of Westminster abbey from Saxon times till the reign of Henry VIII and that of Bishop's hall which was held by the bishops of London from the reign of Edward the Confessor to 1545. The mediaeval history of Chelmsford centred round the manor of Bishop's hall. Early in the 12th century Bishop Maurice built the bridge over the Chelmer which brought the road from London directly through the town, thus making it an important stopping place. The town was not incorporated until 1888. In 1225 Chelmsford was made the centre for the collection of fifteenths from the county of Essex, and in 1227 it became the regular seat of assizes and quarter-sessions. The parish church of St. Mary is a Perpendicular building, largely rebuilt. The grammar school was founded in 1551 by Edward VI. In 1199 the bishop obtained the grant of a weekly market, and in 1201 that of an annual fair, now discontinued, for four days from the feast of St. Philip and St. James. The town has a large agricultural market and a corn exchange in the centre of the square. There are agricultural implement and iron foundries, electrical and engineering works and extensive corn mills. There is a racecourse 2 mi. S. of the town. The see of Chelmsford, founded in 1914, includes the whole of Essex and part of Suffolk and Kent. At the former radio station there the first wireless telephone broadcasting service in the world was transmitted Feb. 23, 1920. The borough is in the Chelmsford parliamentary division of Essex.

CHELMSFORD, a town of Middlesex county, Massachusetts, U.S.A., in the N.E. part of the state, adjoining the city of Lowell. It lies on both sides of the Concord river, and is served by the New York, New Haven and Hartford railroad. Pop. (1940) 8,077. It has numerous factories. Chelmsford is first mentioned in the records of the state in 1655. Lowell was set off in 1826.

CHELSEA, a western metropolitan borough of London, England, bounded E. by the city of Westminster, N.W. by Kensington, S.W. by Fulham, and S. by the river Thames. Pop. (est. 1938) 56,050. Area, 1 sq.mi. Its chief thoroughfare is Sloane street, running south from Knightsbridge to Sloane square. From Chelsea King's road leads west, a commercial highway, named in honour of Charles II and recalling the private road from St. James's palace to Fulham. The main roads south join with the Victoria or Chelsea, Albert and Battersea bridges over the Thames. The Chelsea embankment, planted with trees and lined with fine houses and, in part, with public gardens, stretches between Victoria and Battersea bridges. The residential portion is eastern Chelsea near Sloane street and along the river. Chelsea, especially the riverside district, has many historical associations. At *Cealchythe* a synod was held in 787. A similar name occurs in a Saxon charter of the 11th century and in Domesday; in the 16th century it is *Chelcith*. The later termination *ey* or *ea* was associated with the insular character of the land, and the prefix with a gravel bank (*ceosol; cf.* Chesil bank, Dorsetshire); but the early suffix *hythe* commonly means a haven. The manor was originally in the possession of Westminster abbey, but its history is fragmentary until Tudor times. Henry VIII passed it to his wife Catharine Parr. It fell afterwards to the Howards and the Cheynes, and later to the Cadogans. The memorials in St. Luke's (the old church) include those of Sir Thomas More (d. 1535); Lord Bray, lord of the manor (1539); Lady Jane Guyldeford (1555); Lord and Lady Dacre (1594–1595); Sir John Lawrence (1638); Lady Jane Cheyne (1698); Francis Thomas, "director of the china porcelain manufactory, Lawrence Street, Chelsea" (1770); Sir Hans Sloane (1753); Thomas Shadwell, poet laureate (1692); Woodfall, the printer of *Junius* (1844), and many others. The church, which had never been "restored," was ruined in World War II, though the chapel built by More still stands. Happily, most of the fine monuments were rescued, many almost undamaged. In the 18th and 19th centuries Chelsea was a literary and artistic quarter. Atterbury and Swift lived in Church lane, Steele and Smollett in Monmouth house. Later, Turner, Rossetti, Whistler, Leigh Hunt, Carlyle (whose house in Cheyne row is preserved as a public memorial), Lord Courtney, Count D'Orsay and Isambard Brunel are connected with Chelsea. At Lindsey house Count Zinzendorf established a Moravian society (*c.* 1750). Sir Robert Walpole's residence was extant till 1810, and till 1824 the bishops of Winchester had a palace in Cheyne walk. Queen's (Tudor) house was the home of D. G. Rossetti.

Ranelagh (*q.v.*) in the second half of the 18th century, and Cremorne gardens (*q.v.*) in the middle of the 19th, were famous places of entertainment. Don Saltero's museum contained curiosities from Sir Hans Sloane's famous collections. Sloane gave the Apothecaries' company ground for the Physick garden, which ceased in 1902 to be maintained by the company. The original Chelsea bun-house, claiming royal patronage, stood until 1839, and one of its successors until 1888. The porcelain works existed for some 25 years before 1769, when they were sold and removed to Derby. Chelsea Royal hospital for invalid soldiers, initiated by Charles II and opened in 1694 is well known. A system of outpensioning was found necessary from the outset, and it relieves large numbers throughout the empire. The picturesque building by Wren, the great hall of which was damaged during World War II, stands in extensive grounds, which include the former Ranelagh gardens, site of the annual showing of the Royal Horticultural society. Crosby hall, with new buildings adjacent to it, was opened in 1927 as a residence hall for university women. The hall, built by Sir John Crosby in Bishopsgate in 1466, was removed thence to a site on Sir Thomas More's former garden in 1910 to save it from demolition. The Chelsea public library contains an excellent collection relative to local history. Chelsea returns one member to parliament.

CHELSEA, a city of Suffolk county, Massachusetts, U.S.A., on a peninsula between the Mystic and the Chelsea rivers, opposite the Charlestown and East Boston districts of the city of Boston, and bounded on the north by the city of Everett. It has 3 mi. of water front on upper Boston bay; and is served by the Boston and Maine and the Boston and Albany railways. The population in 1920 was 43,184, of whom 17,198 were foreign-born white (10,042 from Russia and Poland); and in 1940 was 41,259 by the federal census. The central part of the city was practically rebuilt after 1908, when, on April 12, it was swept by a terrible fire. Chelsea is primarily an industrial city, with some 200 factories making products valued at over $50,000,000 annually. Its industries are lithography, manufactures of shoes, shoe cut stock and findings, car wheels, rubber products, bakery products, foundry and machine-shop products, canned fish, furniture, chemicals, paints, wallpaper, elastic webbing, boxes, marine clocks and creosote products. It is a centre for junk salvage, with 2,020 dealers in many kinds of waste material. A U.S. naval hospital, local headquarters of the coast guard of the treasury department and the Massachusetts Soldiers' home are situated there. The assessed valuation of property in 1941 was $44,500,000. Chelsea (called Winnisimmet until 1739) was settled in 1624 by Samuel Maverick, a prominent loyalist and churchman, the first settler on Noddle's island (East Boston) and one of the first slaveholders in the colony. It was set off from Boston as a separate town in 1739, and was chartered as a city in 1857. In May, 1775, a British schooner in the Mystic river was captured by colonial militia under Gen. John Stark and Israel Putnam.

CHELSEA HOSPITAL. The Royal Hospital, Chelsea, to give the institution its full title, was founded by Charles II. Tradition has it that Nell Gwynne moved the king to build the hospital, but it is probable that the idea originated with Sir Stephen Fox, who had been a paymaster general to the forces. Christopher Wren was the architect, and the building was completed in 1692. Many military trophies are preserved at the hospital, including the colours captured at Blenheim and Waterloo, and there is a fine collection of medals and pictures in the Great hall.

The candidates for a Chelsea In-Pension must be Out-Pensioners, *i.e.* in receipt of either a service, disability or campaign pension. Candidates must be 55 years of age, unless through loss of limb or other disability, the result of army service, they are considered eligible for admission to In-Pension at an earlier date. The establishment of In-Pensioners is 558. The candidates must be capable of looking after themselves. In-Pensioners may leave the hospital and revert to Out-Pension if they so wish, but unless there are some exceptional reasons such men are not again admitted to In-Pension.

In addition to the In-Pension establishment, the Board of Commissioners administer long service pensions, special campaign pensions, and deal with disability pensions other than those arising from the World War and earlier wars, which are administered by the Ministry of Pensions. They also approve, after investigation, the applications of pensioners who desire to receive a commuted sum in lieu of a portion of pension for the purpose of house purchase, etc. The number of men on the Army Pension List administered by the Commissioners of the Royal Hospital was in 1927 approximately 103,000.

CHELTENHAM, a municipal and parliamentary borough and watering place of Gloucestershire, England, with railway stations on the L.M.S. and G.W. railways. Pop. (1938) 51,900. Area 8 sq.mi. The town, modern in appearance, is well situated in the valley of the Chelt, a small tributary of the Severn, under the high line of the Cotswold hills to the east.

Cheltenham (*Celtanhomme, Chiltham, Chelteham*), an early settlement, had a church in 803. The manor belonged to the crown; it was granted to Henry de Bohun, earl of Hereford, in the 12th century, but in 1199 was exchanged for other lands with the king. In 1252 the abbey of Fécamp purchased the manor, and it afterwards belonged to the priory of Cormeille, but was confiscated in 1415 as the possession of an alien priory, and was granted in 1461 to the abbey of Lyon, by which it was held until once more returning to the crown at the Dissolution, it went to the family of Dutton. The town is first mentioned in 1223, when the benefit of the markets, fairs and hundred of Cheltenham was leased to the men of the town for three years; Henry III renewed the lease in 1226, and in 1230 granted a Thursday market, also a three-day fair on July 24. A market town in the time of Camden, it was governed by commissioners from 1852 till 1876, when it was incorporated. It became a parliamentary borough in 1832, returning one member. After the discovery of mineral springs in 1716, and the erection of a pump room in 1738, Cheltenham rapidly became fashionable, the visit of George III and the royal princesses in 1788 ensuring its popularity.

The Montpellier and Pittville springs supply handsome pump rooms in public gardens, and are the property of the corporation. The parish church of St. Mary is 14th century, but is almost completely modernized. A new town hall, including a central spa and assembly rooms, was opened in 1903. The free grammar school (1576) is the oldest local school. The public schools for boys (Cheltenham college, 1843) and for girls (Ladies' college, Cheltenham, 1854) are very well known. A training college for teachers was founded 1846.

Leckhampton hill, adjoining the town and comprising about 200 ac., was bought by the corporation.

CHELYABINSK, a region and town in the Uralsk area of the Russian S.F.S.R. The region has an area of 62,741 sq.mi. Pop. (1939) 2,802,949; urban 1,181,871, rural 1,621,078. It is dotted with forest, marsh and lake, but 59.2% is under cultivation (wheat, oats, rye, millet, peas, etc.). Cattle, sheep, horses and pigs are reared and coal is mined, 200,000 tons being extracted in 1924–25, a total in excess of pre-World War I production. There are flour mills, brandy distilleries, breweries and other factories for food products. The town of Chelyabinsk, lat. 55° 8′ N., long. 61° 35′ E., pop. (1939) 273,127, is a trading centre for coal and Siberian grain. Manufactures of agricultural implements and leather goods are carried on, and the town has an elevator and a radio station. It is connected by rail with the north through Sverdlovsk (formerly Ekaterinburg), with the east, as the beginning of the trans-Siberian railway, and with the west through Zlatoust and Ufa. It was founded in 1658. During the Civil War following the 1917 revolution Chelyabinsk was for a time the headquarters of the Czechoslovak legion and the scene of much internecine warfare.

CHELYS, the common lyre of the ancient Greeks (Gr. χέλυς, tortoise), which had a convex back of tortoise-shell or of wood shaped like the shell. According to tradition Hermes was attracted by sounds of music while walking on the banks of the Nile, and found that they proceeded from the shell of a tortoise across which were stretched tendons which the wind had set in vibration (*Homeric Hymn to Hermes,* 47–51). The word has been applied arbitrarily since classical times to various stringed instruments.

CHEMICAL ACTION is said to occur whenever the properties of a substance are so completely altered that we are entitled to regard the product as a new and distinct substance. In the burning of coal, for example, a combustible, black solid is chemically changed by union with the oxygen of the air, to produce ash, water vapour and gases, all of which differ from the original coal in all their important properties. The chemist pictures the properties of every substance as being determined by the chemical make-up of its molecules, *i.e.,* by the nature of the atoms which are contained in each molecule of the given substance, and the manner of their arrangement. Thus water is different from carbon disulphide because the molecules of water contain atoms which are different from those contained in molecules of carbon disulphide: on the other hand the molecules of grape sugar (glucose) and fruit sugar (fructose) contain identical atoms in identical proportions but the properties of these substances are nevertheless different because the atoms are differently arranged in the two kinds of molecules.

The complete change of properties which is associated with chemical action is therefore to be considered as being accomplished by the recombination or rearrangement of atoms to produce new sorts of molecules. The science of chemistry (*q.v.*) is mainly concerned with the study of chemical change. The details thus far accumulated are commonly presented in chemical text-books under headings that correspond with the various individual elements. The general results and such principles as are generally applicable to chemical change, form the subject-matter of physical chemistry (*see* CHEMISTRY: *Physical*), and of these the present article deals with a few which are related most intimately to the factors that determine *how quickly* a given chemical change may be accomplished.

CHEMICAL REACTION VELOCITY

The variation in the speed of chemical change and its dependence on the nature of the reacting substances is illustrated on the one hand by the almost instantaneous change (explosive reaction) which transforms a stick of dynamite into gaseous products, and on the other, by the very slow change by which a steel girder is converted into a pile of iron rust, a process which may require thousands of years. It will only be possible to explain why some changes proceed so rapidly and others with such extreme slowness when we are able to state the cause of chemical change in general. At present, we can merely conclude that this is due to the action of electrical forces, the nature of which we are beginning to understand as the result of recent observations which have provided us with information concerning the inner structure of the atoms themselves. (*See* ATOM.) It usually happens, as Julius Thomsen (1854) and Marcellin P. E. Berthelot (1867) first emphasized, that rapid and energetic chemical reactions take place with the liberation of greater quantities of heat than sluggish reactions although this rule is subject to many exceptions.

A second factor determining the speed of chemical change is *the concentration of the reactants.* By this we mean the amounts of the different reacting substances in unit volume. Thus C. F. Wenzel, in 1777, observed that metals dissolve in moderately concentrated acids more rapidly than they do in very dilute acids. Indeed it was soon recognized, as a result of the work of Claude Louis Berthollet in 1803, that whether a given chemical change or its reverse takes place sometimes depends only on the concentrations in which the several reacting substances are brought

together. In such instances the effect of concentration outweighs the effect of the nature of the reacting substances, loosely termed "chemical affinity." The earliest accurate observations of the effect of concentration on the velocity of chemical changes were made by L. Wilhelmy (1850), who showed that the rate of conversion of cane sugar into glucose and fructose in the presence of an acid is at every moment very nearly proportional to the concentration of the cane sugar. These observations constituted the first definite proof that the influence of the concentration of a reacting substance can be quantitatively stated, but did not lead to any generalized statement.

It is only in the simplest type of chemical change, in which the change may be accomplished with a single molecule of a given reactant, that the velocity of the change is proportional to the first power of the concentration of that reactant. If n molecules of a reactant are required to accomplish the chemical change the velocity of the change is proportional to the nth power of the concentration of that reactant. In many cases n will be indicated by the chemical equation for the change. Thus $2H_2+O_2=2H_2O$, indicates that the formation of water from hydrogen and oxygen demands two molecules of hydrogen for every molecule of oxygen, and thus that the rate at which water is formed at any given temperature is proportional to the first power of the concentration of oxygen but to the square of the concentration of hydrogen. In more complicated reactions, however, the chemical equation gives no clue to the power to which the concentration must be raised in calculating reaction velocity, for the chemical equation often expresses only the total effect and final result of a series of simpler consecutive chemical changes, the slowest of which determines the speed at which the series of changes as a whole may be accomplished. *Changes in pressure* are without effect on the velocity of chemical change, save in so far as pressure may determine concentration, as happens especially with mixtures of gases.

A third factor which affects the velocity of chemical change is the *temperature*. With rare exceptions, which can be readily explained, an increase of temperature increases the rate at which a chemical change will take place. Milk quickly turns sour on a warm day; and a mixture of hydrogen and oxygen, prepared safely enough at room temperature, explodes when it is heated by an electric spark. Commonly an increase of 1° C increases the velocity of a chemical change 10% or more, and most reactions at the temperature of boiling water proceed with several hundred times the velocity observed at room temperature. This striking effect of temperature is examined mathematically later.

A fourth factor is *the presence or absence of particular substances which may increase or diminish the velocity of the chemical change, without being themselves permanently altered.* Thus the velocity of a reaction between substances dissolved in water is different from the velocity of the same reaction, when the solvent is alcohol or benzene. Certain chemical reactions, including many of the most important in animals and plants, appear only to take place in the presence of these substances, which apparently need only be present in relatively small quantities. Changes of this sort are grouped under the head of *catalytic action,* or *catalysis* (*q.v.*); the substances essential to bring about the chemical changes between the reactants are called *catalysts,* or, in the case of the animal and plant ferments, *enzymes* (*q.v.*). The phenomena of catalysis and adsorption (*q.v.*) are closely connected with reaction velocity.

Finally, the velocity of a chemical change may be determined by the supply of energy to the reacting system from an external source. If this is light energy we have the phenomena of *photochemistry* (*q.v.*); if electrical energy, the velocity of the reaction will depend on the principles discussed under *electrochemistry* (*q.v.*), especially the laws of Faraday. (*See* ELECTROLYSIS.) The transformations of matter which occur in radioactive changes (*see* RADIOACTIVITY) differ from ordinary chemical changes in proceeding at rates which are determined entirely by the inner structure of the atoms of the radioactive elements, and are thus quite independent of the states of combination of those elements and even of the temperature.

CHEMICAL EQUILIBRIUM

Law of Mass Action.—We have referred to the observation of Berthollet that the concentration of the reactants is often sufficient to determine whether a given reaction or its reverse will take place. In this way we may explain why it so often happens that a chemical change fails to become complete, and comes to an apparent halt before the reacting material has been completely transformed. Evidently the forward reaction, transforming reactants A and B into resultants A′ and B′, is accompanied by a reaction which transforms A′ and B′ into A and B. Thus each reaction offsets the other, and the chemical change accordingly remains incomplete. The result is chemical equilibrium, commonly formulated with reversed arrows, thus:

$$A+B \rightleftarrows A'+B'$$

The proportions in which the different reactants are present in a mixture of substances which have attained a condition of chemical equilibrium are determined by a principle discovered by C. M. Guldberg and P. Waage in 1867. These investigators showed that the state of equilibrium attained in a reversible reaction can be interpreted on the assumption that the equilibrium state is the result of the equality of the speeds of the two opposed reactions, for each of which the velocity v or v' can be expressed in terms of a constant multiplied by *the concentrations of the reacting substances,* expressed by [A], [B], or [A′], [B′]. The velocities of the two opposed reactions are therefore given by $v=k$ [A]·[B] and $v'=k'$ [A′]·[B′]. At equilibrium these two velocities are equal, hence

$$k/k'=[A'][B']/[A][B]=K$$

in which K is the so-called equilibrium constant. If the reaction corresponds with

$$mA+nB \rightleftarrows m'A'+n'B',$$

the equilibrium constant may be written

$$K=\frac{[A']^{m'}[B']^{n'}}{[A]^m[B]^n}.$$

The practical importance of a knowledge of equilibrium constants, calculated as just shown, will be realized when it is remarked that *the equilibrium constant for any given reaction at a given temperature is independent of the concentrations in which the reactants are brought together.* Thus when the numerical value of the constant has once been determined we may substitute this in the preceding equations, and determine the proportions in which the reactants and resultants will be intermingled when equilibrium is reached, starting from any given initial concentrations.

Though the mathematical expressions just given (commonly called *mass-action* expressions) may be regarded as empirical statements of actual laboratory experience with systems in chemical equilibrium, nevertheless they may readily be derived from the *kinetic theory.* (*See* MOLECULE.) It may be assumed in the simplest case that the interaction of two reactants A and B is the result of collision between the respective molecules. It follows that the rate of change should be proportional to the frequency with which such collisions occur. The frequency with which a given molecule of A collides with molecules of B is proportional to the number of the latter in unit volume, *i.e.,* the molecular concentration of B; and in the same way the frequency of the collisions between a given molecule of B and the molecules of A is proportional to the molecular concentration of the latter. The total number of collisions between the molecules of A and B is therefore proportional to the product of the molar concentrations. Kinetic considerations thus led to $v=k[A][B]$ which is the expression for the reaction velocity, embodied in mass-action expressions above. The coefficient k in this formula is called the *specific reaction rate,* and represents the velocity when the concentrations of the two reacting substances are each equal to unity. It depends on the nature of the reacting substances, the temperature, and the medium (solvent) in which the reaction occurs. In the case of gaseous reactions there is no solvent to be considered, but it may be noted that many apparently gaseous reactions are in reality surface reactions, *i.e.,* reactions which take

place largely, if not entirely, on the surface of the walls of the containing vessel. (*See* ADSORPTION.)

Influence of Temperature on Reaction Velocity.—The principal weakness of the explanation which makes chemical change depend solely on collisions between molecules, is that the velocity should be approximately the same for all reactions of the same type under like conditions of temperature and concentration. Actually rate of chemical change is a highly specific quantity, which varies widely from one reaction to another. Moreover, if we conceive of reaction rate as depending altogether on the frequency of collisions between molecules, we find it impossible to account for the extraordinary influence of temperature on reaction rate. In the simplest cases, an increase of temperature of 10° C would speed up the molecules sufficiently to make collisions between them several per cent more frequent, whereas reaction velocity in that temperature range is actually increased several hundred per cent. The simplest way of explaining this involves the assumption that molecular collision is not always followed by chemical change. Collision between molecules, when reactants A and B are transformed into resultants A′ and B′, is a *necessary* but not *sufficient* condition for reaction.

We have then to account for the fact that the proportion of the colliding molecules which react grows rapidly larger as the temperature is increased. We might assume that reaction takes place only when molecules collide that happen to have velocities exceeding some stated critical velocity. Yet the proportion of such molecules, calculated from Maxwell's *law of distribution of velocities* (*see* MOLECULE), does not increase with increasing temperature in a way that fits the experimental facts. Actually, as was first pointed out by Svante Arrhenius (1889), the specific reaction rate k for many common reactions varies with the temperature in a way that may be explained by assuming that only a very small proportion of the molecules are in a condition to react on collision. In other words the vast majority of collisions do not result in chemical change but this only takes place when the energy content of the colliding molecules is much greater than the average. The proportion (α) of the effective collisions increases rapidly with the temperature and if the extra energy (energy of activation) required at the absolute temperature T is represented by q, then the empirical relation of Arrhenius for the connection between reaction velocity and temperature may be put in the form

$$dln\alpha/dT = q/RT^2 \quad \text{or} \quad \alpha = e^{-q/RT}.$$

At a given temperature, the value of α thus depends on the magnitude of q and diminishes as q increases. When the concept of active molecules is incorporated in the mass action equation, this becomes

$$v = k \cdot e^{-q/RT} \cdot [A] \cdot [B]$$

in which q represents the extra energy of the impact which is required for the collisions between molecules of A and B to be effective.

This discussion neglects the possibility that even molecules possessed of the requisite supply of energy may not react when they collide unless they happen to be disposed in favourable positions with respect to each other at the moment of collision. A collision between molecules of ethyl alcohol and acetic acid, for example, would not be expected to produce a molecule of ethyl acetate unless the hydroxyl and carboxyl groups are favourably placed when collision takes place. Neglecting this difficulty, the coefficient k can be evaluated in terms of specific and general constants and the equation for the bimolecular reaction becomes

$$v = N\sigma^2\sqrt{[8\pi RT(1/m_A + 1/m_B)]} \cdot e^{-(q_A+q_B)/RT} \cdot [A] \cdot [B]$$

in which N is the Avogadro number (6×10^{23}), σ is the mean diameter of the molecules and m_A and m_B are the molecular weights of A and B. This equation, due to W. C. McC. Lewis (1918) does actually enable us to calculate certain reaction rates with an accuracy which is satisfactory in view of the fact that the effective diameter of the colliding molecules is known only very roughly.

Unimolecular Reactions.—The assumption embodied in the preceding discussion, that chemical change occurs when molecules collide which happen to be possessed of a more-than-average supply of energy, at once meets the difficulty that many reversible reactions are known in which collisions between molecules appear to play no part. Thus when phosphorus pentachloride dissociates, forming phosphorus trichloride and chlorine, according to the equation $PCl_5 \rightleftarrows PCl_3 + Cl_2$, each molecule of PCl_5 would seem to decompose independently of other molecules in accordance with the ordinary law of chance. By some chemists it has been asserted that such chemical changes (called *unimolecular reactions*) are not really possible. The fact that they seem to be of frequent occurrence is presumed to be explained by the presence of traces of foreign substances, which, in acting as catalysts, provide the means for interpreting the mechanism on the basis of molecular collisions.

Recent work would, however, seem to have definitely established the occurrence of non-catalysed gaseous reactions which proceed in accordance with the requirements of the unimolecular type of change over a wide range of concentration. An explanation of these has been sought in the radiation hypothesis, according to which the cause of the reaction is to be found in the selective absorption of radiant energy. The mechanism of the photochemical change would on this view be extended to all types of chemical *reaction* (*see* PHOTOCHEMISTRY). The wave-length of the active radiation can be derived from the heat of activation of the molecules by Planck's relation, $q = h\nu$ (*see* QUANTUM THEORY), but in general the reacting substances afford no evidence of the requisite absorption bands. For this and other reasons the radiation hypothesis cannot be said to be acceptable. For a fuller discussion see *Trans. Faraday Soc.* (1922).

On the other hand, it seems probable that the apparently unimolecular reactions are primarily due to molecular collisions, for it is only necessary to assume that the molecules activated by collision are for the most part deactivated by further collisions before they have time to reach that particular internal phase which is essential for chemical change to occur and the observed facts can be readily accounted for.

Since the molecules of the reaction products are the result of collisions between active molecules of the reactants and therefore, in general, distinguished by a high energy content, it follows that such "hot" molecules may hand on their excess of energy to other molecules of the reactants leading to a so-called chain reaction. Such chain reactions constitute a type which is illustrated by the combination of hydrogen and chlorine.

Chemical Activity.—Reference may now be made to the results which have followed from the application of thermodynamics to the problems of chemical action. Although the time factor is alien to the processes with which thermodynamics is concerned, the arguments peculiar to this branch of analysis can of course be applied to the states of equilibrium which are finally attained in reversible reactions. If the reacting substances are ideal gases (or solutes) thermodynamic reasoning leads to results which are identical with the expression for the law of mass action which follows from the kinetic theory. When the substances are not ideal, thermodynamics leads to the conclusion that the concentration terms in the mass-law expression should be replaced by the corresponding *activities*. The activity or *effective concentration* a of any substance is defined by the relation $\Delta F = RT \log a/a_0$, in which ΔF is the diminution of free energy associated with the reversible transformation of the substance from the condition defined by a to a standard condition defined by a_0. The activity in the standard condition may conveniently be taken as unity.

In practical applications the attempt is made to calculate activity or effective concentration by multiplying the actual concentration c, for the given substance, by an activity coefficient, f, which is itself a function of the concentration. Then by substituting $a = fc$ for c, in the mass-action expressions given above, more nearly constant values for the equilibrium constant are found than would otherwise be obtained. To be fully satisfactory, this method would require that the activity coefficient, f, by

means of which actual concentrations are converted into effective concentrations, should be independent of the nature of the reaction in which the given substance takes part. This has been found not to be the case. Accordingly J. N. Brönsted has introduced the assumption that the interaction of two substances A and B involves the intermediate formation of a "collision complex" X and this leads to $v=kc_A\cdot c_B\cdot f_A\cdot f_B/f_X$ where f_X is the activity coefficient of the complex. In this connection it may be noted that the activity coefficients of ions depend largely on their charges and on the ionic strength of their environment. (Ionic strength is calculated by taking half the sum of products formed by multiplying the concentration of each cation or anion in the solution by the square of its valence.) In accordance with the theory of P. Debye and E. Hückel, the relation may be expressed in the form $-\log f=0{\cdot}5x^2\sqrt{\mu}$ where x is the valence of the ion concerned and μ is the ionic strength of the solution in which it is present. This relation, when combined with Brönsted's reaction-velocity formula, affords results for ionic reactions of varied types which are in accord with experimental observations provided that the solutions are sufficiently dilute.

IONIC THEORY

Relative Strengths of Acids and Bases.—Although much recent work has been concerned with the precise significance of "active mass," the classical interpretation of this as synonymous with molecular concentration has yielded results of the greatest importance in the interpretation of the manifold phenomena associated with aqueous solutions of acids, bases and salts (*see* SOLUTION). Such substances are, in general, electrolytic conductors, and in accordance with the theory of Arrhenius are ionized to a greater or less extent. The traditional view, that salt formation corresponds with the neutralization of opposite qualities which characterize the acids and bases respectively, finds simple expression in the ionic theory, for, according to this, acids are substances which increase the hydrogen-ion concentration of water, whilst bases have the opposite effect. In aqueous solutions, the concentration of the hydrogen ion is directly connected with the hydroxyl-ion concentration, by the mass-action expression

$$K=\frac{[H^+]\cdot[OH^-]}{[H_2O]}.$$

In all dilute aqueous solutions however the concentration of the un-ionized water $[H_2O]$ is nearly constant (55·5 moles per litre). Accordingly in all dilute aqueous solutions, whether *acid, alkaline or neutral,* the product of the two ion concentrations has a nearly constant value (10^{-14} at 25° C). In neutral solutions hydrogen-ion (sometimes called hydrion) and hydroxyl-ion are present in equal concentrations (10^{-7} gram-ions per litre at 25° C). In acid solutions the concentration of hydrogen-ion exceeds that of hydroxyl-ion; in alkaline solutions the reverse is true. Yet hydroxyl-ion is never completely absent from acid solutions, nor hydrogen-ion from alkaline solutions, for the concentrations of the two ions must always be so related that the ion-product, $[H^+]\cdot[OH^-]$ has the constant value 10^{-14}, at 25° C. At higher temperatures the ion-product increases very rapidly, attaining a value of about 60×10^{-14} at 100° C.

Equivalent solutions of different acids show very great differences in the hydrion concentration. These are exhibited very clearly when the electrical conductivities of such solutions are compared or when a comparison is made of the velocities with which certain reactions take place when these are subjected to the catalysing influence of the various acids. The two series of numbers show a close parallelism which finds a simple interpretation in terms of the view that the differences between the acids are primarily due to differences in their respective degrees of ionization. The conductivity is indeed proportional to the concentration of the ionized fraction of the acid and the catalytic effect is determined for the most part by the hydrion concentration. The application of the mass law to the equilibrium between the un-ionized acid and the corresponding ions, as represented by $HA\rightleftarrows\overset{+}{H}+\overset{-}{A}$, gives

$$K=[\overset{+}{H}][\overset{-}{A}]/[HA]=(c\alpha)^2/c(1-\alpha)=c\alpha^2/(1-\alpha)$$

for the ionization constant, c being the molar concentration of the acid and α the fractional degree of ionization. In spite of the charges on the ions, this relation between the concentration of the acid and its degree of ionization is in very close agreement with the actual behaviour of weak or slightly ionized acids, as was clearly demonstrated by Wilhelm Ostwald. The results obtained in this connection constitute in fact the strongest and most comprehensive evidence as yet available in favour of the quantitative application of the law of mass action to states of equilibrium. The Ostwald dilution law does not hold for solutions of salts or more active (largely ionized) acids or bases. Many chemists have indeed arrived at the conclusion that most salts are completely ionized, at all concentrations. (*See* also ELECTROLYSIS; and HYDROGEN IONS, DETERMINATION OF.)

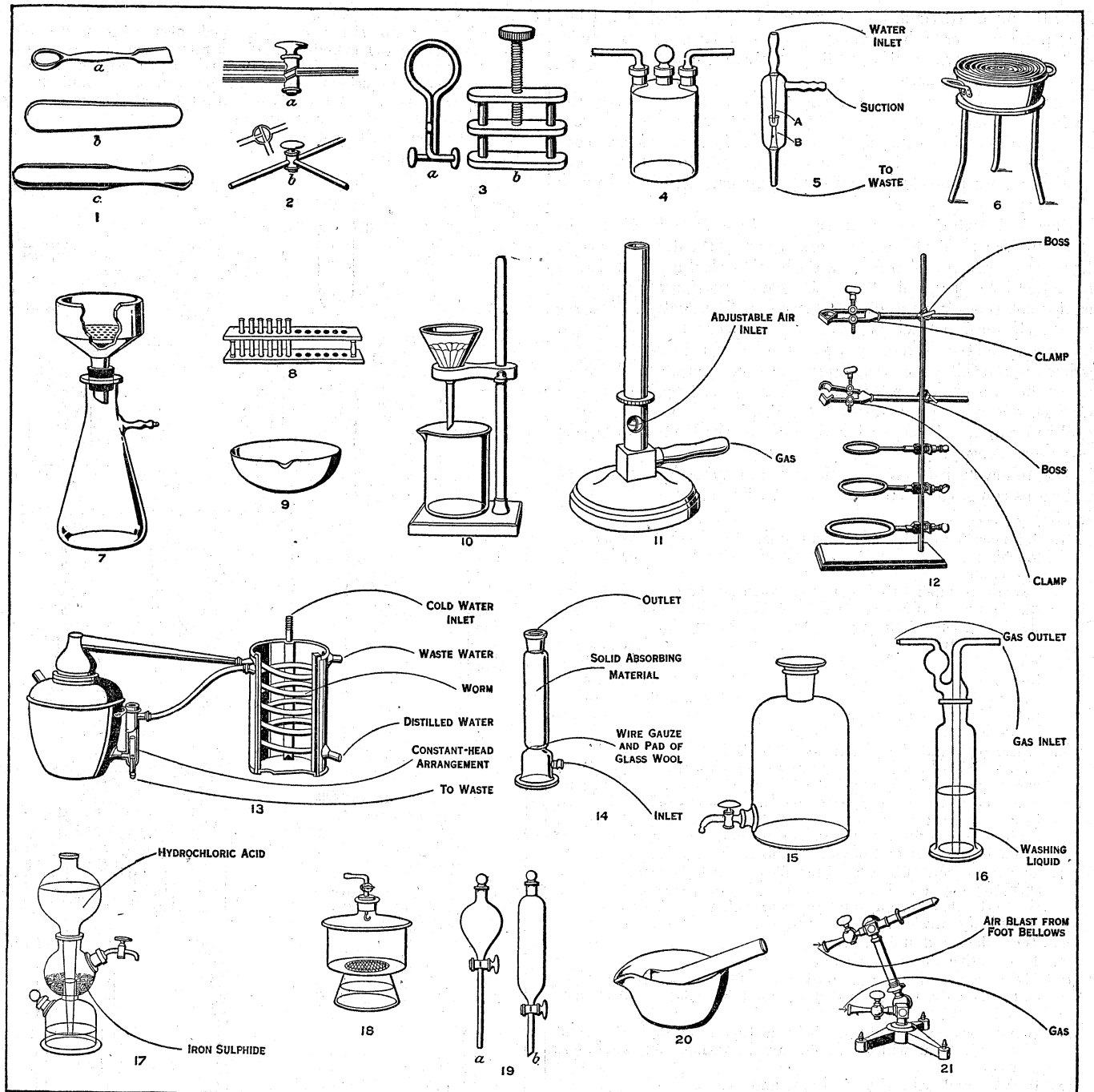
Neutralization of Acids by Bases.—In the neutralization of an acid by the gradual addition of a base, the essential reaction consists in the combination of hydrogen ions with hydroxyl ions until the concentration of both reaches the value for pure water, viz., 10^{-7} gram-equivalents per litre (25°), which condition is shown by suitable indicators (*q.v.*). The constancy of the heat of neutralization of the strong acids by the strong bases is explained in this way (*see* THERMOCHEMISTRY). If one equivalent of a base BOH is added to a solution which contains one equivalent of each of two different acids HA_1 and HA_2, the relative proportions of the two acids which are neutralized afford a measure of the so-called relative affinities of the acids for the base. Because of such differences stronger acids tend to displace weaker acids from the corresponding salts. Such displacement effects, however, are not always the result of a difference in the affinities of the acids, for complications may occur in consequence of the removal of one of the resultant substances from the sphere of action in the form of an insoluble solid or a volatile gas; *e.g.,* the displacement of nitric acid by the relatively very weak acid hydrogen sulphide in accordance with $2AgNO_3+H_2S\rightarrow Ag_2S+2HNO_3$ is directly due to the insolubility of silver sulphide. The basic affinities of a pair of acids can in fact only be derived from a determination of the relative amounts which are neutralized by a base when the system is homogeneous. If x is the fraction of the acid HA, which is neutralized by the base, BOH, in the above solution, the resulting equilibrium can be represented by

$$(1-x)HA_1+(1-x)BA_2=xBA_1+x\text{–}HA_2,$$

and the evaluation of x, which can be effected by a variety of physical methods, gives us the ratio $x/(1-x)$ which expresses the affinity of HA_1 relatively to HA_2. When such affinity values, referred to an acid chosen as standard, are compared, it is found that the acids form a series which is essentially the same as the series given by the relative conductivities and catalytic activities. It can be shown that this experimental result is generally consistent with the hydrion theory of acids for the application of the mass law to the equilibria which are involved in the above mentioned competition of two acids for a base shows that the affinity ratio $x/(1-x)$ is the ratio of the degrees of ionization of the two acids. The fact that $x/(1-x)$ is independent of the nature of the base is also explained at the same time. Similar considerations apply to the relative strengths of bases. At a given concentration their characteristic properties can be explained in terms of the hydroxyl-ion concentration. Since degrees of ionization vary with the concentration, it is convenient to eliminate the latter. This can be done by comparing the strengths of acids and bases in terms of the respective ionization constants.

BIBLIOGRAPHY.—J. H. van't Hoff, *Studies in Chemical Dynamics,* trans. T. Ewan (1896); J. W. Mellor, *Statics and Dynamics* (1914); G. N. Lewis and M. Randall, *Thermodynamics* (1923); H. S. Taylor, *A Treatise on Physical Chemistry* (1924); E. K. Rideal and H. S. Taylor, *Catalysis in Theory and Practice* (1926); C. N. Hinshelwood, *The Kinetics of Chemical Change in Gaseous Systems* (H. M. D.)

CHEMICAL APPARATUS. Underlying all types of chemical work is analysis. Much of the industrial work has to do with



FIGS. 1–21.—GENERAL CHEMICAL APPARATUS (THE NUMBERS REFER TO DESCRIPTIONS IN THE TEXT)

determining purity, evaluating raw materials, and certifying manufactured products.

Many means are employed. The chemist may work under high pressures or in almost complete vacua, at temperatures approaching absolute zero and those of melting tungsten. It is obvious then, that the apparatus employed by the chemist will vary with the work in hand. He needs porcelain, which will stand sudden and extreme changes of temperature; glass that is insoluble in the majority of the reagents he uses, which will stand great temperatures, and possesses high mechanical strength; and fashioned crucibles, dishes and other devices from platinum, fused quartz, and special alloys. The balances he employs are of the highest precision. He utilizes the wave length of light in measurement. The spectrograph, the microscope, the polariscope are familiar instruments. Burettes enable him to measure by the drop, while sensitive electric instruments have become essential in determining the concentration of hydrogen ions, the modern method of determining acidity. He uses the burning flame to judge contents by colour or to identify the lines in the spectroscope; electric conductivity becomes the measure of pureness of the water employed in analysis; and the complexity of the compounds and mixtures with which the chemist has to deal, frequently introduces in the perfection of apparatus problems well nigh as difficult as the one with which he began. (H. E. H.)

The forces which operate in chemical change are effective only through extremely short ranges as measured on the everyday scale of length. One of the first tasks of the practical chemist is to subdivide his reagents (*see* CHEMISTRY: *Analytical*) so finely that they can be brought into intimate contact. This intimate mixing is most effectually promoted by dissolving these reagents in suitable media. Hence a considerable proportion of laboratory apparatus is devoted to the processes of solution, extraction, filtration, precipitation, evaporation, distillation and desiccation. All of these have to do with the treatment of chemicals either in or separating

from the dissolved condition. For these purposes reagent bottles, filter pumps, water baths, funnels, evaporating basins, filter stands, flasks and stills are employed. Representative types of such apparatus are here illustrated.

Certain important chemical reagents are gaseous under the ordinary laboratory conditions. Special apparatus has been devised to deal with such highly volatile fluids. Gases are conveniently manipulated in drying towers, aspirators, Kipp's gas generators, wash-bottles and glass tubing connections including three-way taps.

Chemical analysis (*see* CHEMISTRY: *Analytical*) is the touchstone by which all chemical theories must ultimately be tested. Hypotheses which fail to pass through this ordeal are regarded as no longer valid or useful. A considerable proportion of laboratory equipment subserves the essential needs of the analyst. The accurate chemical balance is described elsewhere (*see* BALANCE), but among the typical requirements of analytical chemistry figured below are the following: weighing bottles, crucibles, potash bulbs, measuring vessels (burettes, pipettes, graduated flasks and cylinders), and special apparatus, for example, for the quantitative evaluation of arsenic and carbon dioxide and for the determination of vapour density.

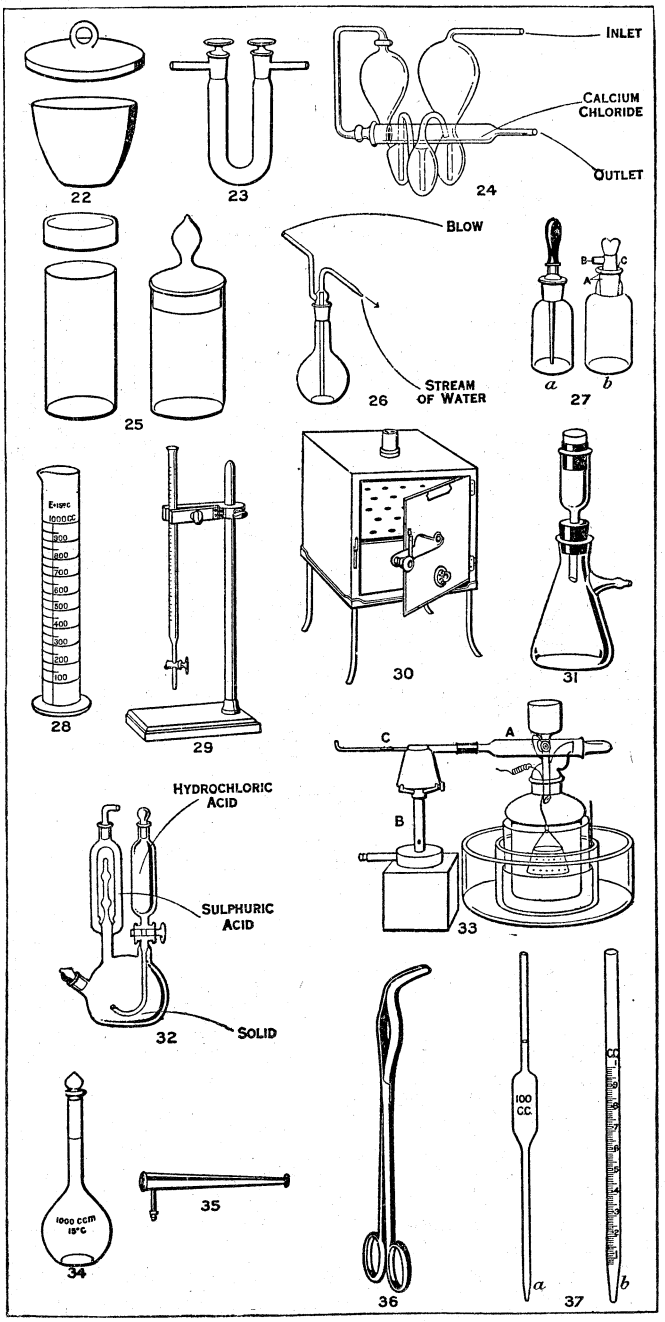
The following list refers to the accompanying illustrations of apparatus commonly used in a chemical laboratory:

General Apparatus.

1. Spatulas, for dealing with small quantities of material without touching by hand. They may be of metal (*a* and *b*) or vulcanite, etc. (as *c*).
2. Three-way taps: (*a*) A half turn connects the upper limb with the right-hand tube. (*b*) T-piece and tap (*see* section).
3. (*a*) Spring clip (Mohr's pattern). (*b*) Screw clip.
4. Reagent bottle.
5. Filter pump, for use with filter flask and either Buchner funnel (fig. 7) or Gooch crucible (fig. 31). The stream of water is broken up at the jet A, and the resulting drops tend to carry air down the tube B. This is capable of reducing the pressure as low as the vapour pressure of water.
6. Water-bath and rings on tripod. The bath is nearly filled with water which is heated by a burner underneath. Removal of one or more of the rings enables any circular vessel (*e.g.*, an evaporating basin) to rest in the hole of appropriate size, and its contents are slowly heated or evaporated. A constant-level device may be fitted (*see* fig. 13) to maintain the level of the water in the bath and obviate refilling.
7. Büchner funnel fitted in filter flask, which is attached to a suction pump (*see* fig. 5). A circle of filter paper is placed on the perforated bottom, and the material retained by it can be sucked dry, washed, and pressed.
8. Test-tube stand and test tubes.
9. Evaporating basin (porcelain).
10. Filter stand, funnel, and beaker. A filter paper is folded so as to fit in the funnel as shown; it retains solids, while liquids filter into the beaker.
11. Bunsen burner, whereby gas is burned with any desired amount of air, giving at will a luminous or a non-luminous flame (*see* FLAME).
12. Retort stand with rings, clamps, and bosses.
13. Still (with constant-level device) and condenser.
14. Drying tower. Similar in function to 16, but used where gases have to be passed through solids.
15. Aspirator. If this is filled with water, and the stopper is replaced by a cork carrying a tube, on opening the tap water will flow out, and this will draw air through the tube, which may be attached to any other apparatus.
16. Wash-bottle for gases (Drechsel pattern). If the gas is bubbled through the liquid it can be freed from one or more impurities, *e.g.*, it can be dried by passage through concentrated sulphuric acid, or freed from carbon dioxide by a solution of caustic potash.
17. Kipp's apparatus. Hydrochloric acid (HCl) is allowed to run down the central tube and rise so as to act on the iron sulphide; if the tap is open, sulphuretted hydrogen (H_2S) is expelled by the "head" of acid; when the tap is shut, the gas forces the acid into the top bulb and no more gas is produced. If marble is used instead of iron sulphide, carbon dioxide (CO_2) is obtained.
18. Desiccator. Strong sulphuric acid or granular calcium chloride is kept in the bottom; the material to be dried is spread on a watch-glass or clock-glass resting on the gauze. If the nozzle is attached to a pump, the vacuum produced accelerates drying.

General Apparatus—continued.

19. Separating funnels: (*a*) pear-shaped—also called a dropping funnel; and (*b*) cylindrical. If ether has been used to extract an organic substance from water, two layers are formed and the lower (aqueous) layer can be run off. Similarly, if chloroform had been used instead of ether, the lower layer would be the chloroform extract.
20. Pestle and mortar (of porcelain).
21. Foot blow-pipe.

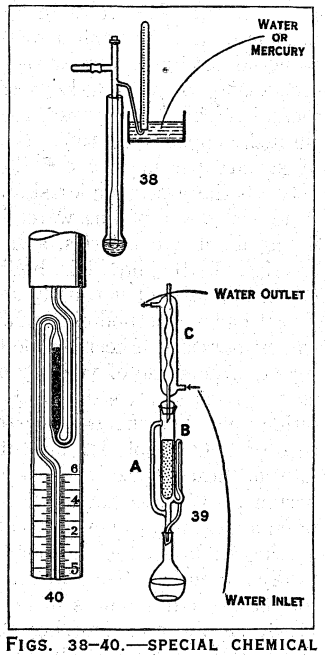


FIGS. 22–37.—CHEMICAL APPARATUS USED FOR ANALYSIS

Apparatus used in Analysis.

22. Crucible and lid; used for igniting precipitates.
23. U-tube. May be filled with granulated soda-lime to absorb carbon dioxide, or with pumice soaked in sulphuric acid to absorb water vapour. The ground-in taps can be turned to shut off connection with the outer air.
24. Potash bulbs. A 50% aqueous solution of potash is in the bulbs. A gas has to bubble through the three in succession and is dried in the calcium chloride tube; the increase in weight, if any, is due to carbon dioxide absorbed from the gas.
25. Weighing bottles, for protecting material from the air while it is being weighed. A portion of the contained substance is tipped out and the whole reweighed, the amount of material thus taken being the difference in weight.

26. Wash bottle. A fine stream of water (or other liquid) can be directed where required.
27. Dropping-bottles: (*a*) By slightly pressing the rubber teat and releasing the pressure, a few drops are drawn up in the teat and can be squeezed out one at a time when the nozzle is withdrawn. (*b*) Liquid flows along the capillary tube at A when the bottle is tilted, and a drop falls from B, air entering through another channel at C. Used chiefly for indicators (*q.v.*).
28. Measuring cylinder. Used for rough measurements of volumes of liquids.
29. Burette in stand. Used for *titrations*. The graduated scale shows what volume of liquid is delivered (*see* CHEMISTRY: *Analytical*).
30. Drying oven. The hole at the top carries a cork through which a thermometer is inserted. Material to be dried is placed (in a suitable container) on the tray. The holes in the tray allow the stems of funnels (holding filter paper) to be inserted. A burner is placed under the oven. Similar ovens may be heated electrically. A steam oven is similar but is surrounded by a "jacket" in which steam circulates.
31. Gooch crucible with rubber cone, glass adapter and filter flask. The bottom of the crucible is perforated with small holes, and a mat of asbestos is formed on it by pouring in a pulp of asbestos and water, sucking it nearly dry and completely drying it in the oven. Used for filtering, washing, drying and weighing precipitates.



FIGS. 38–40.—SPECIAL CHEMICAL APPARATUS (THE NUMBERS REFER TO DESCRIPTIONS IN THE TEXT)

32. Carbon dioxide apparatus (Schrötter). The apparatus is weighed with all constituents separated; the hydrochloric acid (HCl) is then allowed gradually to flow on to the solid; the carbon dioxide (CO_2) given off carries some aqueous vapour which is retained by the concentrated sulphuric acid (H_2SO_4), and after warming, cooling and passing air through to displace all the carbon dioxide, the apparatus is reweighed, the loss of weight being due to the carbon dioxide given off.
33. Apparatus for detection and estimation of traces of arsenic (Thorpe). The suspected material is treated so that its arsenic is obtained in acid solution, which is electrolysed and thereby reduced to arsine, AsH_3; this is dried by calcium chloride and purified by lead acetate in tube A, and decomposed by heat from a micro-burner B; it then deposits arsenic as a "mirror" at C, the density and colour (yellow, brown or black) depending upon the amount of arsenic.
34. Standard flask. Contains the stipulated volume when filled to the mark with a liquid at 15° C. Used for preparing "standard" solutions, *i.e.*, those containing a definite quantity of solid dissolved in, *e.g.*, 1,000 cu.cm. of solution.
35. Mouth blowpipe; used for directing a small flame jet on to the substance being analysed (usually supported on a block of charcoal).
36. Crucible tongs; may be tipped with platinum for refined work. These should be placed with points upwards, so as to avoid contamination such as would occur if the points were downwards touching a working-bench.
37. Pipettes (not to scale). (*a*) If filled exactly to the mark by suction, will then deliver the stipulated volume on draining for 15 seconds after continuous flow has ceased. (*b*) Can be used for gradual addition of small quantities which are read off on the scale.

Special Apparatus.

38. Victor Meyer apparatus. A liquid such as aniline is kept boiling in the outer bulb. The side arm holds a small stoppered tube containing a weighed quantity of a liquid. When the apparatus ceases to emit bubbles of air, the small tube is tipped into the inner bulb (a little sand or mercury being present to break the fall and save fracture), and the vapour of the liquid displaces its own volume of air, which ascends the eudiometer, displacing water or mercury, and is there measured. Vapour densities are thus determined (*see* ASSOCIATION; and STOICHEIOMETRY).
39. Soxhlet extractor. The material to be extracted (crushed seeds or cocoa) is placed in a "thimble" of filter paper. Ether is boiled in the flask, passes by the side tube A to the reflux condenser C, the liquid drops into the thimble where it accumulates till it reaches the level of the top of the side arm B, and then siphons over to the flask. Several extractions remove all the fat, which can then be weighed in the flask if all the ether is evaporated from the flask through a non-return condenser.
40. Beckmann thermometer (top only). For showing small temperature changes (of 5° or less) with an accuracy of 0·001° C. By taking mercury from, or returning it to, the reservoir, the range can be altered at will. (A. D. M.)

CHEMICAL ARTICLES. The main article CHEMISTRY includes a general survey of the *History of Chemistry,* and also deals comprehensively with the various branches of this science; viz., *Inorganic, Organic, Physical* and *Analytical Chemistry.* These and their practical applications are treated in fuller detail in the chemistry articles appearing in this encyclopaedia. There are articles elucidating fundamental ideas and definitions, and explaining chemical changes; *e.g.,* ACID; ATOMIC WEIGHTS; CHEMICAL ACTION; COMBUSTION; ELEMENTS, CHEMICAL; MOLECULE, CHEMICAL; OXIDATION AND REDUCTION. ATOMIC WEIGHTS contains a list of the elements; these are described individually, with their chief compounds, in separate articles. There are also separate articles on the more important compounds, *e.g.,* AMMONIA. The compounds of carbon, apart from the simple ones treated under the separate headings (such as CARBONATES; CARBONYLS, METALLIC; etc.), are dealt with in the organic chemistry articles.

Organic Chemistry, a main sub-section of CHEMISTRY, includes a historical introduction followed by a general survey of the subject under the sub-heads *Aliphatic, Homocyclic* and *Heterocyclic Divisions.* CHEMISTRY also includes an account of *Ultimate Organic Analysis.* There are, besides, articles explaining the structure and synthesis of carbon compounds, *e.g.,* ISOMERISM and STEREOCHEMISTRY; and processes and reagents are described under HYDROGENATION; GRIGNARD REAGENTS; etc. The various types and classes of compounds are dealt with in AZO-COMPOUNDS; ALKALOIDS; ALCOHOLS; ESTERS; KETONES; CAMPHORS; PURINES; etc. Separate articles are devoted to the more important sub-groups and members of these classes, *e.g.,* BUTYL ALCOHOLS; ALCOHOL (ethyl alcohol); BENZENE; CHLOROFORM; PYRIDINE; etc.; many being of industrial and medical importance. The chief substances present in living matter are treated under ALBUMIN; CARBOHYDRATES; CHLOROPHYLL, CHEMISTRY OF; PROTEINS; RESINS: *Natural* and *Synthetic;* etc.; and several organic acids have separate headings; *e.g.,* ACETIC, CARBOLIC, OXALIC and URIC ACIDS. Dyes and pigments are dealt with in DYES, NATURAL; and DYES, SYNTHETIC; and under various headings such as ALIZARIN; ANTHOCYANINS AND ANTHOXANTHINS; GLUCOSIDES, NATURAL; INDIGO; OCHRES; etc.

The physical chemistry articles include ADSORPTION; ASSOCIATION, CATALYSIS; HYDROGEN-ION CONCENTRATION; PHOTOCHEMISTRY; VALENCY; THERMOCHEMISTRY; etc. The industrial processes are treated in CHEMICAL ENGINEERING; COAL TAR; DISTILLATION; EXPLOSIVES; SUGAR; etc.; and under the separate headings of the various important elements and compounds. There is a large collection of diagrams of apparatus used in a chemical laboratory under CHEMICAL APPARATUS, and the methods of chemical analysis are described in CHEMISTRY: *Analytical,* which includes *Inorganic* (qualitative and quantitative), *Ultimate Organic* and *Gas Analysis;* and in BLOWPIPE and INDICATORS. There are also short articles interpreting old-fashioned names and dealing with various theories of the alchemists, *e.g.,* ALCHEMY; AQUA REGIA; BRIMSTONE; ELIXIR; HARTSHORN, SPIRITS OF; and VITRIOL.

CHEMICAL ENGINEERING. The branch of engineering which relates to the "design, construction, erection and operation of industrial plants in which matter undergoes a change of state or composition." This definition, due to the Institution of Chemical Engineers, is rather broad but logical. A chemical engineer should possess a good general knowledge of chemistry and physics, a special knowledge of physical chemistry and thermodynamics, a thorough grasp of mechanical and electrical engineering and of those branches of civil engineering which deal with the strength of materials and the theory of design of struc-

tures. There is little doubt that the material rewards of scientific chemical engineering are greater to-day than in any other branch of engineering, while its national importance cannot be over-estimated.

Since the ultimate object of the chemical engineer is economic production, industrial economics and law, business management and factory organization must be given a primary place in his training. He must be able to devise simple and effective methods of recording operations and determining actual costs, prepare designs, specifications and estimates free from ambiguity and error, report efficiently on any problem investigated, obtain technical information readily and compile and index it for future use.

Practical Basis.—The practice of chemical engineering has naturally preceded the scientific analysis of its principles. Typical chemical engineering operations have been performed in certain industries to such an extent as to evolve special types of plant peculiar to those industries. The chemical engineer, however, must understand the underlying scientific principles upon which such operations or processes depend, so as to be able to design an efficient plant for any particular purpose, rather than allow it to be evolved by rule-of-thumb guesswork with expensive large scale experiments and costly alterations in construction before reasonable efficiency is obtained.

Scientific Basis.—The adoption in the factory of one unit of weight and volume together with the decimal system is a first step and facilitates recording, avoids errors, saves time and makes the scientific control of processes comparatively easy.

Chemical Engineering Operations.—Chemical engineering operations are of three general types: (*a*) the conveyance and storage of materials; (*b*) the production, transfer and conservation of heat, and (*c*) the treatment of materials. In these processes an exact knowledge is required to secure the greatest industrial efficiency, and questions relating to rent, capital cost, repairs, labour and superintendence, output, material efficiency, character of the market, etc., must be considered. Unfortunately some of these conditions vary from year to year and the chemical engineer must be somewhat of a seer to achieve the greatest success.

Transport.—Transport is often the most important item of the cost of production; in the factory itself, the cost of carrying materials to a machine is often as great as that of the operation conducted. Methods of weighing and measuring materials in their progress through the factory need careful study, for it is only by maintaining the highest rate of output as a uniform thing, that the best results can be obtained.

Flow of Fluids.—In industrial practice fluids may flow in two distinct ways, usually referred to as "stream-line" and "turbulent" flow. The former method offers advantages in certain operations, filtration, classification, separation, etc., while the latter is essential to secure the greatest heat transfer. The criterion by which it can be approximately determined whether stream-line or turbulent flow is occurring in a tube is given by the value of the modulus $\frac{vd\rho}{\mu}$ where v is the velocity of the fluid, d the diameter of the tube, ρ the density of the fluid and μ its viscosity. The value of the fraction is the same in any system of units and when it exceeds 2,000 the flow is turbulent. The transport of fluids in factories is obviously a simple and cheap process, so that a solid material which is used in solution will be transported more cheaply and conveniently by dissolving it at once and pumping the solution to stock tanks, rather than by conveying the solid itself.

Semi-fluids.—The laws governing the flow of semi-fluids such as dry sand, wheat, etc., which occupy an intermediate position between solids and liquids, must be understood. A peculiarity of such materials is that their flow from an orifice is proportional to the cube of the area of the orifice and independent of the head.

Transfer of Heat.—The production and transfer of heat involve a knowledge of combustion, the study of fuels, their calorific value and intensity, while the electrical generation of heat is becoming more and more important in the development of industrial processes. The design of furnaces of different types, often a matter of rule-of-thumb evolution, involves questions of heat transmission and radiation, the factors of which are very difficult to estimate. The great diminution in density of the hot gases and the increasing importance of radiation as a factor in heat transmission, as the temperature rises, are points needing the most careful study. The loss of heat from exposed hot surfaces by radiation and air contact may be fairly closely estimated, a factor often very important in the operation of a plant. The transmission of heat through a metal diaphragm from gas to gas, gas to liquid, saturated vapour to liquid, liquid to liquid, gas to solid, etc., varies so enormously as to demand the most careful experimental research. The transmission of heat from a gas to a gas through copper 1mm. thick, is of the order of 5 calories per sq.m. of surface per hr. per one degree C. of temperature difference between the gases; under similar circumstances the transmission from gas to non-boiling water is about 20 calories, from liquid to liquid about 350 calories, and from steam to water about 1,500 calories. If the liquid is boiling the heat transfer may be increased greatly; it is usually at least twice and may be over four times that of non-boiling liquid. The importance in steam boilers and evaporators of keeping the liquid constantly boiling is obvious. Again, an increase of velocity of either fluid will raise the rate of heat transmission considerably by an amount which is capable of estimation. The effects of corrosion, of deposited scale, the influence of salts in solution and of precipitates in suspension on the rate of heat transmission are matters of great industrial importance. When a gas or liquid moves over a solid surface or when a gas moves over a liquid surface there exists a film of the moving fluid over the stationary substance in which there is practically no motion. The thickness of this film is mainly responsible for the great differences in heat transmission already mentioned. Much chemical engineering research is necessary to elucidate these questions adequately, and great wisdom in design is necessary to secure the highest economic efficiency.

Solid Materials.—In the treatment of solid materials, size reduction by crushing, grinding and impact must be well understood. The relative cost of the different methods and machines and the different character of the final products must be known, for the size and uniformity of the solid material treated in a chemical operation has, in practically every case, a profound influence on the cost of production of the final product. The separation of solid particles from each other and from liquids involved in the processes of sifting—electrical, magnetic, hydraulic and air separation, classification, flotation, filtration, centrifuging, etc.—often determines the profitable treatment of the material. New discoveries in flotation and similar methods of separation have in recent years proved of the highest value.

Power.—A study of the power required for different processes is of importance and many prevent false conclusions. In size reduction for example, the power required is approximately proportional to the increased surface produced, so that a simple calculation will readily show how costly it is to produce the finest powders from solid materials. Many processes, though well understood, are difficult and costly; their avoidance or replacement by some other method at another stage of the process are important points in the economic possibilities of manufacture. Again, it is a common experience in technical manufacture, that a method by which one process is rendered easy may cause a later process to fail and give rise to a faulty product.

Processes of Separation and Extraction.—Processes of separation in which a change of physical state takes place are peculiar subjects of study to the chemical engineer. Leaching and extracting, evaporation, distillation and condensation, drying, crystallization, absorption and adsorption, etc., are processes requiring the highest research. Processes of extraction which formerly took 12 hours are now being carried out more efficiently in one hour as a result of chemical engineering study. Evaporation is now being done in many works at one-sixth of its former cost, while distillation and condensation in certain industries are now carried on with a fuel saving of nearly 80% in comparison with earlier methods.

Wet Distillation.—The process of "wet" distillation, *i.e.*, distillation by means of direct steam, is used in many industries for

separating a particular substance, essential oil, hydrocarbon, etc. If such substance does not mix with water, then each develops that particular vapour pressure which it would have if heated separately to the same temperature, and the sum of the vapour pressures is the pressure in the still. A study of the vapour pressure curves of each substance and the conditions of decomposition of the particular one, will give the most profitable still pressure at which to work. By this alone, materials which at ordinary pressure require 200 parts of steam to distil one part of substance, may be treated under suitable pressure by 30 parts of steam. Again, by a reduction of pressure before condensation has taken place, a separation of the particular substance will take place and the steam may be economically "boosted" back into the still.

Drying Processes.—The drying of gases, liquids and solids is a common requirement of many industries. The study of drying and drying plant may mean a change from comparative failure to great success. The drying of gases by chemical reagents such as calcium chloride, which after absorbing moisture is itself dried by hot air or flue gases, cooled and again used, is well understood, but the use of absorption processes for this purpose is a development in industry of the last few years. The "gels" (silica gel, alumina gel, etc.) are treated in a similar way to the calcium chloride previously mentioned, but are free from any risk of failure through overheating, and have many other advantages.

Gas Masks.—The efficiency of the gas mask in warfare is paralleled by the importance of the same means in peace to recover benzene and other solvents from air and gas effluents, to remove sulphur from oil and to perform many other chemical functions in a physical way. The absorption of water by "silica gel" is so energetic, and the substance can be so readily regenerated that its general use for refrigeration may be only a matter of time. The chemical engineering problems involved in this process are both interesting and profitable. The treatment of the air of factories to render it constant in temperature and humidity also offers a large field to the chemical engineer. (*See* ADSORPTION.)

Chemical Processes.—The treatment of materials in chemical reactions such as roasting, calcining, destructive distillation, electrolysis, catalysis, hydrolysis, fermentation, etc., demands careful consideration of physical, chemical and engineering factors of increasing exactitude. An examination of these processes on a laboratory scale must precede their study on a manufacturing scale. The chemist does the former and the chemical engineer the latter. Additional factors involving time of reaction, strength of materials, presence of traces of impurity, cost of materials and plant, continuous or discontinuous operation, the handling and disposal of by-products, etc., arise. Increase in efficiency can be obtained by changing from intermittent to continuous working.

Materials.—The design of plant involves the preparation of flow sheets showing the flow and expenditure of material, energy, time and labour, the experimental study of the nature and properties of the materials involved in plant construction and a continuous search for new materials to meet the conditions of service better than those at present in use. The name of a material, unfortunately, is no indication that it is suitable for a chemical engineering purpose. "Chemical cast iron" is a distinct kind of cast iron, characterised by the amount of silicon, sulphur and carbon content and its treatment. Other materials, alloys, bricks, compositions, cements, etc., must be specified for their work both as to composition and history if success is to be made certain. In recent years, great advances have been made in the production of chemical engineering materials of construction, silica-ware, stoneware, glass, alloy steels, alloys, etc., all of which tend to cause modification of design. The effect of heat on the strength of materials is becoming better known every year and the production of non-scaling steels which are as strong at a white heat as ordinary mild steel at the ordinary temperature will make many developments possible which have hitherto failed.

Lay-out of Plant.—The lay-out and construction of factories involves a knowledge of several branches of civil engineering and cannot be neglected, for the erection of buildings, heavy plant and chimneys on marshy soil is a common necessity in industry. The construction of foundations, roadways, railways, etc., must also be understood. In the provision of power, heat and light, the relative value and use of the different methods must be considered for a sound view to be taken as to whether steam, electricity, gas or water-power shall be used. High-pressure steam providing power by means of turbines which exhaust into receivers from which evaporating steam may be drawn, presents the most efficient power plant in many chemical industries, while electricity generally provides the best method of power distribution, and occasionally of heating, in process work. The use of producer or water gas for heating and other purposes must not be neglected nor the value of compressed air and hydraulic water for many purposes. Finally the chemical engineer must be familiar with the Factory Acts, trade union law and all those legal questions which factory managers have to face. (J. W. HI.)

CHEMICAL SOCIETIES. For pharmaceutical societies, *see* MEDICAL SOCIETIES. BRITISH ISLES, London, *Chemical Soc.* (1841, inc. 1848), *Memoirs* (1843, etc.), *Quart. Journ.* (1849, etc.); *Inst. of Chem.* (1877, inc. 1885), *Journ. and Proc.* (1877, etc.); *Soc. of Chem. Industry* (1881, inc. 1907), *Journ.; Soc. of Public Analysts* (1874), *The Analyst* (1876, etc.); *Faraday Soc. Trans; Cavendish Soc.* (1846–72); *Biochem Soc.* (1911), *Biochem. Journ.* MAURITIUS. Port Louis, *Soc. des Chimistes* (1910), *Revue* (every two months). INDIA. Allahabad, *Ind. Chem. Soc.* Calcutta, *Ind. Chem. Soc. Quart. Journ.* (1924, etc.) SOUTH AFRICA, Cape Town, *Cape Chem. Soc.* (1906). Johannesburg, *Chem. Metallurg. and Mining Soc. of S.A.* (1904, inc. 1907), *Journ.* (monthly). CANADA. Toronto, *Canad. Inst. of Chem.* (1919). AUSTRALIA. Sydney, *Austral. Chem. Inst.* (1917).

UNITED STATES. New York, *Amer. Inst. of Chemists; Chemists Club* (1898), *Percolator, Yearbook; Amer. Leather Chemists Assoc.* (1903), *Journ.; Amer. Electrochem. Soc.* (1902), *Bull.* (monthly); Ann Arbor, Mich. *Amer. Soc. of Biolog. Chem.* (1906), *Journ. of Biol. Chem.* Brooklyn, *Soc. of Chem. Indust.* (1894), *Chemistry and Industry; Ann. Rept.* Kansas City, *Ann. Assoc. of Cereal Chemists* (1915), *Cereal Chemistry.* Washington, *Assoc. of Offic. Agric. Chem.* (1844), *Journ.; Amer. Chem. Soc.* (New York, 1876), *Journ. Am. Chem. Soc., Chem. Abstracts, Indust. and Eng. Chem., Journ. Chem. Educ., Journ. Phys. Chem.*

FRANCE. Paris, *Féd. nat. des Assoc. de Chim; Cercle de la Chimie* (1917), *Revue; Un. Internat. de la Chim.* (1919).

GERMANY. Berlin, *Deutsch. Chem. Gesell.* (1867), *Chem. Zentralbl* (1897, etc.); *Verein Deutsch. Chem. e. V.* (1887), *Zeitschr. f. angewandte Chem., Die Chem. Fabrik* and *Geschichte des Vereins Deutsch. Chem.; Verein Deutsch. Nahrungsmittelchemiker* (1902), *Zeitschr. f. Untersuch. d. Nahrungs- u. Genussmittel; Justus Liebig-Gesell.* (1920); *Adolf-Baeyer-Gesell.* (1920). Frankfort, *Emil-Fischer-Gesell.* (1920). Hanover, *Deutsch. Bunsen-Gesell.* (1894), *Abhandlungen, Zeitschr. f. Elektrochem.* Leipzig, *Kolloid-Gesell.* (1922), *Koll-Zeitschr.*

BELGIUM. Brussels, *Soc. Chim. de Belg.;* BULGARIA. Sofia, *Chem. Gesell.* (1900). ITALY. Milan, *Soc. di Chim. indust.* (1919), *Giornale d. Chim. Indus. ed. Applic.* (monthly); *Bollet. Assoc. Ital. Chim. Tessili e Col.* (1925, monthly). Rome, *Assoc. Ital. di Chim. gen. ed. applic.* (1919), *Gaz. chim. ital, Giornale di chim. industr. ed. appl., Ann. di Chim. appl.* LATVIA. Riga, *Latv. Kimi. Biedrība* (1920). NORWAY. Oslo, *Norsk Kjem. Selskab* (1893), *Tidskr. f. Kjemi og Bergvesen.* AUSTRIA. Vienna, *Chem-phys. Gesell.* (1874); *Verein Österreich. Chem.* (1898), *Österr. Chem.-Zeitung.* POLAND. Warsaw, *Polskie Towarzystwo Chem.* (1919), *Roczniki Chemji.* PORTUGAL. Oporto, *Soc. Port. de Quim, e. Fis., Rev. de Quim.* SWEDEN. Stockholm, *Kem. Sällskapet* (1907), *Kemistafundet* (1883), *Svenska Kem. Tidskr.* SWITZERLAND. Basle, *Bas. Chem. Gesell.* (1924). RUSSIA. Moscow, *Lomonosovskoe fiziko-chem. obsh.* (1917), *Vestnik* (1919–21); Shostka, *Atomchem. Gesell.* ARGENTINA. Buenos Aires, *Assoc. quim. argen.* (1912), *Anales.* JAPAN. Tokyo, *Chem. Soc. of Japan,* (1878, as *Tokyo Chem. Soc.,* taking its present title in 1911), *Journ.* (1880, etc.).

CHEMICAL WARFARE. Chemical warfare relates to the employment of substances useful in war by reason of their direct chemical action. Chemistry has found application in military science throughout recorded history. It was not, however,

until the 20th century that chemical warfare in the modern acceptance of that term became a distinct feature of military technique. Modern chemical warfare represents essentially the application of chemical energy in military action, in contrast to physical energy as represented by the impact of bullets or the shock of explosives. The substances employed in chemical warfare are known as "chemical agents." Those that react directly on the human organism are war gases. A second group of agents which are useful in obscuring distant objects are called smokes. A third group are incendiaries or fire-producers.

In each case the desired end is served by chemical reactions that take place after the appropriate agent has been released to atmospheric conditions of pressure and temperature. It is to be noted that these reactions are not necessarily instantaneous, as is the case where firearms or explosives are employed; chemical warfare agents on the contrary may act slowly and continue effective for extended periods of time.

Modern chemical warfare must be regarded as a product of industrial chemistry. Although the chemicals it employs have been known for many years, some of them for many centuries, yet only in relatively recent years has production capacity been available to permit the manufacture of the large quantities of these substances that are required for extended military operations.

Development.—The application of chemical warfare really commenced before recorded history by the use of fire and smoke to overcome an opponent. At the siege of Plataea in 429 B.C. burning pitch and sulfur were used. The so-called "Greek fire" was a mixture of highly combustible substances ignited on water. In 1855 Lord Dundonald proposed the use of burning sulfur on a large scale under favourable wind conditions during the siege of Sebastopol. During the American Civil War it was proposed (1862) that shell containing chlorine be employed by the Union forces.

The science of chemistry advanced rapidly during the 18th and 19th centuries, and the use of toxic substances was foreseen and considered at The Hague Conference of 1899. With the exception of the United States, the great Powers there pledged themselves not to use projectiles whose sole object was the diffusion of asphyxiating or harmful gases.

World War, 1914–18.—The adoption of chemicals as weapons during the World War of 1914–18 was logical in that the principal combatant nations were highly developed scientifically and industrially. A stalemate had been reached when both sides entrenched themselves so firmly that advance was impracticable without terrific losses. Means were sought to restore open warfare. At the outbreak of the war, none of the combatant nations was prepared to use or defend against chemicals.

The introduction of gas as an effective weapon in modern warfare actually dates from April 22, 1915 when the Germans launched a large-scale cylinder attack with chlorine against the Allied position in the Ypres salient where the British and French lines joined. Although intelligence reports had given warnings of an impending attack, little credence was given to them by the Allies. The attack came as a complete surprise to unprotected troops; its success was so far beyond German expectations that adequate reserves to exploit the breakthrough for a decisive stroke had not been provided. Within a few days Allied troops were equipped with pads of cotton dipped in a chemical solution and tied over the nose and mouth. These were soon followed by a crude form of respirator which was continually improved throughout the war both for comfort and efficiency. As protection was obtained against one chemical, the offence sought for and introduced new agents. These frequently required radical changes in the mask. Cloud gas attacks, although highly efficient, were entirely dependent on favourable wind conditions. Consequently the extensive use of gas shell was begun in 1916. This also permitted employment of a greater number of toxic substances.

Lacrimators, sneeze gases and vesicants were introduced as the war progressed, the Germans leading the way. Because of the manufacturing problem, many months were generally required for Allied retaliation in kind. In July 1917, the Germans introduced mustard gas, an extremely vesicant, highly persistent liquid, which causes very severe, slow healing burns. It was difficult to provide effective protection against this agent, which accounted for the majority of gas casualties during the War.

Use Since 1918.—Because of its controversial aspects, European powers have shrouded with silence their recent operations in the field of chemical warfare. However, all of the major world powers have maintained research facilities. Some have manufacturing facilities and chemical troops. The speedy conquest of Ethiopia by Italy has been ascribed to the extensive use of a vesicant material similar to mustard gas; against the unprotected native, its vesicant qualities proved irresistible. In China and in Spain, chemical warfare appeared chiefly as incendiaries, much damage thus being caused.

The use of toxic chemicals during the European war in 1939–40 had not been confirmed up to July 1940. Incendiary bombs were extensively used in air raids by both sides. Probably the chief use of chemical warfare was in the extensive adaptation of screening smoke tactics to both land and sea battles. Germany utilized smoke tactics with exceptional efficiency to blind observation, eliminate enemy-aimed fire and to immobilize enemy movements attempted within smoke. These tactics were especially effective during the closing weeks of the campaign in France to facilitate river crossings, establish bridgeheads, and to assist the rapid advance of infantry and tanks. On the sea, the German pocket battleship "Admiral Graf Spee" dispersed smoke in an attempt to blind its movements from enemy fire. This might have been more successful if a British observation plane had not been able to give accurate information as to course of the ship. During the spring of 1940 the German battleship "Scharnhorst," after being crippled in action, was hidden within a smoke screen laid by a friendly cruiser and was thus enabled to escape.

Chemical Agents.—The term *gas* is applied to those chemical agents used in war which, by ordinary and direct chemical action, produce a toxic or powerful irritant effect on the human body. Solids, liquids or true gases may be so employed; however, in their actual use on the battle area, the solid or liquid is converted by normal or artificial volatilization into a true gas or disseminated as minute solid or liquid particles called *aerosols*. Irritant smokes are types of aerosols included under the term gas because their principal use is for their physiological effect.

From the military viewpoint the most important classifications of chemical agents are in accordance with (1) physiological effect, (2) persistency and (3) tactical use.

Physiological effect classifies the chemical according to its *primary* action on the human body even though it may produce other secondary effects. The severity of effect is roughly proportional to the concentration (amount present in a unit volume of air) and the time of exposure.

Lung irritants act on the respiratory system and are highly lethal. When breathed, they irritate and inflame the interior portion of the bronchial tubes and lungs, cause coughing, impede breathing, and, in severe cases, acute pulmonary oedema will result. Chlorine, phosgene and diphosgene are examples.

Vesicants or skin blistering agents attack any part of the body with which the liquid or vapour comes in contact, especially moistened parts. They are absorbed or dissolved on exterior or interior parts of the body, followed by production of inflammation, burns and destruction of tissue. There is no immediate pain and effect is delayed for some period after exposure. Protection against this class is very difficult because of its insidious action by contact with the liquid or prolonged exposure to the vapour. Examples are mustard gas, lewisite and ethyldichlorarsine.

Sternutators or sneeze gases are also known as irritant smokes. They are disseminated into the air as minute solid or liquid particles which, if inhaled, cause sneezing, intense pain in the nose, throat and chest followed by violent nausea, headache, mental depression and physical weakness. No fatal cases have been recorded from this class; effect, although severe, is temporary, lasting about 12 hours. The charcoal and soda lime mixture of the gas mask canister will not remove these small particles from the air. A most efficient mechanical filter is necessary to give protection. Diphenylaminechlorarsine, an aromatic arsenical derivative, is an example.

Lacrimators or tear gases irritate the mucous membrane around the eyes, causing intense smarting and a profuse flow of tears with resultant hampering of vision. Effect from concentrations in the field is only temporary, recovery being complete within a few minutes after removal from the contaminated area. Chloracetophenone, brombenzylcyanide and xylyl bromide are examples.

The systemic poisons directly affect the heart action, nerve reflexes, or interfere with absorption and assimilation of oxygen by the body. Carbon monoxide and hydrocyanic acid, which pertain to this class, have never been effectively used in war because of their relative lightness compared to air with the consequent difficulty in placing satisfactory quantities on a given area.

The persistency of a chemical agent is determined by the length of time it will maintain an effective concentration without being renewed. Those chemicals which remain effective for longer than 10 minutes after release in the open are defined as persistent. Usually dispersed in the liquid state, persistent agents contaminate the ground on which released and continue to give off dangerous vapour for long periods. Nonpersistent gases are those whose effectiveness in the open continues for less than 10 minutes. They vaporize rapidly, forming concentrated clouds which drift with the wind, increasing in size but becoming diluted in gas content until they finally disappear.

Tactical classification, which is influenced by the persistency, is based on the primary military objective for which any particular chemical is used in the field. War gases are thus classified as casualty or harassing agents; smokes as screening agents; and the various fire producers as incendiaries.

No attempt will be made to enumerate all the chemical agents which might be used in war. Many thousands of compounds were thoroughly studied during the World War period, 1914–18. Comparatively few were deemed worthy of test under battle conditions and of those only about a dozen were in actual use at the termina-

tion of that war. The majority of chemical warfare agents are organic compounds of which the theoretical number is almost limitless. From these, it is quite possible that more effective war chemicals will be found. On the other hand it is more probable that modification of types now known or more efficient methods of dispersion will first appear rather than entirely new discoveries.

To be useful as a chemical agent, certain requisites must be met. These include: adequate and utilizable physiological action, screening power, or incendiary effect; stability in storage and in contact with moisture; capability of manufacture on large scale at low cost from easily procurable, nonstrategic raw materials; suitability for safe handling, transporting and loading in munitions without corrosive effect on ordinary steel; capability of being disseminated in effective quantity under field conditions; gases, preferably much heavier than air, readily compressed to liquids and easily vaporized when released.

Brief descriptions of a few type chemical agents follow:

Phosgene under ordinary conditions is a colourless, nonpersistent gas with an odour varyingly described as of musty hay, green corn or green apples. Tactically, it is classified as a casualty agent. At low temperatures it is a clear, colourless, mobile liquid, which boils at 8.3°C. Under ordinary summer conditions, it will disappear from a given locality about as fast as the wind moves. Even in winter it evaporates very rapidly. In a light wind an effective concentration of phosgene can readily be produced. It is used commercially for dye manufacture. During the World War (1914–18) it was first employed by Germany in Dec. 1915 in a cloud gas attack from cylinders.

Chloropicrin derives its name from its principal method of commercial manufacture by the action of chlorine on picric acid. When free of impurities, it is a nearly colourless liquid of water-like appearance except for a slight oiliness. It has a characteristic sweetish odour somewhat like fly-paper and usually is first detected by lacrimatory effect on the eyes. It is a moderately persistent lung irritant but in addition causes lacrimation, nausea and vomiting. Tactically it may be classed as either a harassing or a casualty agent, depending on the concentration. Commercially, it is used as a seed fumigant and for insect control. Chloropicrin is said to have been first employed by Russia in 1916 and later was extensively employed by the Allies. It is neutralized by sodium sulfite solution in alcohol.

Mustard gas is a compound of carbon, hydrogen, sulfur and chlorine. It should not be confused with the true natural mustard oil or the artificial compounds having properties similar thereto. It was because of its sharp pungent odour and vesicant properties which resembled but greatly exceeded those of natural mustard oil that British soldiers first called it "mustard gas." The commercial product is a heavy oily liquid of dark colour and in low concentrations has the distinct odour of garlic or wild onions. This product freezes at about 10°C. It is one of the most persistent as well as one of the most toxic chemical agents. It is highly vesicant and is also a lung irritant. As the latter, in vapour form, after prolonged exposure, it attacks the whole respiratory system producing inflammation of the trachea and bronchi with necrosis of the mucous membrane and development of secondary bronchitis or bronchopneumonia. Upon slight contact with the liquid it is absorbed in the skin and produces serious burns. First employed by Germany at Ypres in July 1917, it was thereafter known to the French as Yperite. It hydrolizes slowly and may be neutralized by intimate mixture with bleaching powder, steam or gaseous chlorine.

Lewisite resembles mustard gas in many characteristics. It is a colourless or slightly yellow liquid freezing at −18.2°C. As usually prepared it is dark brown in colour with the faint odour of geraniums. Its vapour is distinctly irritating to the eyes and throat, sometimes followed by violent sneezing. It is absorbed by the skin or lung tissue and causes a serious blister. As it hydrolizes it liberates an oxide which poisons the body. It is a vesicant casualty agent, having a persistency of one to several days in summer and a week or more in winter. It is readily decomposed by water and may be neutralized by alcoholic sodium hydroxide spray. It was first made in the United States but has never been used in war. Lewisite has a distinct advantage over mustard gas in that blisters develop in about one hour, but has the disadvantage of rapid hydrolysis.

Hydrocyanic acid, though long known as one of the deadliest of compounds, was used with but little success during the period 1914–18. It is a paralysant acting vigorously on the central nervous system to produce quick death. Under ordinary conditions it is a colourless, mobile and volatile liquid with a slight odour of bitter almonds. It is a nonpersistent casualty agent. Because of its high volatility it is most difficult to maintain effective concentrations of hydrocyanic acid in the field; hence this compound has so far proven of little value in chemical warfare.

Diphenylaminechlorarsine, better known as adamsite, is representative of the large group of irritant smokes which may be used in war. Physically, in pure form it is a bright canary-yellow crystalline solid. Commercially, it is produced in a dark green or sometimes brownish colour. In solid state it is almost odourless, but when dispersed as an irritant smoke, a hazy yellow cloud is formed which gives a characteristic smoky odour. However, the first symptoms are usually a burning sensation in the nose and throat. It is classified as a nonpersistent harassing agent, but as such is extremely potent because very small concentrations with a brief period of exposure will prove effective. The headache, nausea and vomiting which it causes, followed by physical debility, render a person practically helpless. Effective use of the irritant smokes is largely dependent on penetration of the filtering device used with the mask. If protection is not assured, this group of agents has great potentialities in warfare.

White phosphorus, a pale yellowish, translucent crystalline solid of waxy consistency, is very active chemically and combines readily with oxygen. Hence unless protected from air it will burst spontaneously into flame. White phosphorus can be loaded into shell, bombs or grenades. When exploded by the bursting charge the solid phosphorus is broken into small fragments which are scattered in the air. The heat of explosion assists their immediate ignition, forming a cloud of phosphorus pentoxide. This smoke has the highest known obscuring power, yet is harmless when breathed. Fragments of considerable size are scattered about and continue to burn for some time, thus prolonging the emission of smoke. In addition, white phosphorus has limited incendiary value against readily combustible matter. Physiologically it may be classed as a casualty agent, since its ignited particles cause painful flesh burns that heal very slowly. Although primarily used for smoke production within the enemy lines, white phosphorus is also a formidable weapon against machine gun nests or troop concentrations.

FS, a mixture of sulfur trioxide about 55% and chlorosulfonic acid about 45% by weight, is an excellent cheap liquid smoke for release from containers or by dispersion from aeroplanes.

The thermits are mixtures of powdered aluminum and iron oxide which react chemically and generate intense heat. Hence they have powerful incendiary qualities and readily ignite any inflammable material. Allied to the thermits is the so-called Electron bomb, used extensively in small scatter-type bombs during 1936–40 in Europe. This bomb has a case of magnesium alloy which is ignited by a chemical mixture and burns with intense heat.

Table I briefly summarizes characteristics of some important chemical agents used in war.

Protection.—Having in mind the three distinct types of agents employed in chemical warfare, protection is of interest principally as applied against gas, since smoke is harmless and protection against incendiary agents is limited to measures customarily followed in fire fighting. Against gas, protection has been highly developed. This type of defence is actually more effective than the protection that can be afforded against any other military weapon. In considering protection against war gases, it is necessary to distinguish between effect upon the respiratory organs and vesicant effect upon the body surface.

For protection against lung irritants, of which phosgene is typical, the gas mask is the primary protective device. The principle on which the military mask is based is that of filtering out or neutralizing noxious substances that may be present in inspired air. In order to accomplish this, air before it reaches the lungs must first pass through a filtering element containing materials that act mechanically or physically or react chemically with the toxic agents. For this reason a characteristic feature of the gas mask, from which its name is derived, is a tight-fitting facepiece so designed as to prevent air from reaching the respiratory organs from any direction except through the filter.

Since the mask must necessarily cover the entire face in order conveniently to permit normal respiration, it incidentally affords protection against lacrimators which, when the eyes are unprotected, cause intolerable eye irritation.

The principal materials used in gas mask filters (or canisters) are charcoal and soda lime. Charcoal adsorbs and holds a relatively large volume of poisonous gases. Soda lime supplements the action of charcoal by neutralizing any toxic materials which might eventually be released by the charcoal and which otherwise would pass to the lungs with incoming air. Having a proper balance of charcoal and soda lime the gas mask may be worn with safety even after it has been used in concentrations of war gases.

Besides soda lime and charcoal, masks are sometimes provided with mechanical filtration intended to strain out finely divided solid particles (toxic smokes), which severely irritate the nasal passages. The life of a gas mask filter depends on two factors: the length of time it has been exposed in gas attacks and the concentrations of gas that have been encountered. Military masks generally remain serviceable even after use in several gas operations. When the capacity of the filter is approaching exhaustion a slight odour of gas can be detected. This indicates that replacement with a fresh filter is necessary.

Although it is possible to design filtering devices that will neutralize any toxic substance, it is not feasible to combine in one mask protection against all toxics. Military masks are accordingly constructed with a view to counteracting those particular chemicals that are thought most likely to be used in war. The introduction of new types of military gases in future will undoubtedly be followed by appropriate modification of masks now considered standard.

For safeguarding of personnel while sleeping, messing or otherwise engaged where the mask cannot be worn, gasproof installations are provided. These are known as gas shelters or collective protectors. A typical installation is equipped with a filter similar in principle to that used in the gas mask, although much larger. Incoming air is drawn through this filter and thus purified, other outside air being excluded, so that all air within the enclosure may safely be inhaled.

Protection by filtration applies only to those chemical-warfare agents that are dispersed as true gases and which are therefore injurious when breathed. Agents dispersed in liquid form, which attack the body through the skin surface, necessitate a different type of protection.

Against liquid chemical agents, of which mustard gas is typical, special protective clothing is utilized. To insure complete protection for persons obliged to remain in contaminated areas, fabrics used in this clothing must be treated with moisture-resisting compounds (*e.g.*, oilskins) and garments must be so designed as to positively exclude air at all points. The gas mask is invariably worn with protective clothing, so as to prevent inhalation of noxious fumes which are always present where liquid agents are released.

No effort is made to destroy nonpersistent or highly volatile gases, since these are eliminated in due course by dilution and dispersion. However, ground or other surfaces saturated by persistent (liquid) chemicals may be treated to hasten decomposition of toxic materials. Chlorine is most effective for this purpose and is commonly applied in the form of chloride of lime.

The effective use of antigas equipment is dependent on thorough military training and organization. Training establishes skill in the use of protective devices; in locating and identifying gassed areas; and in the selection of positions that lack vulnerability to gas attack. Gas defence organization, based on the assignment of suitable gas specialists to various units, insures attention to all features of chemical security, including such matters as the alerting of troops to gas attack and the degassing of areas contaminated with persistent chemicals.

All measures for protection against gas contribute toward the development of gas discipline. When this is high, military organizations are able to face gas attacks with confidence born of the knowledge that gas casualties will be light and that gas will not unduly impede the attainment of objectives.

First Aid Treatment.—When protective devices are not available, the prompt application of certain simple first aid measures will frequently prevent the development of serious injury from exposure to war gases.

In all such cases the first requirement is immediate removal from the gassed area. For lung irritant casualties, treatment is then directed to conserving the supply of oxygen, all of which is needed for natural recuperation. Thus complete relaxation and rest are essential; warming of the body with loose coverings and drinking of hot coffee are helpful. Patients are evacuated by litter and special precautions are taken to prevent exertion for some time, since fatalities are liable to occur even after a lapse of a day or more when preventive measures are not enforced.

Contact with liquid vesicants necessitates different treatment which, however, must be promptly initiated in order to avoid serious burns. All clothing which may have become contaminated is quickly removed and portions of the body contacted by the liquid agent are repeatedly swabbed as soon as possible with a solvent such as gasoline or alcohol. In lieu of the latter, scrubbing with soap and water is helpful. Treatment administered as late as 30 minutes after exposure is seldom efficacious.

For the painful burns caused by contact of ignited fragments of white phosphorus with the skin, immediate relief is had by immersion in water. Application of an aqueous solution of copper sulfate enables the coated phosphorus particles to be removed, after which medical treatment is undertaken.

Lacrimation is soon counteracted by removal from the gassed area and exposure of the eyes to fresh air. From the effects of irritant smokes, relief is had by breathing low concentrations of chlorine and by flushing the nose with salt water or a weak solution of baking soda.

Protection of Civilian Population.—The potential threat of air-gas attack against congested population centres has forced wide adoption of protective measures for passive defence of noncombatants against chemical agents. These measures are largely based on principles found effective for protection of military personnel. Gas masks designed for civilian use are ordinarily of lighter construction than those intended for use by soldiers in the field. Gas-proofed air raid shelters on the other hand are in most cases larger and more elaborate than are required for military operations. Civilian defence measures also include organization of medical aid for gas casualties, degassing squads and special fire-fighting units. Civilian air-raid precautions in gas defence had become so highly developed and patently effective during the years immediately preceding 1939 as to assure a large degree of immunity from the effects of toxic gas in aerial bombardments of cities. To this fact may be ascribed, at least in a measure, failure to utilize chemical agents in the air attacks staged against European cities in 1939–40.

Dispersion of Agents.—With gas and smoke, military targets are *areas* rather than points against which fire of high explosives is usually aimed. Over these target areas the technique of chemical warfare is directed principally to establishing and maintaining an appropriate *concentration.*

The technical problems involved in dispersing chemical agents in war differ radically according to whether the medium employed is a volatile gas (or smoke) or a liquid. In the first instance it is necessary to generate an artificial cloud that will cover the selected area either (a) densely enough or (b) long enough to accomplish the desired result—since the effectiveness of chemical warfare agents is a product of two factors: concentration and length of exposure. The most efficient means for generating a gas or smoke cloud is by release from a stationary container (*e.g.*, cylinder). This was the method employed for the first use of gas in modern warfare (1915). It presents, however, certain practical disadvantages in military operations. A favouring wind is required to move the cloud to the target area, and where the distance the cloud must travel is very great the concentration will become unduly lowered before the target is reached. In order to overcome these difficulties, methods have been developed for projecting containers to the upwind side of distant targets and thus generating the cloud from a more advantageous position. This can be efficiently accomplished with smoke, but volatile gases do not lend themselves readily to dispersion at distances greater than 3,000 yards.

The principal methods by which volatile gases are dispersed, in the order of relative efficiency, are from (1) cylinders, (2) pro-

TABLE I—*Characteristics of Some Important Chemical Agents Used in War*

Common name	Chemical name	Chemical formula	Physical state at 68°F and 760 mm. pressure	Physiological effect	Elapsed time between exposure and effect	Lethal index (*) for mice and dogs (10 minute exposure)
Chlorine	Chlorine	Cl_2	Gas	Burns upper respiratory tract	Immediate; delayed in low concentrations	56,000
Phosgene	Carbonyl chloride	$COCl_2$	Gas	Causes lung oedema	Immediate	5,000
Hydrocyanic acid	Hydrocyanic acid	HCN	Gas	Paralysis of nerve centres	Immediate	2,000
Ethyldichlorarsine	Ethyldichlorarsine	$C_2H_5AsCl_2$	Liquid	1/6 as vesicant as mustard gas	30 min.	5,000
Chloropicrin	Trichlornitromethane	Cl_3CNO_2	Liquid	Burns respiratory tract. Lacrimates, causes nausea. Lung irritant	Immediate lacrimation; delayed lung action	20,000
Mustard gas	Bis Beta chlorethylsulphide	$(ClCH_2CH_2)_2S$	Liquid	Burns skin and lung tissue	4 to 24 hrs.	1,500
Lewisite	Beta-chlorvinyldichlorarsine	$ClCH{:}\ CHAsCl_2$	Liquid	Burns skin and lung tissue. Arsenical poisoning in body	1 hr.	1,200
Adamsite	Diphenylaminechlorarsine	$C_6H_4NHAsClC_6H_4$	Solid	Headache, nausea, violent sneezing followed by temporary physical debility	5 to 10 min.	15,000
Chloracetophenone	Phenyl chlormethyl ketone	$C_6H_5COCH_2Cl$	Solid	Severe lacrimation and skin irritation	Immediate	8,500
Brombenzylcyanide	Brombenzylcyanide	$C_6H_5CHBrCN$	Solid	Severe lacrimation and nose irritation	Immediate	3,500
White phosphorus	White phosphorus	P_4	Solid	Incendiary effect	Immediate	
FM	Titanium tetrachloride	$TiCl_4$	Liquid	Eye irritation. Prickly sensation on skin	Immediate	

*Product of the concentration (mg. per cu. m. of air) by number of minutes of exposure. These figures indicate the *relative* toxicity of war gases but do not necessarily represent their lethal effect on man. (After *A. M. Prentiss*)

jectors, (3) shell. Efficiency of dispersion may be reckoned according to the ratio of the weight of the container to the weight of the agent it contains. This ratio is lowest for stationary cylinders, which can only be discharged within friendly lines. When the container is placed within a cannon and fired to the area of intended discharge it must necessarily be of heavier construction, its weight progressively increasing as weapons of greater range are employed.

The chemical projector discharges a container of relatively large volumetric capacity to ranges of approximately one mile. By employing a large number of these weapons in a single operation it is possible to establish effective concentrations of nonpersistent gas at some distance behind enemy lines.

The chemical mortar enables volatile gases to be released at distances of nearly 3,000 yd. But since the mortar projectile is much heavier, the proportion of gas it carries is accordingly lessened, thus reducing the size of gas cloud that can be established. On the other hand the chemical mortar can be fired repeatedly and the gas concentration can thus be maintained for a longer period than is possible with the projector.

The firing of nonpersistent gas containers from artillery weapons presents technical difficulties that have never been overcome nor have satisfactory aerial bombs been devised for this purpose. Liquid agents of the mustard gas type, however, may be employed in artillery of all calibres, the technique of firing being modified here to insure uniform distribution of impacts over the target area. The ideal shell for such use is of simple construction, designed to burst on or before impact so as to efficiently disperse the agent.

Aerial liquid-filled bombs may likewise be employed for dispersing persistent vesicants. Another effective method of aerial dispersion is that of sprinkling, where the agent is carried in tanks and discharged as a spray from low altitudes.

This represents possibly the most portentous form of chemical attack because the liquid chemical may thus be placed directly upon personnel.

Areas may also be contaminated by means of sprinklers operated from various types of vehicles. Another method applicable to delaying actions is by the use of land mines: tin containers which when statically detonated discharge their contents of liquid agent over the nearby ground.

The dispersion of smoke involves little deviation from the principles observed in the cloud-gas form of attack. The smoke cloud is in many tactical situations required for a longer period than may be the case with a gas cloud. Also with favourable wind conditions a much narrower screen of smoke will suffice to obscure vision. These factors make smoke well-adapted to discharge from artillery weapons. Liquid smoke agents (*e.g.*, titanium tetrachloride) may be discharged from aeroplane tanks, forming a smoke curtain that is of especial use in naval warfare.

Military Application.—The extent to which chemical warfare is employed in military operations may be said to depend principally upon its likely contribution to tactical success. Smokes and incendiaries have proven most valuable adjuncts to military force, so that these agents are commonly included in all modern armament. Gas on the other hand has been used but sporadically in battle since 1918, even though nonlethal types have found wide application in the control of domestic disturbances.

The casualties resulting from gas attacks made in Europe between 1915 and 1918 were impressive enough to justify regarding gas as a military weapon of considerable importance. However, the effectiveness with which gas may be counteracted by appropriate protective measures, which have been improved in recent years, introduces a factor that must be carefully evaluated in studying the possibilities of offensive gas warfare. So long as antigas protection is highly maintained, the prospects for successful gas attack are materially lessened: when on the contrary gas defense is neglected, the gas weapon becomes one of exceptional potentiality.

The principal tactical value of the cloud-gas form of attack is in weakening defensive positions that successfully withstand assault. In warfare of continued movement this type of operation has limited value.

The most effective of all war gases is of the mustard gas type. This agent has important uses in both offensive and defensive action. The irritant smokes have definite possibilities when properly dispersed.

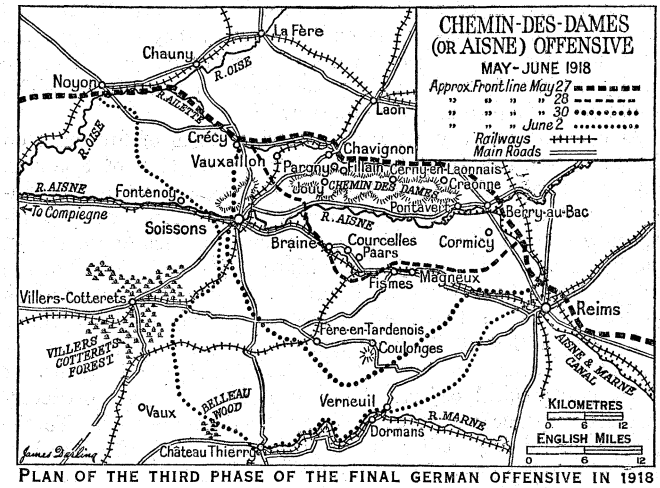
None of the gases so far employed in warfare satisfies the ideal of a substance, the use of which will permit an army to easily subjugate an opposing force.

The quest for such an agent may be unending, yet meanwhile the possibilities of chemical warfare will continue to receive close study.

BIBLIOGRAPHY.—A. A. Fries and C. J. West, *Chemical Warfare* (1921); V. Lefebure, *The Riddle of the Rhine* (1921); E. B. Vedder, *The Medical Aspects of Chemical Warfare* (1925); P. Bloch, *La Guerre Chemique* (1927); R. Hanslian, *Der Chemische Krieg* (1927); H. L. Gilchrist, *A Comparative Study of World War Casualties* (1931); H. Buscher, *Grun und Gelbkreuz* (1932); H. C. Foulkes, *Gas: The Story of the Special Brigade* (1934); A. M. Prentiss, *Chemicals in War* (1937); M. Sartori, *The War Gases* (1939); H. F. Thuillier, *Gas in the Next War* (1939); *Air Raids Precaution Handbooks*, British Home Office. (HA. SH.; G. J. B. F.)

CHEMIN-DES-DAMES, BATTLE OF THE, 1918.

This is the name commonly given to the May offensive of the Germans in 1918, the third act of their plan to reach a military decision before the weight of American numbers could turn the scales against them. It is alternatively called the Battle of the Aisne, 1918, or, less frequently, the Battle of Soissons-Reims. After the relative failure of the German offensives of March and



PLAN OF THE THIRD PHASE OF THE FINAL GERMAN OFFENSIVE IN 1918
The German attack, launched May 27 on a 30 mile front, took the Allies by surprise and drove them across the Aisne to the Marne. Here, German efforts to push westwards failed

April it was essential for the Germans, if they wished to preserve the initiative, to deliver another powerful blow without delay. The choice of the front of attack and the battleground fell on the oft-contested chain of heights between the Ailette and the Aisne, the Chemin-des-Dames.

Dispositions for the German Attack.—The German supreme command had decided to attack with the VII and I armies against the sector between north of Soissons and Reims. If this attack proceeded favourably, it was to be prolonged on the right over the Ailette to the Oise and on the left as far as Reims. The German supreme command hoped that the push southward would succeed in reaching the neighbourhood of Soissons and Fismes, and by this means attract strong forces from Flanders so that it might be possible to continue the attack there according to plan. Preparations began about the middle of May. The VII army under Böhm was charged with the main attack across the Chemin-des-Dames, the I army under Below with the neighbouring attack on the left in the direction of Compiègne. The right wing of the main attack, the LIV corps and the VIII Res. corps, had the task of pushing forward in a southwesterly direction on both sides of Soissons. The XXV Res. corps was to strike on both sides of Cerny-en-Laonnais direct towards Braisne, and on the east to take as much country as possible towards the south; the IV Res. corps was to attack the high ground at the eastern end of the Chemin-des-Dames, immediately north of Craonne; in concert with this on the left the LXV corps was to occupy with its left wing the river bend north of Berry-au-Bac. Of the I army only one corps was to be launched at the outset to throw the opposing forces over the Aisne-Marne canal. The corps was to provide itself with bridgeheads in order to take the heights of Cormicy if the attack of the VII army proceeded favourably.

For success there were two essentials; the first, surprise and the second, effective artillery preparation. Most elaborate and thorough precautions were taken to secure secrecy. As regards artillery preparation the ascent of the steep slopes on the heights of the Chemin-des-Dames was only possible if the Germans should succeed in silencing the bulk of the opposing guns. All registration was to be abandoned in order to surprise the enemy as much as possible. The first aim was to be a thorough gassing of the Allied position right down into the Aisne valley. Preparations were completed by the evening of May 26, 1918. At that moment four battle-worn British divisions were resting in this

supposedly quiet sector. They had been sent to the French front, after strenuous exertions in the battles of the Lys, in return for French reinforcements which had gone north to the aid of the British in the later stages of that "backs to the wall" struggle. On the tranquil Aisne they could recuperate, while still serving a useful purpose as guardians of the trench-line. It was too quiet to be true. But the uneasiness of the local British commanders—shared by certain of their French neighbours—was slightly discounted by their Allied superiors. On May 25 they received from French headquarters the message that "in our opinion there are no indications that the enemy has made preparations which would enable him to attack to-morrow."

At one A.M. on May 27, 1918, a terrific storm of fire burst on the Franco-British front between Reims and north of Soissons, along the famous Chemin-des-Dames; at 4:30 A.M. an overwhelming torrent of Germans swept over the front trenches; by midday it was pouring over the many unblown bridges of the Aisne, and by May 30 it had reached the Marne—site and symbol of the great ebb of 1914. Happily, it proved to be "thus far, and no farther." Like the two great preceding offensives of March 21 and April 9, that of May 27 achieved astonishing captures of ground and prisoners, but it brought the Germans little nearer to their strategical object. And, even more than its predecessors, its very success paved the way for their downfall. To the reasons for this we shall come. But why, a month after the last onslaught, in the north, had come to an end, why, when there had been this long interval for preparation and for examination of the situation by a now unified command, should a surprise greater than any before have been possible?

It has long been known, of course, that the French command, that directly concerned with the safety of this Aisne sector, did not believe in the likelihood of an attack. Nor did the British higher command, which, however, was personally concerned with the front in the north. But the intelligence of another of the Allies, better placed to take a wide survey, did give the warning—only to be disregarded until too late. On May 13, a fortnight after the fighting in Flanders had died away, the British intelligence came to the conclusion that "an attack on a broad front between Arras and Albert is intended." Next day this was discussed at a conference of the intelligence section of the American Expeditionary Force, and the head of the battle order (of the enemy) section gave a contrary opinion holding that the next attack would be against the Chemin-des-Dames sector, and between May 25 and 30.

The warning in detail was conveyed to the French general headquarters, but fell on deaf ears. Why should credence be given to an opinion coming from such a new army, not yet tested in battle, over the verdict of war-tried and highly-developed intelligence services? The warning was reiterated, however, and the French intelligence was won over to its acceptance. But now, as at Verdun two years before, the operations branch opposed until too late the view of its own intelligence. This time, however, it was less blameworthy, for it was tugged the other way by the comforting assurances of the commander of the VI. French Army, in charge of the Chemin-des-Dames sector. This general, indeed, had a still heavier responsibility, for he insisted on the adoption of the long-exploded and wasteful system of massing the infantry of the defence in the forward positions. Besides giving the enemy guns a crowded and helpless target, this method ensured that, once the German guns had eaten up this luckless cannon-fodder, the German infantry would find practically no local reserves to oppose their progress through the rear zones. In similar manner all the headquarters, communication centres, ammunition depots and railheads were pushed close up, ready to be dislocated promptly by the enemy bombardment.

Pétain's instructions on a deep and elastic system of defence had evidently made no impression on this Army command, so that it was still less a matter for wonder that the protests of junior British commanders met with a rebuff. It was unfortunate, also if perhaps less avoidable, that when the four British divisions forming the IX. Corps (Hamilton Gordon) arrived from the north at the end of April, their depleted ranks filled up with raw drafts from home, they were hurried straight into the line, as the best place to complete their training. The backbone of the Aisne defences was formed by the historic Chemin-des-Dames ridge north of the river. The eastern half of this "hog's back" was to be held by the British, with the 50th Division (Jackson) on the left, next the 8th Division (Heneker), and, beyond the end of the ridge, in the low ground from Berry-au-Bac along the Aisne and Marne canal, the 21st Division (Campbell), joining up with the French troops covering Reims. The infantry of the 25th Division (Bainbridge) was in reserve.

Altogether the French VI. Army front was held by four French and three British divisions, with three and one respectively in reserve. Against these tired or raw troops, in the main attack from Berry-au-Bac westwards, fifteen German divisions, all but one brought up fresh, were to fall upon five, with two more for the subsidiary attack between Berry-au-Bac and Reims, while seven German divisions lay close up in support. Even so, the German superiority was not so pronounced as in the March and April offensives, whereas both the rapidity and the extent of their progress were greater. Yet this time the tactical surprise of the assault was unaided by the heavy ground mists which had previously helped so much by wrapping their initial advance in a cloak of invisibility. The conclusion is, therefore, that the advantage was due in part to the strategic surprise—the greater unexpectedness of the time and place—and in part to the folly of exposing the defenders so completely to the demoralizing and paralyzing effect of the German bombardment—by 3,719 guns on a front of under 40 miles. This last, indeed, was a form of surprise, for the object of all surprise is the dislocation of the enemy's morale and mind, and the effect is the same whether the enemy be caught napping by deception or allows himself to be trapped with his eyes open.

We pass to the events of May 27. For three and a half hours the unfortunate troops had to endure a bombardment of exceptional intensity. And the ordeal of those hours of helpless endurance, amid the ever swelling litter of shattered dead and untended wounded, was made more trying by crouching, semi-suffocated in gas-masks. Then the grey waves advanced—relief, if only of action, at last. Three-quarters of an hour later they had reached the crest of the ridge in the centre near Ailles. This uncovered the flank of the left British division, the 50th, forcing its survivors to fall back down the other slope. Next to it, the 8th Division was being forced to give way, although two of its brigades held on stubbornly for a time on the north bank of the Aisne. On the British right, the attack on the 21st Division developed later; this division was awkwardly placed with the swampy Aisne and Marne canal running through the centre of its battle zone, but most of it was successfully extricated and withdrawn west of the canal. By midday the situation was that the Germans had reached and crossed the Aisne at most points from Berry-au-Bac to Vailly—helped by the fact that the order to blow up the bridges had been given belatedly. Hitherto the German progress had been evenly distributed, but in the afternoon a heavy sagging occurred in the centre, at the junction of the French and British wings, and the Germans pushed through as far as Fismes on the Vesle. This was natural, both because the joint is always the weakest point, and because the heaviest weight—more than 4 to 1—of the assault had fallen on the two French divisions in the centre and the left of the 50th Division adjoining them.

This sagging, together with the renewed German pressure, compelled a drawing back of the flanks. On the east, or British flank, this operation was distinguished by a remarkable manoeuvre of the 21st Division, wheeling back during the night through hilly, wooded country, while pivoting on and keeping touch with the Algerian division, which formed the right of the Army. After a pause in the morning of May 28, the Germans forced the passage of the Vesle, and on the 29th they made a vast bound, reaching Fère-en-Tardenois in the centre, and capturing Soissons on the west, both important nodal points, which yielded them quantities of material. The German troops had even outstripped in their swift onrush the objectives assigned to them, and this, despite the counter-attacks which Pétain was now shrewdly directing against

their sensitive right flank. On the 30th the German flood swept on the Marne, but it was now flowing in a narrowing central channel, for this day little ground was yielded by the Allied right flank, where the 19th Division as well as French divisions had come to reinforce the remnant of the original four British divisions, which next day were relieved.

From May 31 onwards the Germans, checked on the side of Reims and in front by the Marne, turned their efforts to a westward expansion of the great bulge—down the corridor between the Ourcq and the Marne towards Paris. Hitherto the French reserves had been thrown into the battle as they arrived, in an attempt to stem the flood, which usually resulted in their being caught up and carried back by it. On June 1, however, Pétain issued orders for the further reserves coming up to form, instead, a ring in rear, digging themselves in and thus having ready before the German flood reached them a vast semi-circular dam which would stop and confine its now slackening flow. When it beat against this in the first days of June its momentum was too diminished to make much impression, whereas the appearance and fierce counter-attack of the 2nd American Division at the vital joint of Château-Thierry was not only a material cement, but an inestimable moral tonic to their weary allies. In those few days of "flooding" the Germans had taken some 65,000 prisoners, but whereas this human loss was soon to be more than made up by American reinforcements, strategically the Germans' success had merely placed themselves in a huge sack which was to prove their undoing less than two months later (*see* MARNE, SECOND BATTLE OF THE). As in each of the two previous offensives, the tactical success of the Germans on May 27 proved a strategical reverse, because the extent to which they surprised their enemy surprised and so dislocated the balance of their own command.

As the disclosures of Gen. Kuhl have revealed, the offensive of May 27 was intended merely as a diversion, to attract the Allied reserves thither preparatory to a final and decisive blow at the British front covering Hazebrouck. But its astonishing opening success tempted the German command to carry it too far and too long, the attraction of success drawing thither their own reserves as well as the enemy's. Nevertheless it is a just speculation as to what might have resulted if the attack had begun on April 17, as ordered, instead of being delayed until May 27, before the preparations were complete. The Germans would have worn out fewer of their reserves in ineffectual prolongations of the Somme and Lys offensives, while the Allies would have still been waiting for the stiffening, moral and physical, of America's man-power. Time and surprise are the two supreme factors in war. The Germans lost the first and forfeited the second by allowing their surprise to surprise themselves. (B. H. L. H.)

CHEMIST, one who, for pleasure or profit, concerns himself with the acquisition of information relating to the composition and structure of substances and the changes of composition and structure which they undergo. The chemist traces his evolution from the Greek philosophers, who speculated without experiment as to the constitution of matter, through the mediaeval alchemists, who experimented with little logic, in the hope of transmuting one element into another. During the middle ages another sect, the iatro-chemists, also existed, who carried out experiments which were to make chemistry more useful to medicine. Many types of chemists exist, classed usually according to the kind of matter or the kind of change with which they are most concerned. When the individual applies his information to the production, manufacture or commercial use of commodities, he is customarily considered an industrial chemist or chemical engineer.

CHEMISTRY. The science that is concerned with the composition of bodies and with the changes of composition they undergo. Analytical chemistry deals with the methods of separation of purer substances from mixtures, of elements from compounds, and with their estimation; synthetic chemistry treats of the methods by which complex bodies may be built up from simpler substances. In each case it is the changes of composition that concern the chemist. The combination of atoms, and the arrangement of atoms in a molecule, used to be regarded as the special province of the chemist; while the physicist dealt with changes of state and with the motions of the molecules: but today this distinction cannot be maintained.

With the rapid growth of modern chemistry it has become the practice to divide the theoretical study of the science into three main branches, and this conventional division is adopted in the present article, which, in addition, contains sections dealing with the history of chemistry and the practice of chemical analysis:—History of Chemistry; Inorganic Chemistry; Organic Chemistry (Aliphatic Division, Heterocyclic Division, Homocyclic Division): Physical Chemistry; Analytical Chemistry (Inorganic Analysis, Ultimate Organic Analysis, Gas Analysis).

HISTORY OF CHEMISTRY

Chemistry as a science had its origin in Egypt (*see* ALCHEMY)—the product on the one hand of much practical experience of workers in metals, glass and pottery, of users of dyeing and tanning materials; and on the other of Greek and Eastern speculation on the nature of the material world. The great school founded at Alexandria was the natural meeting place of the two streams, and from their union came in time the alchemy of the Arab conquerors, the iatrochemistry (*q.v.*) of the medical chemists and finally our modern science. In all the older cosmogonies we find the idea that there was some primordial element or principle from which the visible universe was derived. Perhaps the oldest speculations assigned to water this elementary character; its teeming life, its vivifying power, its solid deposits all marked it as the origin of things. The doctrine that water was the prime element—associated with the name of Thales—exerted an immense influence on scientific thought throughout the centuries. Van Helmont in the early 17th century thought he had proved it experimentally; it remained for Lavoisier in the late eighteenth to disprove it by more decisive experiment. But water was not the only "element" that was regarded as primordial by Greek philosophers. That air could be condensed into clouds and clouds into rain was taught by Anaximenes; water could be evaporated into air, leaving solid earth behind. Everything therefore sprang from air. That fire was the first principle of things would appeal to those who came in contact with the fire-worship of the Chaldeans, or with the religion of the Persians and Parsees, whom Zoroaster taught to look on fire as the symbol of goodness in creation. Heracleitus among the Greeks espoused the cause of fire, Pherecides that of earth; it was indeed easy to show that from combustible solids fire, air and water could be derived. That all four were primal elements, and that the varieties of matter were made from intermixture of these, was the conception of Empedocles, who regarded each element as distinct and unchangeable. But the doctrine of the Four Elements which gave so powerful an impulse and direction to chemistry was that taught by Aristotle. The importance of his doctrine lay not so much in the nature he assigned to matter, or to the modes in which qualities might be affixed to it, but in the broad principle that one kind of matter could be changed into another kind—in a word, that transmutation was possible. Underlying all tangible bodies was an indeterminate *matter-stuff* (ὕλη) on which properties might be impressed giving matter its particular *form* (εἶδος).

If such fundamental qualities as hotness and dryness (or their opposite qualities, coldness and wetness) are impressed on the matter-stuff, we may conceive two qualities combining to give a primal form of matter. For instance, the combination of dryness with heat gives fire, with cold gives earth: the combination of wetness with heat gives air, with cold gives water. Moreover these qualities are not unalterable. If the coldness of water is overcome by heat, the water changes to steam or air; if its wetness is overcome by dryness it leaves earth.

Aristotle's conception differed therefore not only from the unchangeable elements of Empedocles, but from the mechanical hypothesis of Democritus, who imagined the world built up by the fortuitous meeting of rapidly moving atoms—themselves of unalterable nature.

In Egypt the Aristotelian doctrine of the four elements readily took root. Working in metals had been practised for centuries not only along the Valley of the Nile, but in the Valleys of the

Euphrates and the Indus, between which there had long existed intercourse.

How far the teaching of the Alexandrine school directly affected chemical practice among the Egyptians is doubtful. It is clear from the chemical writings that have been preserved—especially from the famous papyrus at Leyden—that the priests were well acquainted with methods for imitating gold and silver, and for covering metal vessels superficially with gold alloys so that the base metal could be removed and leave a pure gold surface which would "pass the test."

ALCHEMISTS AND IATROCHEMISTS

When the Arabs conquered Egypt in the 7th century and overran Syria and Persia, they brought a new spirit of enquiry to bear on the old civilizations they subdued. The great name that stands out in the alchemic period is that of Jabir—probably the same Geber of the Latin books *Summa Perfectionis* and *Liber Fornacum* of which the existing mss. date from the 13th century. Jabir ibn Hayyan accepted the Aristotelian doctrine of the four elements, but to these he added the special chemical elements mercury and sulphur, by which he meant not so much the two elements as met with in nature, but rather the principles giving metals their unalterable property, and the earthly impurity that it was possible to cleanse them from. Gold, unaltered by fire, contained a very pure mercury; lead and copper contained much sulphur. That gold could be extracted from copper pyrites, and that silver remained when galena was long roasted, were regarded as evidence that the lustrous crystals of pyrites and galena, looked on as metals, had been transmuted by purification from the sulphur or dross into the nobler metals.

The two alchemic elements were thus introduced; the third element "salt"—representing the residue that remained fixed after calcination—was added by the iatrochemists. These three elements constituted the *tria prima* of Paracelsus and his disciples of the 16th century. Jabir himself seems to have believed in the philosopher's stone, and the term Kimya may have signified the secret powder which had to be projected on the molten metal to cause transmutation.

A century after Jabir came Rhazes, physician and chemist; and he was followed by Ibn Sina, better known as Avicenna, who knew that metals could be changed in colour, but not really altered in substance.

In the 11th century Mansur distinguished between *natron* (sodium carbonate) and *qali* (potassium carbonate). He describes the preparation of a plaster of Paris, for use in surgery, by heating gypsum and mixing it with white of egg.

When the Arabs penetrated into Spain they brought with them their chemical knowledge and their love of learning. Through the Arab universities founded in Spain, the knowledge not only of alchemy, but also of much of Greek thought first illuminated the backward States of Europe. We cannot be sure of the origin of many of the Latin texts of the 12th and following centuries. It is said that the book translated from the Arabic by Robert of Chester in 1144 contains passages which occur in the earlier alchemist mss. It is even probable that the names which figure largely among the early chemists in Europe—Albertus Magnus, Roger Bacon, Raymond Lully, Vincent de Beauvais—are those of writers who made known not so much their own chemical experience as that of the Arabian alchemists. Albertus takes the same view as Avicenna concerning "chemical gold"—it is a superficial imitation, not real gold.

Paracelsus, the son of a physician, studied at Basle and at Würzburg, and after wandering through Europe returned to Basle in 1526 and was appointed professor of medicine. His first public act was to burn the works of Galen and of Avicenna, the great handbooks of medicine, and to proclaim that chemistry was not concerned with the transmutation of metals but was the handmaid of medicine. His reckless use of inorganic salts—many of them poisonous—led to his expulsion from Basle.

Contemporary with the restless and dogmatic Paracelsus, Agricola devoted many years to the study of ores and the preparation of pure metals and salts from them. His *De Re Metallica* records many first-hand experiments—on the amalgamation process of extracting gold, on the properties of bismuth, on flame-tests for various metals. A little later Libavius, a German physician, published his *Alchymia,* which may be regarded as the first European textbook of chemistry. Coming later still, Glauber made his reputation as a great practical chemist: he gave a clear description of the mineral acids and of *aqua regia* (*q.v.*), and he left his name attached to sodium sulphate.

Last of the iatrochemists came van Helmont, regarded by many as the link between the alchemists and the modern chemists. He rejected the *tria prima* of Paracelsus and the four elements of Aristotle, going back to the older doctrine of Thales that water was the origin of all things. His well-known experiment of growing a willow-shoot in dried earth, and watering it regularly until it had gained many pounds in weight without receiving any appreciable nutriment except from the water, is recalled now with a feeling that Nature had a sense of irony in deceiving the man who discovered carbonic acid gas.

He showed that an air was given off when an acid acted on limestone or potashes, and that this air extinguished a flame. The same air he found was produced in fermentation and occurred naturally in the Grotto del Cane. In his endeavours to prepare the air in closed vessels he discovered the enormous force developed by it; *Ideo, nominis egestate,* he writes, *halitum illum Gas vocavi, non longe a Chao veterum secretum* (*Opera Omnia,* Frankfurt, 1682, p. 69). The term *gas sylvestre,* applied to carbon dioxide, meant the wild chaotic air that could not be coerced into vessels. Van Helmont found he could make an inflammable air, *gas pingue,* by heating animal matter, but he did not further distinguish between his gases.

BIRTH OF MODERN CHEMISTRY

Boyle.—A new era began with Robert Boyle. In early life, a member of the "Invisible College" (the germ from which the Royal Society sprang), he was drawn in 1654 to Oxford where several of the members were in residence. Here he spent his most active years in experimental research. He established by careful experiments the law known by his name—that the volume of a given mass of air varies inversely as the pressure upon it. He determined the density of air and pointed out that bodies altered in weight according to the varying buoyancy of the atmosphere; and he compared the lower strata of the air to a number of sponges or small springs compressed by the weight of the layers above them. It is notable that not only the facts published by Boyle on the "Spring of the Air," but the very images he used were repeated by Mariotte 14 years later.

In 1661 Boyle published the *Sceptical Chymist,* in which he gravely questions the *tria prima*: "There are some bodies from which it has not yet been made to appear that any degree of fire can separate either salt, or sulphur or mercury, much less all three. Gold may be heated for months in a furnace without losing weight or altering, and yet one of its supposed constituents is volatile and another combustible. Neither can solvents separate any of the three principles from gold; the metal may be *added to,* and so brought into solution . . . but the gold particles are present all the time: and the metal may be reduced to the same weight, of yellow, ponderous malleable substance it was before."

Boyle gives many instances in which metals, such as lead or copper, may be dissolved in acids and their properties entirely disguised in the compound. The corpuscles of which the metal is composed, meeting with corpuscles of another kind, may be more disposed to unite with them than with the particles forming their original metallic cluster. From the coalition of two different corpuscles a new body may be formed "as really one as either of the corpuscles before they were confounded." We can trace here the modern idea of chemical affinity uniting atoms into compounds. Boyle devised a method for extracting the element phosphorus, which was long known as Boyle's phosphorus; he made many experiments on air and other gases. He prepared hydrogen by the action of acids on steel filings and on iron nails, and showed that it would burn with a strong flame though with little light. He collected the gas in an inverted glass flask over dilute acid, and

showed that the imprisoned gas was permanent and "dilated itself" like air when the vessel was warmed.

In his "New Experiments touching the Relation betwixt Flame and Air" he showed that the flames of hydrogen, of sulphur, and of a candle were extinguished in the receiver of his air-pump when the air was rarified. But, finding that gunpowder and fulminating gold would burn in his vacuum, he was forced to conclude that flame may exist without air: it was left to his assistant Hooke to make the next advance.

By observing that wood-charcoal was immediately dissipated into white ashes if the retort was opened in the air while still red-hot, Hooke grasped the fact that the air "preyed upon" or "dissolved" the charcoal; and he compared the active constituent of the air with that which is fixed in saltpetre. The oil rising as vapour from a lighted wick is not burnt inside the flame (which is dark) but only as it reaches the surrounding atmosphere where it meets the "nitre-air."

Mayow made careful experiments on the burning of combustible bodies in air confined over water. He showed that part of the air disappeared both in combustion and respiration, and that the residue left would not support flame or life. This residue differed then from ordinary air. He did not isolate his nitre-air, nor show what became of it.

THEORY OF PHLOGISTON

The theory of *phlogiston* first proposed by Becher and greatly advanced by Stahl went back to the old idea of Jabir that combustible bodies lost something when they burnt. Becher's *terra pinguis* became Stahl's *phlogiston,* which was not fire itself but the material of fire. Metals were composed of a *calx,* different for each metal, combined with phlogiston, which was the same in all metals and common to all combustibles. When a metal, such as lead or tin, was calcined in the air, phlogiston was evolved and a calx was left behind. When a candle or charcoal was burnt in the air it gave off phlogiston (manifest as heat and light) and very little residue was left: wax and charcoal mainly consisted of the material of fire. When a calx was heated with charcoal out of contact with air the phlogiston of the charcoal recombined with the calx and the metal was re-generated. In this way a generalization was made which accounted for the two opposite processes of oxidation and reduction, and moreover was able to predict certain chemical consequences which were verified later by experiment. The heat given off by animal bodies and its restoration by food were also explained by phlogiston. The fact that combustion and life ceased in a confined volume of air was due to the swift whirling motion of the phlogiston that filled the air, which when saturated could take no more. In considering the wide acceptance of Stahl's theory it must be borne in mind that it gave expression to the very striking facts that in combustion something was emitted by the burning body, viz., *heat,* and in the reduction of a calx by charcoal something—potential energy, or the power of giving out heat again—was restored to it.

ANTIPHLOGISTIC EXPERIMENTS

Black and Cavendish.—The first blow to the phlogistic theory was dealt by Black, himself an adherent. It had long been known that limestone was turned into quicklime by heating, and that quicklime brought into contact with the mild alkalis rendered them caustic, returning itself to chalk. This was explained by supposing that the fire gave a "burning principle" to the limestone, which handed it on in turn to the mild alkali. Black, using the balance, found that both chalk and magnesia alba lost weight when they were heated, the loss being due to the escape of a gas previously fixed in them. The caustic lime and magnesia, freed from the gas, no longer effervesced with acids: moreover, the chalk and magnesia alba lost the same weight of gas whether they were strongly heated or were dissolved in an acid. The effervescence was obviously due to the escape of the air. Then an aqueous solution of the caustic lime or magnesia when exposed to the atmosphere gradually formed a white precipitate and lost its causticity as the "Fixed Air" from the atmosphere dissolved in the surface layer of the liquid. Caustic lime and magnesia act on the mild alkalis by combining with their fixed air, and not by any exchange of phlogiston. Black had proved by quantitative experiments the difference between the mild and caustic alkalis, and had shown that fixed air (CO_2) was a normal constituent of our atmosphere (1756).

Twenty years later Cavendish published his researches on "Factitious Air," in which he described the preparation and properties of carbon dioxide and hydrogen. His work on hydrogen is of the first importance. "Inflammable Air," he found, could be produced readily by the solution of zinc, iron and tin in dilute sulphuric or in hydrochloric acid. He collected and measured the gas over water, and found that a given weight of one of the metals gave the same measure of gas whichever acid was used as the solvent and however diluted the acid. He concluded therefore that the gas came from the metal and was either phlogiston or a compound of phlogiston with water.

Informed of Priestley's observations that in the explosion of inflammable air with common air a dew was deposited on the vessel and a loss of weight ensued, Cavendish carefully repeated the experiments and showed there was no loss of weight, while "almost all the inflammable air, and about one-fifth part of the common air, lose their elasticity and are condensed into a dew which lines the glass." He then burnt a quantity of hydrogen in air and, collecting the dew, found it had the properties of water; the two airs, he said, "are turned into pure water." Then Cavendish fired a mixture of hydrogen and oxygen, and was puzzled for some time by finding the condensed water to be acid. He proved this acid was due to the presence of adventitious nitrogen (from the air) which was acted on in the explosion if the oxygen was in excess. Afterwards he passed electric sparks through a mixture of air and oxygen in a bent tube over mercury in presence of potash. In this remarkable experiment he not only proved the composition of nitre, but proved that the nitrogen of the air could be completely removed with the exception of a small inert bubble of gas about one $\frac{1}{120}$ part of the whole. He had isolated argon (*q.v.*) from the air—by the same method used by Rayleigh and Ramsay more than 100 years later. In spite of the accuracy and the definite plan of his work, Cavendish was not convinced that water was a compound substance; James Watt saw the true significance of his work, and so did Lavoisier when he repeated it.

Scheele and Priestley.—In contrast to the deliberative work of Black and Cavendish, the rapid series of experiments carried out by Scheele in Sweden and by Priestley in England were remarkable for the brilliant observational powers brought into play and for the many discoveries that flowed from them.

Scheele found that various substances—especially bodies like sulphur and phosphorus—diminished the volume of air in which they were burnt; and the residual gas he found, against his expectation, to be lighter than ordinary air, and this lighter portion was no longer able to support combustion. The portion of the air concerned in the burning—his "fire-air" had disappeared. He burnt a jet of hydrogen in a measured volume of air over water, noticed how the flame died out, and then how the water rose in the vessel. Finding no evidence of any change in the water, he concluded that the missing air being neither condensed in the residual "foul air," nor dissolved in the water, must have escaped through the glass. The phlogiston (hydrogen) must have combined with the fire-air to form "caloric," and this had passed through the glass walls. He set himself to reverse the process. If caloric could be passed into a substance avid for phlogiston, the caloric might be broken up, the phlogiston retained and the fire-air liberated. Several bodies, he thought, would strongly attract phlogiston—such as nitric acid, pyrolusite (which he had himself investigated) and the red calx of mercury. When heat was applied to nitric acid, red fumes were evolved, and when these were absorbed by lime, a colourless gas remained, which supported combustion brilliantly. He had liberated the sought-for "fire-air." Similarly the calx of mercury, when heated in a vessel over a charcoal furnace, combined with the phlogiston of the caloric to form metallic quicksilver and the pure fire-air was set free. He added his fire-air to the residual "foul-air" in due proportion and found the mixture behaved as common air.

Scheele interpreted all his results in terms of the phlogistic theory. Thus when he first isolated chlorine by heating pyrolusite with hydrochloric acid, he imagined the pyrolusite had absorbed phlogiston from the acid, and he named the new gas "dephlogisticated marine acid." We owe to Scheele hydrofluoric, hydrocyanic, arsenic, tungstic and molybdic acids, and a long list of organic substances including glycerine and milk-sugar, with oxalic, tartaric, citric, malic and other acids.

Scheele's discovery of fire-air, probably made in 1773, was not published until 1777. Meanwhile, on Aug. 1, 1774, Priestley had concentrated the sun's rays through his new burning-glass on the red calx of mercury contained in a glass vessel over mercury, and found an air was expelled from it very readily. This air he found was not soluble in water, "but," he writes, "what surprised me more than I can well express was that a candle burned in this air with a remarkably vigorous flame." Now Priestley had previously shown that the respiration of animals acted like burning bodies on common air, diminishing its volume and rendering it noxious. This new air, he found, differed from common air not only in supporting combustion more vividly but in prolonging the life of animals breathing it. His explanation was that while common air is always partially saturated with phlogiston and cannot make room for much more, the new air is uncontaminated and phlogiston can rapidly escape into it—as into a vacuum. He named the new gas therefore "dephlogisticated air," and the residual inert nitrogen he named "phlogisticated air."

Priestley was the first to prepare and describe the gases nitric oxide and nitrous oxide, which he collected over water, and the gaseous hydrogen chloride, ammonia, sulphur dioxide and silicon fluoride, which he collected over mercury.

Lavoisier.—The outstanding feature of Lavoisier's work is the clearness with which he interpreted quantitative results, a clearness founded on his conviction (partly gained from Black) that no ponderable matter disappears in any chemical change. He heated water in a sealed glass vessel for many days, and found the weight of the whole unaltered. On pouring out the water he found the glass had lost in weight, but on evaporating the water he recovered the lost weight in the alkaline silicates which had been dissolved from the glass.

In 1772 Lavoisier began his researches on combustion. When sulphur and phosphorus were burnt in air a portion of the air was fixed. The same thing was observed when lead and tin were calcined in air sealed in glass vessels: there was no change in weight until the vessels were opened and the air rushed in. In 1775, after hearing from Priestley of his "dephlogisticated air," and after repeating the experiment with the red calx of mercury, Lavoisier grasped the true explanation of combustion. The "pure" or "vital" air was combined with the metal in the calx, and this pure air formed that portion of common air which produced calcination by combining with the metal. Then followed the quantitative demonstration that mercury heated in common air slowly combined with the "vital" part and formed the red powder—*mercurius calcinatus:* from this powder, more strongly heated, the vital air was recovered, and this mixed with the inert "azote" (left in the first experiment) exactly reformed the original common air.

Finding that non-metallic elements such as sulphur and phosphorus gave acids when combined with his vital air, and having shown that carbon yielded Black's Fixed Air (Bergman's Aereal Acid), Lavoisier adopted the name oxygen (acid-maker) for the substance which, combined with caloric, formed "oxygen gas." While the non-metallic elements gave acids by their combination with oxygen, the metals gave calces—the oxides of the metals; and the union of the two kinds of oxides gave the various metallic salts. But, the phlogistonists could still object, this did not explain the formation of inflammable air when metals were dissolved in acids. Just the same salt was formed by the union of a calx with an acid as by the solution of the metal in the acid; but in the latter case the metal gave up its phlogiston as inflammable air. Moreover, unless the calx were originally present in the metal, there was no obvious source from which the metal could obtain the oxygen necessary to form the calx. It was a difficulty only to be solved by Cavendish's proof that water was formed when inflammable air was burnt. Informed of Cavendish's work, Lavoisier and Laplace repeated the experiment and by their correct interpretation supplied the missing data. In the solution of a metal by an acid, the oxygen of the water combines with the metal, liberating the inflammable air—now named hydrogen—whilst the two oxides (the calx and the acid) combine to form the salt. This was the death-blow to the Phlogistic Theory.

Founded on Lavoisier's oxygen theory, a new nomenclature was evolved, and this has largely survived to our day. It was perhaps natural that the new school should consider oxygen to be an essential constituent of all acids, and that the acid from sea-salt, muriatic acid, should be regarded as formed by the union of an oxide of an unknown non-metallic element Murion with water, and that chlorine—Scheele's "Dephlogisticated Marine Acid"—should be an oxygenated compound of this, or "Oxy-muriatic Acid."

CHEMICAL COMBINATION

Berthollet, the most distinguished of Lavoisier's colleagues, was one of the group who drew up the new system of chemical nomenclature. He considered he had a decisive proof that chlorine contained oxygen when he had shown that a solution of the gas in water gave off oxygen when exposed to sunlight, and—gradually losing its colour—was reduced to muriatic acid. It remained for Davy to prove that Scheele's gas contained no oxygen, and that chlorine—the non-committal name suggested by him—was one of a family of elements having acid-forming hydrides.

Berthollet's chief claim to fame rests on his statement of the Law of Mass Action (*see* CHEMICAL ACTION), that the amount of a compound formed by an element A with B or with C depends, not only on the relative affinity of A for B and for C, respectively, but also on the quantities of B and C which are present and in a state to interact with A. This law has been of great importance in theoretical chemistry as well as in manufacturing operations.

But Berthollet carried his doctrine further: he considered that the constancy of composition shown by most known compounds depended on certain conditions prevailing at their preparation. When two elements were combining, a particular composition might correspond with insolubility or volatility, and so this compound might be separated out. Under other conditions the two elements might unite to form compounds in proportions varying between certain limits depending on the active masses of the elements. Berthollet instanced the oxides of lead and of other metals as showing such varying composition. This conception was opposed by Proust, and a long controversy ensued in which it was proved that the "varying" oxides were mixtures of two or more definite oxides, while it was still maintained that liquids such as alcohol and sulphuric acid combined with water in all proportions.

DALTON'S ATOMIC THEORY

Not only were Black and Cavendish clearly convinced that chemical combination took place in definite proportions by weight, but all Lavoisier's work shows his belief in this law. On the other hand, Bergman and his followers had worked on the quantities of acid and base required to form neutral salts, and Richter and Fischer had shown that there was a "reciprocal" law governing the weights of acids and bases which would just saturate each other. The several weights of different bases required to neutralize a given acid were also the weights required to neutralize a constant but different weight of another acid. This law of neutrality, embodied later in the "Law of Reciprocal Proportions," received little recognition at the time: it was revived to give support to and be explained by the Atomic Theory.

Dalton first briefly announced his theory in a memoir on the solubility of gases in 1803. He was led back to the old hypothesis of atoms through his study of the physical behaviour of gases, for he states that *the solubility of a gas depends upon the weight and number of the ultimate particles of the gas.* Already in 1801 he had shown experimentally that different gases under the same pressure expanded equally by heat, and had concluded that "all

elastic fluids" did the same; this fact he attributed to the expansion of a gas being entirely due to repulsion between the separated particles caused by heat alone, independently of any chemical attraction between them such as is shown in liquids and solids. His laboratory note-books show that Dalton had the idea of atoms in his mind some time before 1803, and the first table as published (in 1805) differs from the earliest tables found in his notes, but the essential facts are the same—if the weight of an atom of hydrogen is 1 a definite relative weight may be assigned to each atom of another element and to each compound atom formed by the union of these elementary atoms.

Dalton's table of the relative weights of the ultimate particles of gaseous and other bodies

Hydrogen	1	Nitrous gas	9·3	Carbonic acid	15·3
Azote	4·2	Ether	9·6	Alcohol	15·1
Carbon	4·3	Gaseous oxide of carbon	9·8	Sulphureous acid	19·9
Ammonia	5·2	Nitrous oxide	13·7	Sulphuric acid	25·4
Oxygen	5·5	Sulphur	14·4	Carburetted hydrogen	6·3
Water	6·5	Nitric acid	15·2	Olefiant gas	5·3
Phosphorus	7·2	Sulphuretted hydrogen	15·4		
Phosphuretted hydrogen	8·2				

The Law of Multiple Proportion is clearly embodied in this table (in spite of mistakes in the weights given for nitrous "gas" and "oxide"). The two compounds of carbon with oxygen, the two compounds of sulphur with oxygen, and the two compounds of carbon with hydrogen are represented by the sum of their atomic weights—CO and CO_2, SO and SO_2, CH_2 and CH.

Taking, as Dalton did, a fixed weight of one element in two or more compounds formed by it with another, then the weights of the second element which combine with the fixed weight of the first are simple multiples of each other. Dalton seems to have sought for instances of this chemical law to support the theory he had conceived on other grounds. Dalton published the full theory in his *New System of Chemistry* (1808), representing his atoms by circles—⊙ for hydrogen, ⓘ for nitrogen, ● for carbon, ○ for oxygen, etc., and placing these symbols to touch one another in compounds; *e.g.*, ⊙○ for water, ⊙● olefiant gas, ⊙●⊙ marsh gas.

Dalton laid down certain rules for determining atomic weights, remarking that one must always presume where only one compound is known that it is a *binary* one, and that such compound should always be specifically heavier than the mixture of its two ingredients.

Dalton's theory was soon adopted, and elaborate researches were made—especially by Berzelius—to determine by analysis the correct atomic weights. One of the first changes in Dalton's weights was due to Davy's decomposition of soda and potash by the electric current, and the recognition that the alkaline earths were also oxides of metals.

In 1808 Gay Lussac announced his law that *gases when they combine do so in very simple proportions by volume,* and the product formed, when gaseous, also occupies a volume simply related to those of its ingredients. Hydrogen unites with chlorine in equal volumes, and the acid gas formed occupies the same volume as the two; similarly two volumes of hydrogen unite with one volume of oxygen to form two volumes of steam measured under the same conditions. In such facts Gay Lussac saw a strong confirmation of Dalton's theory: assuming that the atoms of his gases occupied the same space, the volumes in which the gases combined ought to be simply related. But the idea that different atoms occupied the same space was repugnant to Dalton, who pointed out that steam was lighter than oxygen, and therefore in forming steam, according to Gay Lussac's idea, the oxygen atom must have divided itself.

The difficulty was overcome by *Avogadro's Hypothesis* (1811) that the chemical particles occupying the same gaseous volume were not single atoms but molecules consisting of 2 atoms, and in the formation of steam the oxygen molecule had divided itself between two hydrogen molecules. That *"equal volumes of all gases, simple or compound, contain the same number of molecules"* was in agreement both with physical and chemical data. This generalization, however, was long opposed by Berzelius, who could not reconcile the diatomic molecule of a simple element with his electro-chemical theory: moreover, the vapour densities of elements such as sulphur and phosphorus appeared anomalous.

With regard to the atomic weights of the metals the law of Dulong and Petit (1819) that *"the specific heats are inversely proportional to the atomic weights,"* and the law of Mitscherlich (1820) that *"salts having the same crystalline forms have similar chemical constitutions"* were of great assistance: but in spite of much detailed progress great confusion existed in the use of different "equivalents" and atomic weights. Order was only restored by the reform advocated by Cannizzaro (1858), who insisted that the atomic weight deduced from the weight of the gaseous molecule agreed with that calculated from the specific heat, and should be adopted.

Meanwhile, the elements had been grouped into families some of which showed marked resemblances between their members. Moreover, it was observed that the members of a family showed a regular gradation in their chemical and physical properties and in their atomic weights. Dumas drew attention to several such "triad" groups and showed that the central element was nearly the mean, in weight and properties, between the first and third; for instance sodium was half-way between lithium and potassium; bromine half-way between chlorine and iodine; selenium half-way between sulphur and tellurium; strontium half-way between calcium and barium. Elements seemed to be cast in certain moulds. Similarly, the formulae of compounds were built up on certain simple types. The use of the water-type by Williamson and of the ammonia-type and methane-type by Hofmann did much to explain similarities in chemical reactions, and led to the recognition of the different valencies of the elements. That atoms had valencies or bonds by which they attached themselves to each other, and that one atom differed from another in this power, gave a reason for the several types—if it was assumed that elements like hydrogen had one valency, others like oxygen had two, and so on. Frankland, who introduced this conception, accounted for elements having varying valencies by supposing that two of the bonds might be mutually satisfied, so that a pentad atom like $=N\equiv$ (with five bonds) might also act like a triad by the self-junction of two bonds, $<N\equiv$.

CLASSIFICATION OF THE ELEMENTS

As early as 1815 Prout put forward the view that all the elements were compounded of hydrogen, and all the atomic weights were simple multiples of that unit. That so many of the atomic weights approached whole numbers very closely seemed to exclude that this was a mere chance coincidence; but on the other hand there were well-established cases, such as chlorine, where the weight could not be reconciled with Prout's hypothesis. It was only after Cannizzaro's reform that a "natural" arrangement of the elements became possible. A scheme due to de Chancourtois in 1862 was followed by the law of Octaves published by Newlands in 1864. The latter placed all the known elements in eight vertical columns of seven each in the order of their weights, the second column starting with fluorine, the third with chlorine, and so on. Neither of these arrangements was accepted by chemists, although they both embodied the idea that carried conviction when put forward, quite independently, by Mendeleyev in 1869.

In the Periodic Classification Mendeleyev showed how regularly the elements changed in character as they changed in weight until the end of each "period" was reached, when by a sudden leap the character of the first was reproduced. In some doubtful cases he assigned atomic weights so that the elements should fit their places. Moreover he left many blank places to be filled, and was able to predict in some cases the atomic weight and the chief properties of the undiscovered element. His predictions were most startlingly fulfilled in the discovery of gallium, scandium and germanium.

The discovery of the inert gas, argon, by Rayleigh and Ramsay in 1894, and their proof that its molecule contained a single atom only, appeared at first at variance with the Periodic System.

But when Helium was discovered Ramsay was able to place these two gases as transitional elements and to predict another member of this family with an atomic weight between those of fluorine and sodium. By an exhaustive series of fractional distillations of the argon residues from air he and his colleagues separated first Neon and finally the two heavier gases Krypton and Xenon. These gases, like helium and argon, are chemically inert, and like them are monatomic. The chemical inertness of these elements has been explained, on the electron theory, by the symmetry of the orbits of their valency-electrons.

The proved success of the Periodic System both in co-ordination and prediction of chemical facts naturally led to the conviction that either its "weight" or its "place" held the secret of an element's properties. Many attempts were made to show "multiple" relations between the atomic weights, but no real advance was made until new discoveries in physical chemistry gave fresh views as to the ionization of salts in solution, the nature of electric discharges in gases, and the mechanism of radioactivity (*q.v.*).

IONS AND ELECTRONS

J. H. van't Hoff first explained osmotic pressure, the molecular depression of the freezing-point and raising of the boiling-point of solutions by showing that in dilute solution substances behaved like a gas. This conception was widened by S. Arrhenius and W. Ostwald, who concluded that salts and strong acids in aqueous solution were dissociated into charged ions, and the electric conductivity of the solution measured the number of such ions. The theory of electrolytic dissociation has given a consistent explanation of a great number of observed facts concerning solutions, and familiarized the idea of a mobile hydrogen atom bearing a unit charge of positive electricity. After Crookes' pioneering work on discharges in high vacua—his "fourth state of matter"—the discovery of the Röntgen rays in 1895, and of the radioactivity of uranium in 1896 opened a new era. In 1897 J. J. Thomson showed the independent existence of "gaseous" electrons as electrified units with a mass very minute compared with the lightest atom known; and since the same electrons were produced from different elements, he inferred that all atoms might be built up of these minute electrons. The charge carried by a gaseous ion was proved to be equal to that borne by the hydrogen ion in electrolysis.

The separation of radium salts from uranium ores by the Curies in 1898 revealed that the uranium was undergoing a spontaneous transformation through a succession of atomic explosions giving out radiations of three kinds—the heavy α-particles, the β-electrons and the γ-high-frequency waves. That the α-particles shot out from radium were atoms of helium was shown in Ramsay's laboratory in 1903.

Then followed Rutherford's achievement in counting the individual helium atoms shot out in unit time from a disintegrating element, from which he could deduce the actual number of atoms and molecules of any gas in a defined volume. The speed of the rejected α-particle showed the intense internal energy of the disintegrating atom, and the use of this "projectile" to probe other atoms led to the conception of an atom as composed of a heavy but very small positive nucleus, round which the inner electrons revolved with enormous rapidity, while the orbits of the outer electrons, circular or eliptical, were far removed from the positive focus (*see* ATOM).

ATOMIC NUMBERS

It was from the study of the X-ray spectra of various elements, all exhibiting bright lines similar in type, that H. G. J. Moseley was led to his Atomic Numbers. The vibration-frequency of these lines varied as the squares of whole numbers which advanced by one unit as the series of elements was ascended.

This series of whole numbers when applied in order to the elements in the Periodic Table, beginning with H=1, gives the number of units of positive electricity in the nucleus and the number of negative electrons round the nucleus required to neutralize them, thus fixing the number of electrons attached to each element—a number ranging from one in the hydrogen atom to 96 in the curium atom. The atomic numbers in this system are more fundamental than the atomic weights, for the properties of the elements depend directly upon them. The Table of Atomic Numbers could, like the Periodic Table, claim the power of successful prediction, for the element hafnium (celtium) (*q.v.*), subsequently discovered, filled the vacancy left at No. 72.

The breaking down of radioactive elements such as uranium and thorium by the successive losses of a helium atom to produce in many cases substances which appeared to have almost identical chemical characters, and the natural occurrence of groups of elements of similar character and approximately equal atomic weights, led F. Soddy and K. Fajans, quite independently of each other to formulate the theory of isotopes (*q.v.*), *i.e.*, of elements having the same number in the atomic order, but having different atomic weights. If, for instance, both uranium and thorium lose helium atoms until they reach a stable form in lead, it might be conjectured that two forms of lead could be found—associated with different minerals—differing only in atomic weight. Chemical analyses have shown such differences in lead from different sources, so that it is permissible to regard ordinary lead as a mixture of two isotopes. This conclusion is much strengthened by the actual separation by F. W. Aston of the positively charged atoms travelling to the negative pole in the case of many of the simpler elements, of which neon formed a striking example. Similarly Aston was able to show that ordinary chlorine contains at least two isotopes differing by two weight-units. In all the cases examined, Aston found the weights of each isotope to be close to a whole number.

Lastly Rutherford, using the newly ejected helium atom as his shell, and C. T. R. Wilson's water-laden gas as marker, has shown that certain elements of low *uneven* atomic number yield on bombardment a swiftly moving atom which is conjectured to be hydrogen. Elements of *even* number are not so attacked. The inference is that elements such as nitrogen may contain hydrogen atoms in or close to the nucleus, whilst the even elements are built up of helium atoms, in each of which four hydrogen atoms are so packed that they have lost a portion of their mass.

In Bohr's theory of the genesis of atoms, it is assumed that electrons are bound on successively to a nucleus originally naked. If such a synthesis begins in the interior of a star by the coalescence of four hydrogen atoms into one helium atom weighing less than its four components, there must be a definite loss of mass (energy) which might maintain the heat and radiation of the star. Again, if the outer electrons failed to join up, or were stripped off in the turmoil of the stellar centre, matter far denser than any of our elements might be formed. Of such condensation of matter there is astronomical evidence in *dense* stars—such as the Companion of Sirius.

BIBLIOGRAPHY.—M. Berthelot, *Les Origines de l'Alchimie* (1885); A. Ladenburg, *History of Chemistry since the time of Lavoisier* (trans. L. Dobbin, 1900); T. E. Thorpe, *History of Chemistry* (1921); J. M. Stillman, *History of Early Chemistry* (1924); D. Mendeléeff, *Principles of Chemistry* (ed. T. H. Pope, 3rd ed. 1905); W. Ostwald, *Outlines of General Chemistry* (1912); G. F. Hood and J. A. Carpenter, *Text-book of Practical Chemistry* (1921); T. E. Thorpe, *Dictionary of Applied Chemistry*, 7 vols. (1921, etc.); F. Ullman, *Enzyklopaedie der Technischen Chemie*, 12 vols. (1922); E. J. Holmyard, *The Cultivation of Gold, Al Dragi* (Paris, 1923); Roscoe and Schorlemmer, *Treatise on Chemistry*, vols. i. and ii. (new edition). *See* also F. A. Mason, *Introduction to the Literature of Chemistry* (1924), which gives a list of journals in which original papers appear, and *The Chemist's Yearbook*, 2 vols. yearly, ed. F. W. Atack, which contains useful information and lists of journals. (H. B. D.)

INORGANIC CHEMISTRY

Inorganic Chemistry, which is concerned with the preparation and properties of the elements and non-carbon compounds, was primarily developed through the investigation of minerals, and was in consequence termed mineral chemistry, whereas organic chemistry resulted from the study of plant and animal products. Though it was well recognized that organic substances were amenable to the same general chemical laws as mineral substances, it was not found possible, prior to 1828, to prepare organic substances from the elements synthetically, and it was supposed that a fundamental difference existed between organic

and inorganic substances. In 1828, F. Wöhler's synthesis of urea imparted a great impetus to the study of organic substances, and within a few years it was found convenient to separate chemical science into the domain of the carbon compounds, organic chemistry, and that of the elements and non-carbon compounds, inorganic chemistry. It is usual and convenient, however, to include in inorganic chemistry the oxides and nitride of carbon and their simpler derivatives, such as metallic carbonyls, carbonates and cyanides.

Early Discoveries.—The earliest discoveries in inorganic chemistry were made in the metallurgical and medical arts and in the domestic economy of the ancients. Gold, silver, copper, tin, iron and lead, some of the simpler alloys, metallic salts and mineral products, and the rudiments of metallurgical, glass-making, enamelling, painting, dyeing, alchemical and medical arts were known to the ancient Chaldeans, Hindus, Chinese, Egyptians and Greeks, many centuries before the Christian era. By about the middle of the 17th century, the alchemists were acquainted with most of the common metals, their alloys and salts, a few acids, alkalis, medicinal minerals, and non-metallic elements. In 1733 G. Brandt of Sweden isolated cobalt, and in 1750 A. F. Cronstedt prepared metallic nickel. These discoveries were followed by Henry Cavendish's recognition of elementary hydrogen in 1766, the isolation of nitrogen by Daniel Rutherford in 1772, manganese by J. G. Gahn in 1774, oxygen by Joseph Priestley and chlorine by K. Scheele in 1774, and molybdenum by P. J. Helm in 1782. Cavendish in 1784 made the far-reaching discovery that water is composed of two volumes of hydrogen to one of oxygen, and in the following year he succeeded in synthesizing nitric acid by passing electric sparks through moist air. His further discovery, that a minute residue of the air would not combine with oxygen, was ignored for over a century, until Lord Rayleigh and Sir William Ramsay in 1895 proved that the inert residue consists of a mixture of the noble gases, argon, krypton, neon and xenon.

The mineral pitchblende, in which M. H. Klaproth detected uranium in 1789, is of great historical importance, for W. F. Hillebrand exactly a century later obtained from it a gas which he supposed was wholly nitrogen, but which Ramsay in 1894 proved was a mixture with about 12% of the noble gas, helium, first detected spectroscopically in the sun by E. Frankland and Sir J. N. Lockyer in 1868. Henri Becquerel's detection in 1896 of the emission of radiation by uranium salts from pitchblende, led to the epoch-making discovery in 1898 of the radioactive compounds of polonium and radium by Marie and Pierre Curie, and of the heaviest noble gas, radon, by Ernst Dorn in 1900 (*see* RADIOACTIVITY).

Zirconium was detected by Klaproth in 1788, and titanium by McGregor in 1791. Don Fausto d'Elhuyar isolated tungsten in 1794, though the existence of tungstic acid had been proved by Scheele 20 years earlier. In 1794 J. Gadolin discovered the "rare earth" yttria, the chief constituent of the mineral later called gadolinite found in Ytterby in Sweden. The "rare earth" group of closely allied elements has been the subject of intensive chemical research for over a century. Cerium was detected simultaneously and independently by Klaproth, J. J. Berzelius and W. Hisinger in 1803. C. G. Mosander detected lanthanum in 1839, "didymia" in 1841 and terbium and erbium in 1843. "Ytterbia" was detected by J. C. G. de Marignac in 1878, scandium by Lars F. Nilson in 1879, samarium in the same year by Paul E. Lecoq de Boisbaudran and also holmium and thulium by P. T. Cleve. Mosander's "didymia" was resolved in 1885 into praseodymia and neodymia by Carl Auer von Welsbach, and G. Urbain resolved Marignac's "ytterbia" into ytterbia and lutecia in 1907. In 1886 Lecoq de Boisbaudran detected dysprosium and, with Marignac, gadolinium. The radioactive element actinium, the heaviest of the "rare earth" series, was detected by A. Debierne in 1899. The gap in atomic number between neodymium (60) and samarium (62) was filled in 1926 by the discovery of illinium by X-ray spectroscopy by J. A. Harris, L. F. Yntema and B. S. Hopkins, thus completing the series of "rare earth" elements. These eighteen elements are all proper to group III. of the periodic classification, scandium to period 4, yttrium to period 5, the 15 elements from lanthanum to lutecium to period 6 and actinium to period 7.

Platinum was probably known to the natives of Mexico and South America many centuries before its recognition by Scalinger in 1558 and William Brownrigg's description of it to the Royal Society in 1750. W. H. Wollaston discovered palladium in 1803 and rhodium in 1804. In the following year Smithson Tennant discovered iridium and osmium. The lightest of the "platinum metals" was not discovered till 1826, when Osann claimed to have isolated three new elements in native platinum alloys from Ruthenia in Russia. C. E. Claus was able to confirm the existence of only one of these new elements, which he called ruthenium.

Beryllium and chromium were detected by L. N. Vauquelin in 1797, and in the following year Klaproth isolated tellurium. Its congener, selenium, was not discovered till 1817, when Berzelius detected it as a red deposit in Swedish sulphuric acid chambers. In similar seleniferous deposits in German sulphuric acid works, Sir William Crookes in 1861 discovered thallium, the heaviest metal of the aluminium family.

The beginning of the 19th century witnessed the discovery of the most powerful method for the analysis of compounds into their elements, that of electrolysis. By this means Sir Humphry Davy was enabled to decompose the supposed elements, soda and potash, and isolated the metals sodium and potassium in 1808. Shortly afterwards he obtained magnesium, calcium, strontium and barium from magnesia, lime, strontia and baryta respectively. The discovery of boron by J. L. Gay Lussac and Davy in 1809 led Berzelius to investigate the supposed element, silex or silica, which he proved in 1810 to be the oxide of a new non-metallic element, silicon. The element was obtained by the reduction of fused silica with carbon and iron, and was finally obtained pure in 1823 after Berzelius had discovered the general method of reduction by heating potassium double fluorides with potassium. Using the new method he isolated zirconium in 1824, titanium shortly afterwards and thorium in 1828. A similar but more accessible method was introduced by Wöhler in 1827, beryllium and aluminium being isolated by heating their chlorides with potassium.

In 1812 B. Courtois isolated the element iodine from the ashes of marine plants. The analogy of iodine to chlorine was quickly recognized, and in 1815 Gay Lussac isolated cyanogen, a compound which in combination behaves very similarly to the halogen elements, chlorine and iodine. Bromine, intermediate in atomic weight and properties between chlorine and iodine, was discovered by A. J. Balard in 1826. The lightest of the halogen family of elements, fluorine, though well recognized as an element, resisted numerous attempts to isolate it until 1886, when Henri Moissan obtained the elementary gas by the electrolysis of a solution of potassium hydrogen fluoride in hydrofluoric acid in a platinum vessel.

The lightest of the alkali metals, lithium, was discovered by Arfedson in 1817, but the two heaviest, rubidium and caesium, were not detected till 1861 and 1860, respectively, when Robert W. Bunsen and G. R. Kirchhoff applied spectrum analysis to the detection of elements, a new method discovered by them in 1859. This method has been of immense service in chemistry, and has led to the discovery of thallium by Crookes, indium by F. Reich and H. T. Richter in 1863, and gallium by Lecoq de Boisbaudran in 1875, all members of the aluminium family. The spectroscopic method has also played an important part in the characterization of the "rare earths," and has proved of fundamental importance in ascertaining the composition of the sun and stars. Its extension to X-ray spectra has in recent years led to great advances in physical knowledge of the structure of atoms.

Vanadium was discovered by Del Rio in 1801, and the allied element, niobium (columbium), by C. Hatchett in the same year. Tantalum, the next heavier member of this family, was discovered by A. G. Ekeberg two years later, but Wollaston in 1809 pronounced niobium and tantalum to be identical. These elements were not separately distinguished until 1844, when H. Rose showed that the mineral columbite contained two distinct elements, the lighter of which he named niobium and the heavier

tantalum. Nevertheless, confusion continued to exist between these elements till Marignac proved in 1866 that Rose's niobium was in fact Hatchett's columbium. The separation of these elements is one of the most difficult problems of analytical chemistry, most methods being based on slight differences in solubility or hydrolizability of their double fluorides. The radioactive element, protoactinium, is the heaviest of the vanadium family, and was discovered by Otto Hahn and Lise Meitner in 1918. The atomic weight of protoactinium is uncertain and its atomic number is known only by inference from the radioactive disintegration series.

FORMULAE AND NOMENCLATURE

A chemical formula is a collection of letters and numerals indicating the elementary composition of a compound substance. The symbol for an atom of an element is either the capital letter of its English or Latin name, as C for carbon and K for potassium (Latin, *kalium*), or the capital letter followed by a small letter, as Co for cobalt and Cr for chromium. The qualitative composition of a compound substance is indicated by a formula consisting of the symbols of the elements in juxtaposition, as CO for carbon oxide. Chemical formulae, however, convey quantitative as well as qualitative composition. Empirical formulae indicate the component elements and the simplest ratio between them, as Fe_2O_3 for iron oxide, the subscript numerals signifying a ratio of two atoms of iron to three of oxygen. Rational formulae indicate further the actual number of atoms of each element in one compound molecule, *i.e.* in the smallest portion of the compound that can exist as a separate entity. The empirical formula of acetylene, for example, is CH, but the rational formula is known to be C_2H_2. Empirical and rational formulae are, however, often identical. A chemical formula generally attempts to show the scheme of combination between the various atoms comprising a molecule. For example, the rational formula of thorium sulphate is ThS_2O_8, but is usually rearranged as $Th(SO_4)_2$, the subscript numeral 2 indicating that two SO_4 or sulphate groupings are separate radicals independently in combination with one atom of thorium. Rational formulae thus rearranged as structural formulae are in general use, particularly in organic chemistry, and conventional schemes have been adopted to convey the *exact* mode of combination in compounds with many different identifiable radicals.

By common agreement, the names of compounds of atoms of two elements are formed from the name of the electro-positive element followed by the name of the electro-negative element inflected by the suffix *ide,* as in sodium chloride, calcium oxide, zinc sulphide. When two elements form more than one compound, Greek numerical prefixes are generally used to inflect the electro-negative term, as in carbon monoxide, carbon dioxide, phosphorus trioxide and phosphorus pentoxide. The Latin prefix *sesqui* is, however, used to indicate one and a half, as in the case of chromium sesquioxide (Cr_2O_3), in order to distinguish it from chromium trioxide (CrO_3). Elements, which form more than one oxide and give rise to corresponding series of salts, have the different series distinguished by an inflecting suffix to the electro-positive term, the numerical prefix to the electro-negative term being omitted. The suffix *ous* is used to indicate the lower and the suffix *ic* to indicate the higher condition of oxidation, as in the copper compounds, cuprous oxide (Cu_2O), and cupric oxide (CuO).

Oxides may be classified as acidic or basic, according to whether they neutralize bases or acids. Acidic oxides on solution in water give rise to acids, sulphur dioxide (SO_2), for example, combining with water to form sulphurous acid (H_2SO_3). The more highly oxygenated sulphur trioxide (SO_3) yields sulphuric acid (H_2SO_4). The terminations *ous* and *ic* are generally used to distinguish the acids derived from the lower and higher acidic oxide. Basic oxides also usually combine with water, but form bases not acids, basic barium oxide (BaO), for example, combining with water to form the base, barium hydroxide [$Ba(OH)_2$]. When acids and bases neutralize one another water is eliminated and the same salt is formed as by the combination of the basic and acidic oxide. Barium hydroxide, for example, combines with sulphurous acid to form the salt, barium sulphite ($BaSO_3$), the product of the combination of barium oxide and sulphur dioxide. Similarly, barium hydroxide and sulphuric acid yield barium sulphate ($BaSO_4$), the product of the combination of barium oxide with sulphur trioxide. The terminations *ite* and *ate* are used to indicate the salts derived from acids terminating in *ous* and *ic,* whereas the termination *ide* is used for salts and compounds in general formed from only two elements, as in the case of oxide, chloride and sulphide. If more than two series of acidic oxides, acids and salts are derived from an element, the inflecting prefix *hypo* is used for the series lowest in oxidation, and *per* for the series highest in oxidation, as in the case of hypochlorous, chlorous, chloric and perchloric acids, and hypochlorites, chlorites, chlorates and perchlorates. As acidic oxides are derived from acids by abstraction of water, such oxides are alternatively referred to as anhydrides, particularly in organic chemistry.

A few oxides and hydroxides are at once basic and acidic, combining with either acids or bases, and are termed *amphoteric.* Aluminium oxide, for example, is amphoteric in yielding aluminium salts with acids and aluminates with bases, as in the case of aluminium nitrate and sodium aluminate.

The oxygen of acids is replaceable in whole or in part by other elements allied to oxygen, for example sulphur. If one oxygen atom in a sulphate, for example, be replaced by a sulphur atom, the product is a thiosulphate (*theion,* sulphur), as in the case of sodium thiosulphate (Na_2SO_3S or $Na_2S_2O_3$). Similarly the replacement of the oxygen by sulphur in potassium carbonate gives potassium thiocarbonate (K_2CS_3).

The capacity of an element for combination is not exhausted by simple salt formation by reaction of its oxide or hydroxide with acids. Aluminium sulphate, $Al_2(SO_4)_3$, for example, is the salt formed by the reaction of aluminium hydroxide with sulphuric acid, but this salt combines, molecule for molecule, with potassium sulphate K_2SO_4, and water to form a double salt, alum, $Al_2(SO_4)_3,K_2SO_4,24H_2O$, which has many analogues (*see* ALUM). Diverse double salts are furnished by other metals in combination with acidic radicals other than sulphates. Magnesium chloride, for example, combines with potassium chloride and water to form the double chloride, carnallite ($MgCl_2,KCl,6H_2O$). The combination between the simple salts in double salts is, however, relatively loose, and the salts are split into their components often merely by solution in water, and the various metallic and acidic radicals are readily detected by the usual analytical tests. In other types of similar compounds, however, the union between the component simple salts is very much closer, and frequently the compounds are not readily decomposed into their components by the usual reagents. Such compounds are referred to as complex salts, and in these cases two or more of the component radicals, acidic or metallic, cannot be detected by the usual analytical processes. The compound of sodium chloride and platinum chloride, sodium platinichloride or chloroplatinate (Na_2PtCl_6), for example, is soluble in water without decomposition and yields none of the ordinary analytical reactions of either chlorides or platinum salts. The complex salt, potassium ferrocyanide [$K_4Fe(CN)_6$ or $Fe(CN)_2,4KCN$], similarly gives none of the usual analytical reactions of cyanides or iron salts.

A new viewpoint of the constitution of these and many other complex compounds was put forward by Alfred Werner in 1891 and 1893 by the promulgation of his theory of co-ordination (*q.v.*), in which the valency of an atom was regarded as distributed in space around the atom and thus partly available for binding atoms other than those primarily engaged in the principal valency combination (*see* AMINES).

The simplest inorganic compounds are the hydrides, compounds of the elements with hydrogen, but until recent years comparatively few hydrides had been prepared and investigated. The hydrides of the halogen elements, such as hydrogen chloride (HCl), and the hydrides, water, sulphuretted hydrogen (H_2S), and methane (CH_4), have been known for centuries. The phosphorus, arsenic and antimony hydrides analogous to ammonia (NH_3) have long been known, but the corresponding bismuth and polonium hydrides were discovered by F. Paneth only in 1918. The hydrides of tin and lead were discovered by Paneth two years later, and are probably analogous to methane, silane and germanane, the last of which was discovered by E. Vogelen in 1902, though its composition as germanium tetrahydride was not established till 20 years later by Paneth. It is a curious fact that the

gaseous hydrides of the elements (except boron) are confined to groups IV., V., VI. and VII. of the periodic classification (*see* PERIODIC LAW, THE) the hydrides of the alkali metals, the alkaline earth metals, the "rare earth" metals and of thorium and copper all being solids. The hydrides of chromium, cobalt, nickel and iron are also solids. Though hydrides of boron have been known for half a century, their composition was uncertain till 1913, when Alfred Stock commenced his extensive researches on the hydroborons. The simplest hydroboron is diborane, B_2H_6, other hydrides having the formulae B_4H_{10}, B_5H_9, B_5H_{11}, B_6H_{10} and $B_{10}H_{14}$. Owing to the presence of an odd number of hydrogen atoms in some of these hydrides, their formulation is impossible on the ordinarily accepted theories of valency. The existence of these compounds appears to demand the abandonment of the usual conception of valency, and the substitution of the actual number of electrons participating in each chemical bond. It is usual to postulate an invariable valency bond of two shared electrons, and it is almost certain that this type of bond is common to the majority of organic compounds. Evidence is accumulating, however, that this type of bond is not general in inorganic chemistry, particularly in the case of the more reactive non-ionized compounds, and a bond of a single shared electron appears to accord better with the experimental evidence. Each element is described, together with its commoner compounds, under its own heading.

BIBLIOGRAPHY.—R. Abegg and F. Auerbach, *Handbuch der anorganischen Chemie* (8 vols., Leipzig, 1905–27); L. Gmelin and A. Kraut, *Handbuch der anorganischen Chemie* (12 vols. with appendices, Heidelberg, 1907–27); J. A. N. Friend, *Textbook of Inorganic Chemistry* (10 vols., 1917, etc.); W. C. McC. Lewis, *A System of Physical Chemistry* (3 vols., 1918–19); A. E. Roscoe and C. Schorlemmer, *Treatise on Chemistry* (vol. i., 1921, vol. ii., 1923); T. M. Lowry, *Textbook of Inorganic Chemistry* (1922); H. A. Kramer and H. Holst, *The Atom* (1923); A Stock, *The Structure of Atoms* (Eng. trans. S. Sugden, 1923); J. W. Mellor, *Modern Inorganic Chemistry* (1925); A. W. Stewart, *Recent Advances in Physical and Inorganic Chemistry* (1926); F. Ephraim, *Textbook of Inorganic Chemistry* (Eng. trans. P. C. L. Thorne, 1926); A. F. Holleman, *Textbook of Inorganic Chemistry* (7th ed., 1927). (J. D. M. S.)

ORGANIC CHEMISTRY

Organic chemistry, in its modern sense, is the chemistry of all carbon compounds. Carbon, occupying a position in the periodic table between the metals and non-metals, is capable of combining with a large number of elements having widely varying chemical properties, and, in addition, has the special property of combining with itself to an unlimited extent. The result is that the carbon compounds are so numerous that a special branch of chemistry is devoted to their study. Usually, however, the simpler compounds, such as the oxides, cyanogen, etc., are dealt with under inorganic chemistry, and organic chemistry is reserved for the extensive treatment of the more complicated compounds, including those existing in living matter.

HISTORICAL INTRODUCTION

Whereas inorganic chemistry originally arose from the examination of the metals and mineral or earthy materials, the organic side was developed by the study of substances of vegetable and animal origin. The beginnings of organic chemistry were hindered by the alchemists' quest for the philosopher's stone, which should transmute the base metals into gold, and for the elixir of life, a universal medicine to confer immortality, or at least, longevity upon those who drank it. The iatrochemists in the 16th century confined their attention chiefly to the search for medicinal products, which included a study of the distillation of such materials as herbs and resins. The only general classification of substances, based on their physical and superficial properties, led to the correlation of organic and inorganic compounds without regard to their chemical characteristics. All organic substances were grouped with the combustibles in the period of the phlogistic theory.

Development of organic chemistry in the 18th century was confined to improvements in a few practical applications, especially in the arts of medicine and dyeing. It received some impetus from the work of Karl Wilhelm Scheele, and later from that of Michel Eugène Chevreul, who showed the general occurrence of glycerine and fatty acids in all oils and fats, both of vegetable and animal origin. Theoretical speculation was revived by Antoine Laurent Lavoisier, who, after explaining the true nature of combustion, and devising methods of analysis, concluded that vegetable substances in general contained carbon, hydrogen and oxygen, whilst animal substances contained, in addition, nitrogen and sometimes phosphorus and sulphur.

It is well said that the mechanism of chemical combination is the ultimate problem of chemistry, and theories regarding it were propounded even prior to the advent of the atomic theory. In 1787, Guyton de Morveau suggested that all compounds consisted of oxygen combined with a *base*. Lavoisier went further and considered inorganic compounds to be oxides of simple substances, and organic compounds, oxides of complexes or *radicals*. He had observed that some elements were capable of forming more than one oxide, and concluded that organic radicals acted similarly. He thus regarded sugar as a neutral oxide of a hydrocarbon radical (a complex consisting of carbon and hydrogen), and oxalic acid as a higher oxide of the same radical, since it was formed from sugar by treatment with the powerful oxidizing agent nitric acid. Lavoisier considered all radicals as bases, but the latter term was later restricted to the oxides of metals.

There was, at this time, a wide-spread belief, held until much later by Jöns Jacob Berzelius, Leopold Gmelin and others, that the formation of organic compounds was conditioned by the intervention of a so-called *vital force*, a force which could not be imitated for the purpose of a laboratory synthesis. Berzelius was of the opinion that in the sphere of living nature the elements obeyed laws totally different from those ruling in inanimate material. In fact, he stated (1811) that the composition of the majority of organic compounds appeared to be inconsistent with the requirements of the ordinary laws of simple and multiple proportions. Improved appliances and methods of analysis convinced him (1813–14) that, although they possessed much more complicated compositions than the mineral compounds, they did, in fact, follow the simple laws applicable to the inorganic world. The first real blow to the vitalist theory was the synthesis, by Friedrich Wöhler (1828), of urea from ammonium cyanate. Urea, a product of animal metabolism, was thus obtained from a compound hitherto regarded as truly inorganic.

Theories of Organic Radicals.—Berzelius adopted Lavoisier's view that organic compounds were oxides of compound radicals, and contained, therefore, at least three elements: carbon, hydrogen, and oxygen. This view was acceptable to Gmelin, who, in his book of 1817, described inorganic compounds as being of *binary* composition, and organic compounds as *ternary*. Consequently, marsh gas, ethylene and cyanogen were regarded as inorganic. This binary conception received apparent support from the inference by Louis Joseph Gay-Lussac (1815) that alcohol and ether could be regarded as water coupled with one and two particles of ethylene respectively. Gay-Lussac examined the cyanogen compounds and showed that the cyanogen group was an unvarying radical which persisted throughout a series of compounds. As a consequence of these observations, numerous attempts were made to find other radicals which would function as elements.

At this stage another problem was introduced into organic chemistry, namely, to account for the occurrence of two or more substances with similar percentage compositions, but dissimilar chemical and physical properties. John Dalton (1820) discovered a hydrocarbon in oil-gas having the same percentage composition as ethylene (C_2H_4), and it was later suggested that it consisted of two ethylene particles (the formulae in brackets represent the correct modern version). This was confirmed by Michael Faraday (1825), who called the gas butylene (C_4H_8). Justus von Liebig (1823) announced that his analysis of silver fulminate gave the same results as those ascribed to silver cyanate by Wöhler in the previous year. Berzelius (1826–27) followed up Gay-Lussac's suggestion that the difference in properties of these substances with the same percentage composition must be due to differences in the arrangements of the same relative numbers of the same atoms, a suggestion which gained ground with Wöhler's urea synthesis, but it was not until 1832–33 that Berzelius finally accepted

this doctrine, which he called *isomerism.*

Jean Baptiste André Dumas and Polydore Boullay (1827) put forward the theory that ether and the simple derivatives of ethylene all contained the ethylene group, $C_4H_8(C_2H_4)$, for which Berzelius proposed the name *etherin.* Liebig, however, adopted the dualistic view and regarded ether as the oxide of the radical $C_4H_{10}(C_2H_5)$, which he called *etheryl* or *ethyl,* and alcohol as the hydrate of ethyl. He was wrong, since he attributed to alcohol twice its true molecular weight, but despite this and similar errors, the value of the *Ethyl Radical Theory* was recognized. In 1832, Wöhler and Liebig published their outstanding researches on the radical of benzoic acid, and showed that the radical containing carbon, hydrogen and oxygen ($C_6H_5{\cdot}CO$), which they named *benzoyl,* formed the basis of benzaldehyde, benzoic acid, benzoyl chloride, benzoyl bromide, and benzoyl sulphide, benzamide and benzoic ether. Berzelius recognized the importance of this work, although it overthrew his belief that oxygen could play no part in a compound radical. In the following year he reverted to his earlier views and his electro-chemical theory. He then regarded benzoyl as an oxide of the radical $C_{14}H_{10}$ ($C_6H_5{\cdot}C$), which he named *picramyl,* the peroxide being benzoic acid. Many workers were attracted to the task of investigating radicals, and of these, *formyl, methyl, amyl* and *acetyl* were soon established. In this connection should be mentioned the very important work of Robert Wilhelm Bunsen (1839) on *cacodyl.* He proved that the so-called *fuming liquor of Cadet,* the product of distillation of potassium acetate with arsenious acid, contained the oxide of an arseniuretted group, $As_2C_4H_{12}$, which he showed to be a true radical.

In 1837, Dumas admitted the failure of the etherin theory, and, in conjunction with Liebig, outlined what is now known as the *Older Theory of Radicals,* and defined organic chemistry as the chemistry of compound radicals. In the following year Liebig described a compound radical as the unchanging constituent of a series of compounds, which should be capable of replacement in these by simple substances, and, where it is combined with a single element, the latter should be exchangeable for its equivalent of another element. The radical was supposed to be constituted of atoms held together by forces stronger than those uniting the complete group to other atoms. These ideas attained a real significance for chemists, and, as the dualistic theory and the theory of compound radicals became more definitely useful, they rendered the atomic theory, on which they were founded, essential to chemistry.

Instances had already been recorded of the substitution of electro-positive atoms by electro-negative ones. Gay-Lussac obtained cyanogen chloride from hydrocyanic acid, and Faraday, hexachlorethane from ethylene dichloride, in both cases a replacement of hydrogen by chlorine. Dumas, especially, studied these substitutions, and from his examination of the action of chlorine on alcohol, put forward his *Substitution Theory,* in which he postulated that for every hydrogen atom eliminated, an equivalent amount of chlorine was taken up, without any material alteration in the nature of the resulting product. Dumas' pupil, Auguste Laurent (1836), went further, and compared in detail the original compounds with their substitution products. As a result, he propounded his *Nucleus Theory,* which differed from the original radical theory in that it recognized that the groups formerly termed radicals were subject to change, such as substitution by the interchange of equivalent amounts of their constituents. The discovery of chloracetic acid afforded Dumas the occasion for attacking the radical theory, and for supporting Laurent's view. There was vigorous opposition from Liebig and Berzelius, especially the latter, who resorted to fantastic hypotheses to explain the observed facts in order to suit his own theories. Finally he abandoned experiment for pure speculation, and there arose an embittered controversy which lasted for years.

Charles Frédéric Gerhardt also rejected the theory of unchangeable radicals and put forward his *Theory of Residues,* by which the substitution process consisted in the union of two residues to form a unitary whole. He considered radicals to be merely the residues of molecules which took no part in a particular chemical reaction, but which appeared as independent portions of those molecules, only when displaced in a reaction by combination between the reacting portions of molecules. Such residues then joined together to form a *copulated* or *conjugated* compound. He thus represented Liebig and Wöhler's reactions with the benzoyl compounds as double decompositions.

Theories of Chemical Types.—The radical theory, essentially dualistic, was destined to fall before a unitary conception. Dumas (1840) combined his theories of radicals and substitution with portions of Laurent's nucleus theory and Gerhardt's theory of residues into a comprehensive whole, now known as the *Older Theory of Types.* According to this a chemical *type* embraced compounds containing the same number of equivalents combined in a similar manner and exhibiting similar properties; thus acetic and trichloracetic acids ($CH_3{\cdot}COOH$ and $CCl_3{\cdot}COOH$), acetaldehyde and chloral ($CH_3{\cdot}CHO$ and $CCl_3{\cdot}CHO$), marsh gas and chloroform (CH_4 and $CHCl_3$) are pairs of compounds referable to the same type. He also postulated, with Henri Victor Regnault, the existence of *molecular* or *mechanical types,* referring to substances which, although having the same number of equivalents, are essentially different in character; for example, alcohol and acetic acid ($CH_3{\cdot}CH_2{\cdot}OH$ and $CH_3{\cdot}CO{\cdot}OH$), in the second of which one atom of oxygen replaces two of hydrogen. This unitary conception may be summarized as follows: every chemical compound forms a complete whole and its chemical character depends primarily upon the number and arrangement of the atoms, and, in a lesser degree, upon their chemical nature.

Charles Adolphe Wurtz (1849) described the amines or substituted ammonias, previously predicted by Liebig. August Wilhelm von Hofmann continued the investigation, and established their recognition as ammonia in which one or more hydrogen atoms had been replaced by alcohol or hydrocarbon radicals, thus formulating the *ammonia type.* Alexander William Williamson (1850) demonstrated in a similar manner that the alcohols and ethers could be referred to the *water type.* In 1851, Adolph Wilhelm Hermann Kolbe put forward his *New Theory of Radicals,* but the main theoretical conclusions were better correlated by Gerhardt (1853) in his *Theory of Simple Types,* in which he regarded all compounds as derived from hydrogen, hydrogen chloride, water, and ammonia types. Thus the hydrogen type included the hydrocarbons, aldehydes and ketones, the hydrogen chloride type, all halogen derivatives, the water type, alcohols, ethers, monobasic acids, acid anhydrides and analogous sulphur compounds, and the ammonia type, amines, acid amides, and the analogous phosphorus and arsenic compounds. Gerhardt's services to chemistry can never be questioned.

The recognition of the polybasicity of some acids, following the researches of Thomas Graham, led Williamson to suggest that dibasic acids could be referred to a *double water type,* and the multi-basic acids to *multiple water types.* These views were extended by William Odling, and adopted by Gerhardt. A further generalization was effected by August Kekulé (1857), who rejected the hydrogen chloride type as being a variant only of the hydrogen type, and introduced instead the *methane type.* He elaborated Gerhardt's suggestion of *mixed types,* compounds derived from more than one fundamental type, and in so doing, laid the foundation of the doctrine of valency.

The Idea of Valency.—In 1852, Edward Frankland published his classical research on the organo-metallic compounds and represented them by formulae which brought out the analogy with the inorganic types. Frankland then developed the idea of *saturation capacities* of the various elements, the germ of which may be recognized much earlier in the law of multiple proportions. This law states, in effect, that the elements show different, yet definite stages in their combination. Frankland was able to predict the possibility of compounds then unknown, namely, the secondary and tertiary alcohols, and to show relationships between compounds previously held distinct, for example, lactic acid and alanine, glycollic acid and glycine, and salicylic and benzamic acids, were shown to be hydroxy- and amino-derivatives of propionic, acetic and benzoic acids respectively.

Kolbe and Frankland had recognized the quadrivalency of carbon, but this was first expressly stated by Kekulé (1858). Kekulé went further, and suggested the manner in which two or more of

these quadrivalent carbon atoms could unite with one another, mutually satisfying some of their saturation capacities. In the same year Archibald Scott Couper, quite independently, developed a similar system of atomic linkage. From this arose the idea of atomic carbon chains, either open, as in the fatty, or closed, as in the aromatic and cyclic series. This gave precision to the earlier observation of Jacob Heinrich Wilhelm Schiel (1842) that a very simple relation existed between the then known alcohols (general formula $C_nH_{2n+1}\cdot OH$), and to Dumas' demonstration in the same year of the existence of a similar relation between the several members of the fatty acids ($C_nH_{2n+1}\cdot COOH$). Gerhardt (1844) was the first to use this knowledge of related series of chemical compounds to predict the possibility of hitherto unknown members. These series of compounds, called *homologous series,* are now known to possess the same characteristic groups at the ends of carbon chains of variable length. Thus the first members of the simple fatty acid series are: acetic acid, $CH_3\cdot COOH$; propionic acid, $CH_3(CH_2)\cdot COOH$; butyric acid, $CH_3(CH_2)_2\cdot COOH$, etc.

The doctrine of valency permitted the graphic representation of the molecule. These representations were at first written in one plane only, but a number of cases were then discovered which did not appear to be capable of explanation by such *structural formulae.* Ludwig Carius (1864) suggested the term *physical isomerism* to describe these anomalies, but Johannes Wislicenus (1873) introduced the term *geometrical isomerism* and showed that it was possible to account for the phenomenon if such molecules were represented in three dimensions. This *Structure Theory* of the carbon compounds, founded by Kekulé and Couper, was further developed by the work of Jacobus Henricus Van't Hoff and Joseph Achille Le Bel on *stereochemistry* or chemistry in space. By its aid the molecule is represented as a collection of atoms connected together by chemical *bonds* or valencies in such a manner that the part played by each is adequately represented. After 1870 the determination of the constitution of complex molecules became one of the chief aims of chemistry, to be brought to a logical conclusion by subsequent synthesis.

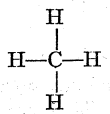
BIBLIOGRAPHY.—V. Meyer and P. Jacobson, *Lehrbuch der organischen Chemie* (2nd ed., Leipzig, 1909 etc.); W. H. Perkin and F. S. Kipping, *Organic Chemistry* (1911); V. von Richter, *Organic Chemistry, or Chemistry of Carbon Compounds* (ed. R. Anschüter and G. Schroeter, trans. and revised P. E. Spielmann, 1915–22); F. Henrich, *Theories of Organic Chemistry* (trans. T. B. Johnson and D. A. Hahn, 1923); J. Schmidt, *Organic Chemistry* (Eng. ed. H. G. Rule, 1926); F. K. Beilstein, *Handbuch der organischen Chemie* (9 vols., 4th ed. 1926). For history, *see* E. Hjelt, *Geschichte der organischen Chemie* (Braunschweig, 1916). (E. Ho.)

ALIPHATIC DIVISION

In this section are outlined the classification, general methods of preparation, and characteristics of the very large number of substances concerned. There are special articles on most of the technically valuable members of this subdivision and on important theoretical considerations such as valency, isomerism and stereochemistry.

Hydrocarbons.—The compounds of carbon and hydrogen known as hydrocarbons occur naturally as petroleum, mineral oil, and ozokerite, or are formed by the distillation of coal, brown coal or shale. The chemical characteristics of those individual hydrocarbons isolated from such sources are so well defined that it is possible to classify them into three groups: aliphatic, homocyclic and heterocyclic, this section dealing with the first group. This group, of which marsh gas found in the coal measures is the simplest representative, is further subdivided by the chemical properties of its members into four main classes: (i.) paraffins, (ii.) olefines or ethylenes, (iii.) acetylenes and (iv.) di-olefines. The number of these hydrocarbons, and more particularly of their derivatives, is so large that it will only be possible to consider a few simple members in each important class; but since the members of any one series closely resemble one another, a description of the simpler gives a general knowledge of the more complicated.

(i.) *Paraffins.* Analysis and molecular-weight determination of the simplest possible hydrocarbon, marsh gas or methane, lead to the formula CH_4. Organic chemistry has been built up on the conception that carbon is quadrivalent; *i.e.,* that this element is capable of combining with four atoms of hydrogen to form a stable compound. Further, it has been shown experimentally that the four hydrogen atoms are of equal value, and consequently the only method of picturing the arrangements of the atoms in this molecule is to regard the carbon as situated in the centre of a sphere, with its four valencies directed symmetrically in space. This view of the molecular architecture of marsh gas will be referred to later; in the meanwhile, the graphic formula will be written as

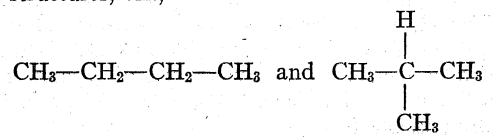


When chlorine acts on marsh gas, the first substance formed is methyl chloride, a sweet-smelling gas boiling at −24° C; one hydrogen atom in the original substance has been replaced by chlorine with the simultaneous formation of hydrogen chloride. The further action of chlorine replaces a second and so on, until finally tetrachloromethane or carbon tetrachloride, CCl_4 (b.p. 76° C), results; this is a valuable commercial solvent (*see* CARBON). This behaviour of marsh gas with chlorine is typical of the whole group of the paraffins, and it is for this reason that they are termed *saturated,* and are alluded to as the *limit hydrocarbons.*

Methyl iodide, corresponding closely to the chloride, is a liquid boiling at 43° C. If dissolved in an inert solvent and treated with metallic sodium, it forms sodium iodide, and the two methyl groups join together forming ethane, $CH_3–CH_3$, the next member of the series. It is possible similarly to synthesize propane, $CH_3–CH_2–CH_3$, boiling at −44° C, butane, $CH_3–CH_2–CH_2–CH_3$, boiling at 1° C, and so on, with a complete knowledge of the molecular structure of these substances. Hydrocarbons of this type, the molecules of which consist of carbon linked to carbon in unbranched chains, are known as *normal* (written as *n*-), and the term *homologous* is applied to such a series in which each member differs by $-CH_2$ from the next. The general physical properties of homologous series vary in much the same way; the lower members are gases and as they become more complex, they pass to liquids of low, then high, boiling points, and finally to solids of low, then high, melting points.

Paraffins of this type occur in various petroleums. Ethane, a gas, is found dissolved in the oils from certain wells, such as those of Pittsburgh. Pentane, boiling at 36° C, hexane at 69° C, and heptane at 93° C, etc., have been isolated from Pennsylvanian oils. Similar oils also contain in varying amounts the solid members of this series known as *paraffin wax,* a mixture of *n*-hydrocarbons, which is also manufactured by the distillation of shale or brown coal. Waxes of Scottish origin, and probably all such materials, are composed of about 10 to 12 normal hydrocarbons of which the most important are: docosane $C_{22}H_{46}$, tetracosane $C_{24}H_{50}$, pentacosane $C_{25}H_{52}$, hexacosane $C_{26}H_{54}$, octacosane $C_{28}H_{58}$, nonacosane $C_{29}H_{60}$, and hentriacontane $C_{31}H_{64}$. Many of these solid hydrocarbons have also been isolated from the animal or plant world, the most complex being hexacontane $C_{60}H_{122}$, melting at 102° C.

There are two hydrocarbons known of the formula C_4H_{10}: one, *n*-butane, has been mentioned above; the other boils at −17° C, and has exactly the same percentage composition and vapour density and hence molecular weight. This phenomenon, termed *isomerism* (*q.v.*), receives a most satisfactory explanation on the conception of valency previously mentioned. With four carbon and ten hydrogen atoms, it is possible to form two and only two different structures, viz.,



Hydrocarbons containing such a branched chain are designated by the prefix *iso;* hence, in this case, as but two isomerides exist, the names *n*-butane and isobutane are sufficient to identify these substances.

Another example of isomerism is seen in the existence of three different hydrocarbons for the formula C_5H_{12}. The first, *n*-pentane, has been mentioned; the second boils at 30° C, and the third at 9° C. As it is only possible to arrange five quadrivalent carbon atoms and 12 hydrogen atoms in three ways, these hydrocarbons must be

(1) $CH_3—CH_2—CH_2—CH_2—CH_3$,

(2) $CH_3—C(C_2H_5)H—CH_3$, and (3) $CH_3—C(CH_3)_2—CH_3$

As the hydrocarbons become more complex, the number of theoretically possible isomerides increases very rapidly indeed; in fact, it can be calculated that the hydrocarbon tridecane, $C_{13}H_{28}$, could exist in 802 different forms. The *normal* hydrocarbon, however, is the only one known. After the seventh member of the series, the number of known isomerides is very considerably less than those theoretically possible, and after the eleventh, with but few exceptions, the *normal* isomerides only have been examined.

The whole of this group of hydrocarbons is characterized by great inertness towards chemical reagents, thus differing very markedly from the benzene series. With chlorine (or bromine), however, they give substitution products, some of which are of industrial value. Partial oxidation (when this operation is effected without breaking down the hydrocarbon to carbon dioxide and water—the ultimate oxidation products of all organic substances) leads to valuable derivatives. Both formaldehyde (*q.v.*) and methyl alcohol (*q.v.*) can be prepared by the partial oxidation of marsh gas, and since this hydrocarbon can be obtained by the reduction of either carbon monoxide or dioxide, the possibility of preparing organic substances such as acetic acid and acetone from coal or even from limestone becomes realizable (*see* METHYL ALCOHOL).

(ii.) *Olefines.* When ethyl iodide, C_2H_5I, is heated with alcoholic soda, a gas called ethylene (or olefine) is evolved which, on analysis and density determination, is found to have the molecular formula C_2H_4. The same substance can be formed by the dehydration of ethyl alcohol. These reactions may be depicted thus: $CH_3–CH_2I–HI=CH_2–CH_2$ and $CH_3–CH_2OH–H_2O=CH_2–CH_2$. In ethylene and all its homologues two adjoining carbon atoms appear each to be trivalent. Ethylene and its homologues show a set of reactions which differentiate them sharply from the paraffins; they readily absorb hydrogen, becoming paraffins, and combine with chlorine or bromine to yield oily di-substitution products of saturated hydrocarbons. It is to the formation of its oily dichloride that ethylene owes its historic name of olefine or olefiant (oil-forming) gas (1795). Owing to these and similar "additive" reactions, the olefines are termed *unsaturated,* and the conventional method of indicating such characteristics is to regard the carbon atoms as linked together by two valencies: *e.g.,* $CH_2=CH_2$. This arrangement retains the conception of the quadrivalency of carbon, but it is not intended to indicate that the carbon atoms are more tightly held together than they are in the case of ethane $CH_3–CH_3$ with a single linkage between each other.

Some of the reactions of ethylene may be summarized:— (i.) $CH_2=CH_2+H_2=CH_3–CH_3$; (ii.) $CH_2=CH_2+Br_2$ (or Cl_2) $=CH_2Br–CH_2Br$, ethylene dibromide (or $CH_2Cl–CH_2Cl$, ethylene dichloride); (iii.) $CH_2=CH_2+HI=CH_3–CH_2I$, ethyl iodide; (iv.) $CH_2=CH_2+H_2SO_4=C_2H_5HSO_4$, ethyl hydrogen sulphate; (v.) mild oxidation converts ethylene into glycol, $CH_2OH–CH_2OH$. Generally these reactions are manifested by all organic substances containing the double linkage. In the homologous series of olefines, the phenomenon of isomerism is first noticed in the case of butylene, C_4H_8, which occurs in the three theoretically possible forms:—

$CH_3–CH_2–CH=CH_2$; $CH_3–CH=CH–CH_3$; $(CH_3)_2C=CH_2$.

(iii.) *Acetylenes.* When ethylene dibromide is treated with alcoholic potash or soda, acetylene is formed: $CH_2Br–CH_2Br–2HBr=CH–CH$. In this hydrocarbon, and its homologues, carbon appears to be bivalent, and for reasons similar to those just ascribed in the case of ethylene, a *triple linkage* is written between the carbon atoms; *e.g.,* $CH\equiv CH$. This gas, which is much more easily and inexpensively prepared by the action of water on calcium carbide (*see* CARBIDES), readily takes up hydrogen, giving ethylene. The homologous hydrocarbons of this series readily undergo a change known as *polymerization* (*q.v.*); thus acetylene passed through a red-hot tube gives benzene: $3C_2H_2=C_6H_6$. The hydrogen atoms in acetylene can be replaced by metals, and the explosive red copper and white silver compounds are used for the characterization of this substance. Under the catalytic influence of mercuric salts, acetylene combines with water giving acetaldehyde (*see* ALDEHYDES), a substance which may be readily oxidized to acetic acid (*q.v.*), or reduced to ethyl alcohol.

(iv.) *Di-Olefines.* These hydrocarbons are isomeric with the homologues of acetylene, butadiene, $CH_2=CH–CH=CH_2$, being isomeric with ethylacetylene, $CH_3–CH_2–C\equiv CH$. Unlike the acetylenes, they do not form copper or silver salts. The most interesting members of this series are those which undergo polymerization to a substance resembling caoutchouc. This is the case with butadiene and with isoprene, $CH_2=C(CH_3)–CH=CH_2$. The latter hydrocarbon, warmed for 50 hours at 60° C with sodium in a sealed tube, gives a nearly quantitative yield of a substance with properties very similar to those of rubber.

Oxidation Products of Hydrocarbons.—The paraffins are oxidized only with difficulty; consequently other sources of their valuable oxidation products have to be found. It has already been mentioned that methane and methyl alcohol can be obtained by the reduction of carbon monoxide or dioxide, and that acetic acid and acetone can be prepared indirectly from coal. Methyl alcohol (methanol), CH_4O, acetic acid, $C_2H_4O_2$, and acetone, C_3H_6O, also arise from the distillation of wood. Ethyl alcohol, C_2H_6O, is manufactured in enormous quantity by vinous fermentation, and butyl alcohol is the most important product of the bacterial fermentation of maize. Such oxidized products of the hydrocarbons, and not the inert hydrocarbons themselves, are the starting materials for a large number of aliphatic syntheses.

The Alcohols. Methyl alcohol, CH_4O, when acted upon by metallic sodium, evolves hydrogen and gives sodium methoxide, CH_3ONa. This and other reactions show that one hydrogen atom is different from the other three, indicated graphically by linking that hydrogen to oxygen, forming the *hydroxyl group* (OH), thus methyl alcohol is $CH_3·OH$, ethyl alcohol $CH_3·CH_2·OH$, and so on. It has been observed that when once oxygen has entered into such stable substances as the paraffins, further oxidation is easy. Ethyl alcohol, for example, is readily oxidized to acetaldehyde:

$$CH_3·CH_2·OH \rightarrow CH_3·CH·(OH)_2 \rightarrow H_2O+CH_3·CHO$$

Substances containing two hydroxyl groups attached to one carbon atom are very unstable and at once lose water giving the aldehyde. It will be noticed that oxygen has attacked the carbon atom which is already partly oxidized. This is invariably the case provided that such a carbon atom has hydrogen attached to it.

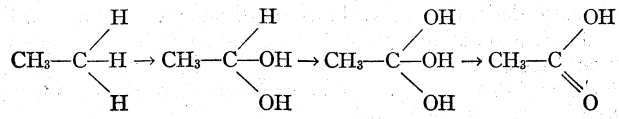
In the hydrocarbon propane, $CH_3–CH_2–CH_3$, the *terminal* hydrogen atoms are symmetrically situated in the molecule, hence theoretically but one *n*-propyl alcohol, $CH_3–CH_2–CH_2·OH$, is capable of existence, and one only is actually known. This alcohol behaves on oxidation in a similar manner to ethyl alcohol, giving first propyl aldehyde, $CH_3·CH_2·CHO$, and then propionic acid, $CH_3·CH_2·COOH$.

When the two central hydrogen atoms in propane are considered, it will be seen that a second isomeric alcohol, $CH_3·CH(OH)·CH_3$, is possible, and actually, two isomerides are invariably found when a hydrogen atom in propane is replaced by univalent groups or such elements as chlorine, bromine, etc. Isopropyl alcohol, $CH_3–CH(OH)–CH_3$, is oxidized to acetone, a typical member of the group of *ketones* (*q.v.*):—

$$CH_3–CH(OH)–CH_3 \rightarrow CH_3–C(OH)_2–CH_3 \rightarrow CH_3·CO·CH_3.$$

The Aldehydes. When acted upon by phosphorus pentachloride, the oxygen of the aldehydes is replaced by two atoms of chlorine; thus, acetaldehyde, $CH_3·CHO$, gives ethylidene chloride,

$CH_3{\cdot}CHCl_2$, isomeric with ethylene dichloride, $CH_2Cl{\cdot}CH_2Cl$. When aldehydes are further oxidized, they pass to acids as follows:—



the third substance, for reasons already mentioned, being unstable and losing a molecule of water.

The Organic Acids, $R{\cdot}CO_2H$ (*see* Acids), all contain the carboxyl group –COOH. If acetic acid, $C_2H_4O_2$, is acted upon by phosphorus pentachloride, acetyl chloride, C_2H_3OCl, results, a proof that the acid contained the OH group. The chlorine atom in this substance can be replaced by NH_2 by acting upon it with ammonia, and the resulting substance, $C_2H_3ONH_2$, can be dehydrated, giving acetonitrile, C_2H_3N, which can also be synthesized from methyl iodide and potassium cyanide, $CH_3I+KCN=KI+CH_3CN$. These observations, which show that acetic acid contains a methyl group (CH_3) linked to carbon, and in addition, a hydroxyl group, support the foregoing formula for acetic acid.

The alcohols, ketones, aldehydes and acids constitute the most important oxygen-containing materials of organic chemistry. Derivatives are known containing two or more of the same characteristic groups; *e.g.,* glycerine, $CH_2(OH){\cdot}CH(OH){\cdot}CH_2(OH)$, or malonic acid, $CH_2(COOH)_2$, and, on the other hand, organic substances have been synthesized, or occur naturally, containing two or more different groups such as lactic acid, $CH_3{\cdot}CH(OH){\cdot}COOH$ (*q.v.*) or one of the tartaric acids, $COOH{\cdot}CH(OH){\cdot}CH(OH){\cdot}COOH$ (*q.v.*).

Alcohols.—These substances are classified in accordance with the nature of the hydrocarbon in which hydrogen has been replaced by (OH). If such an atom be replaced in the paraffins, the *saturated alcohols* result, several of which have been previously discussed. When the replacement occurs in one of the ethylene hydrocarbons, an *unsaturated alcohol* such as allyl alcohol, $CH_2=CH{\cdot}CH_2OH$, is formed. An alcohol of this type, besides showing the characteristics of alcohols, has, in addition, the properties of unsaturated hydrocarbons. Allyl alcohol on oxidation gives acrolein, $CH_2=CH{\cdot}CHO$, which in turn gives acrylic acid, $CH_2=CH{\cdot}COOH$, and on reduction passes to *n*-propyl alcohol, $CH_3{\cdot}CH_2{\cdot}CH_2OH$.

Those alcohols containing the group—CH_2OH, which pass on oxidation into aldehydes and acids of the same carbon content, are known as *primary* alcohols. Those containing the CH:OH group, termed *secondary* alcohols, on oxidation give ketones having the same number of carbon atoms. A third class called *tertiary* alcohols, for instance, tertiary butyl alcohol, $(CH_3)_3C{\cdot}OH$, give, when oxidized, substances of smaller carbon content.

Alcohols can be synthesized from the corresponding halogen derivative by the action of hydrated silver oxide or lead oxide and water; thus ethyl iodide, C_2H_5I, gives ethyl alcohol. Such a reaction as this may be used for introducing several OH groups. Ethylene dibromide, treated in a similar manner, gives glycol, $CH_2(OH){\cdot}CH_2OH$. Alcohols also result from the reduction of ketones and aldehydes. Ethylene dissolves in strong sulphuric acid to give ethyl hydrogen sulphate, $C_2H_5HSO_4$; when this is treated with warm water, it generates sulphuric acid and gives ethyl alcohol, which may be separated by distillation. Propylene, $CH_2=CH–CH_3$, dissolves in the concentrated acid to give isopropyl hydrogen sulphate, $(CH_3)_2CH{\cdot}HSO_4$, which passes to isopropyl alcohol, $(CH_3)_2CH{\cdot}OH$, on treatment with water. Since propylene is formed by dehydrating *n*-propyl alcohol, this process effects the conversion of a primary into a secondary alcohol. The properties of the more important alcohols are described under Alcohols.

The lower members of the paraffin alcohols are miscible with water in all proportions, but as the series is ascended, the solubility diminishes rapidly. Both methyl and ethyl alcohols are extremely valuable solvents for organic substances.

With sulphuric acid, alcohols give hydrogen sulphates: $CH_3OH+H_2SO_4=CH_3HSO_4+H_2O$. If this acid sulphate be distilled, dimethyl sulphate is formed $(CH_3)_2SO_4$, a substance largely used in industry for the introduction of the methyl (CH_3) group. The corresponding organic analogues are prepared by heating together alcohol and an organic acid, and are called *esters*. From acetic acid and ethyl alcohol, for instance, ethyl acetate $CH_3{\cdot}COOC_2H_5$, is formed.

Ethers.—The group of ethers is closely related to the alcohols, and ordinary ether (*q.v.*) may be taken as a typical representative. This substance may be regarded as ethyl alcohol in which the hydrogen of the hydroxyl group has been replaced by another ethyl group, $C_2H_5{\cdot}O{\cdot}C_2H_5$. When sodium acts on ethyl alcohol, the resulting derivative is sodium ethoxide, C_2H_5ONa, and when this is treated with ethyl iodide, the following reaction takes place: $C_2H_5ONa+IC_2H_5=NaI+C_2H_5{\cdot}O{\cdot}C_2H_5$. This synthesis, which is of general applicability, leads directly to the constitutional formula of the resulting ether. The usual method for the preparation of this valuable anaesthetic consists in the interaction of ethyl alcohol and ethyl hydrogen sulphate: $C_2H_5HSO_4+C_2H_5OH=(C_2H_5)_2O+H_2SO_4$.

Ethers, which are isomeric with alcohols, are neutral substances only slightly soluble in water, and ethyl ether is largely used as a solvent in organic chemistry. The simplest, methyl ether, $CH_3{\cdot}O{\cdot}CH_3$, isomeric with ethyl alcohol, C_2H_5OH, is a gas only slightly soluble in water and unacted upon by sodium, whereas ethyl alcohol is miscible in all proportions with water and evolves hydrogen when acted upon by an alkali metal.

Aldehydes and Ketones.—Both in their mode of formation and in their properties the ketones show great resemblance to the aldehydes (*see* above), the two series resulting from the oxidation of the secondary and primary alcohols respectively, and both can be obtained by the distillation of suitable calcium salts of the acids or mixtures of these.

The simplest ketone, acetone, $CH_3{\cdot}CO{\cdot}CH_3$ (*q.v.*), is one of the products of the bacterial fermentation of maize, and is made technically by the distillation of calcium acetate $(CH_3COO)_2Ca=CaCO_3+CH_3{\cdot}CO{\cdot}CH_3$. Ketones neither oxidize as readily as aldehydes, nor polymerize; otherwise their reactions are strikingly similar. Like the aldehydes, the ketones combine with sodium bisulphite and hydrocyanic acid; both aldehydes and ketones condense with hydroxylamine to form "aldoximes," $R{\cdot}CH{:}N{\cdot}OH$, and "ketoximes," $RR'C{:}N{\cdot}OH$, respectively.

Acids.—Organic acids containing the carboxyl group, ·COOH, are classifiable according to the nature of the hydrocarbon the hydrogen atom of which is replaced by this group. If replacement occurs in the paraffins, the saturated acids result. Thus, methane gives acetic acid, $CH_3{\cdot}COOH$. If a hydrogen atom in the ethylene hydrocarbons is replaced, the unsaturated acids appear; thus $CH_2=CH_2$ gives acrylic acid, $CH_2{:}CH{\cdot}COOH$. The possibilities of isomerism in the saturated acids are very similar to those previously discussed. Thus, there are two isomerides containing four carbon atoms, namely, *n*-butyric acid, $CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}COOH$, and isobutyric acid, $CH_3{\cdot}CH(COOH){\cdot}CH_3$ (*see* Acids). The substances under discussion are termed fatty acids, since the higher members, combined with glycerine as esters, form the group of natural fats or glycerides (*q.v.*), which on boiling with alkalis give glycerine and the alkali salts of such saturated acids as stearic and palmitic acids, together with the unsaturated oleic acid. This breakdown of an organic ester is termed *saponification,* although the term is now used in the somewhat broader sense of hydrolysis (a loosening by water).

A valuable synthetic method for the preparation of acids consists in the formation of *nitriles* by the interaction of an alkyl iodide such as ethyl iodide with potassium cyanide, $C_2H_5I+KCN=C_2H_5CN+KI$, and the subsequent saponification or hydrolysis of nitriles with aqueous alkali, the alkali salt of the acid being formed: $C_2H_5{\cdot}CN+KOH+H_2O=C_2H_5{\cdot}COOK+NH_3$.

The reactions of the acids are described under that heading, and the acid-amides derived therefrom by replacement of a hydroxyl group by an amino-group are also described separately. The action of phosphorus pentachloride upon acids gives the *acid chloride, e.g.,* $CH_3{\cdot}COOH+PCl_5=CH_3{\cdot}COCl+POCl_3+HCl$, and

these react with the alkali salts of the acids to give anhydrides: $CH_3{\cdot}COCl + CH_3{\cdot}COONa = (CH_3CO)_2O + NaCl$.

The anhydrides react with water, alcohol or ammonia to give the acid, ester or amide respectively:—

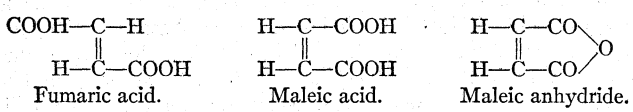
$$(R{\cdot}CO)_2O + H_2O = 2R{\cdot}CO{\cdot}OH;$$
$$(R{\cdot}CO)_2O + 2R'OH = 2R{\cdot}CO{\cdot}OR' + H_2O;$$
$$(R{\cdot}CO)_2O + 2NH_3 = 2R{\cdot}CO{\cdot}NH_2 + H_2O.$$

Palmitic, stearic and oleic acids are of great commercial importance and are dealt with in the article FATTY ACIDS. The structures of the first two are known from application of methods already indicated to be respectively $C_{15}H_{31}{\cdot}COOH$ and $C_{17}H_{35}{\cdot}COOH$, all the carbon atoms being in a straight chain. Since oleic acid is $C_{17}H_{33}{\cdot}CO_2H$, it is of importance to determine the actual position of the *double linkage,* and this has been shown by the investigation of the ozone addition product. Such compounds result from the interaction of the two doubly linked carbon atoms with this reagent, and when decomposed break down at this point. The oleic acid derivative yields an aldehyde $CH_3{\cdot}(CH_2)_7{\cdot}CHO$ and an aldehyde-acid $CHO{\cdot}(CH_2)_7{\cdot}COOH$. Consequently the double linkage lies in the centre of the $CH_3{\cdot}[CH_2]_7{\cdot}CH{:}CH{\cdot}[CH_2]_7{\cdot}COOH$ molecule.

Dicarboxylic Acids.—These acids contain two carboxyl groups. Glycol, $CH_2(OH){\cdot}CH_2OH$, on oxidation gives oxalic acid, $COOH{\cdot}COOH$. Ethylene dibromide gives ethylene dicyanide, or succinonitrile, $CH_2CN{\cdot}CH_2CN$, when acted upon by aqueous potassium cyanide; this nitrile when saponified gives succinic acid, $CO_2H{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H$.

The properties of these acids depend on the relative position in the molecule of the two carboxyl groups. Malonic acid, $CH_2(COOH)_2$, when heated evolves carbon dioxide and forms acetic acid, whereas succinic acid gives an anhydride $(CH_2{\cdot}CO)_2O$.

If succinic acid is chlorinated, the first product is chlorosuccinic acid, $CO_2H{\cdot}CH_2{\cdot}CHCl{\cdot}CO_2H$. When this is acted upon by alcoholic alkalis, fumaric acid is formed, $COOH{\cdot}CH{=}CH{\cdot}COOH$. This *unsaturated acid* shows the properties both of ethylene and of succinic acid. It sublimes at 200° C, and at a higher temperature gives an anhydride which on warming with water, does not revert to fumaric acid, *but gives an isomeride, maleic acid,* which melts at 130° C, and reverts to fumaric acid when its aqueous solution is heated to about 200° C. Both of these acids have the same structural formula, viz., COOH–CH=CH–COOH, and consequently this is the first case considered where the uniplanar conception of valency fails to account for the existence of a pair of isomerides. An extension of the conception used hitherto is therefore necessary, and this is made along the lines of STEREOCHEMISTRY (*q.v.*). Briefly, the explanation of this type of isomerism (or stereoisomerism) is to be found in the different relative positions in space of the groups attached to the carbon atoms, thus:—



Fumaric acid. Maleic acid. Maleic anhydride.

The decision as to which formula should be ascribed to the individual acids may be determined by their chemical reactivity. Thus, maleic acid very readily loses water and passes into maleic anhydride, and for this reason the two carboxyl groups are supposed to be near together in space. By this and similar arguments, it is possible to determine the configuration of such pairs of isomerides.

Substances Containing Two or More of the Functional Groups.—Alcohols containing one or more hydroxyl groups have been mentioned. Similarly aldehydes, ketones and acids have been discussed, and in addition a few dicarboxylic acids and their derivatives have been alluded to in order to bring out points of theoretical importance. A knowledge of the characteristics of these functional groups in these four classes, and of the alteration in the properties of the hydrocarbons when such groups are substituted for hydrogen atoms, affords very valuable evidence for the determination of the structure of new organic substances discovered in the animal or plant world. Large and important groups of aliphatic derivatives have been synthesized containing two or more different functional groups, and of these a few selections will now be discussed.

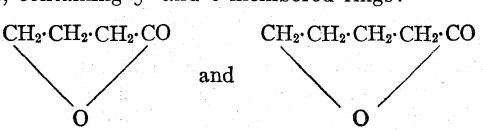
Hydroxy-Aldehydes and -Ketones.—The hexahydric alcohols such as mannitol or mannite, $CH_2OH{\cdot}(CHOH)_4{\cdot}CH_2OH$, are soluble in water and have a sweet taste, but unlike the sugars they do not reduce alkaline copper solutions, are not fermented by yeast, and cannot be utilized as a food by the body. When a (CH_2OH) group is oxidized to the CHO group, or an adjacent (CHOH) group is converted into a CO group, the *sugars* result. These important compounds are also termed *carbohydrates* and are described more fully under that heading. Grape-sugar (*d*-glucose), $CH_2OH{\cdot}(CHOH)_4{\cdot}CHO$, occurs in many fruits and in honey, and in most sweet fruits laevulose (fruit-sugar or *d*-fructose), $CH_2OH{\cdot}[CHOH]_3{\cdot}CO{\cdot}CH_2OH$, is found.

Owing to the different arrangements of the valencies of the carbon atoms in space, numerous other compounds are capable of existence having the same *plane* formulae; thus there are 16 possible stereoisomerides all having the same structure as glucose, and 14 of these are known. The carbohydrates are divided for convenience into four main groups according to the number of actual or potential CO groups present. In each of these four groups the ratio of hydrogen atoms to oxygen atoms is 2:1, as in water—hence the name carbo*hydrate.*

The monosaccharides are grouped about the *hexoses,* $C_6H_{12}O_6$, of which glucose and fructose (*see* above) are the most important; *pentoses,* $C_5H_{10}O_5$, are included in this group. The *disaccharides,* $C_{12}H_{22}O_{11}$, may be regarded as derived by the loss of water from two similar or dissimilar monosaccharide molecules:—$2C_6H_{12}O_6 - H_2O = C_{12}H_{22}O_{11}$. Cane-sugar (sucrose or saccharose) is the most important member of this group, which also includes lactose (or milk-sugar) and maltose (or malt-sugar); on hydrolysis it yields equal parts of glucose and fructose, whereas maltose gives only glucose. The *trisaccharides,* $C_{18}H_{32}O_{16}$ $(= 3C_6H_{12}O_6 - 2H_2O)$ are rare, but the *polysaccharides* $(C_6H_{10}O_5)_n$ where n is generally a large number, are very well known in the form of starch and cellulose.

Hydroxy-Acids.—When acetic acid is chlorinated, the first product is monochloroacetic acid, $CH_2Cl{\cdot}COOH$, which, on boiling with water, yields hydroxy-acetic or glycollic acid, $CH_2OH{\cdot}COOH$, also found in unripe grapes. One of the most characteristic reactions of aldehydes is the formation of cyanohydrins with hydrocyanic acid. Thus, acetaldehyde readily gives acetaldehyde cyanohydrin, $CH_3{\cdot}CH(OH){\cdot}CN$. When this is saponified, *inactive* lactic acid, $CH_3{\cdot}CH(OH){\cdot}COOH$, is formed. Lactic acid, which contains an asymmetric carbon atom (*see* STEREOCHEMISTRY), occurs in three forms; the optically inert isomeride is formed during the lactic acid fermentation of carbohydrates such as lactose and glucose, and is consequently present in sour milk. Sarcolactic acid, the dextrorotary modification, occurs in meat juice, and the laevoform may be prepared by resolution of the ordinary inert acid. Isomeric with lactic acid is β-hydroxy-propionic acid $CH_2(OH){\cdot}CH_2{\cdot}COOH$, which may be taken as an illustration of the nomenclature employed in this group of acids. The next higher is termed γ-hydroxybutyric acid $(CH_2OH{\cdot}CH_2{\cdot}CH_2{\cdot}COOH)$.

On heating these hydroxy-carboxylic acids, it is found that their behaviour depends on the relative position of the two functional groups. Lactic acid, where both are linked to the same carbon atom, loses two molecules of water from two of the acid and gives lactide. β-hydroxy-propionic acid loses water and gives the unsaturated acrylic acid, $CH_2{=}CH{\cdot}COOH$. But the most interesting anhydride formation takes place with the next homologues —the γ- and δ-hydroxy-acids—which give rise to stable γ- and δ-lactones, containing 5- and 6-membered rings:—



Citric acid, $CH_2(COOH)\cdot C(OH)(COOH)\cdot CH_2\cdot COOH$, widely disseminated in many varieties of fruit—lemons, currants, gooseberries, etc.—is manufactured from lemon juice which contains 6–7%, and also by a fermentation process (*Citromycetes*) from carbohydrates, glycerine and similar substances. It has been synthesized from dichloroacetone, $CH_2Cl\cdot CO\cdot CH_2Cl$, which absorbs hydrocyanic acid, giving $CH_2Cl\cdot C(OH)(CN)\cdot CH_2Cl$, a cyanohydrin, saponifiable to the dichlorohydroxy-acid. The chlorine atoms are then replaced by cyanogen (CN) groups through the agency of potassium cyanide, and saponification of the resulting dinitrile leads to citric acid.

Ketonic Acids.—The most interesting member of this group is acetoacetic acid, best known as $CH_3\cdot CO\cdot CH_2\cdot COOC_2H_5$, ethyl acetoacetate, which, owing to its peculiar properties, and great chemical reactivity, has been more fully investigated than any other aliphatic derivative, and is therefore described separately. Its behaviour is often in accord not only with the above formula, but also with the constitution $CH_3\cdot C(OH):CH\cdot COOC_2H_5$. A substance such as this, the constitution of which appears to vary according to conditions, giving rise to two types of derivatives, is an example of the phenomenon of *tautomerism* (*see* ISOMERISM).

Acetoacetic ester, when treated with sodium, or with alcoholic sodium ethoxide, gives a highly reactive sodium derivative which, when acted upon by ethyl iodide, yields ethyl ethylacetoacetate, $CH_3\cdot CO\cdot CH(C_2H_5)\cdot COOC_2H_5$. A repetition of these processes gives ethyl diethylacetoacetate, $CH_3\cdot CO\cdot C(C_2H_5)_2\cdot COOC_2H_5$. Acetoacetic ester itself or its mono- or di-ethyl derivative can be decomposed by alkalis or acids in suitable concentrations to give a preponderating yield of either ketones or acids. The mono-ethyl derivative can give either a ketone, $CH_3\cdot CO\cdot CH_2(C_2H_5)$, or an acid, $CH_2(C_2H_5)\cdot COOH$, and when it is remembered that a variety of groups can be introduced into the original ester, it will be realized that a large number of derivatives can be synthesized, of acetone on the one hand, and acetic acid on the other.

Moreover, the sodium derivatives of acetoacetic ester and of its mono-alkyl homologues, when acted upon by alcoholic iodine, furnish a condensation product,

$$CH_3\cdot CO\cdot CR(COOC_2H_5)\cdot CR(COOC_2H_5)\cdot CO\cdot CH_3$$

with elimination of sodium as sodium iodide. The new derivative can then be decomposed to give either di-ketones,

$$CH_3\cdot CO\cdot CHR\cdot CHR\cdot CO\cdot CH_3,$$

or dicarboxylic acids, $CO_2H\cdot CHR\cdot CHR\cdot CO_2H$, where R is a hydrogen atom or an alkyl group.

Malonic ester, $CH_2(COOC_2H_5)_2$, is another very reactive ester of considerable utility in syntheses. Thus, with either sodium or sodium ethoxide, it gives a reactive sodium derivative which readily decomposes with ethyl iodide to give ethylmalonic ester, $CH(C_2H_5)(COOC_2H_5)_2$. The acids derived from any of these malonoid esters decompose when heated, giving off carbon dioxide, and yielding derivatives of acetic acid, $C(C_2H_5)_2(COOH)_2 = CO_2 + CH(C_2H_5)_2\cdot COOH$. Moreover, the sodium derivative of the ester may be acted upon by iodine to give a tetracarboxylic ester, $CH(COOC_2H_5)_2\cdot CH(COOC_2H_5)_2$, and by repeating these processes, acids containing a large number of carboxyl groups have been synthesized.

Halogen Derivatives.—By the limited action of an alcoholic solution of an alkali on ethylene dibromide, the monobromo-substitution product of ethylene, vinyl bromide, $CH_2=CHBr$, can be isolated, but such derivatives containing the halogen linked to an unsaturated carbon atom do not show the reactivity of the saturated halogen products. The most important member of the unsaturated series is allyl iodide, $CH_2=CH-CH_2I$, which is as reactive as the paraffinoid iodides.

Ethyl iodide dissolved in dry ether is rapidly acted upon by metallic magnesium to form a solution of magnesium ethyl iodide, $C_2H_5\cdot MgI$ [or $C_2H_5\cdot MgI + (C_2H_5)_2O$] (*see* GRIGNARD REAGENTS), and when this acts on lead chloride, lead tetraethyl, $Pb(C_2H_5)_4$ or lead ethide, is formed. This substance is of importance as an "anti-knock" in petrol or gasolene, a suitable mixture being sold as the proprietary brand "Ethyl." Chloroform, $CHCl_3$, prepared by the action of bleaching powder on alcohol, and iodoform, CHI_3, by the interaction of iodine, alcohol and alkali, are used in medicine, the former as an anaesthetic, the latter an antiseptic. When acetic acid is chlorinated, it gives mono-, then di-, and finally tri-chloroacetic acid, $CCl_3\cdot COOH$, and all of these are very much stronger acids than acetic itself.

Sulphur Derivatives.—When the oxygen in, for instance, ethyl alcohol is replaced by sulphur, the resulting substance is called ethyl mercaptan, $C_2H_5\cdot SH$. It is prepared technically by the interaction of ethyl chloride and potassium hydrosulphide, KSH, and readily condenses with acetone, as follows:—

$$(CH_3)_2CO + 2C_2H_5SH = (CH_3)_2C(SC_2H_5)_2 + H_2O.$$

The resulting sulphur derivative, when oxidized by potassium permanganate, gives sulphonal, $(CH_3)_2C(SO_2C_2H_5)_2$, which is used as a hypnotic. When carbon disulphide is treated with alcoholic potash, potassium xanthate, $C_2H_5\cdot O\cdot CS\cdot SK$, is formed, which crystallizes in yellow needles, and derives its name from the yellow colour of its cuprous salt. Cellulose xanthate (viscose) is of great value for the preparation of artificial silk.

Derivatives Containing Nitrogen.—When ethyl iodide and alcoholic ammonia interact, the following amines are produced in the form of their hydriodides: ethylamine, $C_2H_5NH_2$; diethylamine, $(C_2H_5)_2NH$; and triethylamine $(C_2H_5)_3N$; together with tetraethylammonium iodide, $N(C_2H_5)_4I$. The salts of all except the last are readily decomposed by alkalis, and the separation of the organic bases is described under AMINES. The amines are stronger bases than ammonia, but very similar to it in their properties (*see* AMMONIA). The lower members are inflammable gases with an ammoniacal odour, soluble in water, giving alkaline solutions, and all form characteristic salts with acids.

The Acid-Amides (*see* AMIDES), of the general type $R\cdot CO\cdot NH_2$, are hydrolyzed by boiling alkalis to ammonia and the salt of the corresponding acid, whereas amines are unaffected by this treatment. Urea (*q.v.*), $CO(NH_2)_2$, the acid-amide of carbonic acid, obtained artificially in a memorable synthesis from ammonium cyanate by Wöhler in 1828, may also be synthesized by the action of ammonia on phosgene, $COCl_2$. It is one of the most important of the final products of protein metabolism, and occurs in the urine of mammals; a human adult, for instance, excretes about 30 grams per day. The *nitriles*, R·CN, and the *hydroxy-nitriles*, or *cyanohydrins, e.g.*, acetaldehyde-cyanohydrin, $CH_3\cdot CH(OH)\cdot CN$, have been previously discussed. The former on reduction give primary amines such as propylamine, $C_2H_5\cdot CH_2\cdot NH_2$. When the cyanohydrins are treated with ammonia, they are converted into amino-nitriles, *e.g.*, $CH_3\cdot CH(NH_2)\cdot CN$, and on saponification, these yield the amino-acids.

The Amino-Acids are of great physiological importance since it has been shown that the proteins (*q.v.*) on hydrolysis yield a variety of acids belonging to this group. Glycine, glycocoll or amino-acetic acid, $NH_2\cdot CH_2\cdot CO_2H$, the simplest representative of the class, is a solid melting at 232° C, soluble in water, and can be obtained by boiling glue with dilute sulphuric acid, or synthetically by the action of ammonia on mono-chloroacetic acid. By the hydrolysis of different proteins, a large number of amino-acids have been obtained and their constitution determined by synthesis. These acids have been very closely studied as a preliminary step in the attempts that have been made to synthesize the proteins themselves.

The Proteins are of profound biological importance, for they appear to be the essential constituents of the living cell, and are intimately bound up with the processes of life. Their molecular weight is very large, but no exact estimations have yet been made. The simplest proteins include such substances as the albumins, the plant globulins, and the albuminoids such as gelatin, or silk fibroin, caseinogen from cheese, etc. Conjugated proteins are such individuals as haemoglobin, etc. When boiled with concentrated hydrochloric acid, or with 25% sulphuric acid, they break down, giving various amino-acids. From all the proteins investigated by this method up to the present, 20 of these amino-acids have been isolated, that found most frequently being leucine, $(CH_3)_2CH\cdot CH_2\cdot CH(NH_2)\cdot COOH$. The conclusion that different proteins are built up of varying numbers of amino-acids is obvious,

and attempts have been made to reconstruct them, commencing with these simpler acids of known molecular structure. The result has been the synthesis of a group of substances called the *polypeptides,* of which the molecular architecture is therefore known, and some of which are of considerable molecular magnitude. They show many of the characteristic reactions of the proteins themselves but are not identical with them, so the constitution of this important group of substances is still unknown.

Laboratory Synthesis and Photosynthesis.—Throughout this summary of the aliphatic derivatives, many have been mentioned as occurring in the plant kingdom. It is well to point out that although a considerable number of these have been synthesized in the laboratory, and are identical in every respect with the natural products, the methods employed in their preparation are entirely different from those taking place in the living cell. The two sugars, dextrose and laevulose, and palmitic, stearic and malic acids, for instance, have been obtained synthetically, although starch, cellulose and the proteins have not. All these complex substances, however, are manufactured by the living cell from the carbonic acid present in the atmosphere, from nitrogenous material and various inorganic constituents in the soil, under the influence of moisture and with but slight variations of temperature, the energy required being obtained directly or indirectly from the sun; so that, without the last factor, the whole process would cease. Attempts have been made in the laboratory to imitate the reactions which are believed to take place in the living cell; these are meeting with an increasing measure of success, which should give rise to a new organic chemistry of great importance to man.

See advanced works on organic chemistry, and numerous articles in the *Journal* and *Annual Report* of the Chemical Society, *British Chemical Abstracts* and *see* also list of journals, in which original papers appear, in F. A. Mason, *Introduction to the Literature of Chemistry* (1924). (F. Fr.)

HOMOCYCLIC DIVISION

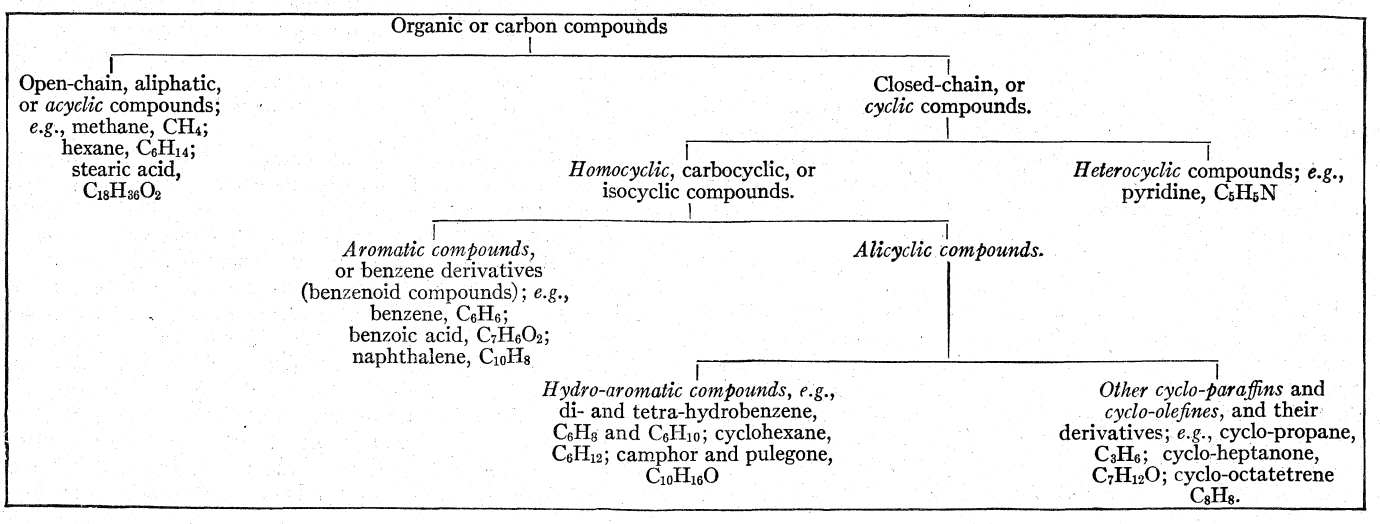
Organic compounds may be classified on the basis of molecular structure into two main divisions: (1) open-chain, aliphatic or *acyclic* compounds, and (2) closed-chain, or *cyclic* compounds. The latter division presents a great diversity of types: oxygen, nitrogen, sulphur and other elements may participate with carbon in manifold ways to form cyclic nuclei; the resulting ring-systems exhibit characters closely resembling open-chain compounds, in so far as they yield substitution derivatives and behave as compound radicals. In classifying closed-chain compounds, the first step consists in dividing them into (i.) carbocyclic, in which the closed chain, ring, or nucleus is composed solely of carbon atoms —these are known also as *homocyclic* or isocyclic on account of the identity of the members of the ring—and (ii.) *heterocyclic,* in which different elements go to make up the ring. A molecule containing two or more ring-systems, *e.g.,* naphthalene or camphor, is said to be polycyclic.

Homocyclic compounds may be conveniently subdivided into (*a*) benzene derivatives, benzenoid compounds or *aromatic compounds* proper, and (*b*) *alicyclic compounds.* The homocyclic nucleus of benzene, C_6H_6, and its derivatives invariably contain six carbon atoms associated with fewer hydrogen atoms (or their substituents) than suffice to satisfy the carbon valencies, the deficit being in all instances the equivalent of three double linkages; this peculiarity of structure is associated with the "benzenoid" or "aromatic" character which is shown also by certain similarly constituted heterocyclic compounds, such as pyridine, C_5H_5N. Alicyclic compounds do not exhibit the "aromatic" character, but, as indicated by their name, bear a general chemical resemblance to the aliphatic compounds.

The alicyclic subdivision embraces the important class of *cycloparaffins* or *polymethylenes* $(CH_2)_n$ and their derivatives, in which the nucleus contains three or more carbon atoms, all of which are fully saturated. In addition, it comprises a similar range of *cyclo-olefines* and their derivatives, in which the carbon nucleus contains one or more olefinic linkages (double bonds). The most important members of these two classes, like the aromatic compounds, contain a nucleus composed of six carbon atoms: it is convenient to classify these six-membered-ring compounds under the special heading of *hydroaromatic compounds.* A particular significance thus attaches to all homocyclic compounds containing six carbon atoms in the ring; *i.e.,* to the aromatic compounds and the hydroaromatic compounds. A summarized scheme of classification is appended:

Aromatic Compounds.—The presence of a closed chain, or ring, in an organic molecule was first suggested for benzene by Kekulé, in 1865. The representation of this hydrocarbon and its innumerable derivatives as closed-chain compounds has been termed the crowning achievement of the doctrine of the linking of carbon atoms (Japp, *Chemical Society's Memorial Lectures,* 1901). The benzene derivatives, or aromatic compounds, form the most important and most numerous class of homocyclic compounds; it has been stated, indeed, that three-quarters of organic chemistry is concerned with benzene and its derivatives, and that the benzene ring is the most familiar emblem in scientific literature. Most of these substances are purely synthetic in origin, and became known as a result of the enormous volume of research upon coal-tar components which followed the synthesis of the first coal-tar dye by W. H. Perkin, Sr., in 1856. Organic chemical research for more than 50 years after Perkin's discovery centred mainly around the synthetic production of aromatic compounds from benzene and related coal-tar components. These derivatives are of great scientific and industrial interest; but although the benzene nucleus is found in most of the natural organic colouring matters and in numerous other plant and animal products, it does not possess the biochemical importance of the open-chain and other non-benzenoid structures of carbohydrates, fats and proteins.

The treatment of aromatic compounds will be restricted mainly to a general consideration of their structure and fundamental



chemical characteristics; specific information concerning important individual compounds should be sought under their names and under such headings as AZO-COMPOUNDS and DIAZO-COMPOUNDS; NITRO-COMPOUNDS, QUINONES and DYES, SYNTHETIC.

Sources of Aromatic Compounds.—The origin of the name "aromatic" may be traced to the fact that many of the aromatic spices and fragrant oils of plants contain benzene derivatives; only a limited number of these derivatives, however, are characterized by an aromatic odour. Benzene and homologous hydrocarbons occur also in natural petroleums, particularly in those of Borneo and Papua. By far the most important source of aromatic compounds is coal-tar, of which coal yields from 4 to 7% when destructively distilled in horizontal retorts at 900–1100° C, as in the manufacture of coal-gas. Coke-oven tar is very similar in composition to gasworks tar, but the carbonization of coal at lower temperatures, or in vertical retorts, furnishes tars in which the aromatic substances are replaced largely by paraffins and naphthenes (*vide infra*). Gasworks coal-tar contains some 300 substances, but of these only about ten are isolated for common use as "primaries," in the synthesis of coal-tar dyes, medicinal chemicals, perfumes, high explosives and other aromatic compounds of industrial importance. When submitted to nitration, sulphonation, chlorination, oxidation and other chemical processes, the "primaries" give rise to "intermediates" (of which several hundreds are manufactured) and these by further treatment, which often includes an interaction between two intermediates or their derivatives, yield the finished synthetic dyestuffs and related "coal-tar chemicals." The most important primaries are the four aromatic hydrocarbons, benzene, toluene, naphthalene and anthracene, together with phenol (carbolic acid) or hydroxybenzene. These are separated from the tar by repeated fractional distillation, supplemented by appropriate chemical treatment. Coal yields only about 0·5% of the five chief primaries; *i.e.*, about 11lb. per ton, of which naphthalene forms approximately two-thirds, benzene together with toluene one-fifth, and phenol and anthracene each one-fifteenth.

Benzene.—Benzene (*q.v.*), C_6H_6, is theoretically the fundamental substance from which all the aromatic compounds are derived; it is also the most economical practical source of many of them: these two facts combine to render benzene one of the most outstanding of all organic compounds. Much study has accordingly been devoted to its physical and chemical properties and to the satisfactory representation of these properties by means of a structural or constitutional formula. Benzene was discovered in 1825 by Michael Faraday, in an illuminating gas prepared from fish oils, and its presence in coal-tar was established by A. W. Hofmann, in 1845; but it was not until 1865 (seven years after the publication of the theory of molecular structure) that Kekulé arrived at his conception of the benzene ring, or closed chain, of six carbon atoms. This delay was due to the difficulty of giving an adequate structural interpretation of the fundamental chemical differences which exist between aromatic and aliphatic compounds; differences which it is essential to include in a general review of the chemical behaviour of benzene and its derivatives before proceeding to a discussion of its molecular structure.

Chemical Behaviour of Aromatic Compounds.—In comparison with hexane, C_6H_{14}, the molecule of benzene lacks eight hydrogen atoms; but in spite of the high unsaturation indicated by its molecular formula, benzene is a particularly stable substance. It is affected only very slowly by oxidizing agents, and is indifferent towards hot dilute acids and alkalis, bromine water or the ordinary reducing agents. In these respects it differs profoundly from the isomeric open-chain compound, dipropargyl,

$$HC:C\cdot CH_2\cdot CH_2\cdot C:CH,$$

which has all the chemical properties of a highly unsaturated substance. More striking still, the typical reactions of benzene are substitution reactions. Benzene derivatives may be regarded as formed through the replacement of the hydrogen atoms of benzene by other elements, groups or radicals; and in this respect they resemble the substitution products of saturated aliphatic hydrocarbons. They are often produced, however, by reactions peculiar to the aromatic series. Ability to undergo direct nitration and sulphonation is especially characteristic of aromatic compounds. Thus, benzene and its homologues react readily with (*a*) a mixture of concentrated nitric and sulphuric acids ("nitrating mixture" or "nitrating acid") and (*b*) fuming sulphuric acid, to yield nitro-derivatives and sulphonic acids, respectively; the nitration and sulphonation of benzene are represented by the following equations:

$$(a)\ \underset{\text{Benzene}}{C_6H_6}+HO\cdot NO_2=\underset{\text{Nitrobenzene}}{C_6H_5\cdot NO_2}+H_2O$$

$$(b)\ C_6H_6+HO\cdot SO_3H=\underset{\substack{\text{Benzene-}\\\text{sulphonic}\\\text{acid}}}{C_6H_5\cdot SO_3H}+H_2O$$

The corresponding aliphatic derivatives usually have to be prepared by indirect processes. In the presence of certain catalytic agents (halogen carriers), benzene and its homologues may also be chlorinated and brominated, the process being again one of substitution:

$$(c)\ C_6H_6+Br_2=\underset{\substack{\text{Bromo-}\\\text{benzene}}}{C_6H_5Br}+HBr$$

Evidence of a certain type of unsaturation in the aromatic molecule is provided by the capacity of benzene and its derivatives to form substitution products under special conditions. When exposed to bright sunlight (in the absence of a halogen carrier), benzene combines with a maximum proportion of six atoms of chlorine or bromine per molecule, to form benzene hexachloride and hexabromide, $C_6H_6Cl_6$ and $C_6H_6Br_6$; it also forms a triozonide, ozobenzene, $C_6H_6(O_3)_3$; but it is unable to combine, like the olefines, with hydrogen chloride, hypochlorous acid, etc. Benzene also undergoes catalytic hydrogenation (*q.v.*) in presence of finely divided nickel, forming cyclohexane, C_6H_{12}; but this substance reverts to benzene upon oxidation. Thus benzene differs profoundly from ethylene and other unsaturated open-chain compounds in possessing a greater stability than its reduction product.

Besides exhibiting distinctive reactions—in particular, ready nitration and sulphonation—aromatic compounds differ from aliphatic compounds by virtue of their higher proportion of carbon and their greater tendency to solidify. No aromatic compound proper contains fewer than six carbon atoms in the molecule, and the more complex members tend to break down thus far when submitted to oxidation and other disintegrative processes; further oxidation of the resulting C_6-complex then usually disrupts the molecule at a stride to carbon dioxide and other simple substances. Thus, anthranilic acid, $C_7H_7O_2N$, yields aniline, C_6H_7N, and carbon dioxide when heated; and naphthalene, $C_{10}H_8$, upon oxidation gives phthalic acid, $C_8H_6O_4$, which when heated with lime is degraded further to benzene. Such changes point to the presence in the molecules of benzene and its derivatives of a stable nucleus containing six carbon atoms.

Equivalence of the Six Hydrogen Atoms in Benzene.—That the six hydrogen atoms in the molecule of benzene are similarly situated may be inferred from the fact that isomerism does not occur among monosubstituted benzenes of the general formula C_6H_5X; thus only one bromobenzene, C_6H_5Br, one nitrobenzene, $C_6H_5\cdot NO_2$, and one benzoic acid, $C_6H_5\cdot COOH$, are known. This equivalence, which was assumed by Kekulé, was first demonstrated by Ladenburg in 1874. It is unnecessary to detail the formal experimental proof, but the underlying principle may be illustrated by referring to the isomeric nitrobenzoic acids, $NO_2\cdot C_6H_4\cdot COOH$, of which three are known. When the nitro-group is replaced experimentally by a hydrogen atom, all three isomerides yield one and the same substance, viz., benzoic acid; thus in all three cases the carboxyl group,—COOH, may be assumed to have taken the position originally occupied by a particular hydrogen atom (*a*) of the molecule of benzene. The existence of three distinct nitrobenzoic acids shows that after the introduction of the carboxyl group the remaining five hydrogen atoms of the original benzene molecule are not equivalent; denoting these atoms by the letters (*b*) to (*f*), it may be assumed further that hydrogen atoms (*b*), (*c*) and (*d*), respectively, have

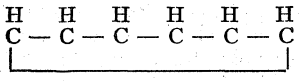
been replaced by the nitro-group in the three nitrobenzoic acids, which may now be represented as follows:

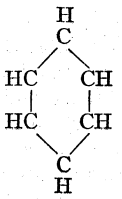
$(b)NO_2{\cdot}C_6H_4{\cdot}COOH(a)$ $(c)NO_2{\cdot}C_6H_4{\cdot}COOH(a)$
$(d)NO_2{\cdot}C_6H_4{\cdot}COOH(a)$

Each of these acids when distilled with lime yields nitrobenzene, $C_6H_5{\cdot}NO_2$, and since the product is identical in all three cases it follows that three of the hydrogen atoms of the original molecule of benzene—namely, (*b*), (*c*) and (*d*)—are equivalent. An extension of this principle has shown that the replacement of any one of the six hydrogen atoms by the same atom or group leads to an identical product.

Isomerism of Benzene Derivatives.—A large volume of experimental evidence indicates that disubstitution products of benzene, whether of the type $C_6H_4X_2$ or C_6H_4XY, can exist in three isomeric forms, as indicated above for the nitrobenzoic acids, in which X=NO_2 and Y=COOH. Trisubstitution products of the type $C_6H_3X_3$ are found to be capable of existence in three isomeric forms, as are also tetra-substituted benzenes, $C_6H_2X_4$, in which the four substituents are identical; only one derivative is known for each of the types C_6HX_5 and C_6X_6.

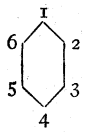
The Benzene Ring.—"I was sitting, writing at my text-book; but the work did not progress; my thoughts were elsewhere. I turned my chair to the fire and dozed. Again the atoms were gambolling before my eyes. This time the smaller groups kept modestly in the background. My mental eye, rendered more acute by repeated visions of the kind, could now distinguish larger structures, of manifold conformation: long rows, sometimes more closely fitted together; all twining and twisting in snake-like motion. But look! What was that? One of the snakes had seized hold of its own tail, and the form whirled mockingly before my eyes. As if by a flash of lightning I awoke; and this time also I spent the rest of the night in working out the consequences of the hypothesis." These are the words in which Kekulé described the way in which the conception of the benzene ring came to him (*v.* Japp, *loc. cit.*). The equivalence of the six hydrogen atoms and the isomerism of the substituted benzenes had not been established at that time (1865); but both of these fundamental characteristics of the benzene structural assemblage are at once accounted for when the molecule is represented as a closed chain, or ring, of six carbon atoms, each of which is associated with one hydrogen atom. The ring may be represented by a circle, or, more conveniently, in one of the following ways:



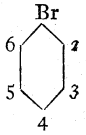




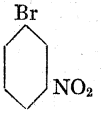
The disposal of the fourth valency of each carbon atom, which is not indicated in these symbols, will be discussed later; for the time being it is sufficient to state that the benzene "ring," however it may be represented, stands as an expression of a completely symmetrical structure in which all six hydrogen atoms are equivalent. The hexagon is in general use as an abbreviated symbol for the benzene molecule; it is assumed that at each corner there is a CH group; the substitution of a hydrogen atom is shown by attaching the replacing atom or group (*i.e.*, the substituent) to the corner concerned, as shown below. For purposes of systematic nomenclature the six carbon atoms are numbered consecutively:



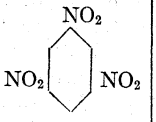
Benzene, C_6H_6



Bromobenzene, C_6H_5Br

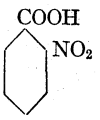


1-Bromo-3-nitrobenzene, $C_6H_4(Br)NO_2$

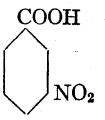


1, 3, 5-Trinitrobenzene, $C_6H_3(NO_2)_3$

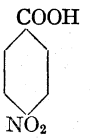
From the second of these formulae it is apparent that the introduction of a substituent in place of any one of the six equivalent hydrogen atoms at once destroys the equivalence of the remaining five, and creates three kinds of positions in the new molecule. The two similar positions (2, 6) adjacent to the substituent are known as ortho-positions, with respect to the substituent; the single position (4) diametrically opposite the substituent is called the para-position; and the two remaining positions (3, 5), which are similar, are distinguished by the prefix meta-. It is obvious, therefore, that disubstituted benzenes should exist in three isomeric forms; and this consequence of Kekulé's theory is in accordance with the facts already outlined. The three nitrobenzoic acids may thus be represented and named as follows, the prefixes *o-*, *m-*, and *p-* being the recognized contractions for ortho-, meta-, and para-, respectively:



o-Nitrobenzoic acid, or 1, 2-nitrobenzoic acid



m-Nitrobenzoic acid, or 1, 3-nitrobenzoic acid

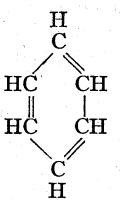


p-Nitrobenzoic acid, or 1, 4-nitrobenzoic acid

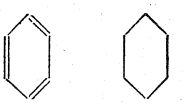
Di- and poly-substituted benzenes related in this way are known as *position isomerides*. It will be seen that 1, 2-nitrobenzoic acid is identical with 1, 6-nitrobenzoic acid, and 1, 3-nitrobenzoic acid with 1, 5-nitrobenzoic acid. It may be added that the closed chain of six carbon atoms, known as the *benzene nucleus*, accounts for the observed isomeric relationships of all types of substitution products of benzene.

The number of isomerides of various types when all the substituent groups are alike has been indicated above. When the groups are unlike a greater number is possible, except in the case of di-derivatives. When two of three substituents are alike, six isomerides are possible, as in the case of the diaminobenzoic acids, $C_6H_3(NH_2)_2{\cdot}COOH$. When all three are unlike, ten isomerides are possible; thus ten hydroxytoluic acids, $CH_3{\cdot}C_6H_3(OH){\cdot}COOH$, are known. In the case of tetra-substituted compounds, 30 isomerides are possible when all the groups are different. Of the trisubstitution derivatives, the 1, 2, 3-compounds are known as "adjacent" or "vicinal" (*v*), the 1, 2, 4- as "asymmetrical" (*as*), and the 1, 3, 5- as "symmetrical" (*s*). The same three terms are applied to tetra-substituted derivatives having the groups in the 1, 2, 3, 4-, 1, 2, 3, 5- and 1, 2, 4, 5-positions, respectively.

Disposal of the Fourth Valency.—Although, very rarely, the carbon atom may exhibit tervalency, as in triphenylmethyl (*vide infra*), there are no grounds for assigning this exceptional valency to the carbon atoms of benzene. Kekulé's original formula (1866) showed the six carbon atoms attached to one another by alternate single and double bonds, as shown in formula (I.):



Full formula

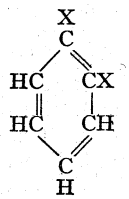


Abbreviated symbols

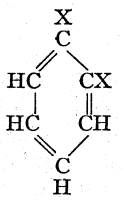
(I.) Kekulé's static formula for benzene (1866)

It may be said at once that despite much criticism this original formula is quite as convenient as any of its modifications, especially in the consideration of syntheses and decompositions of the benzene nucleus. The physical properties are also in keeping with Kekulé's formula, and although benzene is not visibly coloured it exerts a strong selective absorption in the ultra-violet region of the spectrum. The lack of resemblance between benzene and tri-olefines may be ascribed to some extent to the fundamental difference in structure between a symmetrical ring and an open chain;

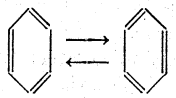
whilst to meet the further objection that isomeric 1, 2-disubstitution products corresponding to formulae (A) and (B) do not exist, Kekulé (1872) suggested a dynamic formula (II.), which represents a rapid oscillation between two tautomeric forms and is curiously reminiscent of his original vision of a structure "twining and twisting in snake-like motion":



(A)



(B)


(II.) Kekulé's dynamic formula for benzene (1872)

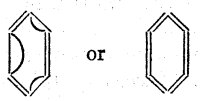
Meanwhile Dewar (1866) proposed an unsymmetrical formula (III.). This has an interest at the present time, since it illustrates a relationship of benzene to the important group of quinonoid colours; it appears also to have a bearing upon the puckering of the benzene ring which has been indicated by the *X*-ray analysis of benzene crystals. Dewar's formula, moreover, finds support, as representing a possible phase of the benzene molecule, in J. F. Thorpe and C. K. Ingold's recent work on intra-annular tautomerism. A "diagonal" formula was suggested by Claus (1867) and a "prism" formula by Ladenburg (1869); but more importance attaches to the so-called "centric" formula (IV.) of H. E. Armstrong and A. Baeyer (1887):


(III.) Dewar's formula for benzene (1866)

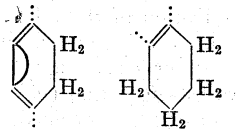

(IV.) Armstrong and Baeyer's centric formula for benzene (1887)

A strong argument against the ethylene linkages of Kekulé's formula is provided by the remarkable stability of all benzenoid compounds towards oxidizing and reducing agents and towards halogens and haloid acids. The widely different behaviour of hydroaromatic compounds, containing either one or two ethylene linkages (which behave towards these reagents exactly as unsaturated aliphatic compounds) suggests that in benzenoid compounds the fourth valencies are symmetrically distributed in such a manner as to induce a peculiar stability in the molecule. The centric formula assumes that the fourth valencies are simply directed towards the centre of the ring, thereby undergoing a mutual saturation; the formula is thus less rigid and precise than most of the others.

More recently (1899), Thiele's theory of partial valencies (*see* VALENCY) has been applied to the benzene structure with considerable success. Thiele's formula (V.) represents the benzene molecule as a particular combination of the so-called conjugated systems which were first studied in open-chain compounds; the centric formula, on the other hand, has been criticized as an *ad hoc* representation calling for a novel system of valencies and a unique distribution of affinity. According to Thiele, benzene is to be represented as a closed series of conjugated double bonds, which, since it possesses no free partial valencies, is devoid of unsaturated characteristics. "As by the neutralization of the partial valencies the original three double bonds vanish, no distinction can be drawn between them and the secondary (conjugated) double bonds. Benzene contains six inactive double bonds. Thus, the difficulty presented by the two ortho-positions, which Kekulé attempted to meet by the aid of his dynamic hypothesis, disappears" (Thiele). Moreover, the appearance of partial valencies in di- and tetra-hydrobenzene, and hydroaromatic compounds in general, explains the resemblance of these compounds to unsaturated open-chain compounds:

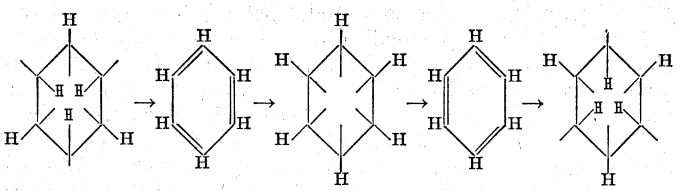


(V.) Thiele's formula for benzene



Thiele's formula for dihydrobenzene (C_6H_8) and tetrahydrobenzene (C_6H_{10})

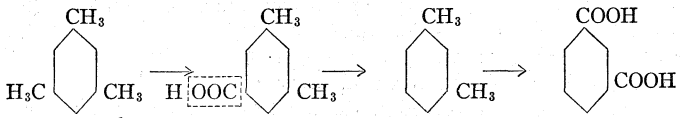
Spatial Configuration of Benzene.—According to the space theory of Le Bel and van 't Hoff (*see* STEREOCHEMISTRY), the six hydrogen atoms of benzene must either be permanently co-planar or capable of easy passage through a co-planar phase. If this were not the case, substitution derivatives (in which none of the substituents contain asymmetric atoms) should exist in enantiomorphous forms, differing in their action on polarized light: such optical isomerism has not been established, in spite of exhaustive experiments. Most of the formulae given above fulfil this condition when interpreted in terms of the theory of the tetrahedral environment of the carbon atom; but Ladenburg's prism configuration, which requires optical isomerism for ortho-disubstituted benzenes, is thereby ruled out. The modern tendency is to regard the molecule of benzene as a vibratory system passing through a number of phases, some of which are represented closely by the formulae of Kekulé, Armstrong–Baeyer, and others. This view was elaborated by Collie (1897), who suggested a spatial configuration consisting of a symmetrical grouping of two triplets of CH groups, each placed at the apex of a regular octahedron; the successive vibration-phases of the molecule, obtained by simple rotation of the space-model, are then represented in plane projection as follows:


First phase — Kekulé's formula (first tautomeride) — Centric formula — Kekulé's formula (second tautomeride) — Last phase

Electronic representations of the benzene molecule, based on the modern ideas of atomic structure and valency, have also been advanced. For all ordinary purposes the original representation of Kekulé remains quite as convenient as any of the proposed modifications; and, aromatic characteristics of homocyclic compounds are thus to be associated with cyclic structures of six atoms which are capable of assuming a symmetrical arrangement of alternate single and double bonds. Cyclo-octatetrene, C_8H_8, which conforms to the last requirement, but possesses a ring of eight carbon atoms, is not aromatic in character (R. Willstätter, 1911). Since, apart from the consideration of additive reactions, it is usually possible to ignore the disposition of the fourth valencies, the simple hexagon provides a convenient symbol for the benzene molecule. It may be added that the purely physical researches of Sir W. H. Bragg and W. L. Bragg have demonstrated conclusively the presence of a six-carbon-atom ring not only in benzenoid molecules but also in crystallized carbon (diamond and graphite) itself. "When we consider the diamond construction we cannot but notice the striking appearance, in every part of the model, of an arrangement of the carbon atoms in a ring of hexagonal form. If we take one of these rings out from the model, it has the appearance of a perfect hexagon when viewed from above, but not a flat ring. There are layers in graphite as in the diamond structure . . . from above it presents the same appearance of a hexagonal network. Recent experiments seem to show that the layers have been flattened out, so that each carbon is now surrounded by three atoms in its own plane. . . . Whether the benzene ring is actually puckered under all circumstances, or is sometimes flat, we find it difficult at present to say." (W. H. Bragg.)

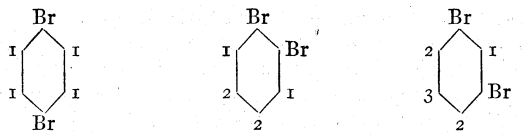
Orientation of Substituent Groups in the Benzene Ring.—The

determination of the relative positions of the substituents in the molecule of a benzene derivative constitutes an important factor in the general investigation of such compounds; the process is known as orientation (*orienté*, situated). Since, as a rule, if high temperatures are avoided, a replacing group enters the nucleus in the position formerly occupied by the replaced group, any compound which can be obtained from or converted into a standard substance, for which the relative positions of the substituents are known, may be definitely orientated. Benzene derivatives of known constitution are now so numerous that this method may be readily applied; but originally the number of standard compounds was very small. Among the earliest derivatives to be orientated in this way were the benzenedicarboxylic acids (phthalic acids), $C_6H_4(COOH)_2$. The ortho-acid was orientated by Graebe (1869), owing to its production from naphthalene by oxidation (*vide infra*). The meta-acid was correlated with mesitylene, which by reason of its formation from acetone (*q.v.*) by condensation must be regarded as 1, 3, 5-trimethylbenzene (Ladenburg, 1875). Upon oxidation, mesitylene yields the monobasic mesitylenic acid; this when distilled with lime loses carbon dioxide and gives a dimethylbenzene (xylene), which must obviously be the meta-compound; and this in turn yields meta-phthalic acid when oxidized:



The third isomeric phthalic acid is thus, by elimination, the para-compound. The orientation of the two remaining xylenes also follows from their oxidation to *o*- and *p*-phthalic acid, respectively.

Körner's "absolute method" (1874) renders it unnecessary to make any assumptions respecting the constitution of standard compounds, such as *o*-phthalic acid and mesitylene. Starting with the three isomeric dibromobenzenes, $C_6H_4Br_2$, he found that when converted into tribromobenzenes, $C_6H_3Br_3$, the first isomeride gave only one tri-derivative; the second gave two; and the third gave three: from the following formulae, in which equivalent positions for the third bromine atom are denoted by identical numerals, it is obvious that the first dibromobenzene was the para-compound, the second the ortho-, and the third the meta-:



The method is generally applicable, but in actual practice it is often difficult to isolate all the various isomerides, since some may be produced in very small proportions. It will be seen that a simultaneous orientation of the tri-derivatives is accomplished; thus, the sole tri-derivative yielded by para-dibromobenzene is 1, 2, 4-tribromobenzene. The same fundamental idea may be utilized by eliminating one and the same group from each of a complete series of isomeric tri-derivatives; thus, when the carboxyl group is eliminated from each of the six possible diaminobenzoic acids, $C_6H_4(NH_2)_2{\cdot}COOH$, the resulting diamino-benzene, $C_6H_4(NH_2)_2$, from one only of these acids is the para-compound; from two, the ortho-; and from three, the meta- (Griess, 1874). The orientation of higher substitution derivatives is determined by considering the di- and tri-substitution compounds into which they may be transformed.

Orientating Influence of Substituents in the Benzene Ring.—When a second substituent is attached to the nucleus of a non-substituted benzene it may enter in one of three positions to form the *ortho-*, *para-* or *meta*-compound. *A priori*, it might be imagined, for example, that upon nitrating toluene (methylbenzene), $CH_3{\cdot}C_6H_5$, with one equivalent proportion of nitrating mixture, an equi-molecular mixture of *o-*, *m-* and *p*-nitrotoluene, $CH_3{\cdot}C_6H_4{\cdot}NO_2$, would be produced. As a matter of fact, the product consists mainly of *o-* and *p*-nitrotoluene, with only about 3% of *m*-nitrotoluene. Thus the substituent originally present in the molecule, *i.e.*, the methyl group, has exerted a pronounced directive action, or *orientating influence*, upon the entering substituent. Again, when nitrobenzene, $C_6H_5{\cdot}NO_2$, is nitrated further it yields *m*-dinitrobenzene, $C_6H_4(NO_2)_2$, to the almost entire exclusion of the *o-* and *p*-derivatives. Thus while the methyl group favours entry to the *o-* and *p*-positions, the nitro-group dominates the *m*-position; or, in other words, the methyl group exerts the ortho-para orientating influence while the nitro-group exerts the meta orientating influence. Such observations indicate a close relationship between the *ortho-* and *para*-positions, which are clearly differentiated from the *meta*-position. The result is independent of the nature of the second group introduced. Experience has shown that as a general rule the ortho-para influence is exerted by hydrocarbon radicals, halogen atoms, and saturated groups such as -OH and $-NH_2$; while the meta influence is associated with unsaturated groups, such as $-NO_2$, $-SO_3H$, -COOH, -CHO, -CN and $-CO{\cdot}CH_3$. As a rule, the former groups facilitate further substitution in the benzene nucleus, while members of the second class hinder further action. A working guide to orientating influence is also provided by the empirical rule of Crum Brown and Gibson (1892): if the hydrogen compound, HX, of the substituent, X, already present in the benzene nucleus can be directly oxidized to HXO, then *meta*-derivatives predominate in further substitution; if not, *ortho-* and *para*-derivatives predominate. For example, since hydrobromic acid cannot be directly oxidized to hypobromous acid, bromobenzene yields mainly *ortho-* and *para*-disubstituted benzenes. It follows from what has been said that the order of introducing substituents into the benzene nucleus is of importance; *e.g.*, the bromination of nitrobenzene yields almost exclusively *m*-bromonitrobenzene, whilst the nitration of bromobenzene leads to the formation of the isomeric *o-* and *p*-bromonitrobenzenes, the product consisting of 35% of the former and 65% of the latter. When a third substituent is introduced into a disubstituted nucleus, the orientating influence of the two groups already present may either be conjoined or opposed, depending upon their nature and relative positions.

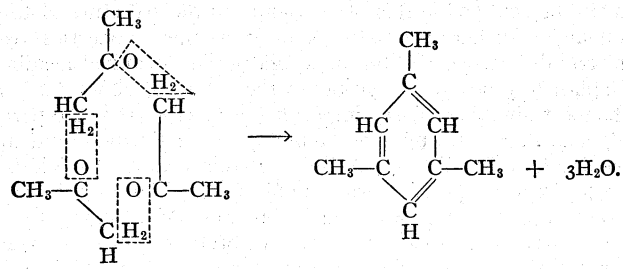
No completely satisfactory mechanism has yet been devised to account for the complex phenomena of orientation. Hypotheses have been advanced by J. N. Collie, B. Flürscheim, A. F. Holleman and others; and more recently attempts have been made to base explanations upon the electronic theory of valency. The phenomena are closely associated with the mutual influence exerted between substituents in the benzene nucleus. Thus, the reactivity of nuclear-substituted halogen is greatly enhanced by the presence of a nitro-group in the *ortho-* or *para*-position to it; no influence of the kind, however, is exerted by a nitro-group in the *meta*-position. An *ortho*-substituent often diminishes the reactivity of the neighbouring substituent, but this effect is due largely to *steric hindrance*, contingent upon the spatial proximity of the groups: for example, di-ortho-substituted benzoic acids of the type $C_6H_3X(1)COOH(2)Y(3)$ cannot usually be esterified with alcohol and hydrogen chloride (V. Meyer, 1894).

Synthesis and Fission of the Benzene Ring.—(1) The characteristic distinctions which exist between aliphatic and benzenoid compounds make the transformations of one class into the other particularly interesting. In the first place, many aliphatic compounds, including simple substances like methane and tetrachloromethane, show a tendency to yield aromatic compounds when subjected to a high temperature, in so-called pyrogenetic reactions; the predominance of aromatic compounds in ordinary coal-tar is probably to be associated with the occurrence of similar pyro-condensations. The termolecular polymerization (*q.v.*) of numerous acetylene compounds to form derivatives of benzene is of considerable interest. M. P. E. Berthelot (1870) first synthesized benzene by passing acetylene through tubes heated to dull redness; at higher temperatures the action becomes reversible, the benzene yielding diphenyl, diphenylbenzene and acetylene. The condensation of acetylene to benzene is also possible at ordinary temperatures in the presence of pyrophoric iron, finely divided nickel, spongy platinum and other catalysts (P. Sabatier and J. B.

Senderens). The homologues of acetylene condense more readily; thus allylene yields trimethylbenzene merely under the influence of sulphuric acid:

$$3\,HC{:}CH \longrightarrow C_6H_6; \qquad 3\,HC{:}C{\cdot}CH_3 \longrightarrow C_6H_3(CH_3)_3.$$
Acetylene Benzene Allylene Trimethylbenzene

The "potassium carbon monoxide" obtained by Liebig (1834) through the action of carbon monoxide on heated potassium was later (1885) found to yield hexahydroxybenzene, $C_6(OH)_6$, when treated with dilute acid; further investigation of this compound brought to light a number of highly interesting derivatives (*see* QUINONES). Mellitic acid, or benzene-hexacarboxylic acid, $C_6(COOH)_6$, first obtained from the mineral honeystone (aluminium mellitate) by Klaproth, in 1799, was afterwards (1883) prepared by the oxidation of graphite or charcoal with alkaline permanganate; this result is of particular interest when correlated with recent work on the crystalline structure of graphite (*vide supra*). A large and important series of condensations may be effected by eliminating the elements of water between carbonyl (CO) and methylene (CH_2) groups. A fundamental and historic example is that of the condensation of three molecules of acetone, in the presence of sulphuric acid, to one molecule of mesitylene (*s*-trimethylbenzene) and three molecules of water; this reaction, which was first observed by Kane, in 1837, is represented below:



Acetone (3mols.) Mesitylene

The condensation of geranial (citral) to cymene (*p*=isopropyl methylbenzene) is noteworthy: $C_{10}H_{16}O = CH_3{\cdot}C_6H_4{\cdot}CH{\cdot}(CH_3)_2 + H_2O$. The foregoing syntheses lead directly to a true benzene ring; but there are many reactions by which aliphatic compounds yield cyclic compounds with reduced benzene rings, from which true benzenoid compounds may then be prepared. An important example is the condensation, upon heating, of sodiomalonic ester, $CHNa(COOC_2H_5)_2$, to phloroglucinoltricarboxylic ester, a substance which gives phloroglucinol (*s*-trihydroxybenzene) when fused with alkalis.

(2) The relative stability of the benzene nucleus invests the question of its fission, or disruption, with a peculiar interest. Kekulé's formula indicates the possibility of a successive fission of the three double linkages, with the production of open-chain compounds. Fission usually occurs at more than one point; so that the six carbon atoms of the nucleus are rarely preserved as an unbroken open chain.

Certain aromatic compounds withstand ring decomposition more strongly than others; thus, benzene and its homologues, and also carboxylic acids and nitro-compounds, are much more stable towards oxidizing agents than amino- and hydroxy-benzenes, aminophenols, quinones and hydroxycarboxylic acids.

Decompositions by strong oxidation to carbon dioxide, formic acid, oxalic acid, etc., are of little interest. More important is the hydrolysis of benzene triozonide (ozobenzene), $C_6H_6(O_3)_3$, to glyoxal, CHO·CHO, since this disruption, suggestive of three double bonds in the ring, has been advanced as evidence in favour of Kekulé's formula: $C_6H_6(O_3)_3 + 3H_2O = 3CHO{\cdot}CHO + 3H_2O_2$. Tartaric acid, containing a chain of four carbon atoms in its molecule, has been obtained by oxidizing 1, 2-dihydroxybenzene (catechol) and hydroxybenzene (phenol) with nitrous acid and dilute potassium permanganate, respectively. 1, 3-dihydroxybenzene (resorcinol) when successively reduced and oxidized yields glutaric acid, $HOOC{\cdot}(CH_2)_3{\cdot}COOH$, with five carbon atoms in the chain. An open-chain compound with six carbon atoms may be had, for example, from 1, 4-dihydroxybenzene (hydroquinone); whilst salicylic acid, or 1, 2-hydroxybenzoic acid, $C_6H_4(OH){\cdot}COOH$, when reduced by sodium in amyl alcohol yields *n*-pimelic acid, $HOOC{\cdot}(CH_2)_5{\cdot}COOH$, an aliphatic compound whose molecule contains, in the form of a seven-membered open chain, the one substituent and six nuclear carbon atoms of the original aromatic molecule.

Chemical Characteristics of Nucleus and Side-chain in Aromatic Compounds.—Aliphatic chains, and also single groups containing carbon, when attached to a nuclear atom of a ring compound, are known as *side-chains*. Thus the molecules of toluene (methylbenzene) and cumene (isopropylbenzene) each contain one side-chain, while that of mesitylene (*s*-trimethylbenzene) contains three. The substituent radical, $-NH{\cdot}CO{\cdot}CH_3$, of acetanilide, $C_6H_5{\cdot}NH{\cdot}CO{\cdot}CH_3$, also is called a side-chain; but the term does not usually comprise simple groups which do not contain carbon, such as $-NO_2$, $-SO_3H$, $-OH$ and $-NH_2$. Side-chains attached to the nucleus by carbon atoms may be oxidized to carboxyl, $-COOH$: thus *o*-xylene, $C_6H_4(CH_3)_2$, upon oxidation yields successively *o*-toluic acid, $C_6H_4(CH_3){\cdot}COOH$, and *o*-phthalic acid, $C_6H_4(COOH)_2$; while the isomeric ethylbenzene, $C_6H_5{\cdot}CH_2{\cdot}CH_3$, yields only benzoic acid, $C_6H_5{\cdot}COOH$. The basicity of the final aromatic acid obtained upon oxidation thus indicates the number of carbon-linked side-chains in the original molecule. Moreover, halogen atoms present in the side-chains are removed in the oxidation, while nuclear halogen atoms remain; for example, benzyl chloride, $C_6H_5{\cdot}CH_2Cl$, oxidizes to benzoic acid, while the isomeric *o*-chlorotoluene, $Cl{\cdot}C_6H_4{\cdot}CH_3$, yields *o*-chlorobenzoic acid, $Cl{\cdot}C_6H_4{\cdot}COOH$.

In *mixed aliphatic-aromatic compounds,* like toluene, $CH_3{\cdot}C_6H_5$, the aliphatic side-chains retain the characters of their class, while the benzenoid nuclei retain their aromatic properties. Thus toluene is readily oxidized to benzoic acid, as stated above, the aromatic residue remaining unattacked. Nitric and sulphuric acids, on the other hand, affect only the nucleus, producing *o*- and *p*-nitrotoluenes, $CH_3{\cdot}C_6H_4{\cdot}NO_2$, and *o*- and *p*-toluene-sulphonic acids, $CH_3{\cdot}C_6H_4{\cdot}SO_3H$, by the usual processes of substitution. Chlorination may result in the formation of derivatives substituted either in the aromatic nucleus or in the aliphatic side-chain. The former substitution occurs more readily, *o*- and *p*-chlorotoluenes, $CH_3{\cdot}C_6H_4{\cdot}Cl$, being produced; while the latter substitution, which needs an elevation in temperature or other auxiliary, yields benzyl chloride, $C_6H_5{\cdot}CH_2Cl$, benzal chloride, $C_6H_5{\cdot}CHCl_2$, and benzotrichloride, $C_6H_5{\cdot}CCl_3$.

Halogen atoms in the side-chain are very reactive, resembling in this respect the halogen atoms of alkyl halides; nuclear halogen atoms, on the contrary, are normally unreactive. Thus, benzyl chloride, $C_6H_5{\cdot}CH_2Cl$ is readily hydrolyzed by aqueous alkali, forming benzyl alcohol, $C_6H_5{\cdot}CH_2OH$; but the isomeric chlorotoluenes, $CH_3{\cdot}C_6H_4{\cdot}Cl$, are unaffected by this treatment. Further differences become apparent when various other typical aliphatic and aromatic derivatives are compared. The introduction of hydroxyl groups into the benzene nucleus gives rise to compounds generically named *phenols,* which, although resembling the aliphatic alcohols in their origin, differ from these substances in their increased chemical activity and their acid nature. Structurally, the phenols resemble the tertiary alcohols, since the hydroxyl group is linked to a carbon atom which is united to other carbon atoms by its three remaining valencies; hence on oxidation, instead of yielding corresponding aldehydes, ketones or acids, they undergo nuclear fission, as indicated above.

The *amines,* or amino-compounds, also exhibit striking differences. In the aliphatic series these compounds may be formed directly from the alkyl halides and ammonia, but in the benzene series this reaction is impossible unless the nuclear halogen atom be weakened by the presence of other substituents; *e.g.,* nitro-groups. Thus, primary aromatic amines are usually prepared by reducing nitro-compounds, nitrobenzene, for example, yielding aniline, $C_6H_5{\cdot}NH_2$, in this way; intermediate reduction products, known as azoxy- and azo-compounds (*q.v.*), may also be prepared from aromatic nitro-compounds. Primary aromatic amines differ fundamentally from primary aliphatic amines in giving the impor-

tant diazo-reaction with nitrous acid (*see* DIAZO-COMPOUNDS). Moreover, whilst methylamine, dimethylamine and trimethylamine increase in basicity with the introduction of successive methyl groups, the opposite effect is observed upon introducing successive aromatic groups, such as the phenyl group, C_6H_5—. For instance, aniline (phenylamine), diphenylamine, $(C_6H_5)_2NH$, and triphenylamine, $(C_6H_5)_3N$, are in decreasing order of basicity, the last-named substance being insoluble even in strong mineral acids. Mixed aromatic–aliphatic amines, both secondary and tertiary, are more strongly basic than the pure aromatic amines, and less basic than the true aliphatic compounds; *e.g.*, aniline, $C_6H_5{\cdot}NH_2$, monomethylaniline $C_6H_5{\cdot}NH{\cdot}CH_3$, and di-methylaniline, $C_6H_5{\cdot}N(CH_3)_2$, are in increasing order of basicity. These observations may be summarized by saying that the benzene nucleus is more negative in character than the alkyl or other aliphatic radicals. In agreement with this conclusion, benzoic acid, $C_6H_5{\cdot}COOH$, is a much stronger acid than acetic acid, $CH_3{\cdot}COOH$.

As a general rule, homologues and mono-derivatives of benzene react more readily than the parent hydrocarbon with substituting agents; for example, phenol is converted into tribromophenol by the action of bromine water, and into nitrophenols by dilute nitric acid. Similar activity characterizes aniline. As already pointed out, not only does the substituent group modify the readiness with which the derivative is attacked, but it exerts also an orientating influence which determines the position of the further substitution.

Homologues of Benzene.—The following homologous formulae are obtained by the progressive addition of the usual increment, CH_2, to the molecular formula for benzene. The isomerism here indicated may readily be deduced from the foregoing discussion:

C_6H_6 Benzene (b.p. 80·4° C).

C_7H_8 Toluene or methylbenzene (b.p. 110°).

C_8H_{10} Xylenes or dimethylbenzenes (3); ethylbenzene.

C_9H_{12} Trimethylbenzenes (3); methylethylbenzenes (3); propylbenzene; isopropylbenzene (cymene).

$C_{10}H_{14}$ Tetramethylbenzenes (3); *p*-methylisopropylbenzene (cymene); etc.

All four isomerides of the formula C_8H_{10} occur, like benzene and toluene, in coal-tar; *o*-, *m*- and *p*-xylene boil at 142°, 139° and 138°, respectively, and ethylbenzene at 136°. Mesitylene or *s*-trimethylbenzene (b.p. 165°), also occurs in coal-tar. Cymene (b.p. 175°) is found in the essential oils of various species of eucalyptus and other plants; hexahydrocymene (menthane or terpane), $C_{10}H_{20}$, is the parent compound of the majority of the terpenes (*q.v.*) and camphors (*q.v.*), and thus cymene is formed when ordinary camphor is dehydrated with phosphorus pentoxide and when pinene is heated with iodine. All these homologous hydrocarbons resemble benzene and toluene in their general character, and readily undergo nitration, sulphonation and halogenation.

Aromatic Radicals.—Among the aromatic radicals which occur commonly in the molecules of mononuclear aromatic compounds are the following: Phenyl, C_6H_5–, often abbreviated to Ph; benzoyl (Bz), $C_6H_5{\cdot}CO$–; benzyl, $C_6H_5{\cdot}CH_2$–; benzylidene or benzal, $C_6H_5{\cdot}CH=$; phenylene, $-C_6H_4-$. Generically, aromatic radicals, or *aryl* radicals, are denoted by the symbol Ar, and *aliphatic* radicals by R. Mixed aromatic–aliphatic radicals, like benzyl, are sometimes called *alphyl* radicals.

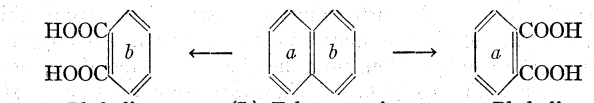
Polycyclic Benzene Derivatives.—The ring-systems of polycyclic or multinuclear compounds may be either distinct or condensed; nuclei of the latter type possess one or more of the ring-atoms in common.

Distinct Nuclei.—The simplest compound of the first type is *diphenyl*, $C_6H_5{\cdot}C_6H_5$, a crystalline hydrocarbon (m.p. 71° C) which may be prepared from sodium and iodobenzene in ether (Fittig's reaction). *Diphenylmethane* (m.p. 26°), $(C_6H_5)_2CH_2$, and *triphenylmethane* (m.p. 92°), $(C_6H_5)_3CH$, are formed when benzene interacts with methylene chloride and chloroform, respectively, in presence of aluminium chloride (Friedel and Crafts' reaction); *tetraphenylmethane*, $(C_6H_5)_4C$, also is known.

In attempting to prepare hexaphenylethane by treating triphenylbromomethane with finely divided silver in an atmosphere of carbon dioxide, M. Gomberg (1900) obtained a substance which differed markedly from the hydrocarbons just mentioned and from hexamethylethane, $(CH_3)_3C{\cdot}C(CH_3)_3$. It combined with iodine, forming triphenyliodomethane $(C_6H_5)_3CI$, and behaved generally as an unsaturated substance. It was eventually accepted as *triphenylmethyl*, $C(C_6H_5)_3$, in which the non-cyclic carbon atom is tervalent. The existence of this exceptional derivative has been ascribed to a "steric dissociation" of hexaphenylethane, the fourth valencies of the "ethane" carbon atoms undergoing a mechanical disengagement owing to the spatial requirements of their three bulky phenyl groups. A dynamic equilibrium of the following nature appears to be set up when the substance is dissolved in fused naphthalene: $2(C_6H_5)_3C \rightleftarrows (C_6H_5)_3C{\cdot}C(C_6H_5)_3$. Tridiphenylmethyl, $C(C_6H_4{\cdot}C_6H_5)_3$, and several similar compounds have also been prepared.

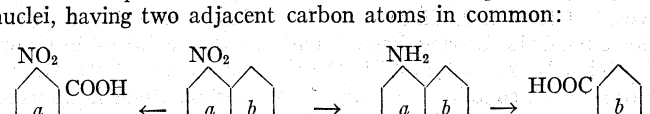
Condensed Nuclei.—The three important coal-tar hydrocarbons, naphthalene, anthracene and phenanthrene, have been assigned molecular structures which result from the fusion of benzene rings; although they are not homologues of benzene, they show the general aromatic behaviour characteristic of the benzene nucleus. The molecule of naphthalene, $C_{10}H_8$, is usually represented as consisting of two benzene rings having a pair of adjacent carbon atoms in common; while the molecular structures of the pair of isomeric hydrocarbons, anthracene and phenanthrene, $C_{14}H_{10}$, are formed from three benzene nuclei. The discussion will be confined in this place mainly to the structure of these compounds; further information concerning their properties, reactions and derivatives will be found under the individual headings.

Naphthalene occurs in coal-tar to the extent of about 5%, and is the most abundant of the important primaries. It is the parent compound of a large number of purely synthetic dyes, and also of synthetic indigotin. It was isolated from coal-tar by Kidd, in 1820, and its composition was established by Faraday, in 1826. In 1866, the year following the publication of Kekulé's theory of the benzene ring, E. Erlenmeyer, Sr., proposed for naphthalene a structure (I.) consisting of two "ortho-condensed" benzene nuclei, with two common carbon atoms. Since naphthalene yields *o*-phthalic acid upon oxidation, its molecule must contain at least one benzene ring; and according to Erlenmeyer's formula, either of the benzene rings (*a*) or (*b*), may undergo oxidative fission to yield this product:



o-Phthalic acid — (I.) Erlenmeyer's formula for naphthalene — *o*-Phthalic acid

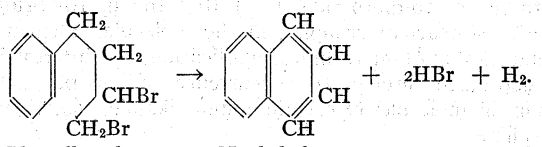
Shortly after Erlenmeyer's suggestion had been made, Graebe established the symmetry of the naphthalene nucleus, and showed that whichever half of the molecule be oxidized *o*-phthalic acid results. Similarly, α-nitronaphthalene, $C_{10}H_7{\cdot}NO_2$, formed by the action of strong nitric acid on the hydrocarbon, yields nitro-*o*-phthalic acid upon oxidation. The nitro-group, entering either of the rings (*a*) or (*b*), serves to distinguish that ring from the other; assuming the group to enter (*a*), it is obviously (*b*) which then undergoes disruptive oxidation. If, however, the nitro-group be reduced to the amino-group prior to this oxidation, the resulting α-naphthylamine, $C_{10}H_7{\cdot}NH_2$, yields *o*-phthalic acid when oxidized; in this instance it is the second nucleus (*b*), distinguished by its non-substitution, which survives in the product. Thus the naphthalene molecule contains two potential benzene nuclei, having two adjacent carbon atoms in common:



Nitro-*o*-phthalic acid. — α-Nitronaphthalene — α-Naphthylamine — *o*-Phthalic acid

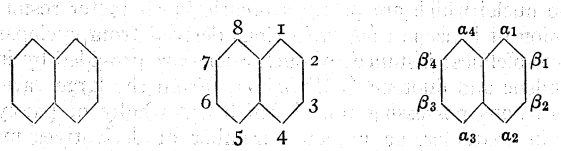
The fundamental character of the naphthalene nucleus has been confirmed by a number of syntheses. Thus, the vapour of

phenylbutylene dibromide yields naphthalene when passed over lime at a faint red heat (Aronheim, 1873):



Phenylbutylene dibromide — Naphthalene

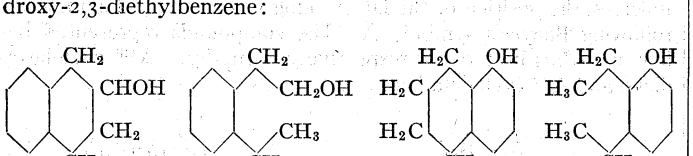
For all ordinary purposes it is sufficient to represent the naphthalene molecule by the double hexagon (II.); in order to facilitate nomenclature, the carbon atoms carrying hydrogen atoms are then numbered and lettered as shown below:



(II.) Abbreviated formula for naphthalene

Mono-substitution derivatives of naphthalene can thus exist in two isomeric modifications, depending upon whether or not substitution occurs on an atom adjacent to one of the two carbon atoms common to both rings: α-derivatives are produced by substitution in one of the equivalent positions, 1, 4, 5 or 8; β-derivatives by substitution in one of the second set of equivalent positions, 2, 3, 6 or 7. Orientation of such derivatives can often be accomplished by oxidation to the corresponding substituted *o*-phthalic acid. Substituted naphthalenes of the types $C_{10}H_6X_2$ and $C_{10}H_6XY$ may exist in 10 and 14 isomeric modifications, respectively. If the two substituents are attached to adjacent carbon atoms in the same ring, the derivative bears a general chemical resemblance to ortho-disubstituted benzenes. Some of the characteristics of the latter compounds, particularly the ability to participate in further ring-closures, are shown also by the so-called *peri*-derivatives, which contain substituents in the 1, 8- or 4, 5-positions.

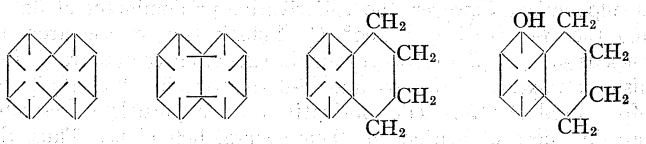
Since, as already indicated, Kekulé's formula affords an inadequate interpretation of the benzene molecule, it is not surprising that Erlenmeyer's derived formula fails to express the complete chemical behaviour of naphthalene. Indeed, the naphthalene molecule, like that of benzene, is probably capable of passing through a series of closely related structural phases. Erlenmeyer's formula explains the decompositions and syntheses of naphthalene derivatives, and accounts satisfactorily for the observed isomerism; but although naphthalene is more reactive than benzene, its chemical character is not in keeping with the presence of five double linkings in the molecule. According to Bamberger, the molecule is aromatic but not benzenoid; however, by the reduction of one ring, the other assumes a true benzenoid character. Thus, β-naphthol yields alicyclic tetrahydro-β-naphthol upon reduction; and this substance, in which the hydroxyl group is attached to the reduced ring, closely resembles the alcoholic 1-β-hydroxyethyl-2-ethylbenzene. Upon reducing α-naphthol, the hydrogen atoms enter the non-substituted ring, and the resulting aromatic tetrahydro-α-naphthol resembles the phenolic 1-hydroxy-2,3-diethylbenzene:



ac-Tetrahydro-β-naphthol — 1-β-Hydroxyethyl-2-ethylbenzene — *ar*-Tetrahydro-α-naphthol — 1-Hydroxy-2, 3-diethylbenzene

Analogous relationships hold for the corresponding amino-compounds.

In order to account for these peculiarities, formulae derived from the centric hypothesis were advanced by Bamberger (III.) and Armstrong (IV.):



(III.) Bamberger's centric formula for naphthalene — (IV.) Armstrong's centric formula for naphthalene — Tetrahydronaphthalene and *ar*-Tetrahydro-α-naphthol (after Bamberger)

Bamberger's formula represents the molecule as containing a monocyclic nucleus of ten carbon atoms, which, however, is capable of facile transition into the *ortho*-condensed bicyclic system. When, as in the formation of naphthalene tetrachloride or 1, 2, 3, 4-tetrahydronaphthalene (tetralin), for example, the one ring becomes saturated, the other might be expected to assume the normal centric form and become truly benzenoid in character. This is so; thus, tetrahydronaphthalene has the character of an alkyl benzene, and *ar*-tetrahydro-α-naphthol that of a phenol, as is shown in the diagram above. Bamberger's observations on reduced quinoline derivatives likewise point this out, that condensed nuclei of this type are not benzenoid, but possess an individual character; this disappears, however, when the molecule is reduced. Armstrong's formula (IV.) obviates the necessity of postulating the existence of a ten-membered ring, by assuming that one of the affinities of each of the two central carbon atoms common to the two rings acts into both rings. This assumption represents a deviation from the ordinary views of valency and affinity, but the symbol harmonizes with the fact that the two rings are in complete sympathy, the one responding to every change made in the other.

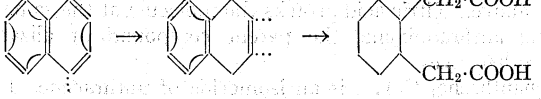
Other structural representations have been based upon Dewar's formula for benzene. Thiele's theory of partial valencies applies to the naphthalene molecule with a considerable degree of success. According to this theory, the molecule of naphthalene, unlike that of benzene, does not necessarily present a closed conjugated system. Thiele's formula (V*a*) indicates open partial valencies in two of the four *peri*-positions. The formula thus gives expression to the fact that naphthalene differs notably from benzene in the ease with which it forms additive compounds; moreover, the additive process sets in at the α-positions. Another phase of the molecule is possibly represented by an alternative formula (V*b*), also based upon Thiele's theory:



(V*a*) (V*b*)

Formulae for naphthalene, based upon Thiele's theory

When naphthalene is reduced with sodium in boiling alcoholic solution it yields 1, 4-dihydronaphthalene, a substance which possesses all the unsaturated characteristics of ethylene. This result is completely in accord with formula V*a*. The constitution of the dihydronaphthalene is shown by its oxidation to *o*-phenylenediacetic acid:

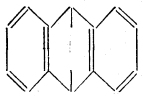


Naphthalene, $C_{10}H_8$ — 1, 4-Dihydronaphthalene, $C_{10}H_{10}$ — *o*-Phenylenediacetic acid

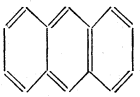
Further reduction yields 1, 2, 3, 4-tetrahydronaphthalene, and finally decahydronaphthalene (decalin, *q.v.*), $C_{10}H_{18}$, a fully saturated hydrocarbon, whose molecule contains two ortho-condensed cyclohexane rings.

As a rule, naphthalene yields mainly α-derivatives in substitution reactions; *e.g.*, when it is chlorinated or nitrated; when it is sulphonated, however, the α-derivative predominates at 80° C and the β-derivative at 160° C. Substitution in the aromatic nucleus of 1, 2, 3, 4-tetrahydronaphthalene, on the contrary, furnishes a mixture of the α- and β-derivatives in which the latter often predominate. The derivatives of naphthalene resemble broadly those of benzene in their general behaviour. Thus, the naphthols exhibit the acidic character of phenols; the naphthylamines may be diazotized like aniline, etc.; and the naphthaquinones are very similar to the benzoquinones. Moreover, halogen atoms attached directly to the nucleus, although more reactive than in the benzene series, are stable towards hot aqueous alkalis.

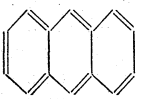
Anthracene, $C_{14}H_{10}$, forms from about 0·25–0·45% of coal-tar. It is the basis of many artificial dyes and also of synthetic alizarin. According to Graebe and Liebermann's formula (I.), the anthracene molecule is composed of three ortho-condensed six-membered nuclei, the medial ring (which contains a para-linkage) being fatty in character, while the lateral rings are benzenoid. This formula represents adequately the syntheses, decompositions and general chemical behaviour of anthracene, but it should probably be regarded as one phase of a dynamic system which embraces formulae (II.) and (III.). The last of these is sometimes called the "ortho-quinonoid" formula. A centric formula also has been advanced by Bamberger.



(I.) Graebe and Liebermann's formula for anthracene

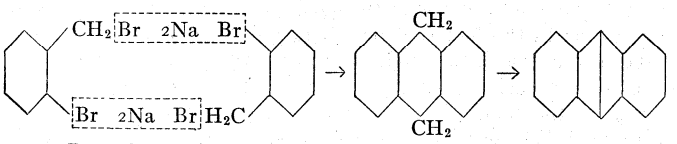


(II.)



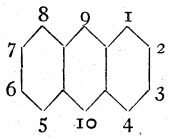
(III.)

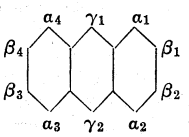
According to Armstrong, one lateral ring is centric, while the remaining lateral ring and the medial ring are ethenoid. The fundamental nature of the anthracene nucleus is evident from the synthesis of dihydroanthracene; this compound, which results when *o*-bromobenzyl bromide is condensed in presence of sodium, may be oxidized to anthracene:

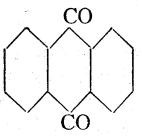


o-Bromobenzyl bromide (2 mols.) → Dihydroanthracene → Anthracene

The abbreviated representation of anthracene, with the accepted numbering and lettering of the carbon atoms, is indicated below. These representations show that three isomeric monosubstitution compounds are possible, together with a considerable variety of disubstitution products:



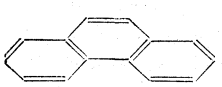




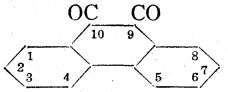
Anthraquinone

When anthracene is reduced with sodium and alcohol, the medial ring is attacked with the formation of dihydroanthracene, mentioned above. Nitric acid attacks the molecule at the same points, yielding anthraquinone, the parent compound of alizarin and many other dyes.

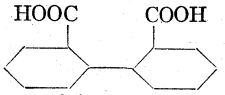
Phenanthrene, $C_{14}H_{10}$, is an isomeride of anthracene. It is not oxidized so readily as anthracene, but with chromic acid it yields phenanthraquinone and then diphenic acid:



Phenanthrene



Phenanthraquinone



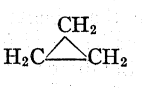
Diphenic acid

Both hydrogen (in presence of catalysts) and bromine yield additive compounds, namely, 9, 10-dihydrophenanthrene, $C_{14}H_{12}$, and phenanthrene 9, 10-dibromide, $C_{14}H_{10}Br_2$; the 9, 10-"bridge" is thus the most reactive grouping in the molecule. Phenanthrene has found no important technical application, but interest is lent to the substance through the occurrence of the phenanthrene nucleus in the molecules of certain opium alkaloids, (*q.v.*), including morphine.

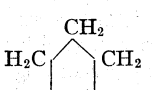
The fraction of coal-tar boiling above 360° contains a number of still more complex hydrocarbons, including *pyrene*, $C_{16}H_{10}$, *chrysene*, $C_{18}H_{12}$, and *picene*, $C_{22}H_{14}$, the molecules of which are obtained structurally through the fusion of four, four and five benzene nuclei, respectively. *Retene*, or methylisopropylphenanthrene, $C_{18}H_{18}$, occurs in certain fossil resins. Condensed hydrocarbon nuclei which are partly aromatic in character result from the union of benzene rings with rings derived from cycloparaffins or cyclo-olefines; instances of such nuclei are provided by indene, hydrindene and fluorene (*vide infra*). From the large variety of hydrocarbons possessing nuclei which are wholly or partly aromatic in character, an immense number of derivatives may be obtained, since the hydrogen atoms may be substituted in the many ways which have been outlined.

Alicyclic Compounds, *Monocyclic Derivatives.*—As already pointed out, alicyclic compounds may be subdivided into cycloparaffins and cyclo-olefines and their derivatives. Substances of these types containing six carbon atoms in the nucleus are particularly important, and are sometimes classified under the separate heading of hydroaromatic compounds. In general, the cycloparaffins closely resemble the open-chain paraffins, while the cyclo-olefines are similar to the open-chain olefinic compounds.

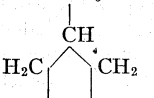
The *cycloparaffins, polymethylenes* or *cyclanes,* are saturated cyclic hydrocarbons of the general formula $C_n H_{2n}$, or $(CH_2)_n$, in which n may be any integer from 3 to about 18. Theoretically, the first member of the series is ethylene, $H_2C{=}CH_2$, in which the double bond may be regarded as a two-membered ring. Cycloparaffins containing five or six atoms in the nucleus are sometimes called *naphthenes.* The simple cycloparaffins and their derivatives have no marked technical importance, although naphthenes are found in natural petroleum, particularly in the Caucasian variety. The terpenes and camphors, however, most of which are derived from *p*-methylisopropylcyclohexane (menthane or terpane), form a special group of outstanding importance, by reason of their abundant occurrence in essential oils and other natural products (*See* TERPENES; CAMPHORS). The formulae of some typical cycloparaffins are appended, the last three being naphthenes:



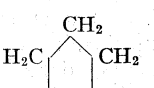
Cyclopropane



Cyclopentane

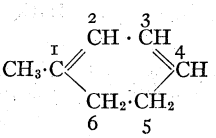


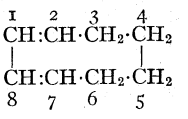
Methylcyclopentane



Cyclohexane

The unsaturated members of the series, or cyclo-olefines, are named on the Genevan system, in which the suffix, *-ane,* is replaced by *-ene, -diene, -triene,* etc., according to the number of double linkages, the position of the latter being indicated by the numerals following Baeyer's symbol, Δ. The compounds represented below may thus be termed, respectively, 1-methyl- $\Delta^{1:3}$ cyclohexadiene and $\Delta^{1:7}$ cyclooctadiene:





An alicyclic ring is often denoted by the prefix *ac-*.

It was long supposed that the simplest ring obtainable contained six atoms of carbon; so that the discovery by Freund, in 1882, of

cyclopropane aroused an interest which was enhanced by the novel chemical properties of the new hydrocarbon. With bromine, it combines less readily than the isomeric propylene, $CH_3{\cdot}CH{:}CH_2$, but it is easily converted by hydrogen bromide into *n*-propyl bromide, $CH_3{\cdot}CH_2{\cdot}CH_2Br$. The separation in this manner of carbon atoms united by single affinities was unprecedented at that time, but a similar behaviour has since been noticed in derivatives of cyclopropane, the ring being very susceptible to fission. Cyclobutane and its derivatives are rather more stable, and the nuclei containing five and six carbon atoms are very stable, showing little tendency to form open-chain compounds under ordinary conditions.

Baeyer has explained these variations in stability with considerable success by a purely mechanical hypothesis known as the "strain" or *"Spannungs"* theory (1885). Assuming the four valencies of the carbon atom to be directed from the centre of a regular tetrahedron towards its four corners, the angle between any two valencies is 109° 28′. According to the strain theory, the valencies undergo deflection in the formation of carbon rings, and the tension thus introduced may be deduced from a comparison of the tetrahedral angle with the new angle. The amount of the deflection is regarded as a measure of the reactivity, or instability, of the ring. Thus, the extraordinary reactivity of ethylene is attributed to the circumstance that the distortion is here a maximum, since, if deflected into parallelism, each valency will be drawn out of its original position through 54° 44′. The values in other cases are calculable from the formula $\frac{1}{2}(\alpha - 109° 28')$, where α is the internal angle of the regular polygon contained by sides equal in number to the number of carbon atoms in the ring. The displacements for various polymethylenes are given below:

Tri-	Tetra-	Penta-	Hexa-	Hepta-	Octa-
−24° 44′	−9° 44′	−0° 44′	+5° 16′	+9° 33′	+12° 46′

The general behaviour of the several types of saturated homocyclic systems is certainly in accordance with this conception. It is found, for example, that the most stable of the above ring-systems are those containing five or six carbon atoms; a slight inward displacement is indicated for the five-membered ring and a somewhat larger outward displacement for the six-membered ring. It is, therefore, noteworthy that when benzene is reduced with hydriodic acid it is converted into a mixture of cyclohexane and methylcyclopentane; many other conversions of six-carbon rings into five-carbon rings have also been recorded. Similar considerations apply to heterocyclic rings; thus the γ-lactones, containing four carbon atoms and one oxygen atom in the ring, are more stable than the δ-lactones, which contain an additional carbon atom in the ring.

The strain hypothesis has been modified by J. F. Thorpe and C. K. Ingold. "It has, for instance, been calculated that whilst the natural inclination of two (carbon to carbon) valencies of a carbon atom carrying two hydrogen atoms is 115·3°, this inclination becomes depressed to 109·5° when the hydrogen atoms are replaced by groups such as methyl, which require a larger share of the space surrounding the carbon nucleus. This attachment of two methyl groups to carbon atoms involved in a 3-, 4-, or 5-membered ring considerably augments the stability of the structure, whilst if the ring contained six or seven carbon atoms a diminution in stability would result." (Thorpe, *Chemistry in the Twentieth Century,* London, 1924, p. 96.)

The limiting number of atoms which can be associated in a carbocyclic system by single valencies has not yet been determined. Large rings, containing up to about 30 carbon atoms, are difficult of access; but once formed they are just as stable as the C_5- and C_6-systems. This striking fact finds an explanation in the Sachse-Mohr theory of strainless rings, according to which the strain in large polymethylene rings may be relieved by a twisting into a multiplanar configuration. Thus, according to Mohr (1918), an indication of the existence of two strainless forms of the cyclohexane ring is to be found in the occurrence of two stable isomeric modifications of decahydronaphthalene, formed by the fusion of two such rings (*Annual Reports on the Progress of Chemistry,* 1926).

No isomerism occurs in the monosubstitution derivatives, but ordinary position isomerism exists in the di- and poly-substitution compounds. Stereoisomerism (*see* STEREOCHEMISTRY) also may occur, since the two atoms or groups attached to each saturated nuclear carbon atom are disposed, respectively, above and below the plane of the ring. The simplest examples are the dibasic acids: these yield a *cis-* (malenoid) form and a *trans-* (fumaroid) form. Such stereoisomerides may be depicted (Aschan) by representing the plane of the carbon atoms of the ring as a straight line. Thus, for the dicarboxylic acids (X=COOH) the possibilities are represented as follows:

Cis: $\underline{X \quad X}$ Trans: $\underline{X \quad\quad}_{X}$ and $\underline{\quad\quad X}_{X}$

The trans-compound, being usually asymmetric, is in such instances capable of existing in enantiomorphous forms, as indicated in the diagram. For example, *trans*-hexahydrophthalic acid, $C_6H_{10}(COOH)_2$, has been resolved into dextro- and laevo-rotatory modifications; the *cis*-acid is symmetrical and unresolvable.

Hydrocarbons may be obtained from the dihalogen paraffins by the action of sodium or zinc dust, provided that the halogen atoms are not attached to the same or to adjacent carbon atoms (Freund, 1882; W. H. Perkin, Jr., 1888):

$$\begin{matrix}CH_2{\cdot}CH_2Br \\ | \\ CH_2{\cdot}CH_2Br\end{matrix} + 2Na = \begin{matrix}CH_2{\cdot}CH_2 \\ | \quad | \\ CH_2{\cdot}CH_2\end{matrix} + 2NaBr$$

Tetramethylene dibromide. Cyclobutane

They may be prepared also by the action of hydriodic acid on benzene hydrocarbons (*vide supra*); by passing the vapour of benzene hydrocarbons over finely divided nickel at 180–250° C (Sabatier and Senderens); from hydrazines of the type $C_nH_{2n-1}{\cdot}NH{\cdot}NH_2$, by oxidation with alkaline potassium ferricyanide (Kijner); and from semicarbazones of the corresponding cyclic ketones, by reduction. Unsaturated hydrocarbons of the series may be prepared by the elimination of water or halogen acid from the corresponding alcohols or halogen derivatives. Pure cyclobutene has been made by distilling the quaternary ammonium hydroxide of aminocyclobutane.

The boiling points of successive cycloparaffins, from cyclopropane to cyclononane, are −35°, 11°, 49°, 81°, 117°, 146° and 171° C. The boiling points and specific gravities of these hydrocarbons are higher than the constants for the corresponding open-chain olefines or paraffins. Cyclohexane, C_6H_{12}, is an important constituent of Caucasian petroleum; it may be prepared by the catalytic hydrogenation of pure benzene. It is oxidized by nitric acid to adipic acid, and is converted by chlorine to monochlorocyclohexane; the latter derivative yields tetrahydrobenzene (b.p. 84°) when treated with alkalis. Aminocyclohexane is fundamentally similar to the primary hexylamines. Cyclopentadecane, $C_{15}H_{30}$, and cycloheptadecane, $C_{17}H_{34}$, prepared by reducing the semicarbazones of the corresponding cyclic ketones, melt at 61° and 65°, respectively.

Of the cyclo-olefines, cyclopentadiene, C_5H_6 (b.p. 41°), occurs in crude coal-tar benzene. Owing to the peculiar reactivity of its methylene group, this substance condenses readily with aldehydes and ketones, acetone, for example, yielding the intensely coloured hydrocarbon, dimethylfulvene:—

$$\begin{matrix}CH{=}CH \\ | \quad\quad > CH_2 \\ CH{=}CH\end{matrix} + OC(CH_3)_2 \rightarrow H_2O + \begin{matrix}CH{=}CH \\ | \quad\quad > C = C < \begin{matrix}CH_3 \\ CH_3\end{matrix} \\ CH{=}CH\end{matrix}$$

Cyclopentadiene Acetone Dimethylfulvene

Cyclohexene or tetrahydrobenzene, C_6H_{10}, boils at 84° (*vide supra*), while $\Delta^{1:3}$- and $\Delta^{1:4}$-cyclohexadiene (the isomeric dihydrobenzenes, C_6H_8), boil at 81–82° C.

Cycloheptatriene (tropilidene), C_7H_8, may be prepared from cycloheptanone; it is also a degradation product of cocaine and atropine (*see* ALKALOIDS). $\Delta^{1:7}$-Cyclo-octadiene, C_8H_{12}, has been prepared from the alkaloid, ψ-pelletierine, by exhaustive methyla-

tion. Cyclo-octatetrene, C_8H_8, is interesting by reason of the fact that it displays no aromatic characteristics, although the nucleus possesses a system of alternating single and double bonds; this evidence was adduced by Willstätter (1911) in favour of the centric constitution for benzene. Mention may also be made of C. Harries' unsubstantiated suggestion of a cyclo-octadiene ring as the possible structural basis of the molecule of caoutchouc, the hydrocarbon of rubber, whose properties show that its molecular structure is more complex than its empirical formula indicates.

Alcohols are obtained from the corresponding halogen compounds by the action of moist silver oxide or silver acetate and acetic acid; by the reduction of cyclic ketones with metallic sodium; by passing the vapours of monohydric phenols, in admixture with hydrogen, over finely divided nickel; by the reduction of cyclic esters with sodium and alcohol; and by the addition of the elements of water to unsaturated cyclic hydrocarbons, on boiling with dilute acids.

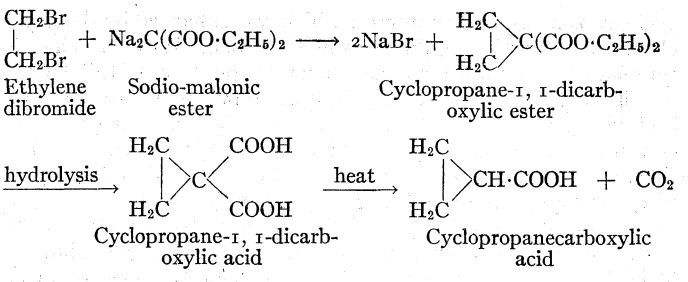
Cyclohexanol or hexahydrophenol, $C_6H_{11}OH$ (b.p. 160·5° C), is readily prepared by the catalytic hydrogenation of phenol in presence of finely divided nickel at 150° C. It reacts with hydrogen bromide to yield monobromocyclohexane (b.p. 162°), and undergoes dehydration to tetrahydrobenzene when heated with oxalic acid. Quinitol (cyclohexane-1:4-diol or hexahydroquinone) $C_6H_{10}(OH)_2$, results when cyclohexane-1:4-dione (*p*-diketohexamethylene) is reduced with sodium amalgam; it exists in *cis*- and *trans*- forms (m.p. 102° and 139°). Quercitol, or cyclohexanepentol, $C_6H_7(OH)_5$, occurs in acorns; it is optically active, forms colourless prisms (m.p. 234°), and has a sweet taste. Inositol, or cyclohexanehexol, $C_6H_6(OH)_6$, is widely distributed in plants and animals. Like the structurally isomeric hexoses, it has a sweet taste. Although it possesses no carbon atom which is asymmetric in the ordinary sense, it is capable of displaying optical activity in the amorphous condition. Anhydrous *d* (or *l*)-inositol melts at 246°, *dl*-inositol at 253°, and an internally compensated form at 225°.

The aldehydes, of which comparatively few have been studied in this series, are prepared in the usual manner from primary alcohols and acids: hexahydrobenzaldehyde, $C_6H_{11}\cdot CHO$, and hexahydro-*m*-toluic aldehyde, $CH_3\cdot C_6H_{10}\cdot CHO$, boil at 159° and 176°, respectively.

The ketones are obtained by the dry distillation of the calcium salts of dibasic saturated aliphatic acids (Wislicenus, 1893), and by synthetic methods from malonic ester, acetoacetic ester, etc. (see *Aliphatic* section). The first method affords satisfactory yields of the saturated members up to cycloheptanone; and cyclooctanone can be obtained in a similar way from thorium azelate in a yield of 25%. Owing to their accessibility, these ketones have been utilized largely in the preparation of other derivatives in this group. Cyclobutanone, $(CH_2)_3CO$, boils at 100°, and cyclopentanone, $(CH_2)_4CO$, at 129°. Cyclohexanone, or ketohexamethylene, $(CH_2)_5CO$, is prepared by distilling calcium pimelate or by oxidizing cyclohexanol, to which it is readily reduced. It oxidizes to adipic acid, and may be acetylated, owing to its tautomeric relationship to Δ^1-tetrahydrophenol. Cyclohexanone boils at 155°, and cycloheptanone (suberone) $(CH_2)_6CO$, at 180° C.

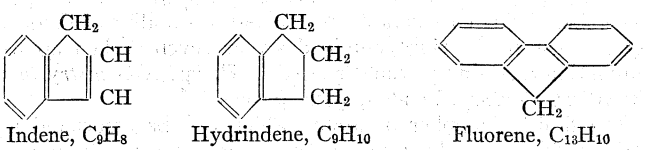
Apart from their existence in a few naturally occurring substances (*v. inf.*), alicyclic rings with from 10 to about 30 carbon atoms are accessible only by vacuum distillation of the thorium salts of the above-mentioned acids (Ruzicka, 1926). The resulting ketones, from cyclododecanone, $(CH_2)_{11}CO$, to cyclo-octadecanone $(CH_2)_{17}CO$, are solids, the melting-points of the successive members being 59°, 32°, 52°, 63°, 56°, 63° and 71° C. These ketones possess characteristic odours, and cyclopentadecanone ("exaltone"), $(CH_2)_{14}CO$, is used as a synthetic substitute for musk. Muscone, $C_{16}H_{30}O$, the main odoriferous constituent of natural musk, is a 2-methylcyclopentadecanone, and civetone of the civet cat is Δ^8-cycloheptadecanone, $C_{17}H_{30}O$ (Ruzicka).

A great impetus was given the study of polymethylene derivatives by the important and unexpected observation made by W. H. Perkin, Jr., in 1883, that ethylene and trimethylene bromides are able to react with sodio-acetoacetic ester to form tri- and tetramethylene rings:



Cyclopropanecarboxylic acid is a colourless oil. The truxillic acids, $C_{18}H_{16}O_4$, are polymerides of cinnamic acid, and they result in the hydrolysis of truxilline. Structurally, they are phenyl derivatives of cyclobutane. Derivatives of the cyclopentane group occur commonly as break-down products of the terpenes and camphors (*qq.v.*); for example, campholic acid, obtained from ordinary camphor by hydrolysis, is 1,2,2,3-tetramethylcyclopentane-3-carboxylic acid. Hexahydrobenzoic acid, or cyclohexanecarboxylic acid, $C_6H_{11}\cdot COOH$ (m.p. 30° C), may be prepared by the vigorous reduction of benzoic acid, or by the action of carbon dioxide on cyclohexyl magnesium iodide (*see* GRIGNARD REAGENTS). The naphthenic acids of Caucasian petroleum are probably homologues of this substance. *l*-Quinic acid, or hexahydrotetrahydroxybenzoic acid, $C_6H_7(OH)_4\cdot COOH$, m.p. 162°, is an important substance occurring in cinchona bark, coffee beans, sugar beet and many other plants. Discovered by Hofmann in cinchona bark, in 1790, it is a by-product in the manufacture of quinine, and is used in pharmacy. At 250° C, it yields the lactone, quinide, which on warming with baryta water furnishes optically inactive quinic acid. Three hexahydrophthalic acids, or cyclohexanedicarboxylic acids, $C_6H_{10}(COOH)_2$, are known, containing the carboxyl groups in the 1, 2-, 1, 3-, and 1, 4-positions, and each exists in *cis*- and *trans*-stereoisomeric forms. The reduced phthalic acids were submitted to a detailed examination by Baeyer in his prolonged researches (1887–92) on the constitution of benzene, and numerous acids of the kind are known. Thus, from *o*-phthalic acid (benzene-1, 2-dicarboxylic acid) alone, it has been possible to prepare two hexahydrophthalic acids, four tetrahydrophthalic acids and eleven dihydrophthalic acids.

Polycyclic Derivatives.—Alicyclic rings may enter into the formation of any of the general polycyclic types which have been indicated in discussing polycyclic benzene derivatives. Such rings may therefore be associated in various ways with other homocyclic rings, which may belong either to the alicyclic or the aromatic division; thus, in decahydronaphthalene and tetrahydronaphthalene (*vide supra*) an alicyclic ring has undergone ortho-condensation with a second alicylic ring and an aromatic ring, respectively. Wholly alicyclic derivatives containing two or three condensed rings are very numerous in the series of terpenes and camphors (*qq.v.*) and their derivatives. It will suffice, therefore, in this place to consider a few typical polycyclic compounds of mixed aromatic-aliphatic type. Among the most important members of this group are indene, fluorene (*qq.v.*) and hydrindene.

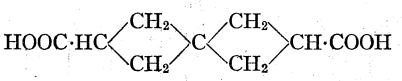


Indene, C_9H_8 Hydrindene, C_9H_{10} Fluorene, $C_{13}H_{10}$

Indene (b.p. 178° C) occurs in the "heavy oil" fraction of coal-tar, and has also been obtained synthetically. The molecule contains a benzene ring ortho-condensed with a cyclopentadiene ring. The methylene group, like that of cyclopentadiene itself (*vide supra*), is unusually reactive. Upon reduction, indene passes into hydrindene (b.p. 176°), the cyclopentadiene ring being thereby converted into a cyclopentene ring. Fluorene (m.p. 113°), also in coal-tar, has been synthesized by passing diphenylmethane through a red-hot tube. The molecule contains two benzene rings condensed with a cyclopentadiene ring. The methylene group, owing to its position between two unsaturated carbon atoms, possesses an enhanced

reactivity: thus, fluorene, like indene, furnishes a potassium derivative and undergoes condensation with aldehydes.

Spirocyclanes and their derivatives possess two alicyclic rings having only one carbon atom in common. Such compounds, although not of natural occurrence, are interesting stereochemically, since the two rings occupy two planes intersecting at right angles through the common carbon atom. A single example is afforded by spiroheptanedicarboxylic acid (Fecht, 1907):



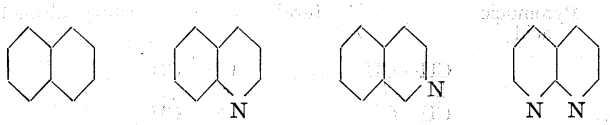
BIBLIOGRAPHY.—J. Read, *Text Book of Organic Chemistry* (1926), gives a general account of the whole subject; B. T. Brooks, *The Non-Benzenoid Hydrocarbons* (1922) alicyclic compounds. (J. RD.)

HETEROCYCLIC DIVISION

The subject of heterocyclic compounds, comprising as it does a large group of substances occurring in nature (alkaloids, anthocyans, uric acid, etc.), is one of fundamental importance not only from the chemist's point of view in particular, but from the more general aspect having as its object the correlation of physics and chemistry with animal and plant metabolism. The synthesis of an enormous number of heterocyclic compounds has been accomplished, and these are of importance: (*a*) because of their identity with or relation to natural products, (*b*) because of some theoretical significance as, for example, in showing the mechanism of a chemical reaction, and (*c*) because of some properties that make them valuable to humanity, such as drugs, dyes, etc.

Heterocyclic compounds are distinguished from homocyclic compounds in that they contain at least one atom other than carbon in the ring. Such atoms may be of a variety of elements, but in most cases are nitrogen, oxygen, sulphur or selenium.

Heterocyclic compounds, like the homocyclic, may also exist in the form of fused ring systems, either with homocyclic or with other heterocyclic nuclei. Moreover while the fusion of two benzene nuclei results in naphthalene, the fusion of a benzene and a pyridine nucleus may result in either quinoline (*q.v.*) or isoquinoline, and the fusion of two pyridine nuclei may result in several isomeric naphthyridines of which the 1:8-derivative has recently been synthesized.

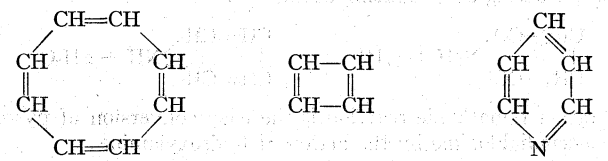


Naphthalene Quinoline Isoquinoline 1:8-Naphthyridine

The heterocyclic compounds are conveniently classified in two distinctive groups: (1) Unsaturated systems which often display a high degree of stability and constitute a well characterized class exhibiting a close relationship to benzenoid types—generally referred to as aromatic in character. (2) Systems resulting from ring closure of aliphatic (straight-chain) compounds to which in their deportment they display a close analogy and into which they are in general convertible by comparatively mild treatment, *e.g.*, by hydrolysis.

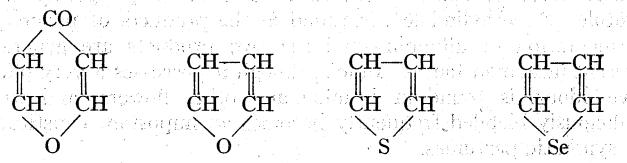
Unsaturated Heterocyclic Compounds.—Unsaturated heterocyclic compounds often exhibit the characteristics of aromatic types, *i.e.*, they usually possess a high degree of stability toward heat, some of them readily withstanding a dull red heat; they are difficult to oxidize, and when oxidation does take place it is generally attended by complete destruction of the ring; furthermore, the action of the halogens seldom results in addition compounds as final products (although these may be formed as intermediates), substitution of hydrogen occurring when reaction takes place at all; the action of nitric and sulphuric acids is characteristic and results in the production of nitro-compounds and sulphonic acids respectively; the action of anhydrous aluminium chloride and an acid-chloride (reaction of Friedel and Crafts) frequently results in the formation of ketones; finally, such compounds are as a rule not easy to reduce, and when reduction occurs the products behave like aliphatic compounds.

Aromatic properties have not been observed in three-, four-, seven-, or eight-membered rings but are restricted to five- and six-membered nuclei. Until the discovery of cyclo-octatetrene by Richard Willstätter, it was generally assumed that the presence of a series of alternate single and double bonds in a ring resulted in mutual saturation, with the consequent appearance of the aromatic properties. On this theory various formulae were ascribed to the benzene ring which were equally applicable to heterocyclic nuclei. Among the more recent developments the theory of the aromatic sextet of electrons has gained considerable favour. This theory does not attempt to account for the double bonds, but assumes that the union of two members of the ring requires only one pair of electrons, so that there is a pair of electrons unaccounted for by each conventional double bond, making in all three pairs or a sextet. It is admitted that the reasons for the stability of this system are not clearly understood, but nevertheless the view is a convenient one and generally applicable to the entire class of compounds which exhibit the aromatic characteristics. In cyclo-octatetrene the four double bonds contribute more than the required sextet of electrons and the substance behaves like an unsaturated aliphatic compound. The same is true of cyclobutadiene (except that there is a deficit of two



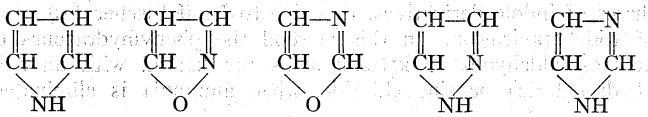
Cyclo-octatetrene Cyclobutadiene Pyridine

electrons here), whereas in pyridine the conditions for the aromatic sextet are fulfilled. The extension of this hypothesis to the γ-pyrones, furanes and thiophens follows, since the oxygen atom in the former is no longer neutral but acquires basic properties, with consequent ability to form stable salts and hence to supply the needed two electrons for the aromatic sextet.



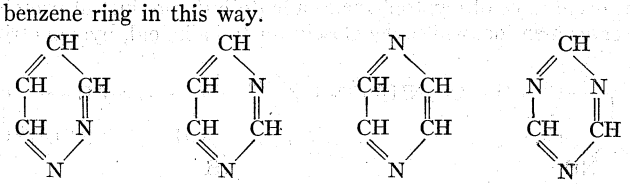
γ-Pyrone Furane Thiophen Selenophen

The application of the above-mentioned hypothesis to the pyrroles, isoxazoles, oxazoles, pyrazoles, glyoxalines, etc., follows readily when certain empirical rules are observed. It is only necessary (1) to attribute an electron pair to each double bond whether that be a C–C or a C–N union, and (2) to attribute an electron pair to any divalent element or group in the ring such as oxygen, sulphur, selenium, imino– (NH=), etc.



Pyrrole Isoxazole Oxazole Pyrazole Glyoxaline

To the six-membered nuclei the same rules are applicable. Six-membered heterocyclic compounds containing nitrogen may be considered as derived from benzene by substituting a nitrogen atom for a methine (≡CH) group. No chemical reactions are known, however, whereby a nitrogen atom can be introduced into a benzene ring in this way.

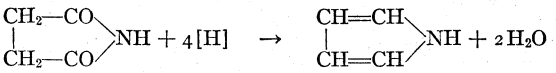


Pyridazine Pyrimidine Pyrazine Cyanidine

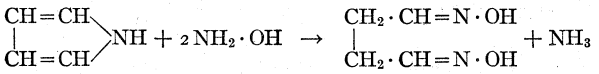
Properties of Unsaturated Heterocyclic Compounds.—The extent to which unsaturated heterocyclic compounds exhibit the properties of benzene and its derivatives varies considerably; thus naphthalene has lost, to some extent at least, the chemical properties of benzene, for example in being much easier to oxidize than the latter. Just as the introduction of substituents into benzene may so modify the chemical properties that the nucleus no longer responds to well-known reactions, so it is hardly to be expected that pyridine should nitrate in exactly the same way that benzene nitrates.

Five-membered Aromatic Nuclei (1).—Five-membered rings containing one hetero-atom naturally fall into two distinct groups: (i.) those containing nitrogen in the ring, and (ii.) those containing oxygen, sulphur or selenium. The members of the second group resemble each other very closely in the methods of their synthesis and in their chemical and physical properties.

Pyrrole and Its Derivatives.—Pyrrole does not occur as such in nature. It is a constituent of bone-oil and is obtained in large quantity, particularly in America, from the products of the destructive distillation of waste leather. Synthetically, it is obtainable (and this is true of its alkyl and aryl derivatives) by distilling succinimide (or substituted succinimides) with zinc dust, the latter acting as a reducing agent.

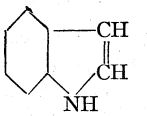


A rather remarkable reaction is the easy conversion of pyrrole into succindialdoxime by the action of hydroxylamine:

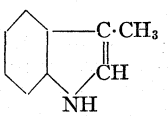


The imino-group is acidic, in that the hydrogen is readily replaceable by potassium with the formation of crystalline potassium pyrrole.

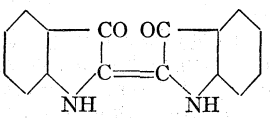
The compounds formed by the fusion of pyrrole with other nuclei occur to some extent in nature. Indole, together with skatole (β-methylindole), is found in the products of pancreatic fermentation of albumins and the two products are generally present in human faeces. Indole, though it possesses a very offensive odour, is found in jasmine and other flowers, and when judiciously blended frequently becomes an important constituent of synthetic perfumes.



Indole

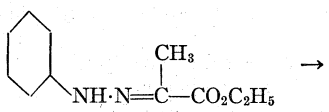


β-Methylindole

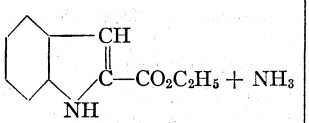


Indigotin

Indole was first obtained by distilling indigotin (the chief constituent of natural indigo) with zinc dust. Among other syntheses of indole derivatives, that due to Emil Fischer (1886) is of wide application. In this method the phenylhydrazones of ketones, aldehydes or ketonic acids are heated with an acid (hydrochloric) or zinc chloride, when ammonia is eliminated.

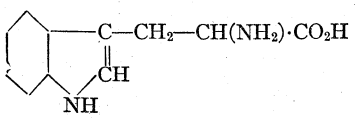


Ethyl pyruvate phenylhydrazone

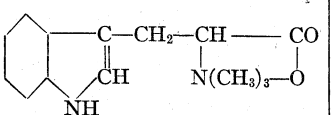


Ethyl indole-α-carboxylate

The occurrence of tryptophane as a hydrolytic product of proteins deserves mention, whilst the closely related alkaloid, hypaphotrine



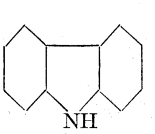
Tryptophane



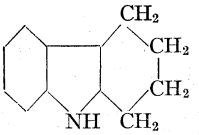
Hypaphotrine

(the betaine of *N*-trimethyltryptophane) occurs in *Erythrina hypaphorus*.

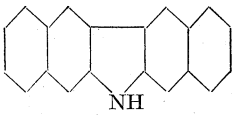
Of the more complex pyrrole derivatives, carbazole, which occurs in crude anthracene, deserves special mention, because it is the parent substance of a large number of closely related compounds (*e.g.*, dinaphthopyrrole) some of which have found application in the manufacture of dyes. An interesting variant of the



Carbazole

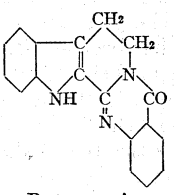


Tetrahydrocarbazole

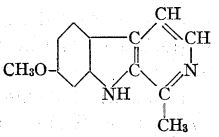


Dinaphthapyrrole

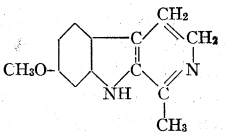
Fischer indole synthesis has been achieved by the use of cyclohexanone phenylhydrazone which yields tetrahydrocarbazole. The latter on mild oxidation with mercuric acetate forms carbazole. The natural alkaloids, rutaecarpine, harmine and harmaline belong to this class.



Rutaecarpine

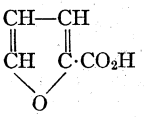


Harmine

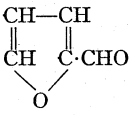


Harmaline

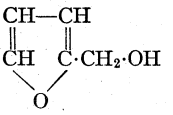
Furane and Its Derivatives.—Furane, the parent substance of this group, was first obtained in 1870 by distilling the barium salt of pyromucic acid. This reaction is analogous to the formation of benzene from benzoic acid. Pyromucic acid, like benzoic acid, may be brominated and nitrated.



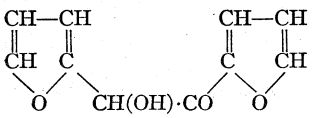
Pyromucic acid



Furfural

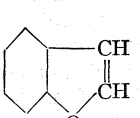


Furfuryl alcohol

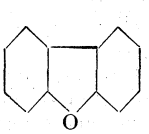


Furoin

Furfural, an important furane derivative both theoretically and commercially (being used in the manufacture of synthetic resins), is produced quantitatively when pentoses, like arabinose, are distilled with dilute acids. In its commercial manufacture, corn cobs, after the removal of grain, are distilled with dilute acid, and the aldehyde is found in the distillate. The methyl-pentoses (rhamnose, fucose, etc.) under similar treatment yield methyl furfural. Furfural manifests all the reactions of aromatic aldehydes (*e.g.*, benzaldehyde), and this behaviour follows necessarily from the aromatic nature of the furane ring. On treatment with caustic potash it yields pyromucic acid and furfuryl alcohol (Cannizzaro reaction) and on treatment in alcoholic solution with potassium cyanide it yields furoin (benzoin transformation). Coumarone and diphenylene oxide are representatives of condensed nuclei containing the furane ring.



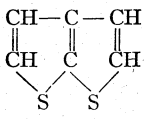
Coumarone

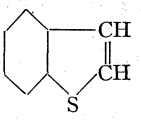


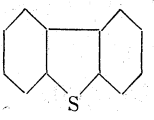
Diphenylene oxide

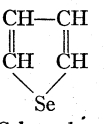
Thiophen and Its Derivatives.—Thiophen, a close analogue of furane, exhibits the greatest similarity to benzene. The four

hydrogen atoms are replaceable by other groups, thus yielding innumerable derivatives, all of which give an intense blue coloration—the indophenin reaction—when mixed with a little isatin and concentrated sulphuric acid. This reaction is given by all commercial samples of benzene, toluene, xylene, etc., and is due to small amounts of thiophen or the methylthiophens which are invariably present. Just as succinic acid (or its imide) may be transformed into pyrrole, so the distillation of a mixture of sodium succinate and phosphorus trisulphide yields considerable quantities of thiophen. Of the fused nuclei, thiophthen, benzothiophen and diphenylene sulphide may be mentioned. Selenophen, the selenium analogue of thiophen, is less well known, but has been definitely characterized by H. V. A. Briscoe and J. B. Peel (1928).

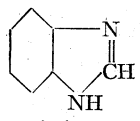

Thiophthen

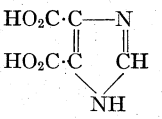

Benzothiophen

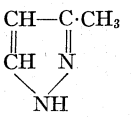

Diphenylene sulphide

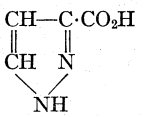

Selenophen

Five-membered Aromatic Nuclei (2).—There is a second series of five-membered heterocyclic compounds containing at least two hetero-atoms, which exhibit very marked aromatic properties. These compounds may be viewed as being derived from the foregoing five-membered heterocyclic compounds by the substitution of nitrogen atoms for methine (=CH) groups, and are collectively known as the azoles. Their names are derived from that of the parent monoheterocyclic nucleus and from the number of nitrogen atoms introduced. Thus furane and pyrrole each yield two isomeric azoles which are called furazoles and pyrazoles respectively. Substitution of two methine groups results in furo-diazoles and pyrro-diazoles. Similarly there are thiazoles, thio-diazoles, thio-triazoles, etc. In general, the azoles are somewhat resistant to oxidation, and when they are fused with the benzene ring it is often the latter which undergoes oxidation first. Thus, oxidation of benziminazole with potassium permanganate gives in part glyoxalinedicarboxylic acid. Further the *C*-alkyl derivatives (derivatives formed by replacing a hydrogen atom


Benziminazole

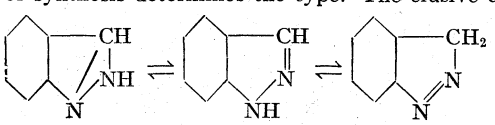

Glyoxaline-dicarboxylic acid

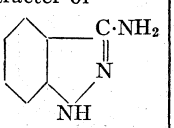

3-Methyl-pyrazole


Pyrazole-3-carboxylic acid

joined to carbon by an alkyl group) are frequently oxidized to carboxylic acids (3-methylpyrazole gives pyrazole-3-carboxylic acid). It frequently happens that the azoles are only known in the form of fused systems (generally with benzene) or in the form of reduced derivatives.

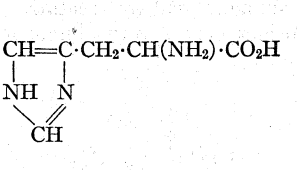
Pyrazoles.—The most convincing evidence of the aromatic nature of the pyrazole nucleus is the behaviour toward sulphuric and nitric acids, sulphonic acids and nitro-pyrazoles being formed respectively. The nitro-compounds are easily reduced to amino-pyrazoles which on treatment with nitrous acid yield remarkably stable diazonium salts. The latter resemble the benzenediazonium salts in their transformations, and may, for instance, be converted into azo dyes by treating them with anilines, phenols, etc. The fusion of a pyrazole and a benzene nucleus results in the so-called indazole. There is no single expression which serves to account for the various transformations of indazole, and at least three different formulae have been suggested at various times. It is convenient to assume that the different forms are mutually convertible into one another and that the environment or the mode of synthesis determines the type. The elusive character of

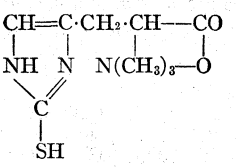

Indazole

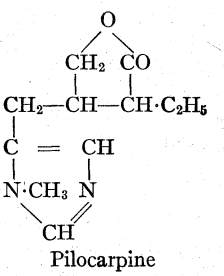

Amino-indazole

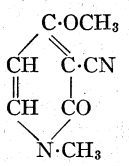
the double bond makes it all the more explicable that indazole is strongly aromatic in properties, and on the basis of the electron sextet theory there is every reason to believe that the hydrogen atoms are in a state of dynamic equilibrium, and the system only becomes fixed when the hydrogen atoms are replaced. The fact that amino-indazole forms a comparatively stable diazonium salt is in complete agreement with the aromatic nature of the nucleus.

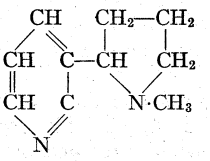
Glyoxalines.—Glyoxaline was discovered by Debus in 1856 as a reaction product of ammonia and glyoxal. Since then a large number of derivatives has been prepared and the chemistry of the entire class has been exhaustively studied by F. L. Pyman and his collaborators. The derivatives of glyoxaline which have been found in nature are perhaps limited to histidine, a product of the hydrolytic fission of many proteins; ergothioneine, found in ergot and blood; and a series of alkaloids (*e.g.*, pilocarpine) which occur in various species of *Pilocarpus*. The alkaloids are closely related to one another and differ only as regards the nature of the second ring.


Histidine


Ergothioneine


Pilocarpine

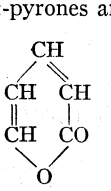

Ricinine

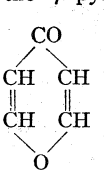

Nicotine

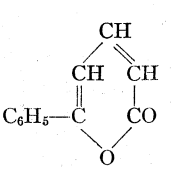
Six-membered Heterocyclic Compounds (1).—The members of this class which contain only one hetero-atom are by far the most important, and of these the nitrogen derivatives deserve special mention. The latter are, for the sake of convenience, divided into (1) derivatives of pyridine, and (2) fused systems containing the pyridine nucleus.

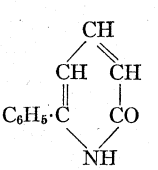
The Pyridines.—Pyridine was discovered in 1851, and together with its homologues it occurs in bone-oil and coal-tar. Its properties and those of its derivatives are described in a special article (*see* PYRIDINE). The occurrence of pyridine derivatives, which do not contain other systems fused with the pyridine nucleus, is restricted to a relatively small number. Ricinine, occurring in the seeds of the castor-oil plant (*Ricinus communis*) is a derivative of α-pyridone; its constitution has been ascertained by its synthesis by Späth and Koller (1923). Another important pyridine derivative is nicotine (*see* ALKALOIDS).

The Pyrones.—The pyrones are six-membered cyclic compounds containing an oxygen atom in the ring, together with a carbonyl (=CO) group. There are two forms theoretically possible, the α-pyrones and the γ-pyrones.


α-Pyrone

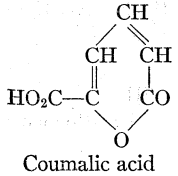

γ-Pyrone

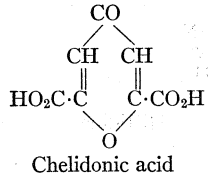

Phenylcoumalin

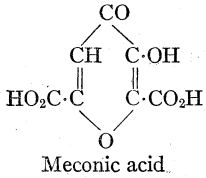

α-Phenylpyridone

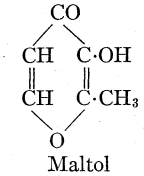
In general, the pyrones have lost their aromatic characteristics to some extent, but are conveniently classified in this section. They are weak bases and the salts are readily hydrolysed by water. Though the pyrones contain a ketonic group, they do not react with the reagents (hydroxylamine, phenylhydrazine, etc.) which are used to characterize ketones and aldehydes. The halogens do not add themselves to the double bond but form substitution products. The action of ammonia, especially on pyronecarboxylic acids is noteworthy, for the oxygen atom is in many cases easily substituted with the formation of pyridones. In this way phenylcoumalin (present in coto bark) even with ammonium acetate gives α-phenylpyridone. This reaction throws some light on to the mechanism by which plants may arrive at a synthesis of cyclic nitrogen compounds. The pyrones are easily formed from certain aliphatic compounds which might occur in nature as intermediates, and the subsequent transformation of the pyrones into pyridine and fused pyridine derivatives is entirely within the bounds of possibility.

Malic acid is converted into coumalic acid by treatment with strong sulphuric acid and the former occurs very abundantly in


Coumalic acid


Chelidonic acid

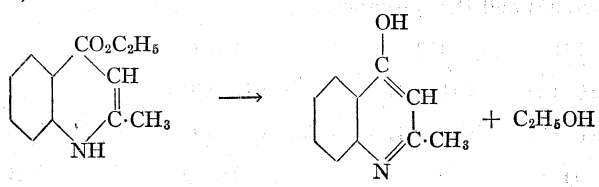

Meconic acid


Maltol

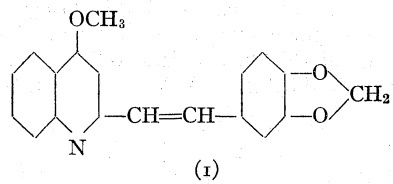
nature. Malic acid has furthermore been found associated with chelidonic acid in a large variety of plants and in particular in *Chelidonium majus* (Stransky, *Arch. Pharm.*, 1920, 258, 56). Finally, the easy conversion of $HO_2C{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}CO_2H$, acetone-dioxalic acid, into chelidonic by loss of water, makes it not improbable that a similar reaction takes place in plants.

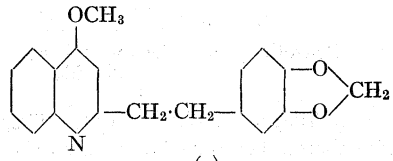
A series of alkaloids accompanies chelidonic acid in many plants and the presence of meconic acid in company with the opium alkaloids (*see* ALKALOIDS) is particularly significant. Ammonia and perhaps other bases are admittedly present in all plants at some stages of growth, and this, together with the pyrones, which are particularly abundant in some plants that elaborate alkaloids, may supply the needed starting products for the vital synthesis of pyridine bases. α-methyl-β-hydroxy-γ-pyrone (or maltol) occurs in the needles of pines and the bark of larches, and is also formed on roasting malt.

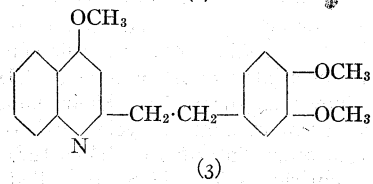
Six-membered Heterocyclic Compounds (2): **Fused Nuclei.**—The fused ring systems containing a heterocyclic nucleus are particularly abundant in nature. They are in many cases more readily accessible by synthetic means than those containing only one ring. This is accounted for by the fact that they are largely derived from ortho-disubstituted benzenes. The latter are available by a great diversity of methods. In many instances, too, it is possible to bring about a ring closure (in the ortho-position) of a benzene derivative having a suitable side chain. For example, aniline reacts with ethyl acetoacetate, $CH_3{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}C_2H_5$, forming first ethyl β-anilino-crotonate (1) which on treatment with sulphuric acid gives α-methyl-γ-hydroxyquinoline (2) and alcohol, thus:


(1) (2)

Quinoline and Its Derivatives.—Quinoline occurs in bone-oil and coal-tar and results when any of a large number of alkaloids is distilled alone or with zinc dust. Its synthesis and properties, together with those of its simple derivatives, are described in the article QUINOLINE. In their synthesis of cusparine, Späth and Brunner (1924) condensed γ-methoxyquinaldine with piperonal, and the resulting piperonylidene derivative (1) was reduced catalytically with hydrogen in the presence of palladium yielding a product identical with cusparine (2), obtained from the natural

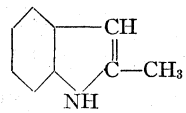

(1)

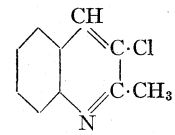

(2)

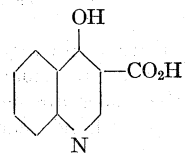

(3)

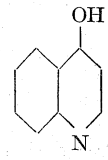
source (the bark of *Galipea cusparia*). The alkaloid galipine (3), which accompanies cusparine in *Galipea cusparia*, was synthesized by a similar series of reactions, except that veratraldehyde was substituted for piperonal in the condensation.

An interesting synthesis of β-chloroquinaldine is achieved by treating a mixture of α-methylindole with chloroform and sodium ethylate.

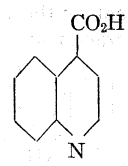

α-Methylindole

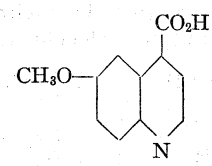

β-Chloroquinaldine

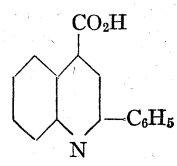

Kynurenic acid


Kynurine

This reaction is applicable to pyrroles and indoles in general and results in pyridines and quinolines respectively. When methylene iodide is used instead of chloroform in this reaction the products are pyridines and quinolines free from halogen. Kynurenic acid is of importance because of its occurrence in the urine of dogs after the ingestion of meat. It is also formed in the transposition of tryptophane and has been prepared synthetically. When it is heated, it loses carbon dioxide and is converted into kynurine or γ-hydroxy-quinoline. Cinchoninic and quininic acids are mentioned because of their relation to cinchonine and quinine respectively.

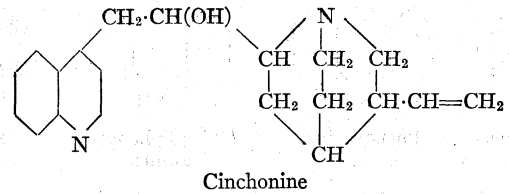

Cinchoninic acid


Quininic acid

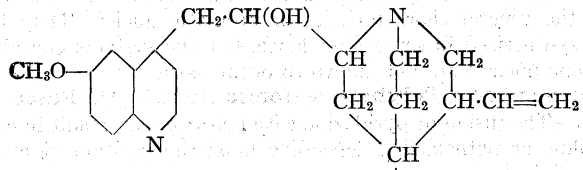

Atophane

Among the synthetic quinoline derivatives, α-phenyl-cinchoninic acid deserves mention on account of its general use as an antineuralgic and as a remedy for gout. It is known in commerce under the name of atophane, and has been specially recommended in the form of its hydriodide. A large number of derivatives of atophane have been prepared with a view to improving its value as a drug. The chemistry of the alkaloids of Cinchona forms one of the most inspiring chapters of historical chemistry. It was in 1792 that Fourcroy first isolated quinine in an impure condition. In 1810, Dr. Gomes, a Spanish physician, obtained a crystalline substance which he called "Cinchonino" from cinchona bark. The basic properties of this material were brought to the notice of Pelletier and Caventou, who, inspired by the recent observation of Sertürner on the existence of "organic alkalies" in nature, undertook an investigation of "cinchonino" and succeeded in isolating two substances which they named quinine and cinchonine. Later, they isolated strychnine and brucine from the seeds of *nux vomica*. The chemistry of strychnine has formed the subject of almost incessant research since its discovery. Over 100 years have elapsed and although it contains only 21 carbon atoms in the molecule, its constitution is still in doubt, although some evidence points to the existence of a partly reduced quinoline nucleus.

More than 20 alkaloids have been isolated from the various species of cinchona and *Remijia* (natural order, *Rubiaceae*) but only cinchonine and especially quinine have found an extensive application in medicine. The antipyretic properties of cinchona bark have been suspected in Europe since 1639, but the drug did not come into general use until nearly thirty years later. Although neither cinchonine nor quinine has been synthesized, the painstaking work of Hesse, of Rabe, of Königs and their collaborators has left no room for doubt regarding the constitution of either base, together with that of a large number of associated alkaloids.

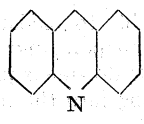


Cinchonine

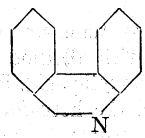


Quinine

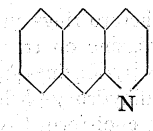
Large numbers of more complex quinolines have also been prepared. These are of the nature of fused systems containing quinoline condensed with benzene and pyridine nuclei. Acridine, phenanthridine and anthrapyridine represent quinolines fused with a benzene nucleus.



Acridine



Phenanthridine

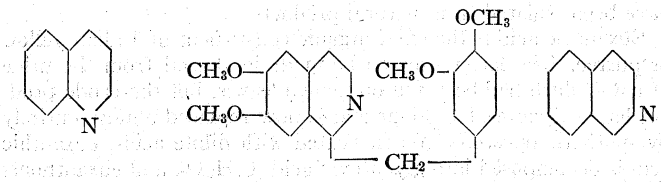


Anthrapyridine

The melting-points of the condensed systems gradually rise as more nuclei are added. There appears to be no upper limit to the number of nuclei that can be condensed into one system. The products, however, become more difficult to work with on account of their sparing solubility and high melting-points.

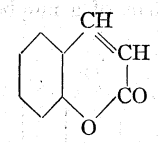
Isoquinoline and Its Derivatives.—Structurally, isoquinoline differs from quinoline in the position that the nitrogen atom takes up in the hetero-ring. In the former the nitrogen member is separated from the benzene nucleus by a methine group: the difference is shown by their formulae:

Isoquinoline occurs to some extent in coal-tar, and is produced in the destructive distillation of certain alkaloids. Its properties are described in the article QUINOLINE. The occurrence of isoquinoline derivatives in nature is restricted (except in one well-defined case—that of papaverine) to systems containing the pyridine ring partly or wholly reduced. The alkaloids of *Anhalonium, Hydrastis, Berberis, Corydalis, Chelidonium,* opium, etc., belong in this group. They exist in a wide variety of types and special works must be consulted for details (*see* ALKALOIDS).

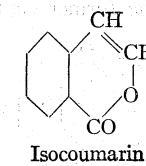


Quinoline Papaverine Isoquinoline

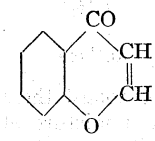
The Benzopyrones.—Three benzopyrones are known: α-benzopyrone or coumarin, iso-α-benzopyrone or isocoumarin, and γ-benzopyrone or chromone. They may be considered as representing the simplest fused systems derived from a benzene nucleus



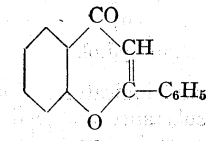
Coumarin



Isocoumarin

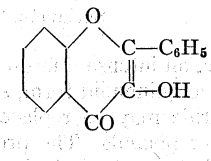


Chromone

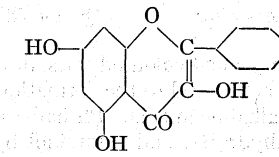


Flavone

and an α- or a γ-pyrone nucleus. Like the simple pyrones, they react readily with ammonia (especially the isocoumarins). The remarks relative to the synthesis of cyclic bases from pyrones, made when considering the latter, apply with equal consequences here. It is not at all uncommon to find benzopyrones and alkaloids in the same plant. The delphiniums contain alkaloids in abundance, and kaempferol and related flavonols have been isolated from a number of them. Many flavonols are dealt with in the article ANTHOCYANINS.

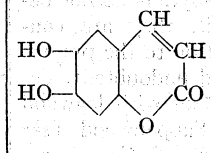


Flavonol

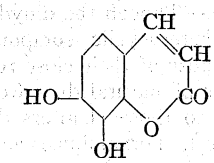


Kaempferol

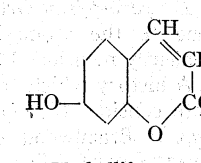
The two glucosides, aesculin and daphnin, on mild hydrolysis yield glucose together with aesculetin and daphnetin respectively.



Aesculetin



Daphnetin

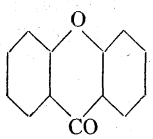


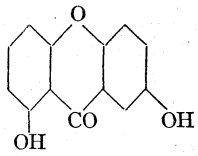
Umbelliferone

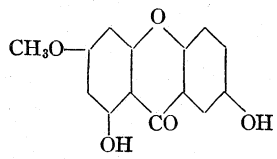
Umbelliferone occurs in the bark of *Daphne mezereum* and is obtained by distilling different resins, such as galbanum and asafoetida. No derivative of isocoumarin has been isolated from natural products.

The Dibenzo-γ-pyrones.—The simplest dibenzo-γ-pyrone, xanthone, is obtained synthetically by a number of methods. The

majority of naturally occurring yellow colouring matters are derived from the latter or from flavone, although xanthone has not


Xanthone

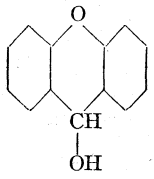

Euxanthone

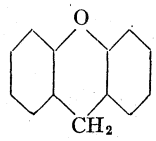

Gentisin

been found in plants. Only two members of the xanthone group have been isolated from natural products.

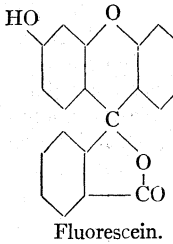
Euxanthic acid is the chief organic constituent of Indian yellow or purree. The latter used to be made in Bengal from the urine of cows which had been fed on mango leaves, but the crude product had a disagreeable odour and is now replaced almost entirely by synthetic dyestuffs. When heated with dilute acids, euxanthic acid is decomposed into glycuronic acid, $C_6H_{10}O_7$, and euxanthone. It is interesting to note that when euxanthone is administered to dogs and to rabbits it is eliminated in the urine in the form of its combination with glucuronic acid, that is as euxanthic acid. Gentisin, the colouring matter of gentian root, is a methoxy-euxanthone.

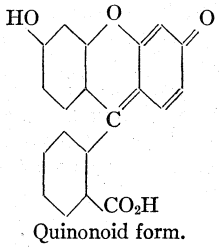
Reduction of xanthone converts it by stages into xanthydrol and xanthene. The former contains the nucleus of a number of syn-

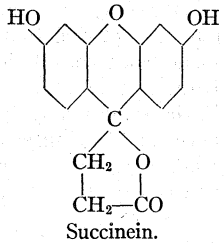

Xanthydrol.


Xanthene.

thetic dyes and indicators. Conspicuous amongst these is fluorescein, the substance obtained by heating a mixture of phthalic anhydride, resorcinol and zinc chloride. Fluorescein and allied products are characterized by the fact that on treatment with


Fluorescein.

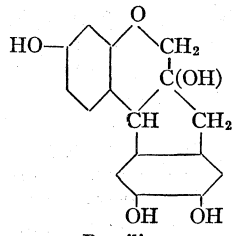

Quinonoid form.

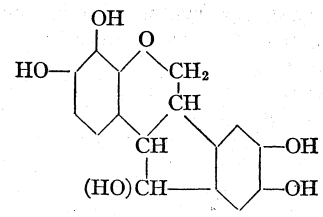

Succinein.

alkalis they yield coloured salts, displaying an intense fluorescence, which is attributed to the formation of the quinonoid form, stable only in alkaline media. Phthalic anhydride may be replaced by other anhydrides, and resorcinol by other phenols. The product from succinic anhydride and resorcinol is termed succinein. The latter, and particularly the phenyl-succineins, also display a series of colour changes, together with a fluorescence, dependent on the alkalinity of the medium.

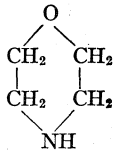
Dihydro-pyran Group.—Though the dihydro-pyrans do not belong to the aromatic heterocyclic compounds, they are conveniently mentioned because of their close relation to the pyrans.

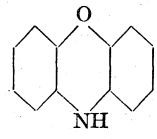
A history which treats of natural dyes would undoubtedly devote considerable space to those chapters dealing with logwood (*q.v.*), Brazilwood (*q.v.*), Pernambuco and Sappanwood (*see* BRAZILWOOD). The Brazilwood is the product of *Caesalpinia braziliensis*. The use of logwood dyes, the product of *Caesalpinia echinata*, was prohibited in England by act of parliament in the reign of Queen Elizabeth, because it was said to produce fugitive colours. The names of W. H. Perkin, Jr., and R. Robinson are intimately associated with the chemistry of Brazilwood and logwood, which contain respectively brazilin ($C_{16}H_{14}O_5$) and haematoxylin ($C_{16}H_{14}O_6$).

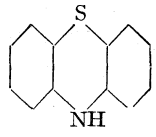

Brazilin.

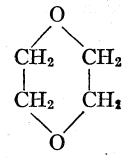

Haematoxylin.

Six-membered Polyhetero-atomic Nuclei (1).—The six-membered nuclei containing two or more hetero-atoms may be regarded as derived from the six-membered nuclei containing one hetero-atom by substituting one or more methine (≡CH) groups by nitrogen atoms. No strictly aromatic nuclei containing other atoms than nitrogen are known to occur, although theoretically ring systems containing quadrivalent oxygen are possible. These would be analogous to the pyrans, but are only known in the reduced form corresponding to the dihydro- and tetrahydro-pyrans. The entire group is known as azines and the members are termed diazines, oxazines and thiazines, according to whether they are derived from pyridine, by the replacement of a methine group by nitrogen, by oxygen or by sulphur, respectively. Only those members which contain nitrogen atoms in the ring are of much importance. A few of these occur in nature and some are used as dyes. It may be mentioned, however, that some complex and valuable dyes are derived from systems containing sulphur in the ring. Morpholine (so called because it was at one time thought that a similar ring was present in morphine), phenoxazin, thiodiphenylamine, and dioxane may be mentioned as examples of a class of substances which contain six-membered rings with only one or no nitrogen atom.


Morpholine.

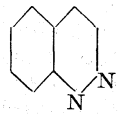

Phenoxazine.

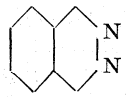

Thiodiphenyl-amine.

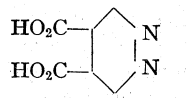

Dioxane.

Reference has already been made to the diazines in connection with the general characteristics of aromatic nuclei. They have been synthesized in some abundance, but the systems containing only one nucleus are not known to occur naturally.

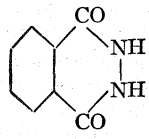
Six-membered Polyhetero-atomic Nuclei (2). **Fused Systems.**—The fusion of pyridazine with benzene may result in either cinnoline or phthalazine, depending upon the position of attachment of the benzene nucleus.

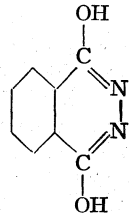

Cinnoline.


Phthalazine.


Pyridazine-4:5-dicar-boxylic acid.

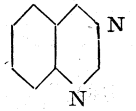
The hetero-rings in these systems are very stable to oxidation. Phthalazine on treatment with alkaline potassium permanganate yields pyridazine-4:5-dicarboxylic acid. Phthalylhydrazine is probably dihydroxy-phthalazine, the keto-form passing into the more stable enol-form (hydroxy-form):


Keto-form.

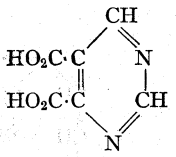

Enol-form.

Among the halogeno-cinnolines and phthalazines those containing the halogen attached to the hetero-nucleus display the same reactions that are characteristic of α-and γ-chloro-quinolines. The halogens are readily replaceable by hydroxyl, amino- and similar groups. The methyl groups in the methyl derivatives are characterized by the same reactivity that they show in quinaldine and lepidine.

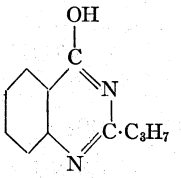
In the pyrimidine series there is only one benzo-derivative possible, namely, quinazoline. Oxidation converts it into pyrimidine-4:5-dicarboxylic acid by rupture of the benzene nucleus. The



Quinazoline.



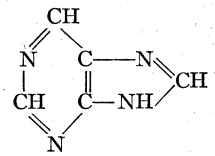
Pyrimidine-4:5-dicarboxylic acid.



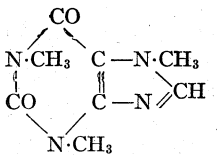
Vasicine.

extended labours of Marston T. Bogert have placed on record a truly formidable number of quinazolines. It is remarkable, however, that this list does not include either 2-*n*-propyl- or 2-isopropyl-4-hydroxyquinazoline, one of which is considered as representing the constitution of vasicine, an alkaloid obtained by Ghose (1927), from *Adhatoda vasica*. This is the only quinazoline derivative so far isolated from natural products.

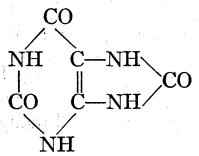
Attention may be directed to the natural occurrence of a group of reduced purine derivatives of which caffeine, which occurs in coffee and tea, represents a member. Purine (*q.v.*) is the name applied to the system formed by the fusion of a pyridazine and glyoxaline nucleus, and is of special interest because it is related to uric acid.



Purine

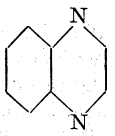


Caffeine

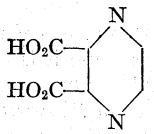


Uric acid

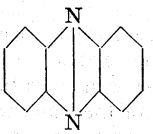
Quinoxaline is the only possible compound obtainable by fusion of a pyrazine and a benzene nucleus. Oxidation ruptures the ben-



Quinoxaline

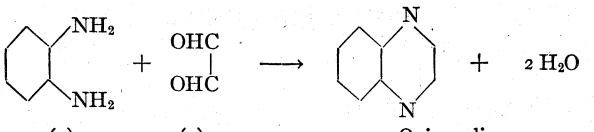


Pyrazine-α:β-dicarboxylic acid



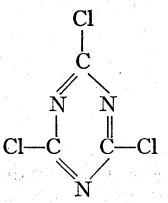
Phenazine

zene nucleus and yields pyrazine-α:β-dicarboxylic acid. Quinoxalines are particularly easy to synthesize from ortho-phenylene-diamines on the one hand and 1:2-diketonic compounds on the other. In many cases the reactions are complete even at low temperatures. The synthesis of quinoxaline from *o*-phenylene-diamine (1) and glyoxal (2) is represented as follows:



(1) (2) Quinoxaline

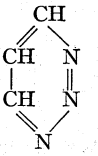
The more complex derivatives of pyrazine and particularly of phenazine form an extensive class of dyestuffs which are of some importance from the technical standpoint. These include, among others, the eurhodines, toluylene-red, the indulines, safranines, indazines, etc. (*see* DYES, SYNTHETIC). The indulines are among the longest known aniline dyestuffs, having been described in 1865 by Caro and Dale. Derivatives of the three theoretically possible triazines are known. Cyanuric chloride is probably trichloro-cyandine, while cyanuric acid is the corresponding hydroxy-deriva-



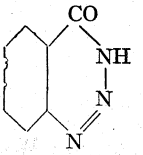
Cyanuric chloride



α-Triazine

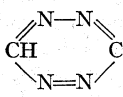


β-Triazine



Benzazimide

tive. Many cyanides polymerize (*see* POLYMERIZATION) to derivatives of cyanidines spontaneously or on treatment with sulphuric acid, etc. Some derivatives of α-triazine are known, but β-triazine is only known in the form of reduced benzo-derivatives, *e.g.*, benzazimide. Three tetrazines are theoretically possible, but only

symmetrical tetrazine, , is known. It is of interest

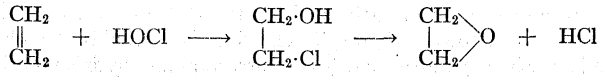
on account of its high content of nitrogen and because of its purple colour. It is quite stable and may be readily sublimed. Heterocyclic systems containing more than four nitrogen atoms are unknown.

Aliphatic Heterocyclic Compounds.—The aliphatic heterocyclic compounds are so closely related to the corresponding straight-chain members that they are conveniently divided into a number of classes, each class being derived from a corresponding type of aliphatic compound by the elimination of a molecule of water, ammonia, etc. On this basis the heterocyclic compounds are conveniently divided into the following groups: (1) cyclic ethers and thio-ethers of glycols and thio-glycols; (2) cyclic alkylene-amines resulting from diamino-paraffins by loss of ammonia or from chloro-amino-paraffins by loss of hydrogen chloride; (3) the lactones and lactides—internal ethers of hydroxy-acids (*see* ACIDS); (4) lactams and betaines (*q.v.*)—internal anhydrides of amino-acids; (5) cyclic derivatives of dicarboxylic acids (anhydrides, imides, hydrazides, alkylene-esters); (6) dihydro-pyrroles and tetrahydro-pyridines derived from amino-aldehydes and amino-ketones by loss of water. In many cases hydrolysis by means of acids and alkalis converts such cyclic compounds into the substances from which they are derived, but there are important exceptions.

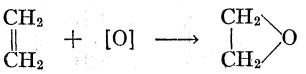
The ease with which heterocyclic compounds are formed varies largely with the number of atoms in the ring. In general three- and four-membered rings are difficult to prepare, and once prepared are easily ruptured. They often behave as unsaturated compounds with which they are isomeric. Compounds containing up to 16 atoms in the ring, including several hetero-atoms, have been reported, but in many cases considerable doubt exists as to the validity of the assigned formulae. It has been frequently observed that three, four, seven, eight and higher carbon rings are usually much more difficult to form than five- and six-membered rings. In order to offer an explanation for this fact A. von Baeyer was led to announce his celebrated "Strain Theory," which has been discussed in the *homocyclic* section, and which applies almost equally to heterocyclic compounds. Thus, in general, five-membered rings are the most stable, six-membered rings are nearly as stable, whilst seven- and four-membered rings are less so, and three-membered still less.

The Cyclic Ethers.—The ethylene oxides are the most important members of this class. Two methods of preparation, both depending upon olefines for their starting materials, are important. In one case hypochlorous acid is added to the double bond and

the resulting chlorohydrin is treated with alkali which removes hydrogen chloride:

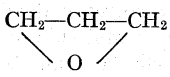


In the second method the olefine is treated with benzoyl peroxide, the function of which is to supply one oxygen atom:

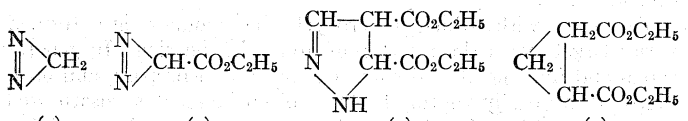


During the World War large quantities of ethylene chlorohydrin were used in the manufacture of mustard gas. It was then made by the combined action of moist chlorine on ethylene, the water and chlorine reacting potentially to give hypochlorous acid. On the cessation of hostilities, peace-time uses were sought for this product, and it was converted into ethylene oxide, which has found a number of technical applications, *e.g.*, as a solvent.

The ether linkage is easily ruptured by a great diversity of reagents. The hydrogen halides open the ring and the products are the halogenohydrins. Amines act similarly and the products are amino-ethanols, *e.g.*, with ammonia, α-aminoethanol, $H_2N{\cdot}CH_2{\cdot}CH_2{\cdot}OH$, is formed. Some amino-ethanols find extensive application in the synthesis of local anaesthetics.

The action of Grignard reagents on ethylene oxide is a particularly useful means of adding two carbon atoms to a chain. When *n*-butyl magnesium bromide, C_4H_9MgBr, is treated with ethylene oxide, an addition compound is first formed, which on gentle heating changes to a product which yields *n*-hexyl alcohol on decomposition with water. This reaction is applied commercially in the synthesis of β-phenylethyl alcohol, $C_6H_5{\cdot}CH_2{\cdot}CH_2{\cdot}OH$, which finds some application in perfumery. Trimethylene oxide, , displays to some extent the behaviour of ethylene oxide, but the higher ring homologues behave like the straight-chain ethers. Cineol, a constituent of eucalyptus oil, is a complex cyclic ether (*see* TERPENES).

Cyclic Imines.—The methods available for the synthesis of cyclic imines are, in general, the same as those for preparing secondary aliphatic amines. Those members of this group containing three and four atoms in the ring are difficult to prepare and not well known. A three-membered ring consisting of two nitrogen atoms and one carbon atom is present in diazomethane (1) and diazoacetic ester (2). Diazomethane is extremely poisonous but is of considerable use as a methylating agent in neutral media.

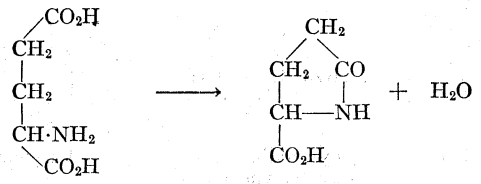


(1) (2) (3) (4)

Diazomethane and its derivatives have the remarkable property of adding themselves to olefine-carboxylic acids; with ethyl fumarate it yields ethyl pyrazolidine-4:5-dicarboxylate (3). The latter when heated loses nitrogen and passes into ethyl *cyclo*propane-1:2-dicarboxylate (4).

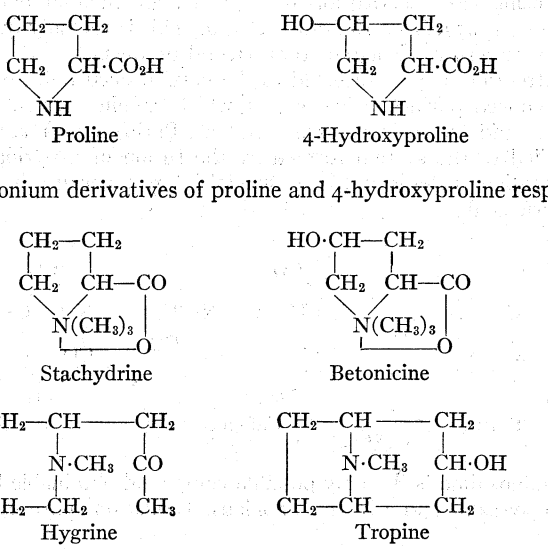
Closely related to the pyrazolines, which are dihydro-pyrazoles, are the pyrazolones, which comprise a group of drugs possessing antipyretic properties. The representative of this group which has found the greatest favour is antipyrine (*q.v.*). Many reduced systems corresponding to and derived from the aromatic nuclei already discussed are known. Except for the five- and six-membered rings containing only one nitrogen atom they are relatively unimportant.

The Pyrrolidines.—The importance of the systems represented by a ring of one nitrogen and four carbon atoms can scarcely be appreciated. This system is present in haemoglobin, chlorophyll (*q.v.*) and haemocyanin, and all evidence points to the existence of a close relationship between these natural products. The chemist has, as it were, supplied proof of the kinship of plant and animal life. The present chemical evidence goes to show that the rings are present in their unsaturated state and therefore these vital products must be classified with the pyrroles. The existence of pyrrolidine derivatives in nature is not confined to a few representatives. It is possible that some proteins may contain a pyrrolidone system, because the glutamic acid formed in their hydrolysis easily passes into pyrrolidonecarboxylic acid.



Glutamic acid — Pyrrolidonecarboxylic acid

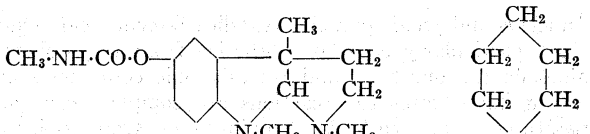
Proline and 4-hydroxyproline are products of the hydrolysis of proteins. Stachydrine (found in *Stachys tuberifera*) and betonicine (found in *Betonica officinalis*) are the betaines of the dimethylammonium derivatives of proline and 4-hydroxyproline respectively. Hygrine, together with a group of related alkaloids, occurs in some varieties of coca leaves, and it is isomeric with tropine, as may be seen from the formulae. Physostigmine, the principal alkaloid of the Calabar bean (from *Physostigma venenosum*) is the only representative, either synthetic or natural, of a compound containing two pyrrolidine rings and a benzene nucleus.



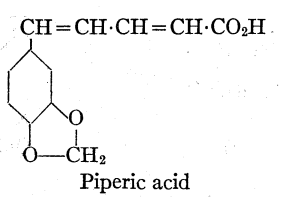
Proline — 4-Hydroxyproline

Stachydrine — Betonicine

Hygrine — Tropine



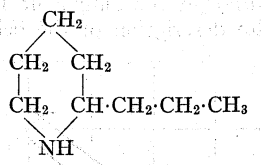
Physostigmine — Piperidine

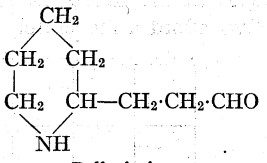


Piperic acid

The Piperidines.—Nature appears to have a special predisposition for the elaboration of piperidines, which are to be re-

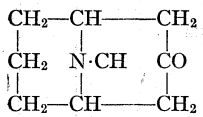
garded as reduced pyridines. Piperine (*q.v.*), the chief constituent of pepper, yields piperidine and piperic acid on heating with alkalis. Conversely, piperic acid chloride on treatment with piperidine yields piperine, showing that the latter is the piperidide of piperic acid. Considerable interest attaches to the chemistry

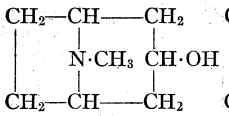

Coniine

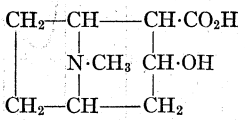

Pelletierine

of coniine, a constituent of common hemlock (*Conium maculatum*) and the first alkaloid to be synthesized. The toxic properties of hemlock juice were recognized by the ancient Greeks, for it is recorded that Socrates was compelled to take an extract of hemlock in order to pay the supreme penalty exacted by the State.

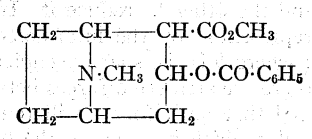
The root bark of pomegranate, *Punica granatum,* contains a mixture of alkaloids from which five individuals have been isolated. Pelletierine and three others are closely related to coniine. The fifth alkaloid, pseudo-pelletierine, is the best known of the group, and is closely related to the tropine alkaloids,

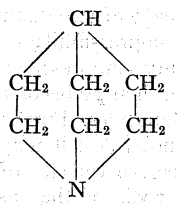

Pseudopelletierine


Tropine


Ecgonine

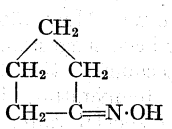
which include cocaine, tropococaine, benzoyl-ecgonine, etc. This group of alkaloids is characterized by the fact that hydrolysis by alkali resolves them into two parts, one an acid and the other a hydroxyamino-compound. Atropic acid, $C_6H_5{\cdot}CH(CH_2{\cdot}OH){\cdot}CO_2H$ (from hyoscyamine), benzoic acid and cinnamic acid are among the acid constituents. The basic groups are somewhat restricted to tropine and ecgonine, but others of less frequent occurrence are known. The alkaloids can be regenerated from their hydrolytic products and are therefore to be regarded as esters of the acid in combination with the secondary hydroxyl group. Frequently the carboxyl group is esterified; thus cocaine is methyl benzoyl-ecgonine.

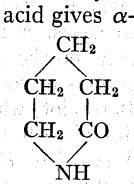

Cocaine


Quinuclidine

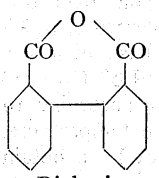
Closely related to piperidine is quinuclidine, which represents an unusual type of organic architecture present in the cinchona alkaloids. The synthesis of quinuclidine, which involved a considerable number of stages, must be regarded as a noteworthy achievement. The alkaloid, sparteine, occurring in *Cytisus scoparius,* is generally regarded as containing either one or two quinuclidine groups (*see* ALKALOIDS).

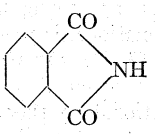
Lactams.—The lactams are cyclic amides of amino-acids, and are present in abundance in protein molecules. The synthesis of lactams from the oximes of cyclic ketones is interesting, and is a special case of the Beckmann transformation. Cyclopentanone-oxime on treatment with strong sulphuric acid gives α-piperidone.

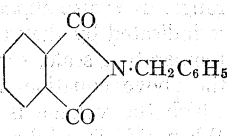

Cyclopentanone-oxime


α-Piperidone

Anhydrides and Imides.—Anhydrides of dibasic acids are readily formed when they contain either five or six atoms in the ring. A few seven-membered cyclic anhydrides are known and among these that of diphenic acid may be mentioned.

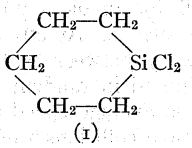

Diphenic anhydride

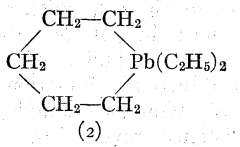

Phthalimide


Benzylphthalimide

The most important member of the cyclic imides is phthalimide, obtained by heating phthalic anhydride and ammonia. It forms a potassium derivative, which when heated with alkyl halides forms potassium halide and an alkyl-phthalimide, which on hydrolysis with acids yields phthalic acid and the corresponding alkylamine. This reaction is applicable to an infinite variety of alkyl halides and is due to the extended researches of Gabriel and his co-workers. The hydrolysis with acids is, however, difficult in some cases, and a recent communication has overcome this obstacle by the ingenious use of hydrazine hydrate, which, with an alkylphthalimide, yields the free amine and phthalylhydrazide. For example, benzylamine, $C_6H_5{\cdot}CH_2{\cdot}NH_2$, is readily formed by treating benzylphthalimide with hydrazine hydrate. Benzylphthalimide is obtained by heating potassium phthalimide with benzyl chloride, $C_6H_5{\cdot}CH_2Cl$.

A number of heterocyclic compounds containing phosphorus, arsenic, antimony, bismuth, silicon, lead, mercury and tellurium in the ring have been prepared. They are frequently derived from the Grignard compounds of 1:4-dibromobutane or 1:5-dibromopentane. The latter on treatment with silicon tetrachloride or with the compound, $PbCl_2(C_2H_5)_2$, yields the two products (1) and (2) respectively.


(1)


(2)

BIBLIOGRAPHY.—A. G. Perkin and A. E. Everest, *Natural Organic Colouring Matters* (1918); J. T. Hewitt, *Synthetic Colouring Matters* (1922); F. D'Albe, "Heterocyclic Compounds," Richter's *Organic Chemistry* (1923); T. A. Henry, *The Plant Alkaloids* (1924); C. Hollins, *Synthesis of Nitrogen Ring Compounds* (1924).

(R. H. F. M.)

PHYSICAL CHEMISTRY

Physical chemistry is concerned with the dependence of physical properties on the chemical nature of the different forms of matter and the changes which these undergo. In the description of these relations, a convenient basis of subdivision is afforded by the three states of aggregation—gaseous, liquid and solid.

THE GASEOUS STATE

General Characteristics.—Matter in the gaseous state is distinguished by its tendency to occupy all the space at its disposal. This tendency may be counteracted by external forces, and the fact that the earth's gaseous atmosphere is confined within definite limits is to be attributed to the circumstance that the gaseous molecules are under the influence of gravitational force. Gases are particularly susceptible to changes of pressure and of temperature.

In 1662 Robert Boyle showed that the volume occupied by a gas varies inversely as the pressure when the temperature is constant. When kept at constant pressure, a gas expands when heated and the expansion or relative change in volume was found by Joseph Louis Gay-Lussac and John Dalton (1802) to be proportional to the rise in temperature. If v and v_0 are the volumes occupied at $t°$ C and 0° C, the relation between the volumes is given by $(v-v_0)/v_0=\alpha t$ in which α, the coefficient of expan-

sion, represents the expansion which takes place when the temperature is raised from 0° C to 1° C. The value of α is about $1/273$, and we may therefore write the previous equation in the form $v/v_0=(273+t)/273$. At $t=-273°$ C the volume of the gas will become zero provided that the relation is valid over this range. It is also apparent that if this singular temperature, which is indicated by the volume relations, is made the basis of a new temperature scale, such that $(t+273)°$ C$=T°$ and 0° C$=273°$ the above equation may be written $v/v_0=T/273$ according to which the volume is proportional to the absolute temperature. When this is combined with $pv=p_0v_0$ (Boyle's law) we obtain $pv/p_0v_0=T/273$ or $pv/T=p_0v_0/273=R$, where R is a constant. This relation is independent of the nature of the gas, and if the volume v refers to the molecular quantity, *i.e.*, the quantity represented by the molecular weight, the value of R is found to be the same for all gases. It is known as the gas constant.

Experiments made by Gay-Lussac (1808) showed further that the volumes of reacting gases and of their gaseous products can be expressed by simple numerical ratios. The interpretation of these simple volume ratios and of the identical behaviour of gases towards pressure and temperature is greatly facilitated by the hypothesis of Amedeo Avogadro (1811), according to which equal volumes of different gases at the same temperature and pressure contain the same number of elementary particles or molecules. The inability of chemists to distinguish between atoms and molecules was mainly responsible for the lukewarm reception which was accorded to this hypothesis, and its fundamental importance was not recognized until a clear distinction between these entities was made by S. Cannizzaro in 1858.

Kinetic Theory.—The behaviour of gases, which is summarized in the equation $pv=RT$, finds a simple interpretation in terms of the kinetic theory (*q.v.*). According to this, a gas is supposed to consist of a very large number of small particles which are moving about in all directions with high speeds. The paths of these particles are rectilinear until their direction of motion is changed by collision either with other particles or with the walls of the containing vessel. Collision involves no loss of energy since the particles are perfectly elastic. At any instant, the velocities of individual molecules vary between wide limits and the directions of motion are distributed in random fashion. At a given temperature and pressure, the average speed and the mean distance traversed between successive collisions varies with the nature of the gas. For oxygen, the mean free path at 0° and 760mm. is $1{\cdot}0\times10^{-5}$cm. and the average velocity is 461 metres per second.

Denoting the mass of the molecule by m and the mean value of the square of the velocity by u^2, the average kinetic energy of the molecules is $\frac{1}{2}mu^2$, which is a measure of the temperature. On the assumption that the pressure of a gas is measured by the impact of the molecules on the walls of the containing vessel, it may be shown that the pressure is given by $p=mnu^2/3v$, where n is the number of molecules in volume v. Since the temperature is measured by the kinetic energy, it follows at once that the product pv is directly proportional to the absolute temperature as expressed by the equation $pv=RT$ and has a constant value when the temperature is fixed, as required by Boyle's law. If for two different gases, the pressures, volumes and temperatures are the same, and the numbers, masses and mean square velocities are represented n_1, m_1, u_1^2 and n_2, m_2, u_2^2 respectively, then

$$pv=\tfrac{1}{3}n_1m_1u_1^2=\tfrac{1}{3}n_2m_2u_2^2$$

and

$$\tfrac{1}{2}m_1u_1^2=\tfrac{1}{2}m_2u_2^2$$

from which $n_1=n_2$, as required by the Avogadro hypothesis. Since the mean square velocity is given by $u^2/=3pv/mn$, and the density of the gas by $d=mn/v$, we may write $u=\sqrt{3p/d}$, according to which the average molecular velocities for different gases at the same temperature and pressure are inversely proportional to the square roots of the respective densities. For molecules of the same size the rates of diffusion should be proportional to the velocities, and the above result is accordingly in agreement with the results obtained by Thomas Graham (1832) in his experiments on gaseous diffusion. Ocular evidence of the molecular movement postulated in the kinetic theory is afforded by the Brownian movement of microscopic particles suspended in a fluid medium. Such particles must have the same kinetic energy as the surrounding molecules and their visible motion is attributable to the unbalanced effects of molecular bombardment.

Gases at Higher Pressures.—Although the simple or ideal gas laws afford a moderately accurate description of the behaviour of gases at low pressures, there are large discrepancies at higher pressures. The classical experiments of Amagat show that the product pv diminishes at first as the pressure increases, passes through a minimum value and then increases at a constant rate. The general behaviour is shown by the isothermal $pv-p$ curves for ethylene in fig 1. The nature of these curves suggests the incidence of two disturbing factors, one of which tends to increase the compressibility of the gas and the other to reduce it. If the actually compressible space is represented by the intermolecular space, then pv becomes $p(v-b)$ where b is the space occupied by the molecules. Furthermore, if there are attractive forces between the molecules, it may be expected that such forces will tend to reduce the velocity of the molecules which impinge on the boundary walls of the gaseous molecules, for the latter in their approach to the boundary will be subjected to a restraining force. The measured pressure, which is the equivalent of the actual impacts, should therefore be smaller than the intrinsic pressure, that is to say, the pressure which corresponds with the average velocity of the whole of the molecules in the gaseous system. To obtain the intrinsic pressure, the manometric pressure must therefore be increased by a term which takes account of the attractive force. According to Johannes Diderik van der Waals, this correction is proportional to the square of the pressure, or more precisely, inversely proportional to the square of the volume, and when the two correction factors are introduced, the equation $pv=RT$ becomes $(p+a/v^2)(v-b)=RT$, which is the van der Waals' equation. This affords an account of the actual behaviour of gases, as illustrated by the diagram. The constants a and b depend on the nature of the gas. Many alternative forms of such equations of condition have been suggested. The equation of Daniel Berthelot, which takes account of the variation of the attractive force with that of the temperature, is of the type $(p+a/v^2T)\ (v-b)=RT$ and is of special value in the investigation of problems connected with gases at low pressures. By its use, it is possible to determine with great accuracy the

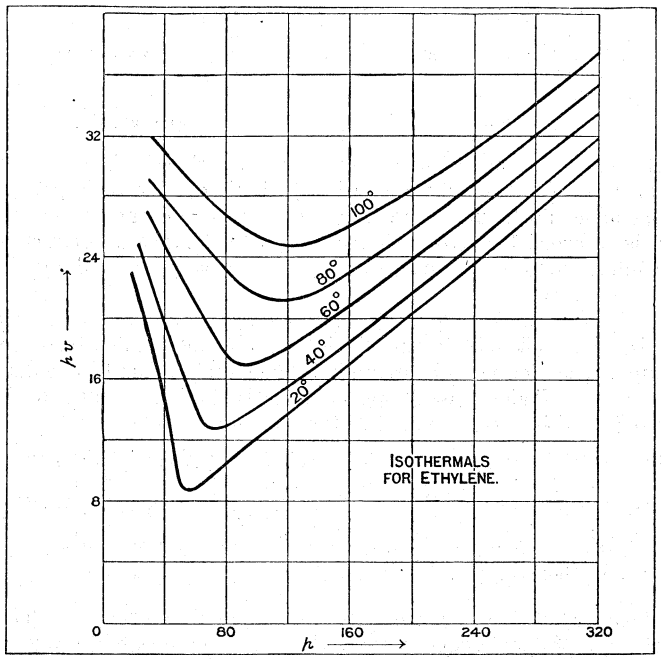


FIG. 1.—DIAGRAM OF CURVES SHOWING THE BEHAVIOUR OF ETHYLENE GAS

Product p.v., where p=pressure and v=volume, of any gas diminishes first as p increases, passes through a minimum value, and increases at a constant rate

molecular volume and the coefficient of expansion of an ideal gas and from these to derive the values of the gas constant R and of the absolute zero of temperature on the gas thermometric scale.

If a perfect gas were allowed to expand without performing external work, there would be neither loss nor gain of heat and the temperature would remain constant. In other words, the internal energy of a perfect gas is independent of the volume which it occupies. When, however, the molecules attract one another, the expansion entails the performance of work against these forces; the internal energy of the gas diminishes and its temperature falls. In the absence of attractive forces, the finite volume occupied by the actual molecules will still have a small influence and it may be shown that this factor will produce a rise of temperature. The combined action of these two factors produces what is known as the Joule–Thomson effect. At ordinary temperatures, most gases are cooled, but hydrogen is heated. From this it may be inferred that the attractive forces between the hydrogen molecules are very small. At lower temperatures the attractive forces increase, and the cooling effect is also obtained with hydrogen when the temperature falls below −80° C. Other gases show a similar inversion, but the inversion temperatures are well above the ordinary temperatures. The Joule–Thomson effect finds practical application in the liquefaction of gases (*q.v.*) by the Hampson and Linde methods.

Heat Capacity of Gases.—The heat required to raise the temperature of a gas varies with the conditions. The molecular heat at constant pressure, C_p, is greater than that at constant volume, C_v, the difference being represented by the external work which has to be done when the volume increases. For a gas defined by $pv=RT$, the expansion per degree is v/T, and the work $pv/T=R$. In heat units, this is approximately 2 cals., and therefore $C_p-C_v=2$. Per gram-molecule the kinetic energy of the gas is $E=\frac{1}{2}Nmu^2$, where N is the Avogadro number, and the increment of kinetic energy for one degree rise in temperature is $E/T=Nmu^2/2T=3pv/2T=3R/2=3{\cdot}0$ cals. This value should be independent of the temperature and of the nature of the gas. It represents the smallest possible value of C_v and corresponds with $C_p=5{\cdot}0$ and $\gamma=C_p/C_v=5/3$. Actual measurements made with monatomic gases are in good agreement with these theoretical deductions. Within the limits of error the value of C_v for helium is 3·0 over the range −250° C to 2,350° C, and measurements of the velocity of sound indicate that the value of γ for the monatomic inert gases, mercury vapour and the alkali metal vapours is 5/3.

For gases which contain more than one atom in the molecule, the observed values of C_v and C_p are not only much larger, but they increase with the temperature. For water vapour the value of C_p is given by $C_p=8{\cdot}81+0{\cdot}0019T+0{\cdot}00000222T^2$. The molecular heat ratio for polyatomic gases is less than 5/3 and in general it diminishes with increase in the number of atoms in the molecule, as is indicated by the values for oxygen 1·40, ammonia 1·33, chloroform 1·15, ethyl alcohol 1·11 and ethyl ether 1·03. The ratio depends on other factors, however, as may be seen from the numbers for CH_4 1·31, CH_3Cl 1·28, CH_2Cl_2 1·22, $CHCl_3$ 1·15, CCl_4 1·13, all of which contain five atoms in the molecule. It would seem that the kinetic energy of a monatomic molecule, the mass of which is concentrated in a tiny nucleus, cannot have any other form than that which is associated with its translatory movements. This kinetic energy corresponds, therefore, with three independent modes of motion or degrees of freedom in three directions at right angles to one another. In accordance with the Maxwell–Boltzmann principle of equipartition (*see* KINETIC THEORY OF MATTER) the energy quantity $C_v=3{\cdot}0$ should be equally divided between these, and it follows that each degree of freedom is associated with a heat capacity approximately equal to one calorie.

In diatomic molecules, there are two mass centres relatively widely separated and such systems suggest the possibility of other degrees of freedom associated with intra-molecular movements, vibratory in type, of the atoms within the molecule, and with rotational or precessional motion of the molecule as a whole. At very low temperatures, the comparatively feeble impacts between the slowly moving molecules may not be sufficient to give rise to such movements, and in this connection it may be noted that the value of C_v for hydrogen at low temperatures is three calories per degree. At these temperatures diatomic hydrogen would therefore seem to behave as a monatomic molecule. In general, the observed variation of the heat capacities of polyatomic gases with the temperature is, however, difficult to reconcile with the equipartition theory if all the molecules are supposed to have the same number of degrees of freedom. It would seem necessary to assume that those collisions for which the impact exceeds a certain critical value give rise to additional degrees of freedom. The total energy of the gas will then be the sum of the energies of that fraction for which the impacts are less than the critical value and of the fraction for which the impacts are greater than this.

An alternative basis of explanation is afforded by the quantum theory (*q.v.*). According to this, the exchange of energy between matter and space is a discontinuous process, radiant energy being absorbed by material systems in the form of discrete units or quanta, the magnitude of which is determined by the frequency ν as expressed by the equation $\epsilon=h\nu$ where h is a universal constant. The frequency of the absorbable radiation depends on the elastic constants of the molecules, and by the application of statistical considerations, the total energy absorbed by a material system at a given temperature and its dependence on the temperature may be calculated. The quanta associated with the translational movements of the molecules are very small, and for these the process of energy exchange is practically continuous and therefore in accord with the equipartition theory. As the temperature increases, larger quanta become available, and in the form of energy of the appropriate frequency such quanta are absorbed by the gaseous molecules in accordance with the statistical formula. In this way it appears to be possible to account for the observed facts.

Viscosity and Conductivity.—There are certain properties of gases, *e.g.*, the viscosity and thermal conductivity, which depend on the mean free path which is inversely proportional to the chance of collision. The viscosity or internal friction is a measure of the inherent tendency towards the equalization of the velocities of portions of gas which are moving relatively to one another. It may be shown that the viscosity η is given by $\eta=\frac{1}{3}dlu$, where d is the density, l the mean free path, and u the average velocity of the molecules. If, at constant temperature, the density is doubled, the mean free path will be halved, and it follows that the viscosity is independent of the pressure. If the temperature is raised at constant volume, it would appear that the viscosity should increase in proportion to the square root of the absolute temperature. The actual increase is greater and the discrepancy is in part attributable to the circumstance that at lower temperatures and smaller velocities the molecules are more likely to be deviated from their rectilinear paths by the action of the attractive forces between the molecules. Since the viscosity depends on the chance of collision, *i.e.*, on the total effective cross-sectional area of the molecules, it is obvious that viscosity data for different gases afford a means for the comparison of the respective molecular diameters.

At the ordinary pressure, gases are normally very good electrical insulators, although well-marked conducting qualities are acquired at very low pressures. Conducting properties may be induced by the action of X-rays, cathode rays, α- or β-particles, light of very short wave-length, or by certain chemical reactions in all of which processes the molecules are converted into ions by the loss or gain of electrons. As a result of the neutralization of the oppositely charged entities, the conducting properties tend to disappear when the ionizing agency is removed. If a difference of potential is created between two parallel plates in an atmosphere of ionized gas, the ions are directed to the plates. If the potential gradient is small, some of the ions may have their charges neutralized before they reach the electrodes, but the number of these diminishes with increase in the potential difference and ultimately all the charged particles reach the electrodes and the current reaches a maximum value. Further increase in the potential difference is without effect on this saturation current until the gradient becomes very much larger, when the current

begins to increase once more, at first slowly, and then more rapidly, until finally spark discharge occurs. Under these conditions, the movement of the electrons under the influence of the applied field is so rapid that ions may be produced by collision with the molecules of the gas. The minimum potential gradient required for this is termed the ionizing potential. The value of this for a particular gas depends on the precise nature of the electron-expelling process. Even when the velocity of the electron is insufficient to ionize the molecules of a gas, it may be able to displace an electron from one orbit to another. The characteristic potential in this case is known as the resonance potential. Such electron displacements are accompanied by the emission of light of characteristic wave-length and the effects in general can be interpreted in terms of the electron theory of atomic structure.

THE LIQUID STATE

If the temperature of a gas is below a certain limiting value and the pressure is gradually increased, the gas condenses to a liquid. This process involves a discontinuity in the relation between the pressure and the volume. On a $p-v$ diagram, the condensation is represented by a horizontal line for which the pressure value corresponds with the vapour pressure of the liquid. The length of the condensation line diminishes with rise of temperature until the end-points coincide. This temperature is the highest at which a gas can be converted into a liquid and is called the critical temperature. The liquid state is non-existent above this limit. The recognition of the critical temperature is due to Thomas Andrews, who showed that this permits of the transition from the gaseous to the liquid state being carried out in a continuous manner. From the theoretical standpoint this is very significant, for it may be inferred that the essential features of the kinetic theory of the gaseous state may be directly applied to liquids. Since the van der Waals and other similar equations, which express generally the behaviour of gases, are derived on the implicit assumption of homogeneity of the system, it is obvious that they cannot be applicable to the ordinary condensation process. The theoretical isothermal curves must necessarily be continuous, and for temperatures at which condensation occurs in practice, the van der Waals equation yields a continuous curve with a maximum and a minimum pressure value (fig. 2). These become less pronounced as the temperature rises, and ultimately vanish. The temperature at which this occurs corresponds with that at which the three roots of the van der Waals equation, which may be shown to be a cubic in v, become equal to one another. This temperature corresponds, in other words, with the critical temperature, and in various ways it may be shown that the critical data are directly connected with the attraction and volume constants in the equation of condition. The relations in question are given by $v_c=3b$, $p_c=a/27b^2$ and $T_c=8a/27bR$. If a and b are known, these equations may be used to derive the critical constants; conversely, if the latter are known the constants a and b may be calculated. In terms of the equation of conditions, the characteristic feature of the liquid state is to be found in the very large magnitude of the pressure (internal pressure) which corresponds with the attractive force term a/v^2 and also in the very small difference between v and b. The kinetic condition of the molecules is nevertheless of the same kind, and the mean kinetic energy of the molecules has the same value as that of a gas at the same temperature. Properties which depend on the close association of the molecules attain to greater significance, however, in the liquid state.

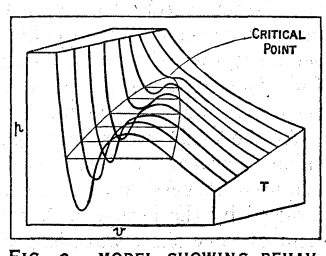


FIG. 2.—MODEL SHOWING BEHAVIOUR OF A GAS AND ITS CONDENSATION BELOW ITS CRITICAL POINT
Pressure, volume and temperature are correlated by Van der Waals's equation

In view of the large magnitude and the specific character of the attractive forces in liquids and the absence of any relation which might be supposed to be analogous to the Avogadro hypothesis, it will be readily understood that the comparison of the physical properties of different liquids is attended by particular difficulties. The correlation of the physical properties of liquids with their composition and chemical constitution represented, nevertheless, one of the most important branches of physical chemistry in its earlier stages of development. It was suspected that the relations in question might possibly be made the basis of methods which could be used to supplement the information provided by the more specifically chemical methods followed in the attempts to determine the structure of chemical compounds. The work done in this connection has been largely empirical and fundamental questions incidental to the problem have not received that amount of consideration to which they are justly entitled.

Comparison of Physical Properties.—The study of a particular physical property for such purposes involves two primary considerations. The first relates to the method of measuring the property and the second is concerned with the conditions under which the comparison is made. These points may be illustrated by reference to the property which is commonly measured by the density or mass of unit volume. The same property may be measured in terms of the specific volume, or volume of unit mass. Both density and specific volume are indeed measures of what may be termed the space-filling capacity of matter. They are reciprocally connected with one another, and it is obvious that the relations shown by a comparison of densities will be very different from those which are indicated by a comparison of specific volumes. Since $d=m/v$ and $\phi=v/m$ and the mass (m) is independent of temperature and pressure, whilst the volume (v) is a function of both, there are obvious reasons for the choice of specific volume rather than density as a measure of space-filling capacity. Since, further, chemically comparable quantities are not those represented by equal masses, but by masses which are in the ratio of the molecular weights, the volumes which should be compared are not the specific volumes, but the molecular volumes defined as $V_m=m\phi$. If molecular volume is accepted as a suitable measure of space-filling capacity, there still remains the question of comparable conditions. In view of the slight compressibility of liquids, the influence of temperature only need be considered. In his classical researches Hermann Kopp decided this matter empirically by comparing the molecular volumes of liquids (1) at the same temperature; (2) at the respective boiling-points of the liquids. The result was to show that simple relations are more clearly evident when the boiling-point data are compared. Kopp's choice was subsequently justified by theoretical developments which culminated in the theory of corresponding states.

Considerations such as have been illustrated by reference to space-filling capacity constitute a preliminary step in the comparative study of all physical properties. For instance, internal friction may be measured in terms of viscosity or fluidity, electrical conducting power in terms of conductivity or resistivity and the discovery of the connection between such properties and the chemical nature of substances is obviously dependent on the choice of the basis of comparison. Not infrequently, the selection involves the consideration of alternative measures which are not merely reciprocal, but bear a much more complex relation to one another. Ideal measures would in fact be those which are entirely independent of external circumstances, temperature, pressure, and even state of aggregation, but apart from mass, the physical properties of matter are not of this ideal nature and the problem of correlation is attended by many difficulties. In so far as the attainment of comparable temperatures is concerned, a finger-post would seem to be provided by the theory of corresponding states. The origin of this is to be found in the circumstance that the ordinary equations of condition with specific constants may be reduced to a general form from which the specific constants have been eliminated. The conversion is effected by measuring for each substance the pressure, volume and temperature in terms of the corresponding critical values, such that $\pi=p/p_c$, $\phi=v/v_c$ and $\theta=T/T_c$. In these circumstances the van der Waals equation reduces to $(\pi+3/\phi^2)\ (\phi-\frac{1}{3})=8\theta/3$ which contains no specific constants and represents, therefore, and is an equation which should be applicable to all substances, independently of their chemical nature. The reduced form of the

equation is the same in type as the original and it may be shown that other equations of condition may be generalized in the same way, provided that these afford an account of the critical state and contain three constants; *i.e.*, the same number of constants as variables. Substances for which the values of π, ϕ and θ are identical are said to be in corresponding states, and the general reduced equation is the analytical expression of the theory of corresponding states, according to which comparable temperatures are provided by equal values of θ. Although the experimental data of Sydney Young show that the above reduced equation is by no means an exact expression of the relation between corresponding states, yet the deviations are such as to suggest that the fundamental idea involved in the theory is substantially correct. From this, however, it does not follow that correspondence in respect of pressure, volume and temperature provides the conditions for correspondence in other properties; any such assumption is necessarily of a tentative character.

In actual practice, the comparison of physical properties has been for the most part made at a fixed temperature. In such circumstances the actual conditions are frequently far removed from those indicated by the theory of corresponding states. The results obtained show that many properties when referred to molecular quantities of the different substances can be represented as the sum of a series of terms which depend on the nature of the constituent atoms and also on the manner in which the atoms are linked together within the molecule. In other words, there is evidence of additivity modified by the incidence of structural factors. At one time the principle of additivity was sought to be maintained by the assumption that the values assigned to certain atoms vary with their mode of combination. More recently the constitutive influence has been taken into account by the hypothesis that the structural peculiarities make a direct contribution to the observed value of the property in the same way as the atoms themselves. In accordance with this view the molecular value of a property of a compound $C_xH_yO_z$ can be expressed by the relation $P=xP_C+yP_H+zP_O+\Sigma P_S$ in which P_C, P_H and P_O are the atomic values of the property for carbon, hydrogen and oxygen, and ΣP_S is the sum of corresponding terms for the constitutional factors.

Volume Relations.—Kopp's measurements of the molecular volume $V_m=m/d$ of substances at their respective boiling-points showed that a given change in molecular composition is accompanied by a fairly constant change in the molecular volume. In ascending homologous series (*see* CHEMISTRY: *Organic: Aliphatic Division*) the change produced by the substitution of the methyl group for the hydrogen atom is on the average about 22 cu.cm., which is taken to represent the volume of the group CH_2. The volume increments for CH_2 vary from 20·5 in the amine series to 24·4 in the ester series. In spite of this variability and of many similar inconsistencies, Kopp came to the conclusion that the molecular volume is essentially additive in nature and can be represented as the sum of the atomic volumes of the constituent atoms provided that the values allocated to certain atoms are assumed to depend on their mode of combination. The values assigned to the different elements are illustrated by the series: C=11, H=5·5, Cl=22·8, Br=27·8, I=37·5, S=22·6, O (singly linked)=7·8, O (doubly linked)=12·2. In the case of nitrogen, the value appeared to vary so largely with its mode of combination that many chemists hesitated to apply Kopp's system to compounds containing nitrogen. Subsequent investigations, in which particular attention was given to isomeric compounds, showed clearly that the idea of constant atomic volumes is not in harmony with the facts. Constitutive effects are clearly shown when isomeric compounds are compared, and in general the largest differences are found when the isomerides compared belong to different chemical groups, whilst the smallest are associated with isomerism of the position type.

Kopp's derivation of the atomic volumes of carbon and hydrogen is based on the comparison of the molecular volumes of aliphatic compounds, *e.g.*, C_4H_{10}, with those of benzene compounds, *e.g.*, C_6H_6, in which an increase of two in the number of carbon atoms is offset by a diminution of four in the number of hydrogen atoms. Such pairs of compounds have very nearly the same molecular volume, and from this observation it was inferred that the volume of the carbon atom is twice as great as the volume of the hydrogen atom. Since $CH_2=22$, it follows that C=11 and H=5·5. The derivation of these values obviously ignores the influence of ring formation on the molecular volume. More recently, a system of atomic volumes has been evolved by G. Le Bas, which is based on a comparison of aliphatic compounds with the corresponding olefines. In this, which yields C=14·7, H=3·7, no account is taken of the influence of the double bond. The relations are nevertheless very similar to those which are exhibited by the older system.

Although the use of the boiling-points for the comparison of the molecular volumes of liquids provides a temperature basis which is theoretically justified in so far as the boiling-points are approximately equally reduced temperatures, it should be recognized that the internal pressures resulting from the attractive forces between the molecules are not generally comparable under these conditions. In this connection, attention may be directed to a new method proposed by S. Sugden, in which the influences of temperature and of pressure are eliminated. In this it is assumed that a measure of the magnitude of the internal pressure is afforded by the surface tension. The development of the actual procedure is based on the observation that the connection between the surface tension (γ) of a liquid, the density (D), and the density (d) of its saturated vapour can be expressed very exactly by the relation $\gamma=C(D-d)^4$, in which C is independent of the temperature. If $C^{1/4}$ is multiplied by the molecular weight, a quantity P is obtained, the value of which may be derived from $P=M\gamma^{1/4}/(D-d)$. This is termed the "parachor," and since $M/(D-d)$ at low temperatures, where d is very small in comparison with D, represents the molecular volume of the liquid, it is obvious that the parachor affords a comparison of molecular volumes under conditions in which the surface tensions and therefore the internal pressures of the different liquids have the same value. In support of the view that the parachor really affords a measure of the volumes occupied by the actual molecules, it is found that this quantity bears a nearly constant ratio to the critical volume as expressed by $P=0{\cdot}78\ Vc$.

For saturated substances the parachor can be expressed additively in terms of atomic constants. These appear to be independent of the mode of combination of the atom and position isomerism is without effect. Unsaturation and ring formation produce notable changes and these vary but slightly from compound to compound. A double bond between two carbon atoms produces the same effect as the double bond between carbon and oxygen, or between nitrogen and oxygen in the nitroxyl group. The same structural constant can be used for the six-membered rings of benzene, cyclo-hexane, pyridine, piperidine and quinoline. The two oxygen atoms in the carboxyl group would, however, seem to require a special constant. The accompanying table shows the values of various atomic and structural parachors:

Atomic and Structural Parachors

C	4·8	F	25·7	≡	46·6
H	17·1	Cl	54·3	3-ring	22·5
O	20·0	Br	68·0	4- „	12·0
O_2 (ester)	60·0	I	91·0	5- „	8·5
N	12·5	=	23·2	6- „	6·1

The results obtained in the study of the parachor are such as to suggest that this may be of real value in the elucidation of many of the structural problems which are presented by organic chemistry.

In the belief that many of the irregularities associated with molecular volumes are due to polymerization (*q.v.*) or the formation of molecular aggregates, J. Traube instituted a comparison of the volumes occupied by substances when dissolved in water or other solvent to form dilute solutions. The derivation of the molecular solution volumes at 25° C involves the assumption that the volume occupied by the solvent is not affected by the presence of the dissolved substance. This is certainly not justified, but it is nevertheless noteworthy that the volume relations exhibited by this system are very similar to those which are found by the comparison of substances in pure liquid condition at the respective boiling-points. The fact that the sum-

mation of the atomic and structural constants leads to values of the molecular volume which are less than the actually measured volume by a constant quantity (12·6 cu.cm. in water at 25° C) suggests that this may be connected with the contraction of the solvent.

Volatility of Liquids.—The term volatility refers to the tendency of a substance to pass into the state of vapour. At a given temperature this may be measured by the vapour pressure, and at a given pressure by the corresponding boiling-point. Many empirical formulae have been put forward to express the connection between vapour pressure and temperature, and some of these find useful application in engineering practice. For many reasons formulae which have a theoretical basis must, however, be considered the more important, and it may be shown that if the vapour be assumed to conform to the requirements of the ideal gas equation, thermodynamic considerations lead to the relation $d \log p/dT = \lambda/RT^2$ in which λ is the heat of vaporization per gram-molecule at the absolute temperature T. If λ is independent of the temperature, this differential formula may be shown to be equivalent to the vapour pressure formula $\log p = C + k/T$, in which C and k are constants. If λ varies with the temperature in accordance with $\lambda = \lambda_0 + aT + bT^2 + cT^3 \ldots$, the integration of the differential expression leads to the somewhat more complicated formula:

$$\log p = C_0 + k_1/T + k_2 \log T + k_3 T \ldots$$

in which the coefficients k_1, k_2, k_3 . . . are related to a, b, c . . . respectively. This thermodynamic vapour-pressure formula is in accord with the observed variation of the vapour pressure over a very wide range of temperature, as may be seen by reference to the data for mercury. The calculated vapour-pressures in this case are derived from:

$$\log p = 10{\cdot}5724 - 3342{\cdot}26/T - 0{\cdot}847 \log T$$

Vapour Pressure of Mercury

$T°$ (abs.)	280·1°	323°	427·2°	495·15°	630·5°	923°	1151°
p obs.	0·$_8$3367	0·0113	3·49	34·4	767·5	(34)	(161)
p calc.	0·$_8$3369	0·0126	3·32	34·7	794	(36)	(157)

At the two highest temperatures the pressures are expressed in atmospheres; for the other temperatures the numbers refer to mm. of mercury. It may be noted that the differential vapour-pressure formula which has been considered here represents a quantitative statement of the influence of temperature on the equilibrium between the liquid and its vapour. In accordance with this, the vapour-pressure formula may be regarded as a particular case of a more general expression which is applicable to states of equilibrium in both homogeneous and heterogeneous systems. In the general case, the equilibrium at a given temperature is determined by a constant K, the variation of which with the temperature is given by:

$$d\log K/dT = Q/RT^2$$

in which Q is the heat change associated with the chemical or physical transformation concerned. This general form of the equation is the quantitative expression of the "law of mobile equilibrium," according to which the alteration of one of the factors determining the state of equilibrium in a system, which is capable of internal adjustment, is accompanied by a change which tends to annul the effect of the original alteration. If the temperature of such a system is raised, the resulting internal adjustment must be accompanied by the absorption of heat, and the fact that the vapour pressure of a liquid always rises with the temperature is directly connected with the fact that vaporization involves the absorption of heat. The recognition of the law of mobile equilibrium, which applies equally to changes produced by pressure and temperature variations, is mainly due to H. Le Chatelier and Jacobus Henricus van't Hoff.

OPTICAL PROPERTIES

Refractivity.—The change in the direction of a homogeneous ray of light when it passes from air into a denser medium is termed refraction. This property of the medium is suitably measured by the index of refraction $n = \sin i/\sin r$, in that the influence of the angle of incidence is thereby eliminated. The refractive index is determined by the relative velocities of light in air and in the medium, and this depends on the wave-length. The choice of wave-length in actual experiment is largely determined by the ease with which homogeneous beams of certain wave-lengths can be obtained. Apart from the arbitrariness which is involved in the selection of a particular wave-length for the comparative study of the refractivity of different substances, it is to be noted that the refractive index (say n_D for the sodium D line) depends on the temperature, pressure and other factors. This variability of the refractive index is responsible for the fact that other quantities have been suggested as a more suitable measure of refractivity. The expression $r_1 = (n-1)/d$ was suggested by J. H. Gladstone and T. P. Dale, and the relation $r_2 = (n^2-1)/(n^2+2)d$ by H. A. Lorentz and by L. Lorenz. The former is purely empirical, but the latter has some theoretical justification. Both these r quantities are insensitive to changes of temperature, and the second has the very important additional qualification that its magnitude for a given substance is nearly the same whether the substance is in the liquid or gaseous state. This is shown by H. H. Landolt's data for the specific refraction (r_2) of water, alcohol and chloroform.

Specific Refractivities $r_2 = (n^2-1)/(n^2+2)d$

	Water	Ethyl alcohol	Chloroform
Liquid state . . .	0·2061	0·2807	0·1791
Gaseous state . . .	0·2068	0·2805	0·1796

In order to provide an appropriate comparative basis for these measures of refractivity, it has been customary to multiply them by the molecular weights of the compounds concerned, whereby the so-called molecular refractivity $R = mr$ is obtained. The significance to be attributed to the quantity R is a matter which does not appear to have received much consideration. It may, however, be pointed out that $(n^2-1)/(n^2+2)d$, which was derived from a consideration of the dielectric action of insulating substances in terms of the Clausius–Mossotti theory, would seem to be a measure of the specific volume if n refers to infinitely long waves. It would therefore seem that the corresponding value of R may be regarded as providing an approximate measure of the molecular volume. In support of this view it may be noted further that the variations of $(n^2-1)/(n^2+2)$ from compound to compound are relatively small and that the differences in the R values are mainly determined by the changes in m or m/d. The use of molecular refraction in the comparison of the refractive powers of substances would therefore seem to have less justification than is usually assumed and the procedure followed in investigations which make use of this quantity may be regarded as largely empirical.

The relations disclosed by the results show that the molecular refractivity is additive in character and that its value for a given compound can be calculated from the molecular formula by the summation of constants (atomic refractions) which are peculiar to the constituent elements. As in the case of other physical properties, structural factors are clearly evident, and the correlation of the data for different groups of substances has made it necessary to attribute refraction effects to many different kinds of structural peculiarities such as double bonds, treble bonds, ring formation, conjugation, etc. When two double bonds are present in a molecule, the refractivity would seem to be dependent on their relative positions. When the double bonds are associated with a common carbon atom (C=C=C) or when they are separated by more than two carbon atoms, their influence is normal, but when they are in juxtaposition (C=CH—CH=C) or "conjugated," their influence is abnormally large. This effect is termed optical anomaly or exaltation. The constants assigned to certain atoms and structural elements from observations on the sodium D line are as follows:—C 2·42, H 1·00, O (doubly linked) 2·21, O(hydroxyl) 1·52, O(esters) 1·64, Cl 5·96, Br 8·86, I 13·90, double bond 1·73, treble bond 2·40.

Dispersivity.—Dispersivity is the name given to the difference between the specific refractivities for light of different wave-lengths. The wave-lengths usually chosen are the α- and γ-

hydrogen lines or the sodium and lithium lines. For comparative purposes, the specific dispersivity is given a molecular basis by multiplication by the molecular weight, but the justification for this procedure has been questioned by K. F. Auwers and F. Eisenlohr, who have attempted to correlate dispersive powers in terms of the specific dispersivities. Both methods of comparison show the existence of relations which resemble those shown by molecular refractivity. According to J. W. Brühl, dispersivity is pre-eminently a constitutive property and in consequence lends itself readily to the study of structural differences. It has been said that the presence of impurities in the compounds examined has a smaller disturbing influence on dispersivity than on refractivity.

Rotatory Power.—When a beam of plane polarized light is passed through certain substances, the plane of polarization is changed in direction; it is said to be rotated. Whilst for solid substances this may be due to an asymmetric disposition of the molecules in the crystalline aggregate, it can only be due to asymmetry within the molecules when this natural rotatory power is shown by isotropic fluids. The relations concerned are dealt with in the article on STEREOCHEMISTRY, and attention will be here confined to similar rotation effects which are shown quite generally by liquids when these are placed between the poles of an electromagnet and the beam of light is allowed to pass along the lines of force of the magnetic field. Our knowledge of magnetic rotatory power is based very largely on the work of W. H. Perkin, Sr., who measured the rotation produced by a column of liquid of fixed length and derived therefrom the specific rotatory power $r=\alpha/d$. Comparable values were sought by the introduction of the molecular weight in the usual way leading to the molecular magnetic rotatory power defined by $R=ma/d$. The comparison of such R values (expressed in relative measure, with water as the standard substance) has shown the existence of relations which are on all fours with those which have been described under refractivity.

Viscosity and **Fluidity** are reciprocal measures of internal friction. The precise definition of the coefficient of viscosity need not be considered here, for actual measurements are almost exclusively confined to the determination of relative viscosities. Such values are readily obtained from the times which are required for a given volume of liquid to flow through a capillary tube under precisely similar conditions. At one and the same temperature the viscosities for different liquids vary between very wide limits. The coefficients for ethyl ether, water and glycerol at 0° C are, for instance, 0·00286, 0·01793 and 46·0, respectively. With rise of temperature, the viscosity diminishes rapidly and in any comparative study of viscosities the question of temperature is very important. The temperatures selected by T. E. Thorpe and J. W. Rodger are those at which the temperature–viscosity curves have the same slope. At such temperatures the rate at which the viscosity changes with the temperature is the same for all substances, and consequently the influence of temperature may be said to be eliminated. On the supposition that the internal friction of liquids depends on the magnitude of the molecular surface, the product of the coefficient of viscosity (η) and the molecular surface has been used in the comparison of liquids with one another. Such molecular viscosities exhibit additive and constitutive relations of the usual kind.

Relations of a very different type are shown by certain other quantities which have been systematically examined in the liquid state. Notable examples are afforded by the Trouton ratio, *i.e.*, the ratio of the molecular heat of vaporization (λ) to the absolute boiling temperature (T), and by the Ramsay-Shields coefficient, which expresses the rate of change with the temperature of the molecular surface energy γ ($m\phi^{2/3}$ when γ is the surface tension, m the molecular weight and ϕ the specific volume). These coefficients have very nearly a constant value for large numbers of chemically different substances, and it has been supposed that deviations from the normal values afford evidence of the combination of the simple molecules to form more complex molecules (polymerization, *q.v.*; association, *q.v.*). The normal value of Trouton's function λ/T is 21, whilst for water the value is only 14·7. If water is a mixture of double and simple molecules in equilibrium with one another, as represented by $2H_2O \rightleftharpoons (H_2O)_2$, there can be no doubt that the boiling-point will be appreciably higher than it would be if the liquid consisted entirely of simple molecules. Since the vapour consists almost entirely of simple molecules, it is also clear that the observed heat of vaporization is a complex quantity which represents the sum of the heat quantities involved in the depolymerization of the liquid molecules and in the volatilization of the simple molecules. The assumption of polymerization thus affords a possible interpretation of the abnormality of the Trouton ratio. In the case of the Ramsay–Shields coefficient, abnormally small values can be readily explained in terms of polymerization, but values greater than the normal present difficulties. Recent observations moreover on the properties of surface layers lead to the conclusion that the molecular condition in the surface is very different from that in the interior of a liquid. This fact would appear to have an important bearing on the interpretation which can legitimately be given to the observed value of the coefficient in question. (*See* SURFACE TENSION.)

THE SOLID STATE

General Characteristics.—Over a long period it was customary to speak of crystalline and amorphous solids, but the grounds on which this distinction was made are now regarded as unsatisfactory. Newer methods of analysis have in fact shown that many apparently amorphous substances are definitely microcrystalline, while others appear to represent supercooled liquids of very high viscosity. The solid state is now generally identified with the crystalline condition, and matter in this form is characterized by its resistance to shearing stresses and by the fact that its physical properties vary with direction. This "anisotropy" of solids presents therefore a very definite contrast to the isotropy of liquids and gases. When crystals are formed under the usual conditions by the cooling of a liquid, they show a regular polyhedral structure and their physical properties are in general related to the external form (*see* CRYSTALLOGRAPHY). The normal development of such crystals involves a time factor, and when the conditions are such that separation of the solid takes place rapidly, there is a tendency towards the formation of granular aggregates in which the recognition of crystalline character may be a matter of some difficulty. In the matter of rigidity, the crystalline and liquid states may be said to overlap. The highly viscous, isotropic substances exemplified by the glasses, pass into the condition of fluid liquids in a gradual and continuous manner when the temperature is raised; there is no sudden transition in the properties such as is observed with crystalline solids at the melting-point. On the other hand, although most crystals are rigid and fracture when subjected to pressure, there are others in which the forces associated with the crystal structure are so weak that the crystals can be easily distorted and made to flow. Their behaviour in this respect simulates that of liquids, but they have the optical properties of crystals and possess a definite melting-point.

The directional properties and geometrical forms of crystalline solids are directly connected with regularities in the arrangement of the atoms or molecules within the crystal. These are no longer free to move from point to. point, but occupy definite mean positions in the space lattice of the crystal. Their kinetic energy is represented by small vibratory or oscillatory movements about these mean positions. When, by a sufficient rise of temperature, the amplitude of the oscillatory motion becomes sufficiently great for the molecules to escape from the action of the force which tends to restore them to their mean positions, the solid melts and the vibratory motion is replaced by the random translatory motion characteristic of the liquid state. The determination of the arrangement of the mean positions has been made possible by the fact that the regularly disposed rows and planes of atoms (molecules) give rise to interference effects when the crystals are submitted to a beam of X-rays, that is to say, to radiation of a wavelength which is of the same order of magnitude as the distances which separate the atomic centres. The X-ray spectra obtained

in this way by M. Laue, W. H. and W. L. Bragg and others afford precise information relative to the architecture of the crystals. For strongly polar substances, such as sodium chloride, it is found that the points of the crystal lattice are occupied by positively charged sodium atoms and negatively charged chlorine atoms. Each sodium ion bears exactly the same relation to six chlorine ions which may be supposed to occupy the central points of the faces of a cube which has the sodium ion at its centre. Each chlorine ion is similarly disposed with respect to six sodium ions. The material structural elements, in other words, are the sodium and chlorine ions, and molecules of sodium chloride in the ordinary sense are non-existent. Substances of non-polar character give *X*-ray spectra, on the other hand, which clearly show that the lattice points are associated with molecular units which are, however, oriented in a perfectly definite manner. The patterns presented by such structures can always be described in terms of a unit or elementary lattice which may contain one, two or more molecules.

Polymorphism.—The one-time supposition that every substance was unique in its crystalline form has been definitely disproved by the discovery of isomorphism, according to which different substances may crystallize in the same form, and of polymorphism, according to which the same chemical substance may have different crystalline forms. In some cases, *e.g.*, the rhombic and monoclinic forms of sulphur (*q.v.*), the two crystalline forms are interconvertible. The change takes place at a definite temperature known as the transition temperature. Below 96° C rhombic sulphur is the stable form; above 96° the stable form is monoclinic and melts at 119°. Superheating readily occurs, however, and rhombic sulphur may be readily heated to its melting-point (113°). The transition temperature is the only temperature at which the two solid forms can coexist in equilibrium at atmospheric pressure and at which their vapour pressures are therefore the same. The relations between the two solid forms at the transition point are clearly very similar to those between a solid and the corresponding liquid at the freezing-point of the latter. In some cases, *e.g.*, benzophenone, the two crystalline forms are not interconvertible. One of them is unstable at all temperatures and the transition point (*i.e.*, the point of intersection of the vapour pressure curves) is higher than either of the melting-points. When a substance can exist in several crystalline forms the equilibrium relations may be of rather complex character, but the correlation of these is greatly facilitated by the use of the phase rule. According to this, the number of phases, *i.e.*, the physically distinct parts of a system, which can coexist in equilibrium is determined by the number of the components. This represents the smallest number of chemical constituents in terms of which the composition of the several phases can be expressed. If P is the number of phases and C the number of the components, the maximum value of P is $C+2$. When this relation obtains, the equilibrium is completely defined by the nature of the system and the variable factors represented by temperature, pressure and concentration can have only perfectly definite values. If $P=C+1$, one of these factors must have a value assigned to it before the equilibrium is determined. If $P=C$, two such factors must have determined values. The number of the variables to which arbitrary values must be given to specify the precise nature of the equilibrium is termed the number of degrees of freedom (F) and in accordance with the "phase rule," $F=C+2-P$. In the simplest possible case where $C=1$, the number of degrees of freedom is 2, 1 or 0 according as $P=1$, 2 or 3. The whole of the relations involved can be conveniently represented by a diagram on which the pressure and temperature are taken as the co-ordinates. Such a diagram, showing the relations between rhombic, monoclinic, liquid and sulphur vapour is presented in fig. 3. Invariant systems ($F=0$) are represented by the points at which three curves intersect. The point *A* corresponds with the system rhombic–monoclinic–vapour, *B* with monoclinic–liquid–vapour and C with rhombic–monoclinic–liquid. Univariant systems ($F=1$) are represented by points on the curves. The curves *r*, *m* and *l* define the respective conditions under which rhombic and vapour, monoclinic and vapour, liquid and vapour can coexist in equilibrium. In the same way the curves *rm* and *ml* give the conditions for equilibrium between rhombic and monoclinic and between monoclinic and liquid. Bivariant systems ($F=2$) are those represented by all other points and the regions of stability of the single phase systems—rhombic, monoclinic, liquid and vapour, are shown by R, M, L and V.

Heat Capacity.—According to the empirical relation discovered by P. L. Dulong and A. T. Petit (1819), the product of

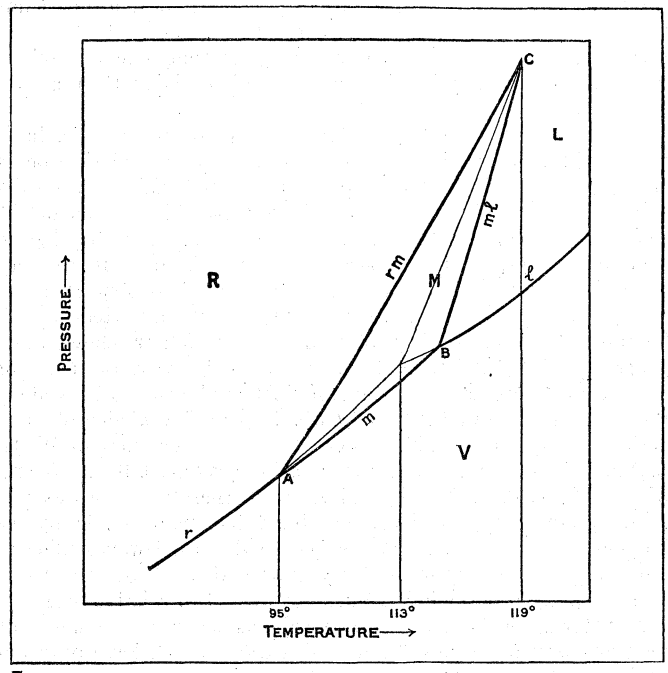


FIG. 3.—PHASE RULE DIAGRAM (NOT TO SCALE) FOR SULPHUR, SHOWING DEPENDENCE OF VAPOUR, LIQUID, MONOCLINIC AND RHOMBIC FORMS ON PRESSURE AND ON TEMPERATURE

the specific heats of the elements and their atomic weights is approximately constant=6·4. This relation was confirmed by Regnault, but it was found necessary to recognize that the non-metallic elements of low atomic weight are exceptions to the rule in that their atomic heats are abnormally small, *e.g.*, carbon 1·8, boron 3·7, beryllium 3·7, silicon 3·8, phosphorus 5·4. According to F. E. Neumann and H. Kopp the molecular heats of compounds can be expressed approximately as the sum of the atomic heats of the constituent elements, from which it may be inferred that the heat capacity is within narrow limits the same whether the elements are free or chemically combined. The experimental results summarized in the rule of Dulong and Petit are in agreement with the deductions from the classical kinetic theory. According to this the atoms in the solid element have three independent modes of movement associated with the three directions of space, and since each degree of freedom corresponds with a heat capacity of $R/2$ calories, and kinetic energy of the oscillatory type is necessarily associated with an equivalent amount of potential energy, it follows that the atomic heat capacity is $6\times R/2=6{\cdot}0$ calories. This value should, however, be independent of the temperature, which is contrary to experiment, for measurements of the specific heats of the elements and of their compounds at very low temperatures have shown that the heat capacity begins to fall rapidly when the temperature is sufficiently low and tends towards a zero value. The explanation of this behaviour represents one of the most important achievements of the quantum theory. Albert Einstein has indeed shown that the observed dependence of the heat capacity on the temperature is in general agreement with the requirements of the quantum theory of heat exchange. The formula given by Einstein, which assumes that the energy absorbed is associated with a particular frequency, has since been modified by Peter Debye and others. According to these later views the characteristic frequency of Einstein represents the upper limiting value of the complete series of frequencies which can actually be absorbed by the atoms. The

observed atomic heats of copper and those calculated on the basis of the quantum theory are compared below:

Temperature (A)	23·5°	33·4°	88·0°	137°	290°	450°
C_p (obs.)	0·22	0·54	3·38	4·57	5·79	6·09
C_p (calc.)	0·15	0·59	3·39	4·65	5·75	6·03

At relatively high temperatures there is no difference between the requirements of the classical and quantum theories. The fact that the value of C_v becomes considerably greater than 6·0 at very high temperatures—for tungsten at 2,000° C, $C_v = 7·35$—is said to be due to the thermal agitation of the electrons.

Electrical Conductance.—Electrical conducting power similar to that possessed by metals and alloys is shown by certain non-metals, *e.g.*, by carbon in the form of graphite, by compounds of some of the less electro-positive metals with elements of the oxygen group, *e.g.*, pyrites, oxides of lead and iron, and also by compounds of the type represented by CH_3Hg. At very low temperatures this metallic conducting power increases very greatly. The resistance of tin becomes vanishingly small at 3·8° A, and that of thallium at 2·3° A. In other cases, *e.g.*, platinum and calcium, the resistance falls to a low limiting value which is independent of the temperature. The supposition that metallic conduction of electricity and heat is due to the movement of free electrons is difficult to reconcile with the very small heat capacity of the electrons, and the suggestion has been made that a metal represents a structure with interleaved ionic and electron lattices, electrical conductance being associated with the movement of the electron lattice through the ionic lattice. Electrolytic conductance of the type exhibited by fused salts and salt solutions is also met with in the case of certain solid salts. Whereas the conductance in liquids is associated with the movement of both positive and negative ions, the passage of the current through these solid compounds is due either to the positive or to the negative ion. In silver chloride and cuprous sulphide the carrier is the metallic ion, whereas the chlorine ion is the migratory constituent in lead chloride. Both metallic and electrolytic conduction are shown by other solid salts.

PROPERTIES OF MIXTURES

The term mixture is applied to a system in which the constituent particles are directly or indirectly distinguishable from one another. When the difference can be recognized directly or by the use of some optical magnifying device, it is customary to speak of mechanical mixtures, whilst the term solution is reserved for mixtures in which the constituent particles are of molecular dimensions. There is no fundamental difference between the two classes of mixtures for they can all be resolved by the application of mechanical forces, for example, by a process of centrifuging. Gases are all completely miscible with one another, but miscibility in the liquid and solid states is much less general. Some pairs of liquids are miscible in all proportions and complete series of mixed crystals are formed by certain pairs of crystalline solids. Other pairs of liquids and solid substances are practically immiscible. A third group is formed by pairs which are miscible in limited proportions. Miscibility depends upon the temperature and in general is favoured by the chemical similarity of the substances concerned. Water does not mix with hydrocarbons, is completely miscible with methyl and ethyl alcohols, partially miscible with butyl and amyl alcohols, but practically immiscible with higher members of the alcohol series.

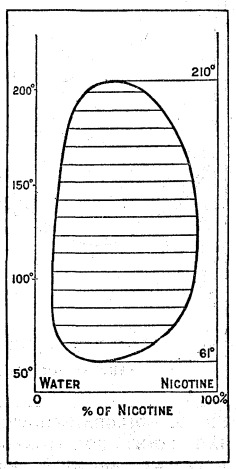


FIG. 4.—DIAGRAM SHOWING THAT WATER AND NICOTINE ARE COMPLETELY MISCIBLE BELOW 61° C AND ABOVE 210° C

When two partially miscible liquid substances A and B are brought together, then, in general, two layers are formed which contain different proportions of A and B. The composition of these layers (so-called conjugate pairs) depends on the temperature. As a rule, the difference between the conjugates diminishes with rise of temperature and in some cases may ultimately disappear. The temperature at which this occurs is the "critical solution temperature" and above this the two substances are miscible in all proportions. Increased miscibility is sometimes produced by a fall of temperature and a few pairs of substances are known for which both upper and lower critical temperatures can be observed. Nicotine and water, for example, are completely miscible below 61° C and above 210° C; between these limits they are only partially miscible. Fig. 4 shows these relations: conjugate pairs are connected by horizontal lines.

In gaseous mixtures at the ordinary pressure, the molecules are so widely separated that the effects of intermolecular forces can be almost entirely ignored. In the absence of chemical interaction between them, the independence of the molecules would lead us to expect that the properties peculiar to the molecules of a substance A will not be affected by admixture with the molecules of B. In these circumstances, the properties of a gaseous mixture which contains A and B in the molecular ratio $(1-x) : x$ should be given by the simple mixture rule, which may be written $P_X = (1-x)P_A + xP_B$, where P_A, P_B and P_X represent the values of the property for A, B and the mixture respectively. Dalton's law of partial pressures affords an example of this relation.

Property–composition Curves.—Since the properties of pure liquids are largely dependent on the attractive forces between the molecules, it is extremely unlikely that the relations connecting the properties of liquid mixtures with those of their components can be of the same simple nature as those which characterize the corresponding gaseous systems. In some cases the mixing of two liquids is accompanied by very pronounced changes in volume, by a rise or fall of temperature and by other effects. For other liquid pairs, such effects are so small as to be scarcely measurable. The relations between the properties of liquid mixtures and those of their components may be conveniently shown by plotting the measured property against the composition of the mixture. The property–composition curves obtained in this way sometimes deviate but little from the straight line which corresponds with the simple mixture rule, but for other mixtures large deviations are found, and not infrequently the curves show a maximum or a minimum.

In the interpretation of such curves, two different points of view have been adopted. On the one hand, the changes in physical properties have been attributed to variations in the molecular attractive forces. If the attractive forces between the unlike molecules and between the two sets of like molecules are denoted respectively by a_{AB}, a_A and a_B, then if a_{AB} is much greater than a_A and a_B, it may be anticipated that the substances in question will mix readily, whilst if a_{AB} is much smaller than a_A and a_B, there are reasonable grounds for the anticipation that most will be only partially miscible. In the former case, pronounced changes in the physical properties may be expected to accompany the mixing of the two substances, whereas if the attractive forces between the unlike molecules are of the same order of magnitude as the forces between the two sets of like molecules, it may be supposed that admixture will not be accompanied by any pronounced change in the general physical properties.

In contrast with the above view, some authors maintain that well-marked changes in physical properties afford evidence that the mixing of the two substances in question has resulted in chemical interaction. It may be that these two views are not so widely different as would be suggested by the arguments of the respective protagonists, for the action of molecular forces of sufficient magnitude between the molecules of A and B may lead to a form of physical association which is by no means easy to distinguish from what would be described as the chemical combination of molecules of A and B. In any case it is probable that deviations from the simple mixture rule may be due in part to differences in the acting molecular forces, whilst the formation of definite chemical compounds may sometimes be the chief cause of the departure.

Theoretical considerations based on the law of mass action (*see* CHEMICAL ACTION) indicate that if the two components of

a liquid mixture combine together to form a compound, the proportion of this in the mixture will be greatest when the composition of the mixture, as a whole, is the same as that of the compound. If such compound formation is the cause of the deviation in the physical properties from what would be expected according to the simple mixture rule, the determination of the composition of that liquid mixture for which the deviation has a

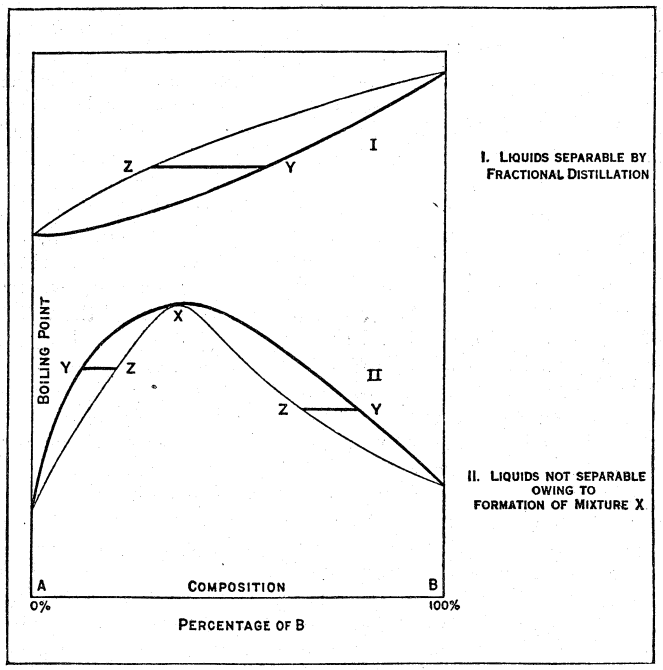


FIG. 5.—DIAGRAM SHOWING THE RELATION BETWEEN THE COMPOSITION OF A LIQUID MIXTURE AND ITS BOILING POINT. LIGHT CURVES INDICATE COMPOSITION OF VAPOUR; E.G., A LIQUID OF COMPOSITION Y GIVES OFF A VAPOUR Z

maximum value should give the composition of the compound. In support of this and of the chemical theory, it is frequently found that maximum deviation occurs at a point which corresponds with a simple molecular ratio of the components. For example, the volume and viscosity curves indicate the existence of the compound $C_2H_5OH,3H_2O$ in ethyl alcohol–water mixtures and the formation of $C_5H_5N,2H_2O$ in mixtures of pyridine and water. The viscosity curve for methyl alcohol–water mixtures suggests the formation of the compound $2CH_3OH,3H_2O$, and the maximum deviation is independent of the temperature between 10° and 60° C.

If the curves for different properties show a maximum deviation at the same composition and if this composition is not affected appreciably by change of temperature, there would seem to be strong evidence for the formation of a compound represented by the corresponding formula. When a single stable compound is formed, its presence should be clearly indicated, but if the compound is relatively unstable and therefore present in small quantity the evidence may be much less conclusive. Furthermore, when more than one compound is formed, the property–composition curves may easily lead to erroneous conclusions, for if the compounds A_2B and AB_2 are actually present, the maximum deviation of the experimental curve from the simple mixture line will probably occur at a point which falls between A_2B and AB_2 and may indeed suggest the formation of the compound AB.

The properties of binary liquid mixtures which have been systematically examined include volume, viscosity, vapour pressure, dielectric capacity, heat capacity, heat of mixing, etc. In the graphic representation of the results it is necessary to correlate the units in terms of which the property is measured with those which are used to represent the composition of the mixture. If the composition is expressed in molecular percentages, in which case the abscissa corresponds directly with the relative numbers of molecules of A and B in the various mixtures, the property should also be evaluated on a molecular basis. The plot of the specific value of a property against the molecular composition would obviously have much less justification. In actual practice, the importance of such matters has not received adequate attention and to this fact must be attributed some of the difficulties which have been met with in the interpretation of property–composition curves.

Boiling-point and Freezing-point Curves.—Of the many properties which have been examined, special consideration may be given to boiling-point and freezing-point curves, both of which are of practical importance in their bearing on the processes of fractional distillation and crystallization (*see* DISTILLATION). Boiling-point curves may be divided into two main groups. In the first the boiling-points of all mixtures fall between those of the components (fig. 5; curve I), whilst the second is characterized by the occurrence of maximum or minimum boiling-point mixtures (curve II). Since the vapour given off by a liquid mixture always contains the more volatile component in greater proportion than the liquid phase (*cf.* dotted curve I) mixtures of the first type may be completely separated from one another by an efficient form of fractional distillation apparatus. This, however, is not possible for mixtures of the second type. Fractional distillation of these leads to separation into two fractions, represented respectively by pure A or pure B and a liquid X, which has the composition of the maximum (minimum) boiling-point mixture. The maximum or minimum boiling-point mixtures are indeed sharply distinguished from all other mixtures by the fact that the liquid and vapour phases are identical in composition. In this behaviour they resemble pure substances and are termed azeotropes. It was at one time supposed that azeotropes corresponded with definite compounds but the fact that the composition of the azeotrope varies with the pressure indicates that this view is untenable.

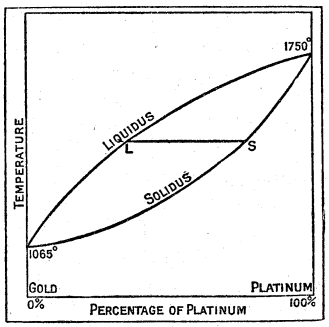


FIG. 6.—DIAGRAM SHOWING FORMATION OF MIXED CRYSTALS OF GOLD AND OF PLATINUM
Crystals of composition S separate from the liquid L. Then the gold content of the liquid and the crystal increases continuously during solidification

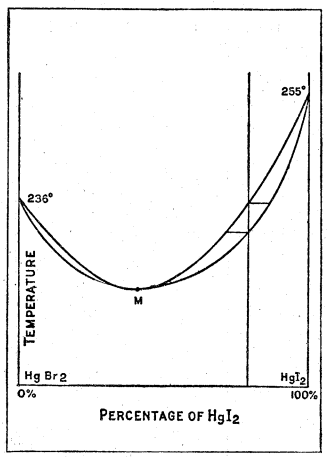


FIG. 7.—DIAGRAM SHOWING FREEZING POINT FOR MIXED MOLTEN MERCURIC BROMIDE, $HgBr_2$, AND MERCURIC IODIDE, HgI_2
From any mixture, mixed crystals separate so that liquid approaches condition M, where it freezes as a whole like a single compound

Freezing-point curves and boiling-point curves are somewhat different from other property-composition curves in that they correspond with conditions which permit of the coexistence of the liquid with a solid or a vapour phase. In accordance with the fact that vapours are completely miscible, the boiling-point curves are nevertheless continuous, whereas the freezing-point curves are generally discontinuous. This is due to the circumstance that miscibility of substances in the solid state is very limited and that the freezing-point depends on the nature of the solid substance which separates out. Many cases are known in which the same liquid mixture has two or more freezing-points, the temperature varying with the product of crystallization.

When the components of a binary liquid mixture are completely miscible in the solid state, the two types of freezing-point curves which are obtained are closely similar to the boiling-point curves already described. For mixtures of the first type the freezing points lie between those of the pure components. In general, the composition of the mixed crystals which separate out differs from

that of the mother-liquor, and the relation between the two can be represented on the freezing-point diagram by two curves—the so-called liquidus and solidus (*see* fig. 6). Corresponding points *L* and *S* on these curves, *i.e.*, points on the same horizontal line, are conjugate in the sense in which this term is applied to two coexisting liquid phases. Binary mixtures of the second type show either a maximum or a minimum freezing-point, at which the liquidus and solidus meet (*cf.* fig. 7). If the proportions of the components in the mixture correspond with this point, the liquid freezes at a constant temperature and then behaves like a pure substance. A vertical line drawn through the maximum (or minimum) point divides the complete series of mixtures into two subgroups, the behaviour of which is exactly similar to that of mixtures of the first type.

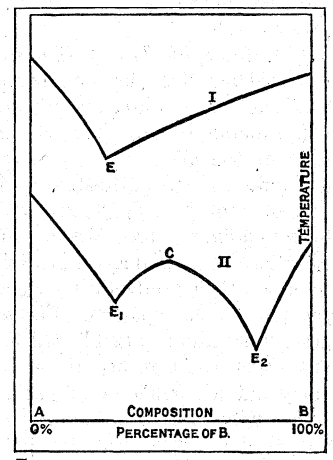


FIG. 8.—CURVES FOR MIXED LIQUIDS
1. Parts of mixed liquids are immiscible in solid state, but liquid freezes as a whole at fusing point, E, after depositing excess of A or B
2. When A and B form a compound there are almost two curves of type 1, E_1 and E_2 being the two fusing mixtures

If the components of a binary liquid mixture are immiscible in the solid state, the freezing-point curve is discontinuous. In the simplest case, it consists of two descending branches which intersect at the eutectic point (*cf.* fig. 8; curve I). The eutectic mixture is that mixture which has the lowest freezing-point, and is further distinguished by the circumstance that the two components crystallize out simultaneously in the proportions in which they are present in the eutectic liquid. The freezing temperature therefore remains constant. Mixtures which contain an excess of A (or B) in comparison with the eutectic mixture deposit A (or B) on freezing. This alters the composition of the residual liquid and the freezing-point falls continuously until the eutectic point is reached. The solidification is then completed at constant temperature.

If one or more compounds separate out on freezing, the diagram is of a more complicated type. Fig. 8, curve II, illustrates the relations when a compound of the type AB crystallizes out. There are now four freezing-point curves and two eutectic points. The two intermediate curves intersect in a point which corresponds with the freezing-point of the compound AB. In spite of the increased complexity of the diagram, the relations are very similar to those which characterize the simpler form, and complex diagrams of this kind can be resolved into a series of simple diagrams by drawing vertical lines through the points which correspond with the several compounds formed. If three such compounds A_2B, AB and AB_2 are formed, this process leads to four separate freezing-point diagrams, for which the components are A and A_2B, A_2B and AB, AB and AB_2, and AB_2 and B respectively. Fig. 9 shows the relations for water and sulphur trioxide where five compounds are formed. It frequently happens that a solid compound decomposes into its components below its melting-point. This is the case for Glauber's salt, $Na_2SO_4,10H_2O$, which decomposes at 32·38° C. When such changes occur, the freezing-point diagram shows one curve only for the compound.

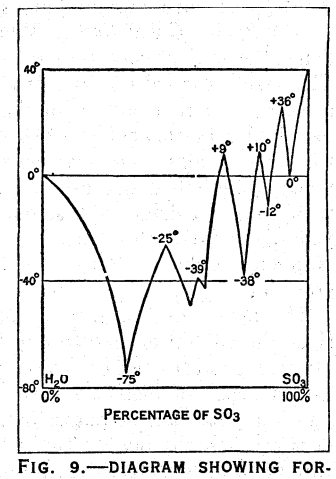


FIG. 9.—DIAGRAM SHOWING FORMATION OF FIVE COMPOUNDS BETWEEN WATER, AND SULPHUR TRIOXIDE, OF MELTING POINTS −25°C, −139°C, +9°C, +10°C, AND +36°C, WITH CORRESPONDING FUSING POINTS

Changes, very similar to those which characterize the equilibria between solid and liquid phases, also occur in systems which are entirely solid, and these are largely responsible for the variations which are found in the properties of solid mixtures such as the alloys (*q.v.*). An exact knowledge of the equilibrium relations is of the greatest importance, for the properties of such solids depend not only on the composition but on the constitution as represented by the phase equilibria. The changes produced in the physical properties of alloys by thermal and mechanical treatment are often directly due to changes in the phase equilibria.

BIBLIOGRAPHY.—*General:* W. C. McC. Lewis, *A System of Physical Chemistry* (2nd ed. 1919); *A Treatise on Physical Chemistry,* ed. by H. S. Taylor (1924); A. Eucken, *Fundamentals of Physical Chemistry,* trans. by E. R. Jette and V. K. La Mer (1925); J. Walker, *Introduction to Physical Chemistry* (9th ed. 1922); E. W. Washburn, *An Introduction to the Principles of Physical Chemistry* (2nd ed. 1921); W. Nernst, *Theoretical Chemistry,* trans. by D. W. Codd (1923). *Special:* A. Findlay, *The Phase Rule and its Applications* (6th ed. 1927); H. W. B. Roozeboom, *Die heterogenen Gleichgewichte,* vols. i. and ii. (i.); E. H. Büchner, *ibid.,* vol. ii. (ii.); A. H. W. Aten, *ibid.,* vol. ii. (iii.); F. A. H. Schreinemakers, *ibid.,* vol iii. (i. and ii.) (Brunswick, 1901–18); S. Young, *Stoichiometry* (2nd ed. 1918); S. Smiles, *Relations between Chemical Constitution and some Physical Properties* (1910); G. Le Bas, *Molecular Volumes of Liquid Chemical Compounds* (1915); S. Young and others, *Distillation Principles and Processes* (1922); E. B. Loeb, *Kinetic Theory of Gases* (1927); J. Perrin, *Atoms,* trans. by D. L. Hammick (1916); *Brownian Movement and Molecular Reality,* trans. by F. Soddy (1910); G. Tammann, *Aggregatzustände* (Leipzig, 1923); W. H. and W. L. Bragg, *X-Rays and Crystal Structure* (4th ed. 1924). (H. M. D.)

ANALYTICAL CHEMISTRY

The specific purpose of analytical chemistry is the resolution of a compound or mixture into its constituent parts or elements by methods which are *qualitative* when the nature only of these constituents is determined, or *quantitative* when their actual quantity or proportion is ascertained. The methods of chemical analysis may be classified as *dry,* consisting of the examination of the substance in the dry state, and *wet,* in which a solution of the substance is treated with other substances of known character, termed *reagents,* to promote a chemical change or *reaction* whereby a new compound of distinctive properties is produced. In quantitative work the methods of analysis may be subdivided into (*a*) *gravimetric,* in which the constituent to be determined is either isolated as such, as in the case of electrolysis, or as a compound of definite chemical composition; (*b*) *volumetric,* in which the volume of a reagent solution of known strength required to produce a certain definite reaction is measured. Colorimetric and gasometric methods are, strictly speaking, branches of volumetric analysis, as indeed is gas analysis (*see* below). Microchemical methods, which, however, involve a special technique, have been developed both on the qualitative and quantitative sides.

INORGANIC ANALYSIS

Analytical chemistry, upon which all other branches of the science are ultimately dependent, has its source in the writings of the chemist-pharmacists of the iatrochemical period. Tachenius recognized many metals in solution together by their reactions in the wet way, but it was not until the phlogistic period that any systematic progress was made, more particularly by Boyle, to whom we owe the term *analysis.* Many of the reactions still utilized in qualitative work were known to Boyle, who also introduced certain plant extracts, notably litmus, for the recognition of acids and bases. Other workers of this period were Hofmann, Marggraf (who introduced the microscope into chemistry), Scheele, and especially Bergman, who devised methods by which the metals might be separated into groups according to their behaviour with certain reagents. The blowpipe (*q.v.*) was introduced into dry qualitative analysis by the mineralogist, Cronstedt, who applied it to the examination of ores, although it was left to Berzelius and Hausmann to bring about its general application. The colorations which sodium and potassium salts impart to the flame were known to Marggraf, but it is to Bunsen, who, with Kirchhoff, devised spectrum analysis, that the full value of the flame test is due.

While the work of the phlogistic period in this field was mainly of a qualitative character, some attempts of a quantitative nature

were made by Marggraf and Black, while Bergman realized that elements need not be separated as such but might be isolated in the form of some suitable insoluble compounds. Klaproth, who with Vauquelin developed the quantitative analysis of minerals, proposed the ignition of precipitates before weighing them, if they were not decomposed thereby. Lavoisier, with his grasp of the importance of the composition by weight of chemical compounds, and because of his systematic use of the balance, must be considered as the first great exponent of quantitative analysis. The substantiation by Richter, and, independently by Proust, of the law of constant proportions and the formulation of the atomic theory by Dalton combined to give a fresh impetus to the development of quantitative analysis, subsequently placed on a firm basis by Berzelius. The later researches of Rose, Wohler and Fresenius standardized various methods of analytical chemistry.

The quantitative precipitation of metals by the electric current, although known to Faraday, was not applied to analytical chemistry until Gibbs, in 1865, worked out the electrolytic separation of copper. Since then the subject has been extensively studied, more particularly by Classen.

Volumetric analysis, possessing as it does many advantages over the gravimetric method, especially in technical work, was founded by Gay-Lussac, although rough application had been previously made; the advantages of his carefully worked out methods of chlorimetry (1824), of alkalimetry (1828), and of the chloride–silver titration (1832) were but slowly recognized. It was not until the application of potassium permanganate to the estimation of iron by Margueritte (1846) and of iodine and sulphurous acid to the estimation of copper and many other substances by Bunsen, that volumetric methods took their proper place alongside the gravimetric. Since that time, these methods have been rapidly developed, particularly by Mohr and Volhard.

The technique of quantitative micro-analysis has been developed mainly by Pregl, although Emich had previously indicated the possibility of working with small amounts of inorganic materials. The same basic principles and methods hold as for macro-analysis, but apparatus and manipulation are necessarily modified when quantities of the order of a few milligrams only are being handled. The same period has seen the advance of the method of potentiometric titration, although this was first put forward in the case of acids and alkalis by Böttger as early as 1897.

Qualitative Inorganic Analysis.—Any inference drawn from the results of the qualitative examination of a substance, whether by dry or wet methods, must always be confirmed by further tests; moreover, it should not be overlooked that the normal course of a particular reaction may be completely prevented by the presence of interfering substances.

Dry Methods.—(1) *Effect of Heat.*—The substance when heated in a hard glass tube may evolve water, condensing on the cooler parts of the tube, derived from substances containing water of crystallization or of constitution and from certain ammonium salts. Its reaction to litmus paper should be observed; alkalinity is probably due to ammonia, acidity to readily decomposable salts.

Oxygen results from the decomposition of peroxides, chlorates, nitrates, iodates and similar oxygenated compounds, and also from oxides of the noble metals; carbon dioxide from carbonates and organic substances, usually accompanied in the latter case by charring; sulphur dioxide from many sulphides and thiosulphates. Chlorine, bromine and iodine are evolved from certain halide salts, particularly in the presence of oxidizing agents; oxides of nitrogen from nitrates. Some cyanides evolve cyanogen or hydrocyanic acid and possibly ammonia in the presence of water. All fluosilicates (silicofluorides) are decomposed on heating, evolving silicon fluoride.

A white sublimate is given by ammonium halide salts, mercurous chloride and bromide, oxides of arsenic; a yellow sublimate may consist of sulphur (reddish brown when molten), arsenic sulphide and mercuric iodide (turning red on rubbing). A blackish deposit results from the condensation of violet iodine vapour or of mercuric sulphide, while most mercury compounds other than those mentioned give a grey deposit. Metallic mercury and arsenic appear as minute globules and a grey mirror.

Colour changes on heating and cooling afford useful information; zinc oxide, titanium dioxide and stannic oxide are of yellow tone when hot, becoming white or whitish on cooling. Lead and bismuth oxides are, short of fusion temperature, brownish red when hot and yellow when cold. The oxides of manganese, cadmium, copper and iron also supply information by this test. All salts of organic acids are decomposed on ignition, usually with charring; the base will be left as carbonate, as oxide, or even reduced to the metallic state, according to the particular metal present.

(2). *Blowpipe Tests.*—The substance is heated in a hollow on a charcoal block in the reducing flame of a blowpipe. Oxygenated salts such as chlorates and nitrates cause deflagration; salts of the alkali metals tend to fuse into the charcoal. The oxides or stable salts of the alkaline-earth metals and of magnesium, zinc, and aluminium give an infusible residue, white when cold, which in the case of strontia, lime, magnesia or zinc oxide glows brightly in the blowpipe flame. The infusible mass is then moistened with cobalt nitrate solution and again heated; a pink coloration indicates magnesia (with a tendency to violet if present as phosphate or arsenate), a green colour is afforded by zinc oxide, while a blue suggests aluminium, possibly silica, or alkaline-earth phosphates. If any other reaction occurs on this direct heating, it is better to carry out a further more decisive test on a mixture of the substance with sodium carbonate. Metallic globules are obtained with copper, gold, silver, lead, tin, bismuth and antimony, together with formation of incrustations in the case of silver, lead, tin, bismuth and antimony; arsenic and cadmium also give analogous incrustations.

(3). *Bead Tests.*—The colourless fluxes obtained by fusing borax (for coloured salts) or microcosmic salt (for silica, or if the substance is white) on a loop of platinum wire are capable of dissolving many metallic salts, often with production of characteristic coloured glasses or enamels; the colour may differ according as the bead is heated in the oxidizing or the reducing flame. Chromium gives a green, cobalt a blue bead; copper in the oxidizing flame a bead, green when hot, blue on cooling, and with a tendency to red in the reducing flame. Iron gives yellow and greenish; nickel, brownish and yellow-grey; uranium and vanadium, yellow and green; manganese, violet and colourless, in the oxidizing and reducing flames respectively. Silica with microcosmic salt usually, but not invariably, gives a semi-transparent bead.

(4.) *Flame Colorations.*—When volatilized in a non-luminous flame, the salts of certain metals display characteristic colorations. This test is carried out by introducing into the flame by means of a platinum wire a portion of the substance, preferably moistened with hydrochloric acid, since the chlorides are comparatively volatile salts. Sodium gives an intense yellow coloration, potassium violet, rubidium and caesium bluish-violet (the latter blue when really pure), calcium red, strontium and lithium crimson, barium yellowish-green and copper bright green; while lead, arsenic and antimony (which should not be tested on platinum) give a greyish-blue.

The utility of this test is not confined to direct observation, since the coloration due to one metal may completely mask that of others, and for such cases the use of light filters is of assistance. Cobalt glass completely absorbs the sodium yellow and thus permits the detection of potassium. The lithium and strontium colours are not cut out by this blue glass; a saturated solution of chrome alum effectively cuts out colorations due to sodium, calcium, barium, lithium and strontium and transmits only those due to potassium, caesium and rubidium; solutions of permanganate and indigo-carmine also cut out the sodium colour.

More definite, however, is the information afforded by observation of the flame through the spectroscope, which is of particular value for ascertaining the purity of precipitates obtained in quantitative work. Of the rarer metals which give flame colorations, indium (blue) and thallium (green) were discovered by means of the spectroscope, as indeed were also rubidium and caesium. The instrument is applicable to the detection of many other metals by examination of their spark spectra.

Wet Methods.—In qualitative analysis of a substance by wet

methods it is necessary to obtain it in solution. Portions should be successively tested with water, dilute acids, strong acids and aqua regia (*q.v.*), first in the cold and then with warming. For substances insoluble in all these reagents, fusion with sodium carbonate alone or in admixture with potassium nitrate, followed by acidification, must be employed. In certain cases sodium peroxide or potassium bisulphate (pyrosulphate) may be used, while for the investigation of some refractory silicates treatment with hydrofluoric acid in the presence of sulphuric acid is useful.

The procedure for the detection of metals in solution consists of separating them first into groups by means of volatile reagents; the group precipitates are then examined separately. From the cold solution, not too concentrated, hydrochloric acid (if this has not already been used in effecting solution) precipitates lead (in part), silver and mercurous salts. The filtrate is rendered nearly neutral and sulphuretted hydrogen passed in to saturation; this causes mercury (-ic), lead (incompletely removed in the foregoing operation), copper, bismuth, cadmium, arsenic, antimony and tin to be precipitated as sulphides; the filtrate from these is boiled until free from sulphuretted hydrogen, finally with addition of enough oxidizing agent such as nitric acid to convert iron from the ferrous to the ferric state. Ammonium chloride and ammonia are now added to precipitate aluminium, chromium, iron and titanium as hydroxides; if phosphoric acid is present, however, these metals are precipitated in part or wholly as phosphates, possibly together with some of the metals of later groups. In this case the precipitate is dissolved in a minimum of hydrochloric acid, a portion of the solution being specially tested for iron, and the remainder boiled with ammonium acetate and a slight excess of ferric chloride, whereby the phosphates are completely eliminated as ferric phosphate, together with the excess of iron as basic acetate; the filtrate is combined with that from the ammonia precipitation. It may be noted that some other acid radicals, *e.g.*, fluorides, borates and silicates, also interfere by precipitation at this stage, while in the presence of certain organic compounds, such as tartaric acid, precipitation in this group may be completely inhibited. From the filtrate from the iron group, ammonium sulphide precipitates nickel, cobalt, zinc and manganese, to the filtrate from which ammonium carbonate is added. A precipitate is obtained in the presence of calcium, barium and strontium, leaving sodium, potassium and magnesium in solution, the last of these metals not being precipitated by ammonium carbonate in the presence of ammonium salts. This completes the separation into groups.

Group I.—The white precipitate formed by cold hydrochloric acid is boiled with a considerable quantity of water, and the solution filtered immediately; lead chloride dissolves and may be identified by the yellow precipitate, insoluble in acetic acid but soluble in caustic soda, formed with potassium chromate. The residue on the filter paper is digested with ammonia, whereby silver chloride passes into solution, leaving a black residue of indefinite composition which retains the mercury. Silver chloride is reprecipitated from the ammoniacal solution by nitric acid.

Group II.—The precipitate formed by sulphuretted hydrogen may contain the black mercuric, lead and copper sulphides, dark brown bismuth and stannous sulphides, yellow cadmium and arsenic sulphides, orange-red antimony sulphide, dirty yellow stannic sulphide and whitish sulphur, this last resulting from the action on sulphuretted hydrogen of oxidizing agents such as ferric salts, chromates, nitrates, etc. Warming with yellow ammonium sulphide dissolves out the arsenic, antimony and tin sulphides, which are reprecipitated from the solution of sulpho-salts, after filtration, by addition of hydrochloric acid; tin is always reprecipitated as yellowish stannic sulphide. If traces of copper are being looked for, sodium sulphide should be used for this extraction; polysulphides are necessary to dissolve stannous sulphide. The mixture of the three sulphides is digested with warm ammonium carbonate solution, which dissolves the arsenic; this is reprecipitated on acidifying, after filtration, and confirmed by due tests. The residual sulphides of antimony and tin are dissolved in strong hydrochloric acid and these two elements tested for individually. When arsenates are present it is preferable to add sufficient sulphurous acid solution to reduce them to arsenites before passing in sulphuretted hydrogen.

The residue from the ammonium or sodium sulphide digestion is warmed with moderately dilute nitric acid, which dissolves the remaining sulphides, other than that of mercury, with separation of sulphur. A little sulphuric acid is added to the solution, together with an equal volume of alcohol; any white precipitate is lead sulphate. As the alcohol must now be boiled off, it is advisable to test separately for lead; if this metal is absent alcohol need not be used. Ammonia in excess added to the filtrate from the lead precipitates white bismuth hydroxide; in the event of the filtrate being colourless, direct passage of sulphuretted hydrogen precipitates yellow cadmium sulphide. A blue filtrate from bismuth indicates copper, and in this case sufficient potassium cyanide must be added to destroy the blue colour before testing for cadmium.

Group IIIa.—In the absence of phosphates (the presence of which is readily ascertained by warming with ammonium molybdate in nitric acid solution) this group consists of the gelatinous hydroxides of titanium and aluminium (white), iron (red-brown) and chromium (greenish), usually accompanied by a little zinc (especially when chromium is present) and manganese, and possibly traces of the group IV. metals precipitated by carbonate present in the ammonia. (To avoid this last contamination in quantitative work hexamethylenetetramine has been suggested in place of ammonia.) The precipitate is dissolved in a little hydrochloric acid; titanium is readily detected in a portion of the solution by the yellow colour it affords with hydrogen peroxide in acid solution. Another portion of the solution is tested for iron with potassium ferrocyanide (blue precipitate) or thiocyanate (deep red coloration), while the third portion is boiled with sodium peroxide until the excess of reagent is decomposed; this dissolves aluminium and chromium hydroxides, the latter being converted to the yellow chromate. By boiling the filtered solution with an excess of ammonium chloride, aluminium hydroxide is again precipitated.

Group IIIb includes the sulphides of cobalt and nickel (black), of zinc (white) and of manganese (usually buff coloured). The precipitate is digested with cold dilute hydrochloric acid and the solution filtered; the filtrate, which contains zinc and manganese, is boiled to expel sulphuretted hydrogen, and then hydrogen peroxide is added, followed by ammonium chloride and ammonia to precipitate manganese as a dark brown hydroxide. Zinc is detected in the filtrate by reprecipitation as sulphide, after decomposition of the peroxide by boiling. The presence of cobalt is readily ascertained in the black residue from the hydrochloric acid digestion by the borax bead test; the remainder of the sulphides is then dissolved in a little aqua regia, the solution diluted and rendered ammoniacal and an alcoholic solution of dimethylglyoxime added. Nickel is indicated by a yellow coloration, followed almost immediately by a red flocculent precipitate; in the presence of cobalt the filtrate is brown, turning deeper and redder on addition of ammonium sulphide.

Group IV.—The precipitated carbonates are dissolved in a little dilute hydrochloric acid and the flame test applied. To a portion of the solution, calcium sulphate solution is added; if precipitation is immediate, barium is indicated, but if delayed, strontium. In the absence of any precipitation, the remainder of the original solution is tested for calcium by addition of ammonia and ammonium oxalate. If, however, barium is present, ammonium acetate is added, followed by potassium chromate to precipitate barium chromate; strontium and calcium are again precipitated as carbonates and then dissolved in the minimum quantity of hydrochloric acid. Ammonium sulphate now serves to precipitate strontium, the filtrate from which is tested for calcium by means of ammonium oxalate as noted above.

Group V.—The basic radicals not precipitated by group reagents comprise magnesium, sodium, potassium and ammonium. The solution is evaporated to dryness and the residue heated to dull redness until cessation of fumes indicates that all ammonium salts have been expelled. The residue is dissolved in water and a portion tested for magnesium by the addition of ammonium chlo-

ride, ammonia and sodium phosphate. The presence of sodium and potassium is indicated by a flame test, but the introduction of sodium through the medium of the reagents must not be overlooked; potassium may be confirmed by precipitation as platinichloride or cobaltinitrite, while ammonia is tested for by boiling a portion of the original substance with caustic soda solution.

Alternative schemes of separation exist, and there are also numerous confirmatory tests for individual metals. It should be emphasized that any inference drawn from the result of the application of a particular group reagent presupposes the absence of all metals belonging to previous groups. The system outlined above includes only the commoner bases, but each of the rarer metals falls into one or other of the groups and for the sake of completion, these are now given without further comment than that the presence of these metals of necessity complicates the identification scheme described above.

Group I.—Thallium (-ous).

Group II.—Gold, the platinum metals, germanium, vanadium, tungsten, molybdenum, selenium, tellurium.

Group IIIa.—Uranium, beryllium, zirconium, hafnium, gallium, indium, thorium, columbium, tantalum, scandium, cerium and the other "rare-earth" metals.

Group IIIb.—Thallium (-ic).

Group IV.—Radium.

Group V.—Caesium, rubidium, lithium.

Acid Radicals.—The detection of acid radicals does not lend itself to such a systematic serial procedure as that available for the bases. Rose noted the nature and colour of the precipitates obtained in neutral and acid solutions with barium chloride, silver nitrate, mercurous nitrate and calcium chloride on separate portions of the solution. The method mostly in use, however, is that due to Bunsen, who divided the acid radicals into groups according to the solubility of the silver and barium salts. It is generally desirable to carry out these tests after removal of the heavy metals by suitable treatment with sodium carbonate; moreover, the solution should not be too strong.

Group I.—Silver salts insoluble in water and in nitric acid; barium salts soluble in water:—Chloride, bromide, iodide, ferro- and ferri-cyanide, thiocyanate, hypochlorite.

Group II.—Silver salts insoluble in water but soluble in nitric acid; barium salts soluble in water:—Sulphide, selenide, telluride, nitrite, acetate, cyanate, hypophosphite.

Group III.—Silver salts (*a*) white, (*b*) coloured, and soluble in nitric acid; barium salts insoluble in water but soluble in nitric acid:—(*a*) Sulphite, selenite, tellurite, phosphite, carbonate, iodate, borate, molybdate, selenate, tellurate, meta- and pyrophosphate; (*b*) phosphate, arsenate, arsenite, vanadate, thiosulphate, chromate, periodate.

Group IV.—Silver salts soluble, barium salts insoluble in nitric acid:—Sulphate, fluoride, fluosilicate (silicofluoride).

Group V.—Both silver and barium salts soluble:—Nitrate, chlorate, perchlorate, manganate, permanganate.

Group VI.—Non-volatile acids forming soluble alkali salts only:—Silicate, tungstate, titanate, columbate, tantalate, zirconate.

The acid radicals having been placed in their appropriate groups, special tests for the individuals are applied which cannot be detailed here. It is interesting to note that certain pairs of salts or free acids are incompatible in solution, thus iodic and hydriodic acids react to form iodine, hypochlorite and sulphite give chloride and sulphate, hydrosulphuric and sulphurous acids liberate sulphur.

Quantitative Inorganic Analysis.—While, broadly speaking, the methods of quantitative inorganic analysis by chemical means follow the lines outlined above in the qualitative scheme by wet methods, the many devices which are resorted to for the purpose of procuring clean and sharp separations and of ensuring that precipitates are obtained in a form most suitable for manipulation are learned by experience. In general, volumetric processes are quicker, especially where many samples of similar nature are being dealt with, but it is, at the least, unwise to apply such methods to a substance of unknown composition. For small quantities, colorimetric or gravimetric methods are preferable, while for large amounts and for precision work gravimetric processes have the advantage that the product isolated and weighed may be examined as to purity.

Gravimetric.—In the ordinary course of events, gravimetric analysis by chemical methods is made up of the following operations: a solution of the weighed substance is treated with a particular reagent which precipitates the constituent to be determined in a suitable form, this is then filtered, washed and finally weighed after requisite treatment. Certain precipitations are best effected from hot solutions, others from cold; in some cases filtration may be carried out almost at once, whilst in others the precipitate should remain in contact with the liquor for several hours.

Filtration is effected by means (1) of folded paper discs of various texture specially prepared for the purpose; (2) of a pad of asbestos supported in a special form of crucible such as that designed by Gooch; or (3) of a porous "sintered" glass diaphragm fused into glass tubing. Whichever means is adopted, it is essential that the filtering medium should be subjected to the same heat treatment before the preliminary weighing as it will be subsequently (except when paper is to be incinerated).

Washing is generally necessary for the purpose of removing substances which are to be determined subsequently or which will interfere with the treatment of the precipitate, but at the same time it must not be carried too far. No substance is completely insoluble, and many of the compounds utilized in analytical work are appreciably soluble, even in the wash-liquors specially devised for use with them; it may even be necessary to apply correction for this solubility. In the case of heavy crystalline precipitates which settle readily, most of the washing can be carried out by decantation; precipitates which are light or bulky and gelatinous are transferred to the filter, the last traces being removed by mechanical means if necessary, and there washed by repeated treatment with water or other liquor. The filter should be allowed to drain as completely as possible between washings.

The precipitate is prepared for weighing by drying in an oven maintained at a definite temperature or by more drastic heat treatment. In the case of a precipitate on paper, ignition in a crucible may sometimes be carried out without any preliminary drying, sometimes after drying in a hot air-oven, while occasionally it is necessary to burn the paper apart from the precipitate before completing the ignition. All vessels after heating must be allowed to cool thoroughly in a desiccator before weighing; platinum may be weighed after about 10 minutes' cooling, porcelain after 20 minutes'. In all cases, the appropriate heat treatment should be repeated until no change in successive weighings is recorded. From the amount of weighed product, which is of known definite chemical composition, the quantity of the constituent sought may be calculated. Blank tests should be made on the reagents, as these may introduce small quantities of the particular constituent which it is desired to determine.

Electrolytic.—Under the influence of the electric current, the ions of a metallic salt in solution are set into motion; those of the metal are impelled in the direction of the current and flow towards the cathode where, given favourable conditions, they may finally be completely deposited as a coherent film of metal in a form suitable for weighing. Factors such as current density, time, temperature, hydrogen-ion concentration, nature of the electrodes and of the electrolyte must, however, all be taken into account.

Where readily applicable, electrolytic methods have much in their favour, especially their simplicity and cleanliness. Perhaps the most generally applied determination is that of copper, especially in its various alloys with zinc and tin; the solutions electrolyzed should be acid, though not too strongly so, with sulphuric or, more commonly, with nitric acid, this latter being used for the preliminary removal of tin. A rotating cathode of platinum gauze is the most convenient; the presence of a little hydrogen peroxide promotes the formation of a bright deposit, particularly from sulphuric acid solution. It is necessary to allow for bismuth which accompanies the copper. In solutions of the acidity required for deposition of copper, lead is completely deposited on the anode. If the quantity of lead is small, no great error is made

in considering the deposit as the dioxide; but should more than 2cg. of lead be present, the dioxide obtained may contain as little as 84% of lead, instead of the theoretical 86.6%. In such cases, or in any event if manganese also be present, the deposit should be dissolved from the anode, and converted into lead sulphate for weighing. Deposition of lead, however, from solutions containing a higher proportion of nitric acid than is permissible for copper, affords practically the correct dioxide.

Another useful electrolytic determination is that of zinc, especially in aluminium alloys of high zinc (12–14%) content. This is effected, after removal of copper, by electrolysis of the zincate solution, the aluminium being retained in solution by means of tartaric acid when the alkali is added. A gold rotating cathode is most convenient for this process; allowance must be made for traces of iron and manganese simultaneously deposited. The presence of chlorides, nitrates and ammonium salts is not permissible. In most other cases where electrolytic methods can be applied, preliminary separations by chemical means are necessary.

Volumetric Analysis.—The metric standard of volume, the litre, is the volume of 1kg. of pure water at the temperature of its maximum density, viz., 4° C., under standard barometric pressure; the one-thousandth part of this volume, the millilitre (ml.) is a convenient subsidiary standard which, it should be pointed out, is not identical with the cubic centimetre (cu.cm.). Actually 1 litre equals 1000·027 cu.cm., and although this difference is too small to be of practical importance, it is desirable from the point of view of strict accuracy that the term millilitre be generally adopted. Vessels marked "grm." or "gramme" are based upon the Mohr litre, which was taken as the volume of 1kg. of water as weighed directly in air at 15° C; the continuation of this system is not desirable, but in any case, such vessels may not be used in conjunction with those based on the true litre. 1 Mohr litre at 15° C=1001·95ml.

Calibrated glassware for volumetric work should not be accepted as correct unless checked or supplied with a reliable certificate of calibration; otherwise an accumulation of errors may result in a difference of several units per cent. The usual vessels are the flask, pipette and burette; the first of these when filled at 15° C to the graduation on the neck contains a specified volume, from which aliquot parts may be withdrawn by means of pipettes. Finally, the standard solution is, in general, run out from the burette, usually graduated in millilitres and tenths, until by appropriate signs visible to the eye or by electrical means, to which reference is made below, the reaction is found to be complete. This procedure is termed "titration."

The usual volumetric processes may be broadly divided into three classes: (*a*) acidimetric and alkalimetric; (*b*) oxidation and reduction; (*c*) precipitation methods. The strength of standard solutions is commonly expressed in terms of normality; a normal solution is one which contains in one litre that weight of the reagent which corresponds to 1·008g. of hydrogen or its equivalent, having regard to the particular reaction involved. This weight is either the molecular weight, expressed in grams, or some simple fraction thereof.

According to Arrhenius's Ionic Theory, salts do not exist in aqueous solution entirely as such but are split up more or less completely into their constituents or "ions"; thus a solution of hydrochloric acid is regarded as containing hydrogen and chlorine ions H· and Cl′, while sodium hydroxide exists in solution as Na· and OH′. The chemical reaction between these two bodies, $HCl+NaOH\rightarrow NaCl+H_2O$, is expressed ionically at $H\cdot+Cl'+Na\cdot+OH'\rightarrow Na\cdot+Cl'+H_2O$ or, by removing the terms common to both sides $H\cdot+OH'\rightarrow H_2O'$. The hydrogen ion and the hydrovyl ion are characteristic of acids and alkalis respectively and, so long as one or other of these predominates, the solution is said to be acid or alkaline in reaction. Indicators are very weak acids or weak bases whose colours in the ionized and in the non-ionized state differ; constitutional alterations may also come into account. These colour changes occur within limited ranges of hydrogen-ion concentration, varying with the particular indicator, and it is upon this principle that the use of indicators in acidimetry and alkalimetry depends. Of those in common use, it may be said in general that phenolphthalein should be used for the titration of weak acids with strong bases, and methyl-orange for weak bases with strong acids. Litmus and methyl-red are both sensitive to carbon dioxide; if these indicators are used when carbonates are present, it is necessary to expel the carbon dioxide by boiling. Bicarbonates react neutral to phenolphthalein; no indicator is suitable for the titration of weak bases with weak acids (*see* INDICATORS).

The numerous volumetric methods based on oxidation and reduction are often of considerable accuracy and ready application. Thus many metals form two (or more) series of salts differing in their degree of oxidation and which may be converted one to the other by means of appropriate oxidizing or reducing solutions of known strength. The oxidizing agents in most general use are potassium permanganate, iodine and potassium dichromate; others employed for more special purposes are potassium bromate, iodate and ferricyanide.

Solutions for oxidations with potassium permanganate and dichromate must be sufficiently acid; with the former the presence of sulphuric acid is preferable to that of hydrochloric acid, although the reducing effect of this on the permanganate is practically negligible in very dilute cold solutions, especially in the presence of manganous sulphate. With permanganate, the end point of the titration is readily observed by the lasting pink colour imparted to the solution; in the case of dichromate the end point may be noted by the use of an external indicator solution or preferably by using diphenylamine as an internal indicator. Iodine forms with starch a deep blue compound, which serves to indicate the presence of a very small quantity of the oxidizing agent; this reagent is used in conjunction with sodium thiosulphate, less frequently with sodium arsenite.

Solutions of reducing agents do not maintain their strength so well as oxidizing agents, but they may be preserved fairly well in a suitable apparatus in which air is replaced by an inert gas such as carbon dioxide. Stannous and chromous chlorides are used and more especially titanium trichloride or sulphate. These last are very powerful reagents of extensive application. In the precipitation methods of volumetric analysis, the standard reagent may be added until no further precipitation occurs, until a precipitate just appears, or until the end point is shown by means of an indicator, internal or external, with which a small excess of the reagent produces a characteristic change. The majority of the determinations in this category belong to the third type; thus chloride is titrated with silver using potassium chromate or fluorescein as indicator, silver with thiocyanate in nitric acid solution using a ferric salt as indicator.

The end point in volumetric work may also be found in many cases by *potentiometric* methods. These depend upon the fact that when a metal or hydrogen is brought into contact with solutions containing these same substances in the ionized state, a difference of potential is set up, the magnitude of which varies with the nature of the substances in contact and with the concentration of the ions in solution. As titration proceeds it generally happens that the potential difference, measured by suitable electrical means, undergoes a marked change at the end point, which may thus be determined. The method can be applied to acidimetric, reducing and oxidizing reactions, but in general holds little advantage over the older processes, the basic principle being the same in each case. The potentiometric method is, however, of especial value for the determination of hydrogen-ion concentration (*q.v.*), the importance of which in analytical as well as other work is becoming increasingly recognized.

Colorimetric Methods.—Colorimetric methods are of extreme value for the accurate determination of traces of certain substances, although interference may be caused by the presence of other compounds which develop colours with the reagent or which inhibit the required reaction. A comparison is made between tints developed from the test solution and those from a definite volume of a standard solution, the amount of which is adjusted until the colours are identical. By this method traces of bismuth may be estimated by reaction with potassium iodide; titanium with hydrogen peroxide; lead as sulphide; copper with ammonia or with ferrocyanide; iron with thiocyanate or with ferrocyanide;

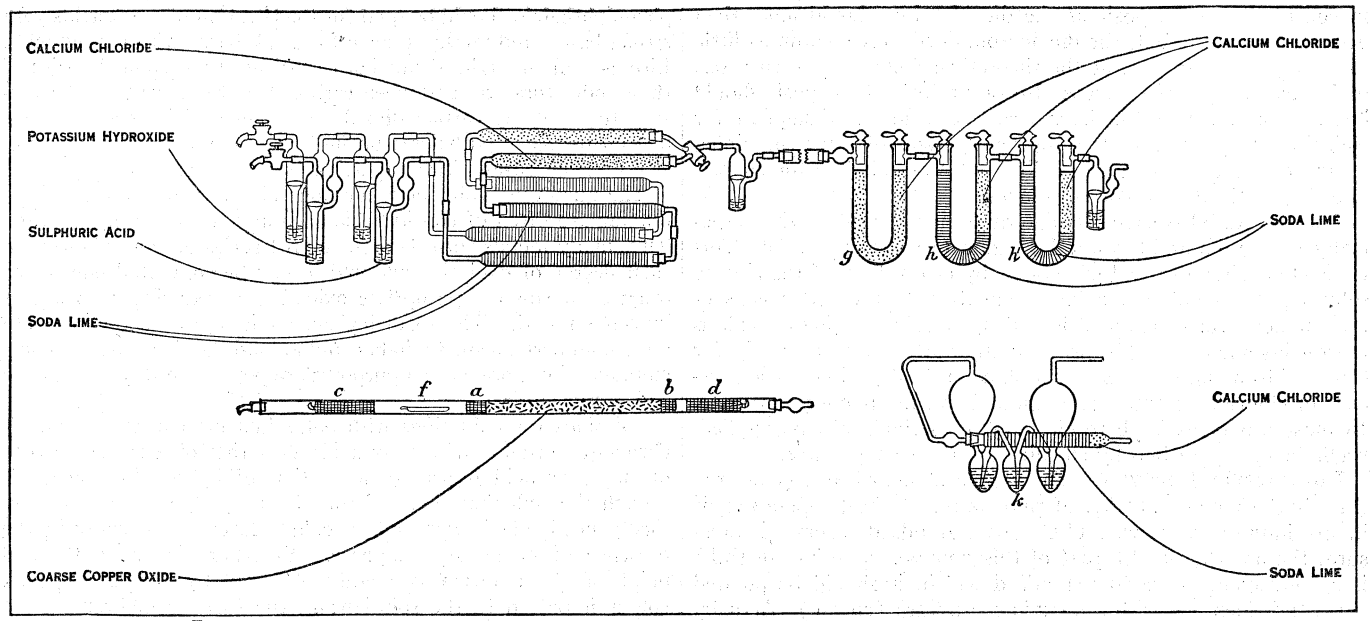


FIG. 1.—APPARATUS FOR QUANTITATIVE ESTIMATION OF CARBON AND HYDROGEN IN AN ORGANIC COMPOUND
The principle depends on oxidizing a weighed quantity of the compound and then weighing the resultant dioxide and water

manganese as permanganate; ammonia with Nessler's reagent.

The most suitable methods for the estimation of any element will be found in the article devoted to that element.

BIBLIOGRAPHY.—W. Crookes, *Select Methods in Chemical Analysis* (4th ed., 1905); H. J. H. Fenton, *Notes on Qualitative Analysis* (4th ed. 1906); J. W. Mellor, *Treatise on Quantitative Analysis* (1913); E. B. R. Prideaux, *Theory and Application of Indicators* (1917); E. Knecht and E. Hibbert, *New Reduction Methods in Volumetric Analysis* (2nd ed. 1918); W. R. Schoeller and A. R. Powell, *The Analysis of the Rarer Elements* (1919); A. Classen, *Quantitative Chemical Analysis by Electrolysis*, Eng. trans. W. T. Hall (1919); C. R. Fresenius, *Qualitative Analysis*, Eng. trans. C. A. Mitchell (1921); F. Sutton, *Volumetric Analysis* (11th ed. 1924); F. P. Treadwell, *Analytical Chemistry: I. Qualitative Analysis, II. Quantitative Analysis*, Eng. trans. W. T. Hall (6th ed. 1924); H. Bassett, *Theory of Quantitative Analysis* (1925); I. M. Kolthoff and N. M. Furman, *Potentiometric Titration* (1926) and *Indicators* (1926). (B. A. E.)

ULTIMATE ORGANIC ANALYSIS

The limited number of elements (carbon, hydrogen, oxygen, nitrogen, sulphur, halogens and occasionally phosphorus and some metals) employed by nature in building up her vast store of organic compounds would suggest that the analyses of such substances are simple operations, and this is true in so far as the determination of the elements present, their relative proportions, and the molecular complexity of the compound are concerned. Naturally such information tells us nothing of the *structure* of the compound and, indeed, leaves us much in the same position as we should be in if we were interested in some building and were supplied with the builder's estimate for material while denied access to the architect's drawings and plans. The problem of determining the manner in which the elements present in organic compounds are arranged, important as it is, lies outside the scope of the present article, which is limited to the description of the ultimate analysis. With the exception of oxygen, all the elements present in organic compounds can be estimated readily; oxygen is nearly always determined by difference, and in view of this fact it is of great importance that a careful qualitative examination be made of a substance, otherwise the results of the quantitative analysis may be interpreted erroneously.

Qualitative Tests for the Elements.—*Carbon and Hydrogen.*—The organic nature of a compound is generally indicated by its behaviour on being heated in air; solids usually melt, then burn with a more or less smoky flame, leaving a black residue of carbon. To test directly for carbon and hydrogen, a small quantity of the material intimately mixed with about 20 times its bulk of dry copper oxide powder is heated in a dry test-tube closed by a cork carrying a delivery tube which dips into a solution of lime-water. The copper oxide is reduced, the hydrogen being oxidized to water which bedews the cool part of the tube, and the carbon oxidized to carbon dioxide which forms a precipitate of chalk in the lime-water.

Nitrogen, Halogens, Sulphur.—When organic compounds containing any or all of these elements are heated strongly with metallic sodium they are decomposed with the formation of sodium cyanide, halide and sulphide, respectively (Lassaigne's test). To test for these elements, therefore, 1mg. of the substance and a small pellet of sodium (or potassium) are heated in a narrow test-tube, gently at first and afterwards more strongly, until the glass softens; the hot tube is shattered by plunging it into water, which converts any residual sodium into sodium hydroxide, yielding an alkaline solution of the sodium salts, which is boiled and filtered, and the filtrate is used in the following tests:—

(*a*) Nitrogen.—A portion of the filtrate is mixed with a solution of ferrous sulphate containing a small quantity of the ferric salt and boiled, thereby converting any sodium cyanide present to ferrocyanide, which gives a bluish-green solution and a precipitate of Prussian blue on adding hydrochloric acid.

(*b*) Halogens.—A second portion of the alkaline filtrate is acidified with nitric acid and silver nitrate added, any precipitate of chloride, bromide or iodide, or a mixture of these, is examined in the usual manner. If the original substance contain also nitrogen or sulphur, the acid solution must be boiled to expel the hydrogen cyanide or hydrogen sulphide before adding the silver nitrate.

(*c*) Sulphur.—A third portion of the alkaline filtrate is tested for sodium sulphide (i.) by the formation of a deep violet colour when treated with a few drops of a freshly prepared solution of sodium nitroprusside; (ii.) by the evolution of sulphuretted hydrogen when acidified—this is readily detected by the odour and also by lead acetate test paper.

Phosphorus.—A small portion of the organic compound is intimately mixed with about ten times its bulk of a mixture of sodium carbonate and peroxide (2:3) and heated to fusion in a nickel crucible. The cold water extract of the melt is filtered, acidified with nitric acid, and tested for phosphoric acid with ammonium molybdate.

Metals.—(i.) Volatile metals. (*a*) Arsenic.—The presence of arsenic in an organic compound is usually revealed by the formation of a dull grey mirror of the metal on the walls of the test-tube when the compound is fused with sodium as in Lassaigne's test. (*b*) Arsenic and Antimony.—A small quantity of the compound is fused with a mixture of sodium carbonate and peroxide as in the test for phosphorus. The fused melt is extracted with water, acidified and tested with sulphuretted hydrogen. (*c*) Mercury.—

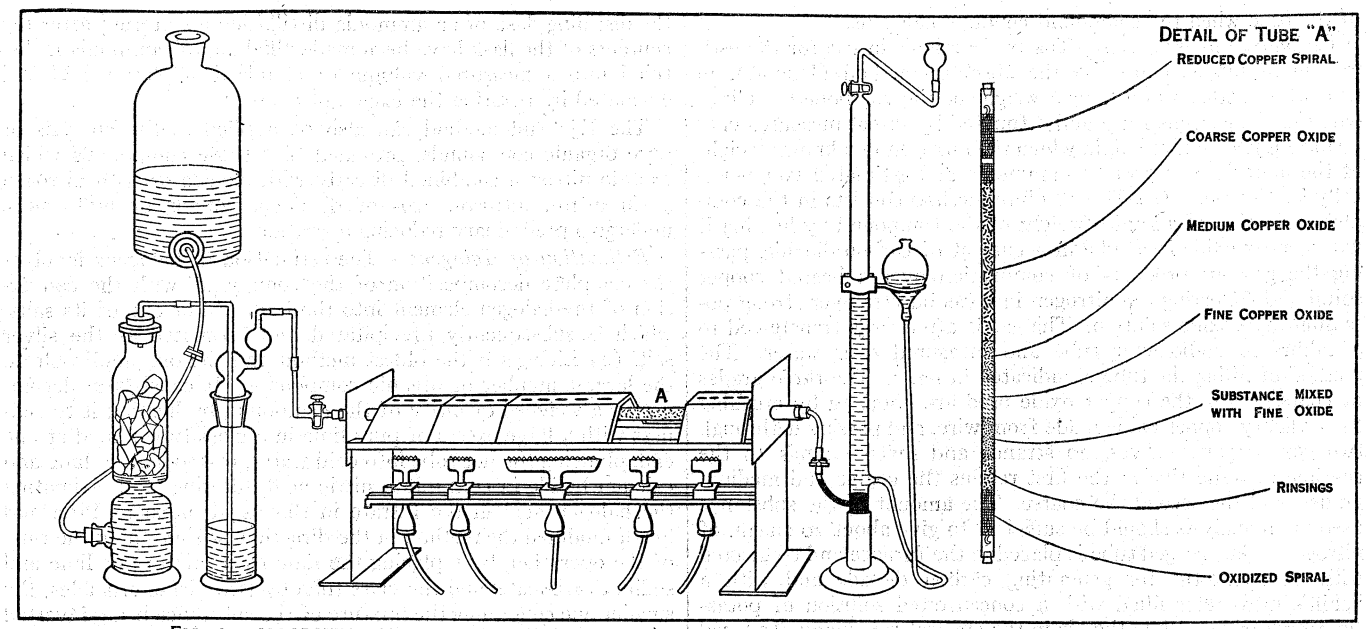


FIG. 2.—APPARATUS FOR ABSOLUTE METHOD (DUMAS) OF ESTIMATION OF NITROGEN IN AN ORGANIC COMPOUND
A known weight of the compound is heated with copper oxide in a current of carbon dioxide; the nitrogen evolved is collected over a strong solution of potassium hydroxide and then measured in a eudiometer tube

When an organic compound containing mercury is mixed with soda lime and heated in a long test-tube, a mirror of metallic mercury is formed.

(ii.) Non-volatile Metals.—Any of these metals that may occur in organic compounds are found as such or in the form of their carbonate or oxide in the ash left after the compound has been ignited on porcelain or silica. The ash is dissolved in dilute hydrochloric acid and the solution examined for metals in the usual manner (*see* section on "Inorganic Analysis").

Quantitative Analysis of Organic Compounds.—*Estimation of Carbon and Hydrogen.*—The carbon and hydrogen in an organic compound are estimated by completely oxidizing a weighed quantity of the substance and weighing the carbon dioxide and water thus formed. The simple method devised by Liebig in 1831 for carrying out this operation is in all essential principles the one still employed. A weighed quantity of the substance is heated in a tube filled with dry copper oxide, and the water and carbon dioxide are absorbed in weighed tubes filled with dried calcium chloride and potassium hydroxide solution or soda lime respectively. A current of dry air or oxygen is passed through the tube to sweep the products of combustion into the absorption apparatus. Fig. 1 shows the essential details of the apparatus required for these estimations; *a* and *b* are closely fitting, short spirals of copper gauze which serve to hold the copper oxide in position; the copper oxide is prepared by oxidizing copper wire; *c* and *d* are longer copper oxide spirals; *f* is the platinum or porcelain boat containing the weighed quantity of the compound.

In the absorption apparatus, the water is collected in the glass stoppered **U**-tube *g*, filled with calcium chloride (carefully freed from lime). The carbon dioxide is absorbed by the soda-lime contained in the **U**-tubes *h* and h^1, the second limb of each tube containing a short filling of calcium chloride. The two soda-lime tubes may be replaced by the apparatus *k*, of which the bulbs are charged with concentrated potassium hydroxide solution and the side tube filled with soda-lime and calcium chloride. The apparatus for purifying the current of air or oxygen is connected with the anterior end of the tube and consists of a series of washing cylinders charged with potassium hydroxide or sulphuric acid, and **U**-tubes filled with soda-lime or calcium chloride to remove moisture and carbon dioxide from the incoming gas. This apparatus is arranged in duplicate, one for the air and one for the oxygen supply. Any simple form of gas-heated furnace may be employed (fig. 2), or the tube may be heated electrically.

The combustion tube and its copper oxide charge are dried by heating the tube to a dull red heat for about an hour while a current of dry air is passed, the posterior end of the tube being protected by a calcium chloride tube. At the end of that time the fore part of the tube containing the oxidized spiral and the first six inches of copper oxide is cooled. While this process is in operation, the weighings are made. About 0·2gr. of the pure dry compound to be analysed is weighed into the platinum or porcelain boat if the compound is a solid or a non-volatile liquid. Volatile liquids are weighed in small thin glass bulbs drawn out to a capillary opening. The tubes for collecting the water and carbon dioxide are also weighed, and attached to the posterior end of the combustion tube. The boat and its contents are then introduced into the cooled anterior end of the combustion tube.

A slow current of air is passed through the tube, and the burners under the oxidized spiral in the rear of the boat are lighted. The heating is gradually extended towards the boat by moving forward the heated screen over the tube, or increasing the flame surface under the tube, the object being to distil the contents of the boat, or the volatile products of decomposition, on to the cold copper oxide where the combustion is completed. This most critical part of the operation must be carried out very slowly, and is finally completed in a current of oxygen which burns any residue of carbon left in the boat, and re-oxidizes the reduced copper oxide. After displacing by air the oxygen in the apparatus, the absorption tubes are removed, closed, cleaned and allowed to cool in the balance room before being re-weighed. From the weight of carbon dioxide and water yielded by the definite weight of the compound, the percentages of carbon and hydrogen in the compound are readily calculated.

The simple method described above applies to compounds containing carbon, hydrogen and oxygen only; if elements other than these are present the filling of the tube must be modified as follows: (*a*) *Nitrogen present.* The copper oxide spiral (*d*) is replaced by a similar spiral of freshly reduced copper to reduce any oxides of nitrogen that may be formed during the combustion. It is introduced into the end of the tube that has been previously cooled, before attaching the absorption apparatus. (*b*) *Halogens, sulphur or arsenic present.* The first six inches of copper oxide after the boat are replaced by a lead chromate cartridge, made by filling a hollow cylinder of copper gauze with freshly ignited fused lead chromate. The copper container becomes oxidized in the preliminary heating of the tube, non-volatile lead compounds being formed with the sulphur or arsenic in the compound, and sparingly volatile compounds with the halogens. A short spiral of silver gauze should, therefore, be introduced at the posterior end

of the tube when the compound contains halogens.

Estimation of Nitrogen.—The two methods in use for the estimation of nitrogen are (*a*) the absolute method (Dumas), in which the nitrogen in a known weight of the compound is eliminated in the gaseous form and estimated by direct measurement; (*b*) the Kjeldahl method, in which the nitrogen in a known weight of the material is reduced to ammonia and estimated volumetrically by titration. (*a*) The absolute method consists in the complete oxidation of a known weight of the compound by heating it with copper oxide in a tube in a current of carbon dioxide, passing the gaseous products of combustion over a heated copper spiral and collecting the nitrogen in a gas burette over strong potassium hydroxide solution. The gas is afterwards transferred to a calibrated eudiometer tube and measured over water. The method of filling the tube is indicated in fig. 2. The three grades of coarseness in the copper oxide used are obtained by crushing the ordinary copper oxide made from wire, and passing it through two copper gauze sieves, 20 strands and seven strands to the centimetre respectively; the first retains the coarse and medium grades, and the second the coarse. The amount of the substance used in an analysis should be sufficient to give about 20 cu.cm. of nitrogen. The charged tube is placed in the furnace and connected with an apparatus for generating carbon dioxide and with a Schiff's nitrometer filled with a concentrated solution of potassium hydroxide. While the air in the apparatus is being displaced by carbon dioxide, the part of the tube containing the coarse copper oxide and reduced spiral is heated to dull redness. When no insoluble gas collects in the charged nitrometer, the current of carbon dioxide is stopped, and the nitrometer is filled with the potassium hydroxide solution which is allowed to overflow into the thistle funnel seal attached to the end of the capillary transferring tube. The burners under the copper oxide spiral are then lighted, and when this part of the tube is at a dull red heat, the heating is extended towards the mixture of the substance with copper oxide, and so regulated that not more than three bubbles of gas are ascending the nitrometer tube at the same time. Finally, when all the burners are lighted, the tube has attained a uniform dull red heat, and there is no further evolution of gas, a slow current of carbon dioxide is again passed through the tube to sweep out the remainder of the nitrogen. The nitrometer is then removed, the gas reduced to atmospheric pressure, by bringing the liquid in the open arm of the nitrometer to the same level as that in the closed arm, and after about 15 minutes transferred to a eudiometer tube over boiled-out water, which is then completely immersed in a tall glass cylinder of water containing also a thermometer. After about ten minutes the volume of the nitrogen (v) the temperature (t) and the barometer (p) are read. If p' is the tension of aqueous vapour under these conditions and w denotes the weight of substance taken, the percentage of nitrogen in the compound is given by the expression

$$N = \frac{v}{w} \times \frac{273 \times (p - p') \times 0{\cdot}12507}{(273 + t) \times 760}.$$

(*b*) The Kjeldahl method is a modification of Will and Varrentrapp's method and is used for the estimation of nitrogen in such materials as foodstuffs, therapeutic substances, fertilizers, etc., in which the amount of nitrogen is small and many determinations have to be carried out simultaneously and rapidly. The method consists in decomposing the organic material by heating it with concentrated sulphuric acid; the carbon is oxidized and the nitrogen converted to ammonia which is retained as the sulphate, and afterwards estimated in the usual manner by distillation (*see* AMMONIA). A weighed quantity of the material (0·5 to 5·0gr.) is placed in a long-necked, pear-shaped flask of 500 cu.cm. capacity, 20 cu.cm. of concentrated sulphuric acid are added, the flask is clamped in an inclined position and the contents heated gradually to avoid frothing. After the acid has been boiling for about 15 minutes, 10gr. of potassium sulphate are added, and the heating is continued until the contents of the flask are clear and a faint straw colour. In cases of not easily oxidizable materials, small quantities of certain metallic salts such as copper or mercuric sulphate or mercurous iodide may be added. Finally the cold acid liquid is transferred, with the washings of the flask, into the distilling flask of an ammonia distillation apparatus; after the contents of the flask have been made alkaline, the ammonia is distilled into a measured volume of standard sulphuric acid and estimated by titrating the excess of acid.

The Kjeldahl method can also be applied to the analysis of pure organic compounds, provided that those compounds which contain nitrogen combined directly with oxygen or with nitrogen as in nitro-, nitroso-, azo- or diazo-compounds or hydrazines, undergo a preliminary reducing operation.

Estimation of Halogens.—The estimation of halogens involves the complete decomposition of the compound, with the conversion of the halogen element into the hydracid or one of its salts, which is subsequently precipitated and estimated as the silver salt. (*a*) Liebig's is the oldest method and the one applicable to the largest number of organic compounds. It consists in decomposing a weighed quantity of the compound by heating it to redness with a large excess of pure lime in a glass tube sealed at one end, plunging the hot tube into cold water, dissolving the lime and calcium halide in cold dilute nitric acid, filtering, and estimating the halogen acid in the filtrate in the usual manner. Piria and Schiff modified the method in the direction of shortening the time of the operation, by replacing the lime by a mixture of lime and sodium carbonate, and the glass tube by two nickel crucibles, the smaller one containing the mixture of the substance being inverted in the larger, and the annular space between the two filled with the lime and sodium carbonate mixture. (*b*) Stepanoff's method, as modified by Bacon, is applicable to compounds in which the halogen is readily eliminated as hydracid by hydrolysis or by reduction. It consists in heating a weighed quantity of the compound with sodium and alcohol, and estimating the sodium halide in the resulting solution. (*c*) The method of Carius, as modified by Kuster, is the one most generally employed; it consists in the destructive oxidation of a weighed quantity of the compound (about 0·2gr.) by means of fuming nitric acid (2 cu.cm.) in the presence of silver nitrate in a sealed tube at a temperature of 250°–270° C. The halogen is converted into the silver salt and weighed as such.

Estimation of Sulphur.—The estimation of sulphur in organic compounds involves the destructive oxidation of the substance whereby the sulphur is converted to sulphuric acid and weighed as the barium salt. The two methods in general use are:—(*a*) The method of Carius, in which the operation is carried out as in the preceding case, no silver nitrate is required, but as the oxidation is facilitated by the presence of a small quantity of bromine, a crystal of potassium bromide is placed in the tube containing the compound. The contents of the tube are diluted with water, the nitric acid removed by evaporation and the sulphuric acid precipitated and weighed as the barium salt. (*b*) The method of Asboth, in which the oxidizing agent employed is a mixture of sodium peroxide (three parts) and sodium carbonate (two parts). A weighed quantity of the substance (0·2 to 0·5gr.) is mixed with about 15gr. of the oxidizing mixture in a nickel crucible which is then carefully heated until the contents become liquid. When cold, the melt is extracted with water, and the soluble sulphate estimated in the usual manner.

Estimation of Phosphorus.—Organic compounds containing phosphorus are oxidized by fuming nitric acid, by concentrated nitric acid and potassium permanganate, or by chromic and sulphuric acids. The resulting phosphoric acid is precipitated as ammonium phosphomolybdate, and subsequently weighed as magnesium pyrophosphate.

Estimation of Metals in the Salts of Organic Acids and Bases. Gold, silver and platinum in organic salts are weighed as the metallic residue left after the organic material has been destroyed by igniting a weighed quantity of the dry salt in a platinum or silver crucible. Sodium, potassium, barium and calcium salts are decomposed by igniting a weighed quantity of the dry salt in the presence of pure sulphuric acid and weighing the sulphate of the metal.

Modern Modifications.—The methods described for the ultimate analysis of organic compounds leave nothing to be desired on the score of simplicity and accuracy, but many of them are

very tedious in operation, and the modifications that have been introduced aim at reducing the time required for the analysis. The earlier attempts were directed towards the employment of more vigorous oxidizing agents than copper oxide, and of these the use of oxygen in the presence of a contact substance (Kopfer, 1876) has been employed with singular success by Dennstedt. He uses a platinum contact material, heated to bright redness, and passes the vapour of the substance over it in a rapid stream of oxygen. The carbon dioxide and water are collected and weighed in the usual manner. If the compound contains nitrogen, chlorine, bromine or sulphur, a boat containing lead peroxide heated to 320° C is placed in the rear part of the combustion tube; this serves to break up any oxides of nitrogen that may be formed, and at the same time to absorb quantitatively the chlorine, bromine or sulphur, which can be estimated subsequently by the usual gravimetric methods. If iodine be present this can be retained by molecular silver contained in a second boat placed in the rear of the first.

Later modifications have aimed at reducing the time required for a combustion by a corresponding reduction in the amount of material analysed and the magnitude of the apparatus employed, and the micro-analytical methods devised by Pregl, Dubsky, Funk and others are now fairly extensively employed in schools of organic research. Using 5–15mg. of the substance, a carbon and hydrogen estimation can be completed within an hour.

H. ter Meulen and his school have recently described new methods for the ultimate analyses of organic compounds which include the direct estimation of oxygen. The analyses are carried out by the combustion (oxidation), or the destructive hydrogenation method, usually with the help of catalysts. The operations can be conducted with great rapidity, as about 50mg. of the compound are employed in each estimation, and many of the final operations are volumetric instead of gravimetric. Thus nitrogen is reduced quantitatively to ammonia and estimated by titration; the halogens are reduced by hydrogen containing ammonia to the ammonium halide and estimated volumetrically by the Volhard method.

BIBLIOGRAPHY.—J. F. Thorpe and M. A. Whiteley, *A Student's Manual of Organic Chemical Analysis* (1926). Fuller treatises are H. Meyer, *Analyse und Konstitutionsermittlung Organische Verbindungen* (3rd ed., 1916); G. Lunge, *Technical Methods of Chemical Analysis*, 6 vols. (2nd ed., 1924); J. Houben, *Die Methoden der Organischen Chemie* (3rd ed., Leipzig, 1925). (M. A. W.)

GAS ANALYSIS

The general principles involved in the various processes of gas analysis are best exemplified by a consideration of the quantitative estimation of the constituents of fuel gases, such analytical tests being the chief task of gas examiners. Gasometric methods are, strictly speaking, branches of *volumetric* analysis, one of the main divisions of quantitative work.

The composition of a gas is usually expressed in percentages by volume, as it is easier to measure a gas than to weigh it. As, however, the volume of a gas depends upon its temperature, pressure and moisture content, all volumes must be compared at the same temperature and pressure and further must be either dry or fully saturated with moisture; if the conditions under which they are compared are not the same, the volumes in each case must be referred to a standard condition. The standard usually employed is the International Standard, in which all volumes are referred to the dry volume which the gases would occupy at 0° C and 760mm. of mercury pressure. If V is the volume of a gas saturated with moisture measured at $t°$ C and $h$mm. of mercury, and a is the vapour pressure of water at $t°$ C (obtained from tables), then the volume V_0 at the standard conditions is given by the equation $V_0=V(h-a)273/760(273+t)$. In Great Britain the gas industry is bound by statute to use a different standard, namely the volume saturated with moisture at 60° F and 30in. of mercury pressure. Thus if V is the volume at $t°$ F and $h$in., the vapour pressure of water at $t°$ F being a, then the volume under standard conditions is $V_0=V(h-a)17{\cdot}64/(460+t)$. Tables to facilitate these calculations are given in text-books of gas analysis.

The volumetric analysis of a gas is usually carried out on a small quantity, ranging from 5 to 100 cu.cm., and if this small sample is to be representative of a large bulk of gas, special precautions must be taken to ensure that the sample is properly taken. Whenever the analysis of a sample of gas cannot be made at the place where it is collected, it must be stored in a sample tube with well-fitting glass taps. If the sample is to be kept for some time, it is preferably preserved in a glass tube with sealed ends.

The methods employed in the volumetric analysis of gases are based on: (1) Successive absorption of the constituents by suitable reagents each of which absorbs one only; (2) burning the gas with air or oxygen and measuring the change in volume and the amount of carbon dioxide produced; (3) selective oxidation by passing the gas over suitable reagents; *e.g.*, heated copper oxide.

The following are typical analyses of fuel gases:

	CO_2	Unsaturated hydrocarbons	O_2	CO	H_2	CH_4	N_2
	%	%	%	%	%	%	%
Coal gas	2·8	3·7	0·5	9·3	44·1	33·2	6·4
Water gas	4·8	..	0·4	37·9	49·2	3·0	4·7
Producer gas	9·9	0·3	0·3	20·0	17·8	2·8	48·9
Waste flue gas	11·3	..	7·0	1·0	0·8	..	79·9

Of these constituents carbon dioxide (CO_2), unsaturated hydrocarbons (which include ethylene, propylene and benzene), oxygen (O_2) and carbon monoxide (CO) are estimated by absorption methods; and hydrogen (H_2), methane (CH_4) and sometimes carbon monoxide by combustion methods. The nitrogen is usually obtained by difference.

The absorbents used are (1) 25% aqueous solution of caustic potash for carbon dioxide; (2) bromine water or fuming sulphuric acid for unsaturated hydrocarbons. In either case these reagents must be followed by an absorption with potash to remove vapours evolved by bromine and sulphuric acid; (3) stick phosphorus or a solution of potassium pyrogallate (10g. of pyrogallic acid dissolved in 100 cu.cm. of saturated caustic potash) for oxygen; (4) acidic or ammoniacal cuprous chloride solution for carbon monoxide—the latter is preferable and is made by mixing 1vol. of ammonia (sp.gr. 0·905) with 3vol. of a solution containing cuprous chloride 200g., ammonium chloride 250g., water 750g. Two absorptions must be made with the cuprous chloride solution, the last one being with a fresh solution. Alkaline pyrogallate and cuprous chloride solutions, which become oxidized and lose their absorbing capacity when exposed to the air, must be stored in the double type of pipette if the Hempel apparatus is being used, the two exterior bulbs being filled with water to prevent access of air.

Certain reagents will remove more than one constituent from the gas so that the order in which the absorptions are made is very important. If the unsaturated hydrocarbons are to be removed by bromine water, the sequence is as follows: carbon dioxide by potash, unsaturated compounds by bromine, oxygen by phosphorus or pyrogallate, carbon monoxide by cuprous chloride. On the other hand, if fuming sulphuric acid is used in place of bromine the order must be: caustic potash, pyrogallate (not phosphorus), fuming sulphuric acid, cuprous chloride. Phosphorus will not remove oxygen from the gas if unsaturated compounds are still present; it is also very slow in action if the temperature of the gas falls below 18° C.

The contraction observed and the carbon dioxide produced when hydrogen and methane are burned together with a known excess of oxygen or air, give a means by which these two gases may be determined, whereas the residual nitrogen is estimated by difference.

When burned with an excess of air or oxygen, 1vol. of hydrogen combines with ½vol. of oxygen to form water, which is condensed,

so that there is a contraction of $1\frac{1}{2}$vol.: $H_2+\frac{1}{2}O_2=H_2O$. With methane the reaction is $CH_4+2O_2=CO_2+2H_2O$, *i.e.*, 1 vol. of methane combines with 2 vol. of oxygen, forming 1 vol. of water vapour (which is condensed) and 1 vol. of carbon dioxide; the contraction is therefore 2 vol. and the carbon dioxide produced is equal in volume to the methane present. When a mixture of the two gases is burned, the methane is A and the hydrogen $\frac{2}{3}(C-2A)$, where C is the contraction on burning or exploding and A is the volume of carbon dioxide formed.

Of the many forms of gas apparatus recommended for these analyses three will now be described in detail—the Hempel apparatus as a type in which the volume of the gas is measured at constant pressure, the Bone and Wheeler apparatus as an example of those in which the pressure of the gas is measured at constant volume and the Haldane apparatus, employed when some of the important constituents are present in very small amounts.

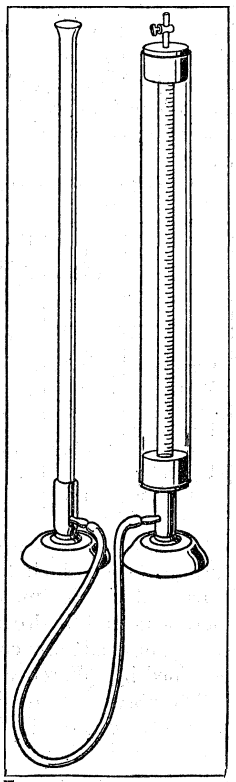


FIG. 1.—HEMPEL BURETTE AND LEVELLING TUBE

The Hempel Apparatus (fig. 1) consists of a cylindrical glass measuring burette which holds 100 cu.cm. and is graduated in $\frac{1}{5}$cu.cm. This tube is surrounded by a water-jacket so that a uniform temperature is maintained during analysis; the pressure is kept constant by always taking the measurements under atmospheric pressure which is assumed not to vary while the analysis is being made. The measuring vessel is connected by rubber tubing to a levelling tube or bottle. Slightly acidified water is poured into the levelling tube and the burette is completely filled by opening the tap at the top and raising the levelling tube, the tap being then closed. The gas to be analysed is drawn into the burette by connecting the top to the sampling tube, opening the top tap and lowering the levelling tube. When sufficient gas has been drawn into the burette, the tap is closed and the volume read, care being taken that the levels of the water in the burette and levelling tube are the same. This ensures that the volume of gas has been measured under atmospheric pressure. The pipette (fig. 2) containing the appropriate absorbing liquid is then connected to the top of the burette by a glass capillary tube bent twice at right angles. The liquid in the pipette must have been previously brought to the top of the capillary portion of the pipette and the bent tube must be full of water so that air does not enter the burette in the subsequent operations. The gas is driven into the pipette by opening the tap and raising the levelling tube, and is gently shaken whilst in contact with the liquid; when the absorption is complete, the gas is drawn back into the burette and measured with the water at the same level in the burette and levelling tube. The loss in volume is the amount of the particular constituent absorbed by the reagent. The operations are then repeated in a similar manner with the other absorbents. The absorptions are usually complete after two or three minutes.

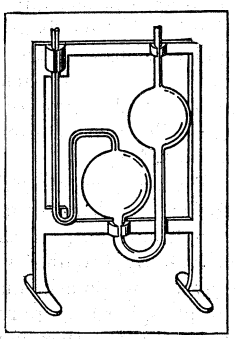


FIG. 2.—HEMPEL PIPETTE FOR ABSORPTION OF GAS IN APPROPRIATE LIQUID

Hydrogen and methane are estimated in the residual gas by diluting 15 or 20 cu.cm. to 100 cu.cm. with excess of air or oxygen and exploding the mixture under reduced pressure over mercury in the explosion pipette. This pipette (fig. 3) is provided with a pair of platinum sparking points which are connected to a small induction coil, and the reduction of pressure is effected by lowering the mercury reservoir which is connected by thick-walled rubber tubing to the pipette. The gas is then returned to the burette and the contraction measured. The carbon dioxide formed is absorbed in the potash pipette and this second contraction measured. The hydrogen and methane present in the small amount of residual gas taken for the explosion can be calculated from the formulae given above, and hence the percentages in the original gas are calculated.

The combination of hydrogen, methane and oxygen can be effected without explosion by passing them at a suitable dilution

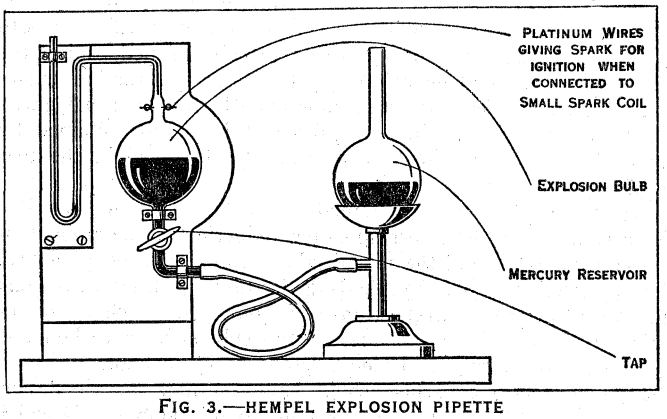


FIG. 3.—HEMPEL EXPLOSION PIPETTE

into a pipette filled with mercury provided with a short length of platinum wire which can be heated by passing an electric current from dry cells or an accumulator.

Hydrogen can be determined in the presence of methane by passing a mixture of the gas and air through a capillary tube containing palladium wire or palladium-asbestos. The gas is passed several times backwards and forwards from the burette through the gently heated tube into a pipette containing water.

The nitrogen remaining is often determined by difference, but it is advisable to check it by a more direct method. For this purpose a fresh sample of the gas is circulated through a silica tube filled with copper oxide heated to bright redness, and is passed into a pipette filled with caustic potash solution. The whole of the

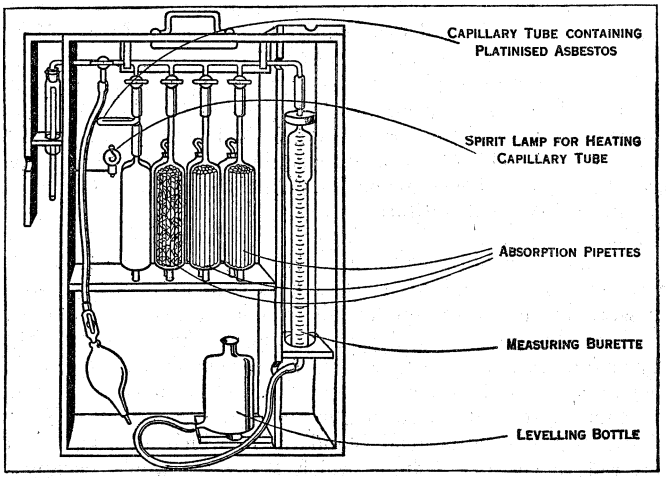


FIG. 4.—THE ORSAT APPARATUS FOR ANALYSIS OF FLUE GASES
This apparatus, being movable, can be transported to a boiler house or similar place and the analysis of waste gas made there without the delay of taking samples to a laboratory

gases present with the exception of the nitrogen are burned to carbon dioxide and water, both of which are absorbed in the potash. The operations are continued until the volume of the residual gas is constant, and a correction is applied for the air originally contained in the silica tube.

The Hempel apparatus is not portable, but a modification known as the Orsat apparatus (fig. 4) is portable. This resembles the Hempel in principle and use except that the pipettes are permanently attached to the burette by a glass capillary tube and taps. When the apparatus is intended for the analysis of flue gases only,

three pipettes are provided filled with caustic potash, alkaline pyrogallate and cuprous chloride, respectively. A bromine pipette and a palladium-asbestos tube are sometimes added. The carbon monoxide found will always be too low as only one pipette is employed for the cuprous chloride.

It has been assumed up to the present that the gases analysed are completely insoluble in water; and with the exception of carbon dioxide, which is appreciably soluble, the assumption is correct enough for ordinary purposes. To avoid loss of carbon dioxide, the water is often saturated with the gas to be analysed; or for more accurate work the water is replaced by mercury. The Sodeau apparatus is based on the same principle as the Hempel arrangement but employs mercury.

In the methods so far described the volume of the gas has been measured at a constant pressure and temperature. The alternative principle of measuring the gas at a constant volume and temperature can be equally well employed. This method has the advantage that 5 or 10 cu.cm. of gas can be expanded to give a pressure of 100mm. and that all the measurements are independent of the barometric pressure.

The Bone and Wheeler Apparatus.—This is the principle of the well-known Bone and Wheeler instrument which, as shown in fig. 5, consists of a glass **U**-tube AB connected at the bottom by

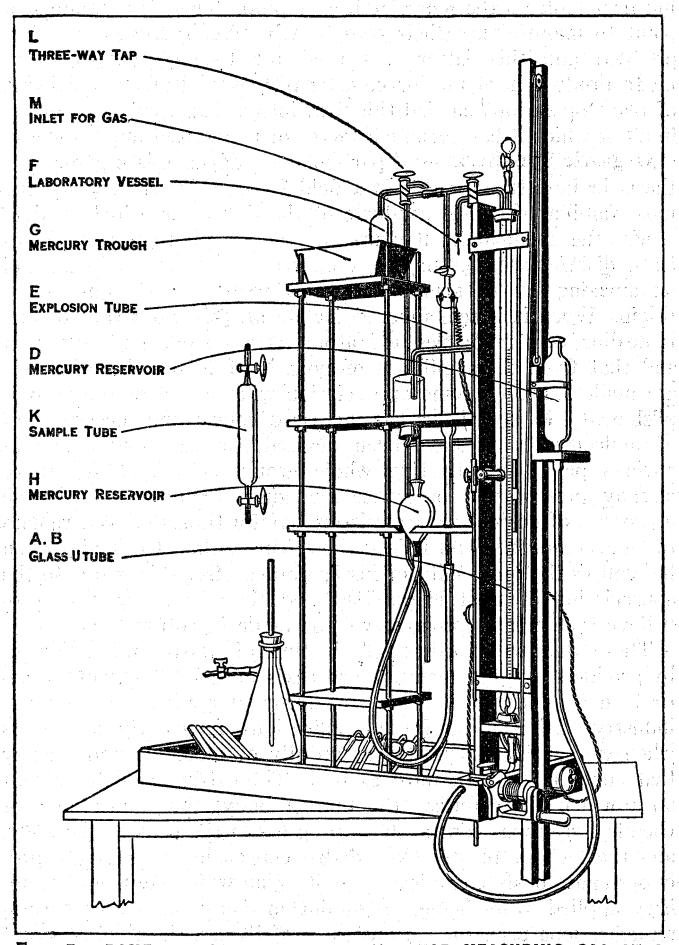


FIG. 5.—BONE AND WHEELER APPARATUS FOR MEASURING GAS AT A CONSTANT VOLUME AND TEMPERATURE

thick-walled rubber tubing to the mercury reservoir D, the latter being raised and lowered by the winch. The **U**-tube is surrounded by a waterjacket through which water at a constant temperature is circulated. The limb B is graduated in mm., the limb A is marked by a series of constant-volume marks, each coinciding with a 100mm. mark on the pressure limb B (*i.e.*, with 0, 100, 200mm., etc.). B is closed at the top with a glass cock, attached with rubber tubing and wired on. A is connected by capillary tubing through various glass taps to the explosion tube E and the laboratory vessel F, which is open at the bottom and sealed with mercury in the trough G. The tap L also affords a passage to the waste bottle, which in turn is connected to a water-pump so that the contents of F can be removed from the apparatus. The explosion tube E is fitted with platinum sparking points at the top end and is provided with a separate mercury reservoir. The whole apparatus is first filled with mercury and all the taps closed; both tubes A and B are moistened with dilute sulphuric acid to ensure

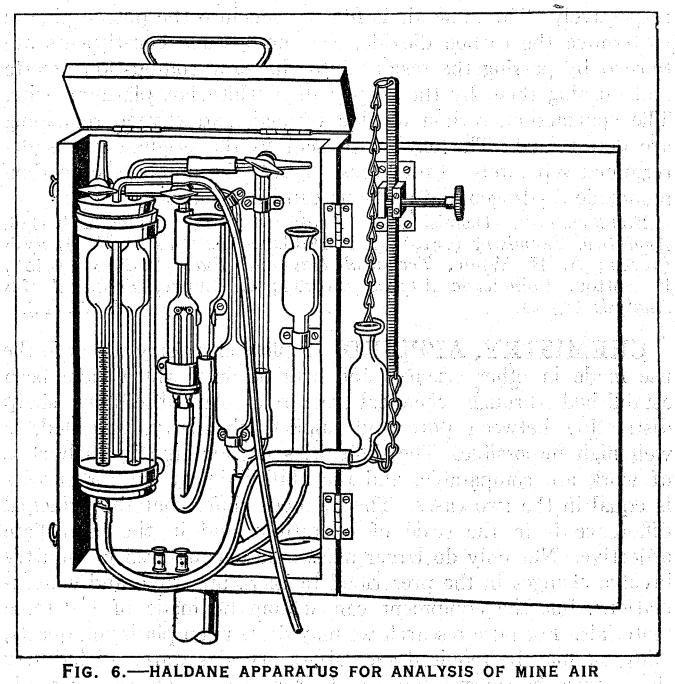


FIG. 6.—HALDANE APPARATUS FOR ANALYSIS OF MINE AIR
This enables the amount of choke-damp or fire-damp in the mine air to be determined very accurately. If the proportion of oxygen in the air is also required, a third pipette, filled with alkaline pyrogallate, is used

both being saturated with moisture and to avoid fouling with alkaline solutions. Reservoir D is lowered and the lower tap opened so that a vacuum is produced in A and B. The lower tap is closed and the apparatus tested for tightness by seeing that the levels of the mercury in A and B remain the same, even when all the taps are opened back to the one closing the exit to the laboratory vessel F. Gas is then admitted either through M or under the mercury in F; by raising or lowering D the level of the mercury is adjusted to one of the constant volume marks. The level of the mercury in B is then read and the difference between the levels of A and B will give the pressure of the gas in mm. of mercury. A few cu.cm. of the absorbent is placed in F, using a pipette with a curved tip for the purpose. The gas is then driven into F, gently agitated in contact with the absorbent until the removal of the constituent is complete, drawn back into A and the level of the mercury adjusted to the same constant level mark as at the start. The difference in the mercury levels now observed subtracted from the previous difference represents the amount of the gas absorbed, and the ratio of the two differences is the proportion of the constituent. The liquid in F is then drawn off to the waste bottle. All the operations are performed by raising or lowering D with the necessary manipulations of the taps. When necessary the absorbents are completely washed from F by 5% sulphuric acid. The hydrogen and methane are determined by explosion under reduced pressure with an excess of oxygen. The mixture in the tube A is passed into the explosion tube and fired by a spark. The subsequent operations are much the same as described in the Hempel method.

The Haldane Apparatus.—The portable form (fig. 6) is commonly employed for the analysis of mine air. This air in addition to oxygen and nitrogen may contain more carbon dioxide than is present in clean air, and may be contaminated with small amounts of carbon monoxide, hydrogen and methane. The determination of these constituents is of the utmost importance in connection with the safety of mines. Mercury is used as the confining liquid in a burette so constructed that small differences of volume can

be accurately measured. This is attained by making the lower portion of the burette of much smaller diameter than the upper. The temperature and pressure of the gas are made to balance that of a constant mass of gas contained in a compensating tube. This tube is similar in shape and capacity to the burette and is placed at its side in the same water-jacket. Pipettes are provided for removing carbon dioxide and oxygen by potash and pyrogallate respectively. The mine air is first passed into the potash pipette to remove the carbon dioxide, the combustible constituents are burned by passing the residue into the slow combustion pipette and burning them by the agency of a white hot platinum wire. The contraction, carbon dioxide formed, and oxygen remaining are determined. The oxygen present in the original gas is determined separately. From these figures the amounts of carbon monoxide, hydrogen and methane can be calculated.

BIBLIOGRAPHY.—Dennis, *Gas Analysis* (1913); Treadwell-Hall, *Analytical Chemistry* (1919); J. S. Haldane, *Methods of Air Analysis* (1920); A. H. White, *Technical Gas and Fuel Analysis* (1920); F. Sutton, *Volumetric Analysis* (1924); G. Lunge, *Technical Gas Analysis* (1925). (E. W. Y.)

CHEMISTRY, APPLIED. Applied chemistry refers to the use made in other sciences and arts of data which have been established through chemical research. An absolutely sharp distinction between pure and applied chemistry, so-called, is well nigh impossible. The difficulties encountered in each class of work are comparable, and the ability demanded for success is equal in the two cases. The methods differ, but the principal difference is in the scale of operations and in the immediate objective. Not only do larger masses as encountered in industry involve changes in the prescribed temperature, time and concentrations, but the equipment can seldom be made of the same materials. For pure research we may draw upon platinum, quartz, alloys as may be required and laboratory glassware. In industry there must be substituted wood, iron, steel, concrete, ceramic products, alloys and other well-known and important materials of great size and strength. Often the greatest difficulty is encountered in selecting suitable apparatus for the plant, bearing in mind length of life and commercial economy. A striking example is the recently perfected method for the manufacture of nitric acid by the oxidation of ammonia, thereby displacing Chilean nitrate as a raw material for this important acid. The perfection of chrome steel and chrome iron has made possible the economic operation of this process. Application of the research in this case awaited the production of these alloys.

C. F. Kettering has said that pure science involves getting facts when they are not needed, while applied science is obtaining these facts when they are wanted, sometimes most urgently. R. A. Millikan believes that all research, to be justified, must ultimately be useful. The attitude of a generation or two ago, when researchers expressed the hope that their work might never become useful and that science might always remain pure, has materially changed, due in some degree to the recognition on the part of industrialists of the vital importance of pure or fundamental research.

It is in applied chemistry that the public has the greatest interest, for it measures the value of scientific work by commercial products which it may enjoy and by other results which appeal to the aesthetic sense and make for creature comforts. The contributions of chemistry are seldom recognized by the ultimate consumer, for their identity has become lost. The achievements of most sciences are more readily comprehended by the non-technical public and it is only within a decade that efforts have been made to remedy the situation. To-day a larger proportion of the public recognizes the relations of chemistry to all activities of modern life, and without claiming for that science too large a share of credit, it may be conservatively said that with physics and mathematics chemistry occupies a fundamental place in the scheme of things.

In industry uniform results are obtained only with raw materials of constant quality within established limits. The simplest application of chemistry has to do with the analysis of these raw materials to ascertain whether they can be used to advantage, and particularly to guard against certain impurities or interfering substances which if present might result in the production of unprofitable seconds or in unsalable merchandise. Analytical chemistry is the basis of plant control and at many stages in manufacture must be relied upon for the guidance of operations. This is true in the manufacture of sugar and in the production of steel, where the molten metal is often held awaiting the report of the chemist before pouring. Obviously the analyst must work at top speed. In other cases samples of ores are rushed to the laboratory, that analysis may be made while the cars are in transit, so that proper proportions may be chosen upon arrival. Another familiar application of analytical chemistry in industry is the check upon finished work which forms the basis of guarantees, particularly where goods are bought on specification or which, though finished, are semi-manufactured products for some other purpose.

Not forgetting that analytical chemistry, which tells how much of various materials are present, underlies all chemical work, attention may be directed to more difficult industrial applications. Success in the utilization of by-products and the elimination of waste in industry are two classical examples of applied chemistry. The employment of by-products has led many a manufacturer into an entirely new line. Thus, a New England lumbering firm took up the manufacture of pulp. The installation of a plant to manufacture their own bleach gave hydrogen as a by-product, and this latter was used for the hydrogenation of oil to produce hard fat for cooking purposes. Further balancing of plant operations has led this firm into a dozen chemical fields, in all of which it has become a factor of recognized importance.

Organic Synthesis.—Of particular significance is organic synthesis in industry, for this is a field from which have come the most familiar chemical products of the day. These include dyestuffs, the medicinals, flavours, perfumes, photographic chemicals, disinfectants, cosmetics, etc., from coal-tar products, and an amazing list of synthetic organic materials of non-coal-tar origin. When it is remembered that in all this work the chemist is dealing with molecules and atoms that no one has ever seen and that from them millions of pounds of identical compounds are made annually, some appreciation will be had of the accomplishment. As knowledge has increased concerning the structure of molecules, ways have been devised for attaching atoms in various places, substituting whole groups of atoms for those already present and otherwise changing the molecule to give a product of desired characteristics. Many things desired remain to be accomplished and indeed the scientist almost despairs when he realizes the profundity of his ignorance. But this is due to the appreciation of what is possible, and there is every reason to believe that greater progress will be made in future.

The reduction of costs, elimination of waste, utilization of by-products, improvement of processes and development of entirely new products, indicate something of applied chemistry in industry. Difficult as these applications frequently are, it is when we consider chemistry as an ally of medicine and surgery that our admiration is most excited. The extremely delicate balance which characterizes the human body, the multiplicity of chemical reactions constantly in progress in the cells of the body, and the lack of positive knowledge concerning these body processes enormously complicate the situation which confronts chemistry applied to medicine. Beginning in many cases with natural remedies long used for various cases of illness, the chemist's first contribution has been the purification and standardization of these naturally occurring active principles. This in itself has been a noteworthy accomplishment and in several cases has been followed by the synthesis of the active principle, yielding a compound of far greater usefulness. Some specifics like chaulmoogra oil could be used only with the greatest difficulty but a soluble salt made in the laboratory from the acids contained in the oil provided a remedy of the greatest promise in combating leprosy. The physician now has at his disposal a long list of synthetic compounds nowhere found in nature, which not only permit a varied attack upon some diseases but offer for the first time in history specifics for certain ailments.

Medicine to-day, while not discarding the alliance with biology, generally recognizes that the greatest hope of the future lies in a chemical approach to a study of the human body and its diseases. Applied chemistry has shown, for example, the importance of knowing not only the type of food used but the products of this food in the alimentary tract. Perfected methods of determining sugar in the blood were the forerunner of insulin, itself separated from the pancreas, purified, and standardized for the relief of thousands of diabetics by methods based on chemistry. Indeed some regard the chemistry of the ductless glands and a chemical knowledge of the hormones as the next important step in the development of medical science. Surgery has also had its contributions. Anaesthetics, both old and new, are chemical compounds, the preparation of which involves the utmost care to insure purity. The methods upon which asepsis is based rest solidly upon a foundation of applied chemistry and the great decrease in the number of deaths following operations is in no small degree due to the availability of chemical compounds used as antiseptics and germicides.

Chemistry also has a share in the perfection of special steels and alloys (*q.v.*) for surgical instruments and the various equipment of the operating room. The ceramic chemist provides the enamelled metalware, the glass and the tiles. The chlorine effective in the Carrel-Dakin solution is the same as that used by the textile chemist for the bleaching of the textiles—and so one might run through the whole list of equipment and appurtenances.

Chemistry in Agriculture.—Applied chemistry has not overlooked agriculture. Intensive crop production depends upon fertilizers, which may still be considered in a formative period of development, notwithstanding their long use in enormous quantities. While potassium, phosphorus and nitrogen are still recognized as the principal plant foods, knowledge is being acquired as to the importance of traces of many other chemical elements in plant and animal metabolism. But for the insecticides and fungicides, all of them chemical compounds, we should face the problem of greatly diminished food supplies, if indeed we were able to avoid the threat of famine from time to time. Not only may yields be increased and the harvest preserved through applied chemistry, but recent work has shown that the dormant period of some tubers can be shortened by chemical means. Potatoes, which ordinarily require several weeks' rest between harvest and seed time, may be used within a few days after simple treatment with chemical reagents. Varieties of oranges and lemons which are ready for use before they have acquired a desirable colour are treated with ethylene, which quickens the respiration of the fruit and causes it to acquire the desired hue.

Modern methods of food preservation (*q.v.*) rest on bacteriology, physics and chemistry; and the transportation of food-stuffs would be impossible but for scientific contributions. In modern building construction further examples of applied chemistry can be found. Cement is produced and used under chemical control, as is the steel of our modern buildings. The multiplicity of colours, shapes and textures in building units gives mute testimony to applied chemistry and her sister sciences. The strength of materials, whether used in a skyscraper, in an automobile or a pair of shears, is due to the chemical composition and the physical state of these component elements. A great field of applied science has been in heat treatment, particularly of metals, to impart given characteristics due to a rearrangement of the crystalline structure.

Supplementing Raw Materials.—Thus far such success has met the efforts of those seeking to supplement natural raw materials that some are inclined to waste such products, confident that when necessary the chemist will provide what is needed. There is nothing to justify such a policy, though a great deal may be said of the success in finding equivalents for the products of nature. The extent to which ammonia synthesised from atmospheric nitrogen has displaced Chilean saltpetre in the world's markets is an example. Methanol (wood alcohol) synthesised from carbon monoxide and hydrogen derived from coal gas, or from carbon dioxide and hydrogen, a product in the fermentation of corn and now made in a volume somewhat embarrassing to the distillers of hard wood, the natural source of the material, is another. Synthetic camphor has displaced the natural product for many purposes. Hard fats produced by the hydrogenation of peanut oil, cottonseed oil, and the like have become a disturbing factor as a competitor of lard. The paint and varnish industry has to adjust itself to the advent of nitro-cellulose lacquers produced by chemistry in answer to a demand for a quick-drying durable finish, particularly for metal as in automobiles, and utilizing cellulose from linters or wood pulp as a basic material. Rayon is a familiar instance and is one of the forerunners of an age of cellulose, utilized for a diversity of products, perhaps even greater than those now made from coal tar. Phenol or carbolic acid, formerly derived from coal distillation, is now produced on a large scale by synthetic means, while resins valued for their own characteristics and suitable as equivalents of naturally occurring gums, are seen on every hand.

A striking example of applied chemistry and chemical engineering is to be found in the great petroleum (*q.v.*) industry, for there would already be an embarrassing shortage of motor fuels and lubricants but for applied chemistry. To-day vast quantities of fuel are removed by activated carbons and absorptive processes from natural gas and "casinghead" gas, while the proportion of gasolene prepared by "cracking" continually mounts in comparison with that prepared by the older stripping methods of simple distillation. A forecast of what applied chemistry may do for the automobile and other places where the internal combustion motor serves is seen in work abroad, where motor fuels are now prepared commercially by the hydrogenation or liquefaction of coal and by the synthesis of a motor fuel, for which carbon monoxide and hydrogen derived from coal are the raw materials.

Applied chemistry has not neglected the household, for every room shows its presence. Under the U.S. pure food laws, chemistry guards the food-supply and with bacteriology guards the water-supply and safely disposes of the household wastes. In the house the wall and floor coverings bespeak applied chemistry, as do the colour and finish of the furniture, the dyes of tapestries and rugs, the waxes of the floors, the cleansing powders and soaps, and the brilliance of the illumination, which is due to the presence of inert gases in the incandescent bulb (*see* LIGHTING) and the ductile tungsten of the glowing filament. The glassware is made by machines under chemical control, whereas formerly it had to be hand blown. The ceramic chemist points with pride to the perfection of china. The metallurgical chemist offers evidences of his contribution not only in the metalware throughout the house, but in the kitchen, where his stainless steel owes to chromium this prized characteristic, and where stainless non-tarnishing iron or monel metal may compete with aluminium and steel in kitchen utensils. Chemistry has had a part in producing the several motors which now perform the drudgery of the household. It is a chemical compound which circulates in the mechanical refrigerator, expanding to cool the food and being compressed by the motor for expansion again. The record of the phonograph is a molded chemical compound with certain fillers, and chemistry is present throughout the radio set.

Chemistry in Warfare.—Above has been given a mere indication of chemistry applied in various directions. It is preferably a science of construction. When it tears down, it does so only for the sake of building again, using these units of construction in different ways to meet every-day requirements. When called upon, it may be destructive, for our highest explosives are made from the same raw materials which give us our medicinals of great healing power. Fortunately these explosives enter more into peace-time pursuits than into war-time activities. Being so intimately related to all industry, chemistry must go to war when called upon and has always done so. There is much evidence to support the belief that chemical warfare will be extensively used should war come again, and that it is as feasible to do without war itself as it is to eliminate chemical warfare. No war is humane, but of the various forms so far practised, statistics show chemical warfare to do less permanent damage than

other types. World War I saw used chlorine, phosgene, mustard gas, and other types of toxic and vesicant compounds. The chemistry of these and similar materials has been studied in all countries since the war, with special reference to defense measures, and it would appear that chemical warfare, while effective, nevertheless gives the intelligent man a real opportunity for self-preservation. A more extensive use of smoke screens for protective and defensive measures will doubtless be seen. These smoke screens may be nontoxic and highly efficient.

Well-meaning efforts to outlaw chemical warfare fail to take into consideration the inseparable relation between the chemicals demanded for all types of lawful peace-time industry and those needed in chemical warfare. The most effective chemical warfare agents are composed of such simple materials as sulphur, chlorine, alcohol and the like. It should also be borne in mind that the by-products of chemical research which are come upon sometimes unexpectedly may also prove to be useful materials in warfare (*see* CHEMICAL WARFARE).

The natural sciences from astronomy to zoology contribute, often in unexpected ways, to industrial development. It is improper and unbecoming for any single science to claim an undue share for what has been accomplished, but it seems fair to point out that, whatever may be contributed by the other sciences, chemistry in its application to all forms of human activity may properly be credited certainly with no less than any of her sister sciences. (*See* various related subjects under other headings.)

BIBLIOGRAPHY.—H. E. Howe, ed. *Chemistry in Industry,* vol. i. and ii., Chemical Foundation, Inc. (New York); J. Stieglitz, ed. *Chemistry in Medicine* (New York); H. E. Howe, *Chemistry in the World's Work* (New York); F. L. Darrow, *The Story of Chemistry* (Indianapolis); E. E. Slosson, *Creative Chemistry;* R. K. Duncan, *Chemistry of Commerce;* H. E. Howe and F. M. Turner, Jr., *Chemistry and the Home* (New York). (H. E. H.)

CHEMNITZ or **KEMNITZ, MARTIN** (1522–1586), German Lutheran theologian, was born at Treuenbrietzen, Brandenburg, on Nov. 9, 1522, and died in Brunswick on April 8, 1586. Educated at Magdeburg (1539–42) and at the universities of Frankfurt-on-Oder (1543) and Wittenberg (1545), Chemnitz became interested in mathematics and astrology, and in 1547 Melanchthon gave him an introduction to Georg Sabinus at Königsberg, where he was made rector of the Kneiphof school in 1548. In 1550 Duke Albert of Prussia made him his librarian and he turned his attention to biblical studies. In a controversy with Osiander, on justification by faith, Chemnitz defended the Lutheran doctrine of imputation. In 1553 he returned to Wittenberg and gave lectures on Melanchthon's *Loci Communes,* which formed the basis of his own *Loci Theologici* (published posthumously in 1591), an exposition of Lutheran theology as modified by Melanchthon. Chemnitz also wrote *Repetitio sanae doctrinae de Vera Praesentia* (1560; in German, 1561) in support of the Lutheran view of the Eucharist, against the Crypto-Calvinists; *Theologiae Jesuitarum praecipua capita* (1562); and *Examen concilii Tridentini* (4 parts, 1565–73). In 1554 he moved to Brunswick, as coadjutor to the superintendent, Joachim Mörlin, and in conjunction with him drew up his *Corpus doctrinae Prutenicum* (1567). In conjunction with Andrea and Selnecker he induced the Lutherans of Saxony and Swabia to unite in adopting the *Formula Concordiae.*

BIBLIOGRAPHY.—Lives of Chemnitz are numerous, *e.g.,* by J. Gasmerus (1588), T. Pressel (1862), C. G. H. Lentz (1866) and H. Hachfield (1867). *See* also Herzog's *Realencyklopädie,* and Goschler's *Dict. encyclopédique de la théol. cath.* (1858).

CHEMNITZ, a town of Germany, in the *Land* of Saxony, the capital of a governmental district, 50 mi. W.S.W. of Dresden and 51 mi. S.S.E. of Leipzig. Pop. (1939) 334,563.

Chemnitz (*Kaminizi*) was originally a settlement of the Sorbian Wends and became a market town in 1143. Its municipal constitution dates from the 14th century, and it soon became the most important industrial centre in the mark of Meissen. A monopoly of bleaching was granted to the town, and thus a considerable trade in woollen and linen yarns was attracted; paper was made here, and in the 16th century the manufacture of cloth was very flourishing. In 1546 the Benedictine monastery, founded about 1136 about 2 mi. north of the town, was dissolved. During the Thirty Years' War, Chemnitz was plundered by all parties and its trade was completely ruined, but at the beginning of the 18th century it had begun to recover. Further progress was made during the 19th century, especially after 1834 when Saxony joined the German *Zollverein.*

The town lies 950 ft. above sea, in a fertile plain at the foot of the Erzgebirge, watered by the river Chemnitz, an affluent of the Mulde. It is the chief manufacturing centre in the kingdom and ranks next to Dresden and Leipzig in point of population. It is well provided with railway communication, being directly connected with Berlin and with the towns of the Erzgebirge and Vogtland. The centre of the town is occupied by the market square, with the mediaeval *Rathaus,* now superseded by a modern building in the Post-strasse. The old inner town is within the old fortifications, and beyond lies industrial Chemnitz. There is an ancient Gothic church dedicated to St. James. To the northwest of the town is the Gothic church of a former Benedictine monastery, dating from 1514–1525, with a tower of 1897. The industry of Chemnitz has gained for the town the name of "Saxon Manchester." First in importance are its locomotive and engineering works. Next come its cotton-spinning, hosiery, textile and glove manufactures. It also has considerable dyeworks, bleachworks, chemical and woollen factories. The local communications are maintained by an electric tramway system. Chemnitz is a favourite tourist centre for excursions into the Erzgebirge.

CHENAB, one of the "Five rivers" of the Punjab, India (the Greek Acesines). It rises in the snowy Himalayan ranges of Kashmir, enters British territory in the Sialkot district, and flows through the plains of the Punjab, forming the boundary between the Rechna and the Jech Doabs. Finally it joins the Jhelum at Trimmu.

The Chenab colony, resulting from the success of the Lower Chenab canal in irrigating the desert of the Bar, was formed out of the three adjacent districts of Gujranwala, Jhang and Montgomery in 1892. It lies in the Rechna Doab between the Chenab and Ravi rivers in the north-east of the Jhang district, and includes an irrigated area of over 2½ million acres. The principal town is Lyallpur (pop. 1931, 42,922) called after Sir J. Broadwood Lyall, lieutenant-governor of the Punjab. It is now an important trade centre, and gives its name to a district with an area of 3,224 sq.m. and a population (1931) of 1,151,351. The Lower Chenab canal is now supplied with water from the Jhelum through the Upper Jhelum Canal, and the Chenab water is utilised for the upper Chenab canal. This canal, opened in 1912, which has 173 m. of main canals and distributaries, and irrigates over half a million acres, forms part of the great Triple canals project.

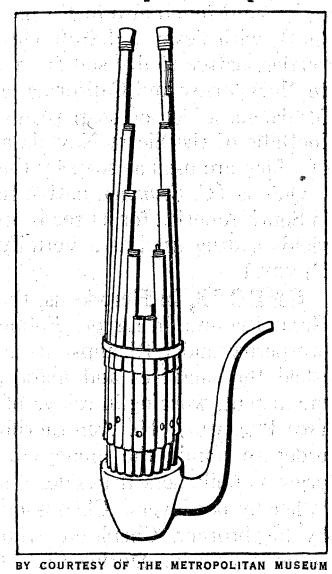
CHÊNEDOLLÉ, CHARLES JULIEN LIOULT DE (1769–1833), French poet, was born at Vire (Calvados). Emigrating in 1791, he fought two campaigns in the army of Condé. On his return to Paris in 1799 he met Chateaubriand and his sister Lucile (Mme. de Caud), to whom he became deeply attached. After her death in 1804, Chênedollé returned to Normandy, where he married and became eventually inspector of the academy of Caen (1812–32).

The works of Chênedollé, which include *Le Genie de l'Homme* (1807) and *Études poétiques* (1820), were edited in 1864 by Sainte-Beuve, who drew portraits of him in his *Chateaubriand et son groupe* and in an article contributed to the *Revue des deux mondes* (June 1849). *See* also E. Helland, *Étude biographique et littéraire sur Chênedollé* (1857); L. de Samie, *Chênedollé* (1922).

CHENERY, THOMAS (1826–1884), English scholar and editor of *The Times,* was born at Barbados and educated at Eton and Caius college, Cambridge. Having been called to the bar, he went out to Constantinople as *The Times* correspondent just before the Crimean War, and it was under the influence there of Algernon Smythe (afterwards Lord Strangford) that he first turned to those philological studies in which he became eminent. After the war he returned to London and wrote regularly for *The Times* for many years, eventually succeeding Delane as editor in 1877. He was then an experienced publicist, particularly well versed in oriental affairs, an indefatigable worker, with a rapid and comprehensive judgment, though he lacked Delane's intuition for public opinion. In 1868 he was appointed Lord Almoner's professor of Arabic at Oxford, and retained his position until he

became editor of *The Times*. He was one of the company of revisers of the Old Testament. He was secretary for some time to the Royal Asiatic Society, and edited the Arabic classic *The Assemblies of Al-Harirī* and the *Machberoth Ithiel*. He died in London on Feb. 11, 1884.

CHENG, TSCHENG or TSCHIANG (Ger. *Scheng*), an ancient Chinese wind instrument in the nature of a primitive portable organ, containing the principle of the free reed which found application in Europe in the accordion, concertina, and harmonium. In shape the cheng resembles a closed teapot to the top of which are fitted bamboo pipes of graduated lengths and furnished in the side with an insufflation tube curved like a swan's neck or the spout of a teapot.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

AN ANCIENT CHINESE WIND INSTRUMENT, ANTICIPATING THE PRINCIPLES OF THE HARMONIUM, PLAYED BY BLOWING THROUGH THE TEAPOT-LIKE SPOUT

CHÊNGTU, the administrative centre of the province of Szechwan and the regional capital of West China, situated 30° 40′ N., 104° 12′ E. In the north-west corner of the Red Basin of Szechwan there lies a smooth plain some 70 miles by 40, whose even surface contrasts strongly with the rest of the highly dissected Basin. Chêngtu is the centre of this plain which forms the deltaic fan of the Min-Ho below its debouchure at Kwan-hien from the high mountain country of north-west Szechwan. By means of a marvellous irrigation system, initially planned by Li Ping in the 3rd century B.C. and further elaborated at several subsequent periods, the river waters are now led off at Kwan-hien along innumerable irrigation channels to fertilize the whole plain instead of littering it with gravel as in its natural state. At the lower end of the plain the channels are drawn together and issue as two rivers, the Min-Ho, and the Chung-kiang, which join the Yangtze at Suifu and Luchow respectively. Although on the average 2,000 ft. above sea-level, the Chêngtu plain lies in a very sheltered position and yields exceptionally heavy crops of all the varied products typical of Middle China (*see* CHINA).

Chêngtu also serves as the commercial outlet of the mountain country of north-west Szechwan, the pastoral products of which are utilized in the industries of the city. Because of its position at the contact of plain and mountain Chêngtu focuses the life of the sheltered agricultural Red Basin and the rugged pastoral mountain country of the west Szechwan border. The Red Basin of Szechwan lies in the far west of China and Chêngtu is placed on the western border of the Red Basin. After 1937, prominent Chinese universities moved to Chêngtu, including the University of Nanking, Yenching university, Ginling College for Women. Szechwan university and the West China Union university are also here. Manufacturing plants were established in Chêngtu for improved agricultural equipment. In the fall of 1940 the First National Forestry and Soil Conservation conference was held there. The population of Chêngtu was 440,988 (1934).

CHÉNIER, ANDRÉ DE (1762–1794), French poet, was born at Constantinople of a French father and a Greek mother. His parents returned to France in 1765, and though the father afterwards served as consul general in Morocco, the children (Marie-Joseph is noticed below) remained in France. André was educated at the college de Navarre in Paris, and after some months in the army at Strasbourg, returned to Paris, where he met the poets and artists of the day in his mother's salon. A visit to Italy in 1784 made a deep impression on his mind, and strengthened his passion for the antique. The next three years were spent in experimenting in eclogues and idylls in the classical manner. Of the works of this period the most famous is *La jeune Tarentine*, classical in form, but characterized by the grace and charm which informed all Chénier's work. He proposed to write and actually composed fragments of a poem modelled on Lucretius, *Hermès*, which was to cover the contents of the *Encyclopédie*. In 1787 he went to London as secretary to his relative, M. de la Luzerne, at that time French ambassador. London displeased him, and in 1790 he returned to France, and plunged into political writing. His prose *Avis au peuple français* (Aug. 24, 1790) was followed by the *Jeu de Paume*, a moral ode addressed to the painter Louis David. Chénier was a member of the Feuillant club, and contributed to the *Journal de Paris* the Iambes addressed to Collot d'Herbois *Sur les Suisses révoltés*. He escaped the massacres of September because his family got him away to Normandy, and after the execution of Louis XVI. he hid in an obscure refuge near Versailles. To this period belong his *Ode à Charlotte Corday* and his *Ode à Versailles*. His lines on the art of writing poetry are still quoted in French university circles.

But on Mar. 7, 1794, he was arrested in the house of Madame Piscatory at Passy. He was lodged first in the Luxembourg and then in Saint-Lazare. His imprisonment lasted 141 days. His brother, Marie-Joseph, a member of the Convention, could not save him, and he was guillotined on July 25, 1794, three days before Robespierre, whose death would have saved him. To this four months' imprisonment belong André Chénier's greatest poems, the *Jeune Captive*, the *Iambes* (in alternate lines of 12 and 8 syllables) attacking the Convention and conveyed sheet by sheet to his friends by a venal gaoler.

These circumstances explain how it was that the greatest French lyricist of the 18th century had to wait 20 years for the merest recognition of his genius. For only fragments of his work were known, and he only reached the full measure of his powers in the months before his tragic end. Only the *Jeu de Paume* and the *Hymne sur les Suisses* were known in his life time. The *Jeune Captive* and the *La Jeune Tarentine* were published in periodicals in 1795 and 1801. The first imperfect attempt to collect the body of his work was made in 1819. Since that date there has been unanimous acknowledgment of his genius, but the critics have been divided as to whether he should be classed, as Sainte-Beuve classed him, as the forerunner of Victor Hugo and the romanticists, or, as Anatole France would have it, as the last exponent of the art of the 18th century. Perhaps his influence was greatest on the classicists who led the reaction against the romanticists at the end of the 19th century, on Leconte de Lisle and Hérédia.

BIBLIOGRAPHY.—The Chénier literature is enormous. His fate has been commemorated in numerous plays, pictures and poems, notably in the fine epilogue of Sully Prudhomme, the *Stello* of A. de Vigny, the delicate statue by Puech in the Luxembourg, and the well-known portrait in the centre of the "Last Days of the Terror." The best editions are still those of Becq de Fouquières (1862, 1872 and 1881), supplemented by those of L. Moland (2 vols. 1889) and R. Guillard (2 vols. 1899).

See also Sainte-Beuve, *Tableau de la Litt. fr.* (1828); Anatole France, *La Vie littéraire* vol. ii.; E. Faguet, *André Chénier* (1902).

CHÉNIER, MARIE-JOSEPH BLAISE DE (1764–1811), French poet, dramatist and politician, younger brother of André de Chénier, was born at Constantinople on Feb. 11, 1764. He was brought up at Carcassonne, and educated in Paris at the Collège de Navarre. After two years spent in the army he began to write plays on the Voltairian model. The notoriety attained by the later plays was due to political considerations rather than to any intrinsic literary merit. His *Charles IX.* was kept back for nearly two years by the censor; its production (Nov. 4, 1789) was an immense success, due in part to Talma's magnificent impersonation of Charles IX. Camille Desmoulins said that the piece had done more for the Revolution that the days of October, and a contemporary memoir-writer, the marquis de Ferrière, says that the audience came away "ivre de vengeance et tourmenté d'une soif de sang." The performance occasioned a split among the actors of the Comédie Française, and the new theatre in the Palais Royal, established by the dissidents, was inaugurated with *Henri VIII.* (1791), generally recognized as Chénier's masterpiece; *Jean Calas, ou l'école des juges* followed in the same year. In 1792 he produced his *Caius Gracchus*, which was proscribed in 1793 at the instance of the Montagnard deputy, Albitte, for

an anti-anarchical hemistich (*Des lois et non du sang!*); *Fénelon* (1793) was suspended after a few representations; and in 1794 his *Timoléon,* set to Étienne Méhul's music, was also proscribed. This piece was played after the fall of the Terror, but the fratricide of Timoléon became the text for unfounded insinuations that, by his silence, Joseph de Chénier had connived at the judicial murder of André. In fact Joseph knew that André's only chance of safety lay in being forgotten by the authorities, and that intervention would only hasten the end. Joseph Chénier had been a member of the Convention and of the Council of Five Hundred, and had voted for the death of Louis XVI.; he had a seat in the tribunate; he belonged to the committees of public instruction, of general security and of public safety. Nevertheless, before the end of the Terror he had become a marked man. His purely political career ended in 1802, but from 1803 to 1806 he was inspector-general of public instruction. *Cyrus* (1804) was written in honour of Napoleon, but Chénier was temporarily disgraced in 1806 for his *Épître à Voltaire.* He died on Jan. 10, 1811. The list of his works includes hymns and national songs—among others, the famous *Chant du départ;* odes, *Sur la mort de Mirabeau, Sur l'oligarchie de Robespierre,* etc.; tragedies which never reached the stage, *Brutus et Cassius, Philippe deux, Tibère;* a *Tableau historique* (1808) of contemporary French literature; translations from Sophocles and Lessing, from Gray and Horace, from Tacitus and Aristotle; with elegies, dithyrambics and Ossianic rhapsodies.

See *Œuvres complètes de Joseph Chénier* (8 vols., 1823–26), containing notices of the poet by Arnault and Daunou; Charles Labitte, *Études littéraires* (1846); Henri Welschinger, *Le Théâtre révolutionnaire, 1789–1799* (1881); and A. Lieby, *Étude sur le théâtre de Marie-Joseph Chénier* (1902).

CHENILLE, a twisted velvet cord, woven so that the short outer threads stand out at right angles to the central cord, thus giving a resemblance to a caterpillar. Chenille is used as a trimming for dress and furniture. The word is French and means a hairy caterpillar.

CHENONCEAUX, a village of central France, in the department of Indre-et-Loire, on the right bank of the Cher, 20 m. E. by S. of Tours on the Orléans railway. Pop. (1936) 166. Chenonceaux owes its interest to its château, a building in the Renaissance style on the river Cher. Founded in 1515 by Thomas Bohier (d. 1523), financial minister in Normandy, the château was confiscated by Francis I. in 1535. An isolated tower flanking a drawbridge is part of an earlier building of the 15th century. Henry II. presented it to Diane de Poitiers, who on his death was forced to exchange it for Chaumont-sur-Loire by Catherine de' Medici. The latter built the gallery which leads to the left bank of the Cher. Chenonceaux passed successively into the hands of Louise de Vaudémont, wife of Henry III., the house of Vendôme, and the family of Bourbon-Condé. It came into the possession of Claude Dupin (1684–1769) and in 1864 it was sold to the chemist Théophile Pélouze, whose wife executed extensive restorations.

CHENOPODIUM or GOOSEFOOT, a genus of erect or sometimes prostrate herbs of the family Chenopodiaceae, comprising some 60 species, natives of temperate regions, some of which have cosmopolitan distribution as weeds. Inclusive of those introduced from the old world, some 25 species occur in North America. A well known representative is the common goosefoot (*C. album*), called also lamb's quarters and pigweed. It is native to Europe and Asia, is found in Great Britain, and is widely prevalent in North America as a naturalized weed. The green angular stem is often striped with white or red, and, like the leaves, often more or less covered with mealy particles. The leaves are entire, lobed or toothed and often more or less triangular in shape. The minute flowers are borne in dense axillary or terminal clusters. The fruit, usually enclosed by the persistent calyx, is a membranous utricle covering a small, black, often glossy seed.

Among other goosefoots found in Great Britain and also naturalized in North America are the maple-leaved goosefoot (*C. hybridum*), the nettle-leaved goosefoot or sowbane (*C. murale*), the oak-leaved goosefoot (*C. glaucum*), the many-seeded goosefoot (*C. polyspermum*), the city goosefoot (*C. urbicum*), and good King Henry (*C. Bonus-Henricus*). Other old-world species naturalized in North America are the Jerusalem oak (*C. Botrys*), the Mexican tea (*C. ambrosioides*) and the wormseed (*C. anthelminticum*).

Among native North American species are the red goosefoot (*C. rubrum*), growing on saline soils on sea coasts and in the interior, and found also in Europe; the strawberry blite (*C. capitatum*), with fleshy red fruit clusters somewhat resembling strawberries, native to dry soil from Nova Scotia to Alaska southward to New Jersey and California, and also in Europe; and the California goosefoot or soap plant (*C. californicum*), found in the foothills of the Sierra Nevada and coast ranges, the grated roots of which are used as soap by the Indians.

Quinoa (*C. Quinoa*), native to the Andean region, is cultivated in South America for its seeds, used as food. The wormseed (*q.v.*) yields a drug used as a vermifuge. (*See* the article GOOD KING HENRY.)

CHEOPS, in Herodotus, the name of the king who built the Great Pyramid in Egypt. Following on a period of good rule and prosperity under Rhampsinitus, Cheops closed the temples, abolished the sacrifices and made all the Egyptians labour for his monument, working in relays of 100,000 men every three months (*see* PYRAMID). He even sacrificed the honour of his daughter in order to obtain the money to complete his pyramid; and the princess built herself besides a small pyramid of the stones given to her by her lovers. Cheops reigned 50 years and was succeeded by his brother, Chephren, who reigned 56 years and built the second pyramid. During these two reigns the Egyptians suffered every kind of misery and the temples remained closed. Herodotus continues that in his own day the Egyptians were unwilling to name these oppressors and preferred to call the pyramids after a shepherd named Philition, who pastured his flocks in their neighbourhood. At length Mycerinus, son of Cheops and successor of Chephren, reopened the temples and, although he built the Third Pyramid, allowed the oppressed people to return to their proper occupations.

Cheops, Chephren and Mycerinus are historical personages of the fourth Egyptian dynasty, in correct order, and they built the three pyramids attributed to them here. But they are wholly misplaced by Herodotus. Rhampsinitus, the predecessor of Cheops, appears to represent Rameses III. of the twentieth dynasty, and Mycerinus in Herodotus is but a few generations before Psammetichus, the founder of the twenty-sixth dynasty. Manetho correctly places the great Pyramid kings in Dynasty IV. In Egyptian the name of Cheops (Chemmisor Chembis in Diodorus Siculus, Suphis in Manetho) is spelt Hwfw (Khufu), but the pronunciation, in late times perhaps Khöouf, is uncertain. How far we may accept Herodotus' view of the distress caused by the building of the pyramid is doubtful. Petrie thinks that he can trace a violent religious revolution with confiscation of endowments at this time in the temple remains at Abydos; but none the less the deities were then served by priests selected from the royal family and the highest in the land. Khufu's work in the temple of Bubastis is proved by a surviving fragment, and he is figured slaying his enemy at Sinai before the god Thoth. In late times the priests of Denderah claimed Khufu as a benefactor; he was reputed to have built temples to the gods near the Great Pyramids and Sphinx (where also a pyramid of his daughter Hentsen is spoken of), and there are incidental notices of him in the medical and religious literature. The funerary cult of Khufu and Khafrē was practised under the twenty-sixth dynasty, when so much that had fallen into disuse and been forgotten was revived. Khufu is a leading figure in an ancient Egyptian story (Papyrus Westcar), but it is unfortunately incomplete. He was the founder of the fourth dynasty, and was probably born in Middle Egypt near Beni Hasan, in a town afterwards known as "Khufu's Nurse," but was connected with the Memphite third dynasty. Two tablets at the mines of Wadi Maghara in the peninsula of Sinai, a granite block from Bubastis, and a beautiful ivory statuette found by Petrie in the temple at Abydos, are almost all that can be definitely assigned to Khufu outside the pyramid at Giza and its ruined

accompaniments. His date, according to Petrie, is 3969–3908 B.C., but in the shorter chronology of Meyer, Breasted and others he reigned (23 years) about a thousand years later, *c.* 2900 B.C.

See Herodotus ii. 124; Diodorus Siculus i. 64; Sethevin Pauly-Wissowa's *Realencyklopädie, s.v.;* W. M. F. Petrie, *History of Egypt,* vol. i., and *Abydos,* part ii. p. 48; J. H. Breasted, *History.*

CHEPSTOW, market town, urban district and river port of Monmouthshire, England, on the Wye, 2 mi. above its junction with the Severn, and on the G.W.R. Pop. (est. 1938) 4,078. Area, 2.41 sq.mi. As the key to the passage of the Wye, Chepstow (*Estrighorel, Striguil*) was the site successively of British, Roman and Saxon fortifications. The Norman castle was built by William Fitz-Osbern to defend the Roman road into south Wales. The castle occupies a hill site on the western bank of the river. It was founded in the 11th and rebuilt in the 13th century. It was granted by Henry I to Walter FitzRichard of Clare, and after its reversion to the crown, Edward II granted it to Thomas de Brotherton. It passed, through Margaret, Lady Segrave, to the dukes of Norfolk, from whom, after again reverting to the crown, it passed to the earls of Worcester. It was confiscated by parliament but restored to the earls in 1660. The church of St. Mary, originally the conventual chapel of a Benedictine priory, has some old features. The borough must have grown up between 1310, when the castle and vill were granted to Thomas de Brotherton, and 1432, when John, duke of Norfolk, died seised of the castle, manor and borough of Striguil. In 1524 the earl of Worcester granted a new charter to the bailiffs and burgesses of the town, which had fallen into decay. This was sustained until the reign of Charles II, when, some dispute arising, the charter lapsed and the town was afterwards governed by a board of twelve. A port since early times, when the lord took dues of ships going up to the forest of Dean, Chepstow had no ancient market and no manufactures but that of glass, which was carried on for a short time within the ruins of the castle. A local trade during the 19th century was handicapped by the narrowness and depth of the channel and the consequent tidal bore. There is a racecourse 1½ mi. N.W. of the town.

CHEQUE or **CHECK.** A cheque, in the simple definition of the English law, "is a bill of exchange drawn on a banker payable on demand." It has proved in practice to be a credit instrument of astonishing usefulness. No one could have foreseen that the cheque would become the chief currency of domestic commerce in Great Britain and the United States. What is perhaps equally surprising is that the British and American example has not been more largely followed in other countries. Over 90 per cent of the internal financial and wholesale trading transactions of Great Britain and the United States are settled by cheque. On the continent of Europe the cheque system is comparatively undeveloped, but it is everywhere making headway, especially in France and Germany. That the cheque will eventually come into universal use cannot be doubted.

The word "cheque," of which "check" is a variant, originally signified the counterfoil or indent of an exchequer bill, or any draft form of payment, on which was registered the details of the principal part, as a "check" to alteration or forgery. The check or counterfoil parts remained in the hands of the banker, the portion given to the customer being termed a "drawn note" or "draft." From the beginning of the nineteenth century the word "cheque" gradually became synonymous with "draft" as meaning a written order on a banker by a person having money in the banker's hands, to pay some amount to bearer or to a person named. Ultimately, the word "cheque" entirely superseded the word "draft."

The law relating to cheques, which is generally one with that of bills of exchange, but has some different and supplemental points, is dealt with elsewhere (*see* BILL OF EXCHANGE). Here we note some of the chief precautions which should be used in drawing cheques.

Cheque Forms.—London banks use a form printed "or order"; the payees cannot obtain the money without "endorsing" the cheque. Therefore no other person could obtain the money without committing forgery. Further, the form may be printed "crossed"; two lines being printed across it. A cheque so crossed can only be cashed through a banker, so that, if we imagine the endorsement to be forged, the forger could not cash the cheque without the aid of a person with a banking account to put the cheque through for him. Further, the drawers of the cheque often take the precaution of adding the words "a/c Payees only" to the crossing. That means that no person other than the payees could obtain payment, even though a forger had signed the payee's name on the back.

In drawing cheque for eight pounds, for example, the words should be carefully written close to the printed words "the sum of," and also close to each other, to prevent the insertion of forged figures, while the space not needed for words is filled in with a thick wavy line. The "t" of "eight" and the "p" of pounds, are written closely together to prevent the insertion of a "y" to turn "eight" into "eighty." For the same reason, the figures are carefully written and the spaces between them filled with lines. As a further precaution, the words "under nine pounds" are written in the top left hand corner. A cheque thus drawn with care and intelligence can hardly be misused, but business firms often take the further precaution of using a machine which perforates the figures as it prints them. A cheque may legally be drawn upon a plain piece of paper, but this, fortunately for the bankers, is rarely done; it is only too likely to lead to mistake and loss. The adoption of an inimitable form of signature by those who draw many cheques should be carefully considered. It is a curious fact that wholly or partly illegible signatures are much safer than those carefully or very legibly written, for a well or beautifully written name is easily imitated by the forger.

Bankers issue to their customers on request cheque-forms either to "bearer" or to "order," and printed either crossed or left uncrossed. It is far the best way to use cheque forms printed "or order" and crossed. If it is desired to make the cheque payable to "bearer" this can be done by crossing out the word order and signing the alteration. Again, if it is desired to cancel the printed cross lines this can be done by writing across them "Pay cash" and signing the alteration.

The usual form of an American cheque carries at the top the date of issuance, the name of the bank on which it is drawn and a number for convenient identification. This is followed by the printed words "Pay to the order of" and a space in which is written the name of the payee. On the next line the amount in dollars is written out and the cents usually shown in figures. There is also provided a place for writing the whole amount of the cheque in figures. At the bottom appears the signature of the maker. To collect the cheque the payee must endorse it exactly as his name is written. When so endorsed the cheque is good in the hands of anyone, as is the case with a cheque made payable to cash. The signature of the person cashing it is usually required. The precautions stated above should be used in drawing the cheque.

The Cheque as Receipt.—The cheque form has come into common sense use as a means of giving a receipt conveniently and expeditiously. It is not surprising that it occurred to business men that as a cheque has to be endorsed on the back by the payee, it would make short work of detail by turning that endorsement into a definite receipt for the money paid. Accordingly, in an increasing number of cases, business firms print on the back of the cheques they use a form of a receipt for the payee to sign. As cheques are always sent back to the drawers when cleared by their bankers, the drawers have only to paste the returned cheques in their cheque book to have a complete and combined record of payments and receipts. A further development of the cheque form has naturally followed. The custom of endorsing a cheque on the back is a strange one. To find such an endorsement one has to turn the cheque over, and it is never well in matters of record to write or print on both sides of the paper. The endorsement on the back of a cheque, useful as it is, is thus seen as a combination of usefulness and inconvenience. Realising this, some business houses have boldly brought the endorsement on to the front of the cheque and at the same time made it a receipt form. This somewhat enlarges the size of the cheque form, but

the complete record can be contrived within a space of 7 or 8 in. by 5 or 6 in. It is probable that so simple and convenient a method of combining payment, endorsement and receipt will come into wide use (*see* BILL OF EXCHANGE; BANKING AND CREDIT; BANK; MONEY MARKET).

CHEQUERS. Chequers Court, near Wendover, Buckinghamshire, became an official residence of British prime ministers in 1921 through the generosity of its owners, Lord and Lady Lee of Fareham. The estate is about 1,500 ac. in extent.

Here Caractacus had a stronghold, of which the earthworks are still visible. "Radulphus," clerk to the Exchequer, was owner under Henry II., and the place appears to have taken its name from his office. In 1565, his descendant, William Hawtrey, remodelled the house and gave it much of its present character and appearance. In the 18th century, a unique collection (which still remains) of Cromwell portraits and other relics was brought by the Russells, who were descended from one of the Protector's daughters. The Russells maintained the Elizabethan house with little alteration, but Robert Greenhill, who inherited from them early in the 19th century, plastered the whole of the outside and redecorated the interior in Strawberry Hill Gothic fashion.

When the Lees entered on a long tenancy in 1909 they sought to reveal all the remaining ancient features, and to introduce others characteristic of the days of the Hawtreys and the Russells. In 1917 Lord and Lady Lee changed their tenancy into a freehold, and created a trust, which, on their deaths should make the house an adequate seat where the prime ministers could entertain guests. The original draft for the Chequers Trust declared that:—"The main features of the scheme are, therefore, designed not merely to make Chequers available as the official country residence of the prime minister of the day, but to tempt him to visit it regularly, and to make it possible for him to live there, even if his income should be limited to his salary. With this object a sufficient endowment is provided to cover the cost of a permanent nucleus staff of servants, of keeping up the gardens and grounds, of maintenance and repairs, and other necessary outgoings. There is also a residential allowance for the official occupant calculated in a fashion deliberately designed to encourage regular week-end visits." The draft, however, insisted upon the unaltered preservation of both house and contents.

In 1920 Lord and Lady Lee resolved that this scheme should not await their death but should take immediate effect. All the preparations for establishing and working the trust having been completed, the prime minister, Lloyd George, held his housewarming on Jan. 8, 1921. His successors have spent part of their time here during their terms of office and ministerial week ends at Chequers Court became a part of English political life.

CHER, a department of central France, embracing the eastern part of the ancient province of Berry, and parts of Bourbonnais, Nivernais and Orléanais, bounded north by the department of Loiret, west by Loir-et-Cher and Indre, south by Allier and Creuse, and east by Nièvre. Pop. (1936) 288,695. Area 2,820 sq.mi. Oolitic rocks occupy much of the department but are covered by Cretaceous and Tertiary deposits in the north. The higher well-drained land of the south and east is suitable both for cultivation and for pasturage. The valley of the Loire is especially fertile and the eastern, sunny slopes are noted for their vines, particularly in the neighbourhood of Sancerre. Wheat and oats are largely cultivated, while hemp, vegetables and fruits are also produced. The central districts are fertile but are low-lying and marshy, being often flooded by the Cher. The department contains much pasturage whence considerable trade in horses, cattle, sheep and wool for the northern markets. Many parts, also, are well-wooded. The chief rivers, besides the Cher and its tributaries, are the Grande Sauldre and the Petite Sauldre on the north, but the Loire, which forms the eastern boundary, and the Allier, though not falling within the department, drain the eastern districts, and are navigable. The Cher itself becomes navigable when it receives the Arnon and Yèvre, and communication is greatly facilitated by the Canal du Berry, the lateral canal of the Loire, which follows the left bank of that river, and the canal of the Sauldre. Mines of iron are worked and stone is quarried. There are brick, porcelain and glassworks, flour-mills, distilleries, oil-works, saw-mills and tanneries. Bourges and Vierzon are metallurgical and engineering centres. The department is served by the Orléans railway. It is divided into the two arrondissements (29 cantons, 293 communes) of Bourges and Saint-Amand-Mont-Rond, of which the former is the capital and the seat of an archbishop and of a court of appeal. The department belongs to the *académie* (educational division) of Paris. Bourges, Saint-Amand-Mont-Rond, Vierzon and Sancerre are the principal towns. Méhun-sur-Yèvre (pop. 4,320), a town with porcelain manufactures, has a Romanesque church and a château of the 14th century. The church at St. Satur has a fine choir of the 14th and 15th centuries; those of Dun-sur-Auron, Plaimpieds, Aix d'Angillon and Jeanvrin are Romanesque in style, while that at Aubigny-Ville is of the 12th, 13th and 15th centuries. Drevant, on the site of a Roman town, preserves ruins of a theatre. The Pierre-de-la-Roche, at Villeneuve-sur-Cher, is the most notable megalithic monument.

CHERAT, a hill cantonment and sanatorium in the Peshawar district of the North-West Frontier province, India, 34m. S.E. of Peshawar. It is situated at an elevation of 4,500 feet. It was first used in 1861, and since then has been employed during the hot weather as a health station for the British troops quartered in the vale of Peshawar.

CHERBOURG, a naval station, fortified town and seaport of northwestern France, capital of an arrondissement in the department of Manche, on the English Channel, 232 mi. W.N.W. of Paris on the Ouest-État railway. Pop. (1936) 39,095. Cherbourg is situated at the mouth of the Divette, on a small bay at the apex of the indentation formed by the northern shore of the Cotentin peninsula, backed by the steep Montagne du Roule.

Cherbourg is supposed to occupy the site of the Roman station of *Coriallum*, but nothing definite is known about its origin. The peninsula, stretching far towards the Isle of Wight, seems to have been used by prehistoric traders of the bronze age as a starting place for the British Isles. William the Conqueror, under whom the settlement appears as *Carusbur*, provided it with a hospital and a church; and Henry II of England on several occasions chose it as his residence. Under Philip Augustus it became of military importance; in 1295 it was pillaged by an English fleet from Yarmouth, and in the 14th century it frequently suffered during the wars against the English. Captured by the English in 1418 after a four months' siege, it was recovered by Charles VII of France in 1450. An attempt was made under Louis XIV to construct a military port. Fortifications constructed by Vauban in 1686 were dismantled in 1689. Harbourworks were begun under Louis XVI and continued by Napoleon I. It was left, however, to Louis Philippe, and Napoleon III, to complete them. By 1858, £8,000,000 had been expended on the works; in 1889, the harbour was farther extended.

The naval and commercial harbours are distant from each other about half a mile. The former consists of three main basins cut out of the rock, and has an area of 55 acres. The minimum depth of water is 30 ft. Connected with the harbour are dry docks, shipbuilding yards, magazines, rope walks, etc. There is a large naval hospital close to the harbour. The commercial harbour at the mouth of the Divette communicates with the sea by a channel 650 yd. long. It consists of two parts, an outer and tidal harbour 17½ acres in extent, and an inner basin 15 acres in extent, with a depth on sill at ordinary spring tide of 25 ft. Outside these harbours is the triangular bay, which forms the roadstead of Cherbourg. The bay is naturally sheltered on every side but the north, where lies the huge breakwater, 2¼ mi. in length (begun by Louis XVI), with a width of 650 ft. at its base and 30 ft. at its summit, which is protected by forts, and leaves passages for vessels to the east and west. The transatlantic liners lie to within this *digue*.

Near the roadstead is the church of La Trinité, a good example of the Flamboyant style (1423–1504), and one of the few historic buildings of Cherbourg. A rich collection of paintings is housed in the *hôtel de ville*. A statue of the painter J. F. Millet, born near Cherbourg, stands in the public garden. Cherbourg is a fortified place of the first class, headquarters of one of the five

naval arrondissements of France, and the seat of a sub-prefect. It has tribunals of first instance and of commerce, a chamber of commerce and a naval school. The chief industries of the town proper are fishing, sawmilling, tanning, shipbuilding, iron and copper founding and ropemaking. The bathing beach is frequented by local holidaymakers. Cherbourg is a port of call for transatlantic steamers. The chief exports are stone for road-making, butter, eggs and vegetables; the chief imports are coal, timber, superphosphates and wine from Algeria. Great Britain is the principal customer.

CHERBULIEZ, CHARLES VICTOR (1829–1899), French novelist and miscellaneous writer, was born at Geneva, where his father, André Cherbuliez (1795–1874), was a classical professor at the university. He resumed French citizenship and was elected a member of the Academy (1881). Cherbuliez wrote many novels, showing the influence of George Sand, of which the following are the best known: *Le Comte Kostia* (1863), *Le Prince Vitale* (1864), *Le Roman d'une honnête femme* (1866), *L'Aventure de Ladislas Bolski* (1869), *La Vocation du Comte Ghislain* (1888), *Le Secret du précepteur* (1893), *Jacquine Vanesse* (1898). He also contributed literary and historical studies to the *Revue des deux Mondes* and *Le Temps*, many of which were collected in book form in *L'Allemagne politique* (1870), *Études de littérature et d'art* (1873), *Profils étrangers* (1889), etc.

See E. Ritter, *Victor Cherbuliez* (1900).

CHERCHEL, a seaport of Algeria, in the arrondissement and department of Algiers, 55 mi. W. of the capital. Pop. (1936) 8,301. It is in an agricultural and vine-growing district. Commercially it is of no great importance. The artificial harbour gives excellent shelter to small vessels. The town is noted for the extensive ruins of former cities on the same site. Cherchel was a city of the Carthaginians, who named it Jol. Juba II. (25 B.C.) made it the capital of the Mauretanian kingdom under the name of Caesarea. Destroyed by the Vandals, Caesarea regained some importance under the Byzantines. Taken by the Arabs it was renamed Cherchel. Khair-ed-Din Barbarossa captured the city in 1520 and annexed it to his Algerian pashalik. In 1840 the town was occupied by the French. The ruins suffered from vandalism during the early period of French rule, many portable objects being removed to museums in Paris or Algiers, and most of the monuments destroyed for the sake of their stone. The museum contains some of the finest statues discovered in Africa.

See V. F. Godell, *Les monuments antiques de l'Algérie* (1901).

CHEREPOVETZ, a town and district in the Vologda region (*q.v.*) of the Russian Soviet Federated Socialist republic. The area of the district is 18,387 sq.mi., and the population 607,735, mainly rural. The soil is mainly of the podzolized bog type favourable to tree growth (*see* RUSSIA: *Forest Zones*) and 76% of the district is forested. The climate is dry and cold, and the waterways are frozen six months in the year; of the average rainfall of 20 to 25 in., most falls in July and August. The summer temperature averages 65° F. Much timber is exported in a raw state to Leningrad and Moscow or to foreign countries; there is little manufacture of furniture or other wooden goods. The timber is floated down the waterways on rafts when the spring thaws begin. During World War I and the Intervention (1914–21), sawmilling and timber works fell off, partly through the blockade of foreign markets and partly through the cessation of building operations. By 1924 it had reached only 50% of the 1913 level. Koustar (peasant) industries in charcoal burning and the production of pitch and tar are carried on in all the forest areas. Hunting is a profitable occupation, mainly for export. Squirrel, fox, marten and polecat fur have the widest sale; other animals hunted are otter and marsh otter, white hare, ermine, lynx, wolf and brown bear. During the war and civil war 1914–21, hunting practically ceased, and wolves and bears became so numerous that they attacked the villagers, and it was necessary to offer rewards for their heads. By 1925 the export of furs from the area reached two-thirds of the prewar level. In the sown area, the chief crops are rye, oats, barley, wheat and buckwheat, which together form 83.5% of the crops. Potatoes, flax and hay are also produced. In the famine year 1921–22, Cherepovetz had a good harvest, since it is largely under the influence of the western cyclonic system and was unaffected by the eastern drought conditions. Cattle, horses, sheep and pigs are reared and a co-operative system of dairy artels is developed for the supply of Moscow and Leningrad. Of industries other than timber working, only the production of matches and leather goods reached prewar level. Printing, the making of small metal goods and work on electric stations are slightly developed, the respective percentages being 1.6, 2.1 and .9. Roads are poor and in many areas do not exist at all, the only railway is the east to west line which links Leningrad with Vologda, and freightage is mainly by the waterways, especially that linking with the famous Marii network to Leningrad.

The town of Cherepovetz, lat. 59° 8′ N., long. 37° 55′ E., population 24,900, is the administrative centre. It is situated at the junction of the Yagorba and Sheksna rivers, which drain into the Volga, and during the spring thaws the banks of these streams are submerged. The Voskresensk monastery, of ancient foundation, certainly prior to the 15th century, led to a settlement of peasants near it, and this settlement was raised to town rank in 1780 and given the name of Cherepovetz. Its situation on the railway and waterways makes it a centre for the products of the province. Agricultural implements and boots and shoes are made in the town, and there are a brandy distillery and a timber mill.

CHERIBON (Tjerebon), a residency of the island of Java, Dutch East Indies, bounded west by Batavia residency, south by Priangan residency, north by the Java sea, and east by the residency of Pekalongan: it is included in the government of West Java. Pop. (1930) 2,069,690, including 3,379 Europeans and Eurasians, and 36,905 foreign Asiatics, Chinese included. Although some Javanese live in the north, Cheribon is Sundanese country, its eastern boundary dividing the Sundanese from the Javanese territory of Central Java. Cheribon has been for many centuries the centre of Mohammedanism in West Java, for it is here that the Mohammedan power was strongly established as early as 1526, under Gunung Jati and much of the opposition to Dutch rule at a later date came from this district. The native population is now, on the whole, orderly and prosperous. The northern half of the residency is flat and marshy in places, while the southern half is mountainous. Southwest of the city of Cheribon stands the huge volcano Cherimaj, clad with virgin forest and plantations, and surrounded at its foot by rice fields. Sulphur and salt springs occur on the slopes of Cherimaj, and near Palimanan there is a cavernous hole called Guwagalang (or Payagalang), which exhales carbonic acid gas, and which is considered holy by the natives, and is guarded by priests. The principal products of cultivation are tea, rice, essential oils, sugar, cinchona, cassava and ground nuts and pulses, the tea and other plantations for the most part being owned by Europeans. The chief towns are Cheribon (pop. 54,079 with 1,653 Europeans and Eurasians and 8,191 Chinese), a seaport and the capital, and Indramayu (pop. 21,190). Cheribon has a good open roadstead, and quay and warehouse-accommodation for the lighters into which cargo is discharged. The town is very old and irregularly built; it is a regular port of call. Cheribon was the residence of the powerful sultans of Tjerebon, and their descendants live there still, on pension, the head of the house being styled the Sultan Sepoeh. Kuningan, famous for a breed of horses, is a hill resort (2,200 ft.) much resorted to by Europeans. Imports and exports respectively, in 1939 were, for Cheribon port, 22,636,000 and 9,371,000 guilders. The residency was occupied by Japan in March 1942.

CHERIMOYA or **CHERIMOYER** (*Annona Cherimola*), a sub-tropical fruit of the custard-apple family (Annonaceae), sometimes called Peruvian custard-apple. It is probably native to the mountains of Ecuador and Peru whence several centuries ago it spread by cultivation to Mexico, Central America and the West Indies; later to the Hawaiian islands, Mediterranean countries, Africa, India and Polynesia, and recently to the southern United States. It succeeds best in a comparatively cool and dry summer climate, and in the tropics must be grown at considerable elevation. It does well in protected foot-hill regions of California and also in southern Florida where there is little frost. The fruits

are roundish to oblong conical, greyish-brown or nearly black, three to five pounds or more in weight, with the skin either smooth or with warty tubercles on the surface. The flesh is soft, sweet, rich and deliciously flavoured. Propagating is done by shield budding or cleft grafting on seedling stocks two years old, and stocks of other species of *Annona* are sometimes used. Mature trees are from 15 to 20 ft. high.

CHERKASSY (CHERKASSI), a town in the Kiev region of the Ukrainian S.S.R., 49° 25′ N., 32° 3′ E. Pop. (1939) 51,693. It is situated near the right bank of the Dnieper, at the south-eastern termination of a patch of forest. It has a radio station and is on the north to south railway which links Chernigov with Odessa. The inhabitants (Little Russians) are employed in agriculture and gardening. Sugar and tobacco are manufactured, and there are timber mills and veneering works and factories for nail and brick making. Cherkassy was an important town of the Ukraine in the 15th century, and under Polish rule, until the revolt of the Cossack *hetman,* Chmielnicki (1648). It was annexed by Russia in 1795. German troops occupied it in 1941.

CHERNIGOV, a town and region in the Ukrainian S.S.R. The region has an area of 4,125 sq.mi., and is much smaller than the former Chernigov government. The Dnieper river forms its western boundary; its eastern boundary reaches long. 32° E. in the north, but toward the south is farther west and runs parallel with the left bank of the Desna river. Its northern boundary coincides with that of the Ukraine, and the region of Kiev lies to the south. The north-west between the Dnieper and the Desna is forested, with marshes near the rivers, but the area on the left bank of the Desna lies in the transitional forest-steppe zone. In the north-west lumbering and the production of wooden wares, tar, pitch and leather goods are the main peasant occupations, beekeeping forming a useful supplement. The sown area is small, the marshy and sandy soil being unfavourable to agriculture. The chief crops are rye and oats. Hemp is also cultivated. The Desna river and its tributaries are navigable in summer and form outlets for timber. The climate is severe, the rivers being frozen for about 130 days. The town of Chernigov lat. 51° 31′ N., long. 31° 20′ E. has an average Jan. temperature of 23° F. and July 68.5° F. Pop. (1939) 67,356. Chief occupations are the making of spirits, leather goods, especially footwear, and flour-milling. The town is a river port, with an elevator and a radio-station; it is the terminus of a branch railway. It has had a long and eventful history and was mentioned in the treaty of Oleg, 907, as next in importance to Kiev. In the 11th century it became the capital of the principality of Syeversk, and its cathedral dates from that time. The Mongol invasion 1239 destroyed its prosperity. In the 14th century it was annexed by Lithuania, and as a part of the grand duchy of Lithuania entered in union with the kingdom of Poland and remained a part of the Polish-Lithuanian state until its occupation by the Russians in 1686. It was occupied by the Germans in 1941.

CHERNYSHEVSKY, NIKOLAY GAVRILOVICH (1828–1889), Russian writer and political leader, was born at Saratov. His first works dealt with literary criticism (*The Aesthetic Relations of Art to Reality,* 1855, and *Studies of the Age of Gogol*). In the reform movement which set in after the Crimean War, he took an active part. His journal, *The Contemporary,* urged a program of education, more railways and a "rational distribution of economic forces"—in other words, emancipation of the serfs. On this last point he laid particular stress, and when the tsar Alexander put forward his first reform program (Jan. 1858), Chernyshevsky in *The Contemporary* ranked him higher than Peter the Great. The incompleteness of the agrarian reform, when promulgated, and the delays in its execution ended in turning Chernyshevsky against the Government, and he and Dobrolyubov, became the leaders of the radical party which demanded immediate and wholesale reform. A visit to Hertzen in London convinced Chernyshevsky of the futility of the Liberal movement, and resulted in a rupture between the Liberals and Radicals. Chernyshevsky, now supported by the Nihilists, increased his agitation till his sudden arrest in 1862. He was tried in 1864 and sent for 24 years to Siberia. During his imprisonment in the fortress of St. Petersburg he had written his famous novel *Shto Delat* ("What is to be done?", 1863, Eng. trans. under the title *The Vital Question,* 1866)—a classic of the revolutionary movement which earned him his severe sentence. In 1883 he was transferred from north Siberia to Astrakhan, where he began to translate Weber's *Universal History.* In 1889 he was allowed to return to Saratov, where he died, broken in health, a few months after.

See G. Plekhanov, *N. G. Tschernyschewsky* (Stuttgart, 1894).

CHEROKEE (chĕr′o-ke). This tribe, of Iroquoian lineage, is one of the largest in the United States. They inhabited the southern Alleghanies, where the Carolinas, Georgia, Alabama, and Tennessee adjoin. Their name seems to be of Muskogi origin and to mean "cave people." Encountered by De Soto in 1540, they first came into contact with the British in the latter half of the 17th century. They fought on the British side in the American Revolution, refusing to make peace until ten years after its termination. White settlement pressing in upon them, part of the tribe withdrew beyond the Mississippi, but the remainder, in 1820, formed a government modelled on that of the United States and soon after adopted the alphabet, or rather syllabary, invented by one of their half-bloods, Sequoyah. In 1838 the nation was reunited in Indian Territory, now Oklahoma, where they were recognized as one of the "five civilized tribes" and set up their capital at Tahlequah, their government remaining effective until 1906, when all Cherokees became United States citizens. Their original numbers were about 15,000, making them one of the largest tribes in North America. Admixture of white and Negro blood, and adoption of aliens of all three races, as well as vigour of the Cherokee stock, have doubled this number.

The Cherokee were divided into seven matrilineal clans. Their general culture was similar to that of the tribes of Muskogi stock to the south. *See* Royce, *Bur. Am. Ethn. Rep. V.* (1887); Mooney, *ibid.* xix. (1902).

CHEROKEE, a city of north-western Iowa, U.S.A., on the west bank of the Little Sioux river, 60 mi. E.N.E. of Sioux City; the county seat of Cherokee county. It is a division point on the Illinois Central railroad. The population in 1940 was 7,469. Cherokee is the trade centre for a rich farming, dairying, and stock-raising country. A State hospital for the insane, accommodating 1,650 patients, is located here.

The first log house in the county was built in 1856, 4 mi. S. of the city, by Robert Perry, who soon thereafter met a colony of emigrants from Milford (Mass.), and persuaded them to settle near by. Two black walnut logs from their first stockade are preserved as a historic relic; and the mill-stones from the first mill have been set up as a monument. When the railway reached the county (1871), the present town-site was located about a mile from the old town. Just south of the city is Pilot Rock, a huge glacial boulder, 40 x 60 ft., which was a well-known landmark in the days of migration westward.

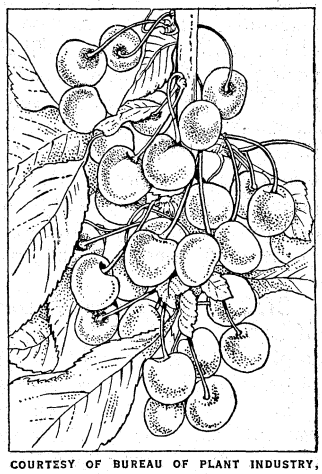
CHEROOT, a cigar made from tobacco grown in Southern India and the Philippine islands. The quality of cheroots varies a great deal, but a good example is esteemed for its delicate flavour. A cheroot differs from other cigars in having both ends cut square, instead of one being pointed, and one end considerably larger than the other. Cheroot, which is also sometimes spelled sheroot, is from the Tamil *shuruttu,* meaning a roll.

CHERRAPUNJI, a village in the Khasi Hills district of Assam, India, notable as having one of the heaviest known rainfalls in the world. Its annual average is 429 in., but the fall varies greatly; 905 in. were registered in 1861 (366 in. falling in July), and only 283 in. in 1873. This excessive rainfall is caused by the fact that Cherrapunji stands on the edge of the plateau overlooking the plains, where it catches the full force of the monsoon from the Bay of Bengal.

CHERRY. Next to the peach and the plum the cherry is the most important stone fruit grown in the United States. The horticultural varieties which are of interest for their value as edible fruit belong to two groups, the sweet and the sour. Sweet cherry fruits are used principally for fresh fruit dessert, while the sours make up the great bulk of the frozen and canned cherries of commerce for use in bakeries, restaurants and homes for

pies, preserves and sauce. This group is sometimes referred to as pie cherries.

Sweet cherries blossom early in the spring, and the flowers are very susceptible to cold and frost injury. The sour cherry tree is as hardy as some apple varieties, but its flower buds are also quite tender to cold after growth starts in late winter, and crops are frequently lost by freezes occurring near blossoming time. Chiefly because of the special climatic requirements of these two groups, the principal commercial production of sweet cherries in the United States is limited to the Pacific and intermountain states of the west, while the sour cherries are grown principally in districts near the Great lakes in the states of Michigan, Wisconsin, Ohio, Pennsylvania and New York. However, the sour cherry is also grown as a dooryard or garden tree in many other parts of the country where winter temperatures are not too severe or the summers too hot and dry.



COURTESY OF BUREAU OF PLANT INDUSTRY, SOILS AND AGRICULTURAL ENGINEERING, U.S. DEPARTMENT OF AGRICULTURE

SWEET CHERRIES ARE MORE OR LESS HEART-SHAPED AND ARE SOMETIMES REFERRED TO AS HEART CHERRIES. THE VARIETY SHOWN IS OF THE GEAN TYPE WITH DARK FLESH AND REDDISH JUICE. THE BIGARREAU TYPE IS SIMILAR IN APPEARANCE BUT HAS FIRM FLESH

All varieties of cultivated cherry belong to two species. The sweet cherries, *Prunus avium,* are tall pyramidal trees with few or no suckers from the roots and with leaves downy on the underside. The sour cherries, *Prunus cerasus,* are small, broader trees with many suckers from the roots and with fruit sour to bitter in taste. Wild forms of the sweet cherry found growing in the United States and in Europe are also called mazzard, bird and wild sweet cherry.

The native habitat of the sweet cherry species is considered by many authorities to be western Asia, while that of *Prunus cerasus* seems to be close to that of *Prunus avium* in the region about the Caspian sea and extending into eastern Europe. These two species are widely distributed through the north temperate zone. The sweet cherry, *Prunus avium,* has been divided by botanists into different groups, but because of hybridization among the varieties it is rather difficult in many cases to classify them. Sweet cherries with soft, tender flesh form one group known by pomologists under the French group name *guigne* or the English *gean.* This group is also often referred to as the heart cherries. Some of the varieties, such as Wood, are light coloured with colourless juice, while that of others, such as Black Tartarian, are dark coloured with reddish juice. A second group includes those distinguished by the firm, crisp flesh of the fruits and often referred to as the Bigarreaus. Bing, a dark red cherry, and Napoleon, a light coloured one, are examples of this group. Like the sweet cherry, the sour cherry is also divided into groups based on the colour of the juice. Cherries with colourless juice are the Amarelles, these having pale red to red fruits more or less flattened at the ends. Montmorency is the most important variety of this group grown in the United States. The Morellos comprise a second group containing varieties such as English Morello, with very dark round to oval fruits and flesh with reddish juice. A group of cherries intermediate in type between the sweets and the sours is known as the dukes. These cherries, which are considered to be hybrids between *Prunus avium* and *Prunus cerasus,* have many characteristics of fruit, skin, flesh, juice colour and flavour, as well as of tree growth, that are intermediate between the sweets and sours. Three other species of cherry of low-growing bush or shrub form with edible fruit are the Nanking or bush cherry, *Prunus tomentosa,* an inhabitant of central Asia; the sand cherry, *P. pumila,* of the shores and beaches of the eastern United States, and the western sand cherry or Bessey cherry, *P. besseyi,* of the western United States.

The cherry is propagated by budding on the wild sweet or mazzard stock, or on the small wild, inedible sour cherry of southern Europe, *Prunus mahaleb.* The average annual commercial production of sweet cherries in the United States for the five-year period 1938–42 was slightly over 79,000 tons while the average production of sour cherries for the same period was 93,978 tons. In addition to dessert and culinary uses in the home, cherry fruit is also used in the making of liqueurs. Kirschwasser is made chiefly on the upper Rhine from a wild black sweet cherry, *Prunus avium.* Maraschino, a liqueur made from the marasca cherry, is used in Europe and the United States in the making of maraschino cherries. The marasca cherry is a native of the province of Dalmatia, Yugoslavia.

The black cherry, *Prunus serotina,* is native to most of the eastern half of the United States and adjacent areas of eastern Canada. Wood of this species has long been valued by cabinetmakers in making high quality furniture. (F. P. C.)

CHERRYVALE, a city of Montgomery county, in southeastern Kansas, U.S.A., served by the Frisco, the Santa Fe and the Union Electric railways. The population in 1940 federal census was 3,185. It is surrounded by rich farmland, lying over deposits of gas and oil. Its industries include a zinc oxide plant, a flour mill and a factory for work pants and work shirts. The city was laid out in 1871 by a railway company later absorbed in the Santa Fe system. Natural gas was discovered in 1889, and oil a few years later.

CHERRY VALLEY, a village of Otsego county, New York, U.S.A., in a township of the same name, 60 mi. N.W. of Albany. Pop. (1930) 707; (1940) 704; of the township (1930) 1,326; (1940) 1,274. It is served by the Delaware & Hudson railway. Cherry Valley is in the centre of a rich farming and dairying region, has a chair factory and is a tourist resort with sulphur and lithia springs. It was the scene of a terrible massacre during the War of Independence. The village was attacked on Nov. 11, 1778, by Walter Butler (d. 1781) and Joseph Brant with a force of 800 Indians and Tories, who killed about 50 men, women and children, sacked and burned most of the houses and carried off more than 70 prisoners, who were subjected to the greatest cruelties, many dying or being tomahawked before the Canadian settlements were reached.

Cherry Valley was incorporated in 1812.

CHERSIPHRON, a Cretan architect, the traditional builder (with his son Metagenes) of the great Ionic temple of Artemis at Ephesus in the 6th century B.C. Remains of this temple were found by J. T. Wood and brought to the British museum. A fragmentary inscription supports the statement of Herodotus that the pillars were presented by King Croesus.

CHERSO, one of the three major islands of the Quarnero group, lying off the E. coast of the peninsula of Istria, Italy. With the adjacent island of Lussin it was transferred to Italy in the settlement after World War I and was included in Venezia Giulia, while Veglia, the third member of the group, was attached to Yugoslavia.

Cherso, 40 mi. long and 8 mi. wide, has a total area of 125 sq.mi. It is separated from Lussin by a navigable channel, crossed by a swing bridge, the channel being believed to be artificial and the result of Roman work. The Roman town of Ossero, now a village but formerly the capital of Cherso, stands where the two islands approach most closely. Lussin, though having an area of only 28 sq.mi., has a larger population than Cherso and contains in Lussin Piccolo a harbour of some importance, while Cherso harbour has no great value. Both islands are structurally a part of the karst plateau of Istria, and show similar features, with numerous swallow-holes and patches of fertile red earth. Cherso contains the interesting karstic L. Vrana. Wine, olive oil and fruits are produced in both, but Cherso, which is mountainous, rising to over 2,000 ft., is devoted largely to sheep raising. Under the Austrians the population of Cherso, about 8,000, was registered as predominantly Serbo-Croat, the Italians forming a minority. But Cherso and Lussin formed together one district, and Italians so largely predominated in the latter island as to make the

total figures for the two stocks practically equal. Since the Italians regarded the Austrian figures as favouring the Serbo-Croat element at their expense the frontier was drawn to include both islands within Italy. The pop. in 1936 was 7,127.

See "The Austrian Littoral," Foreign Office *Peace Handbook,* 10.

CHERSONESE, CHERSONESUS or **CHERRONESUS,** a word equivalent to "peninsula" (Gr. χέρσος, dry, and νῆσος, island). In ancient geography the Chersonesus Thracica, Chersonesus Taurica or Scythica, and Chersonesus Cimbrica correspond to the peninsulas of the Dardanelles, the Crimea and Jutland; and the Golden Chersonese is usually identified with the peninsula of Malacca. The Tauric Chersonese was further distinguished as the Great, in contrast to the Heracleotic or Little Chersonese at its south-west corner, where Sevastopol now stands.

History.—The *Tauric Chersonese* (from the 2nd century A.D. called Cherson) was a Dorian colony of Heraclea in Bithynia, founded in the 5th century B.C. in the Crimea about 2 m. S. of the modern Sevastopol. After defending itself against the kingdom of Bosporus (*see* BOSPORUS CIMMERIUS), and the native Scythians and Tauri, and even extending its power over the west coast of the peninsula, it was compelled to call in the aid of Mithradates VI. and Diophantus, *c.* 110 B.C., and submitted to the Pontic dynasty. On regaining a nominal independence, it came under the Roman suzerainty. In the latter part of the 1st century A.D., and again in the second, it received a Roman garrison and suffered much interference in its internal affairs. In the time of Constantine, in return for assistance against the Bosporans and the native tribes, it regained its autonomy and received special privileges. It must, however, have been subject to the Byzantine authorities, as inscriptions testify to restorations of its walls by Byzantine officials. Under Theophilus the central government sent out a governor to take the place of the elected magistrate. Even so it seems to have preserved a measure of self-government and may be said to have been the last of the Greek city states. It had been the main emporium of Byzantine commerce upon the north coast of the Euxine. Through it went the communications of the empire with the Petchenegs and other native tribes, and more especially with the Russians. The commerce of Cherson is guaranteed in the early treaties between the Greeks and Russians, and it was in Cherson, according to Pseudo-Nestor's chronicle (*see* NESTOR), that Vladimir was baptized in 988 after he had captured the city. Its ruin was brought about by the commercial rivalry of the Genoese, who forbade the Greeks to trade there and diverted its commerce to Caffa and Sudak. The constitution of the city was at first democratic under *damiorgi,* a senate and a general assembly. Latterly it appears to have become aristocratic, and most of the power was concentrated in the hands of the first archon or *proteuon,* who in time was superseded by the *strategus* sent out from Byzantium. Its most interesting political document is the form of oath sworn by all citizens in the 3rd century B.C.

Remains.—The remains of the city occupy a space about two-thirds of a mile long by half a mile broad, enclosed by a Byzantine wall. Remains of a Greek wall going back to the 4th century B.C. have been found beneath this in the eastern or original part of the site. Many Byzantine churches, both cruciform and basilican, have been excavated. The latter survived here into the 13th century when they had long been extinct in other Greek-speaking lands. The churches were adorned with frescoes, wall and floor mosaics, and marble carvings similar to work found at Ravenna. The fact that the site has not been inhabited since the 14th century makes it important for our knowledge of Byzantine life. The city was used by the Romans as a place of banishment: St. Clement of Rome was exiled hither and first preached the Gospel; another exile was Justinian II., who is said to have destroyed the city in revenge. Its coins range from the 3rd century B.C. to about A.D. 200, and there are Byzantine issues.

See B. Koehne, *Beiträge zur Geschichte von Cherronesus in Taurien* (St. Petersburg, 1848); art. "Chersonesos" (20) by C. G. Brandis in Pauly-Wissowa, *Realencyklopädie,* vol. iii. 221; A. A. Bobrinskoj, *Chersonesus Taurica* (St. Petersburg, 1905) (Russian); V. V. Latyshev, *Inscrr. Orae Septentr. Ponti Euxini,* vols. i. and iv. Reports of excavations appear in the *Compte rendu* of the Imperial Archaeological Commission of St. Petersburg from 1888 and in its *Bulletin. See* also E. H. Minns, *Scythians and Greeks* (Cambridge, 1907). Rostovtseff. M., *Iranians and Greeks in South Russia* (Oxford, 1922).

CHERT, in geology, a rock consisting mainly of silica in a finely granular or chalcedonic form, closely allied to flint (*q.v.*). Cherts are probably formed in several different ways; for example, by solution and re-deposition of the silica contained in the spicules of sponges and other siliceous organisms in sedimentary rocks, such as the Carboniferous limestone and Upper Greensand of England; by accumulation on the floor of the sea in ancient times of radiolaria and diatoms, like some of the modern deep-sea deposits; by precipitation of silica from magmatic solutions belonging to the later stages of submarine volcanic eruptions. In some instances it is uncertain which of these causes was concerned in their formation. Cherts rich in compounds of iron, of volcanic origin, were the primary source of the iron ore of the Lake Superior region of the United States. The Rhynie cherts of Devonian age, in Scotland, are noteworthy for the remarkable preservation of the minute details of the structure of fossils embedded in them.

(R. H. RA.)

CHERTSEY, urban district of Surrey, England, 22 mi. S.W. of London by the S.R. Pop. (1938) 21,740. Area 15.6 sq.mi. It is pleasantly situated on the right bank of the Thames, which is crossed by a bridge of seven arches, built of Purbeck stone in 1785.

The first religious settlement in Surrey, a Benedictine abbey, was founded in 666 at Chertsey (*Cerotesei, Certesey*), the manor of which belonged to the abbot until 1539, since when it has been a possession of the crown. In the reign of Edward the Confessor Chertsey was a large village and was made the head of Godley hundred. Chertsey owed its importance primarily to the abbey, but partly to its geographical position. Ferries over the Redewynd were subjects of royal grant in 1340 and 1399; the abbot built a new bridge over the Bourne in 1333, and wholly maintained the bridge over the Thames when it replaced the 14th century ferry. In 1410 the king gave permission to build a bridge over the Redewynd. As the centre of an agricultural district the markets of Chertsey were important and are still held.

Three days' fairs were granted to the abbots in 1129 for the feast of St. Peter ad Vincula by Henry III. for Holy Rood day; in 1282 for Ascension day; and a market on Mondays was obtained in 1282.

Little remains of the abbey buildings, which fell into decay in the 17th century. The ground-plan, however, can be traced and the fish-ponds are complete. Among the abbots the most famous was John de Rutherwyk, who was appointed in 1307, and continued, till his death in 1346, to carry on a great system of alteration and extension. The house in which the poet Cowley spent the last years of his life remains. The town is the centre of a large residential district. Its principal trade is in produce for the London markets.

See Lucy Wheeler, *Chertsey Abbey* (London, 1905); *Victoria County History, Surrey.*

CHERUBIM are winged creatures associated in the Old Testament with the deity. The name, plural of the Hebrew *kĕrūb,* has no Hebrew etymology, and was taken over, with the conception, from older sources. Similar creatures are found in other oriental religions. The cherubim who guard Paradise (Gen. iii. 24) are introduced, without description, as well-known figures. The cherub appears also in Ezek. xxviii. 13–16, behind which passage lies another version of the Paradise story, but the text is too obscure to throw much light on his character. More illuminating is the vision of Ezekiel, ch. i., where the four "living creatures" attendant upon the divine chariot are undoubtedly cherubim, for they are expressly so named in Ezek. x. These have each four wings, and four faces—those of a man, a lion, an ox, an eagle. The two seraphim of Isa. vi. belong to the same category, though these have six wings and, presumably, human faces. In Ezekiel and Isaiah these beings are connected with the divine throne. It is thus natural that we should find two gold cherubim covering the "mercy-seat" (Exod. xxxvii. 6–9, xxv. 18–22). Representations of cherubim are found also in the hangings of the shrine (Exod. xxvi. 1, 31), and figures of two cherubim, overlaid with gold, in Solomon's temple (1 Ki. vi. 23–28, viii. 6 *seq.*), others carved on

the walls (vi. 29–32), and about the bases of the "molten sea" (vii. 29). So the temple of Ezekiel has carved decorations of cherubim, these with two faces, a man's and a lion's (xl. 18 *seq.*). The description of Yahweh riding "upon a cherub," Ps. xviii. 10, has for its parallel "upon the wings of the wind"; this, although in Babylonian myth the south wind has wings that can be broken, suggests that a mythological conception is used merely for poetical effect, a conclusion confirmed by the similar passage Ps. civ. 3, in which the cherub is replaced by clouds.

To sum up, the cherubim are hybrid creatures, with wings of birds, human or animal faces, regarded as attendants upon the divine throne, or guardians of specially sacred places. The four "living creatures" of Rev. iv. 6 are lineal descendants of those in Ezekiel's vision. In Jewish literature the cherubim appear as a class of angels. Representations of figures similar to the Old Testament cherubim have been discovered in many places, a pair from Dendera showing striking resemblance to those described in Exodus.

See the illustrations in Gressmann's *Altorientalische Texte und Bilder zum Alten Testamente,* nos. 378 *seq.;* Vincent, *Revue Biblique,* p. 487 *seq.* (1926). (W. L. W.)

CHERUBINI, MARIA LUIGI CARLO ZENOBIA SALVATORE (1760–1842), Italian musical composer, was born at Florence on Sept. 14, 1760, and died on March 15, 1842 in Paris. His father was *Maestro al Cembalo* at the Pergola theatre, and began to teach him music when he was six. By the time he was 16 he had composed a great deal of Church music, and in 1777 he went to Bologna, where for four years he studied under Sarti. This famous master well earned the gratitude which afterwards impelled Cherubini to place one of his double choruses by the side of his own *Et Vitam Venturi* as the crown of his *Treatise on Counterpoint and Fugue,* though the juxtaposition does Sarti's music no good. Cherubini also worked at operatic composition, and Sarti sometimes, like the great masters of painting, entrusted his pupil with minor parts of his own works. Cherubini's first complete opera, *Quinto Fabio* was produced in 1780 and was followed in 1782 by *Armida, Adriano in Siria,* and other works. In 1784 he was invited to London to produce two works for the Italian opera there, one of which, *La Finta Principessa,* was favourably received while the other, *Giulio Sabino,* was, according to a contemporary witness, "murdered" by the critics.

In 1786 he left London for Paris, which became his home after a visit to Turin in 1787–88 on the occasion of the production there of his *Ifigenia in Aulide.* His first French opera, *Dêmophon* (1788), which was not a popular success, already marks a departure from the Italian style, which Cherubini still cultivated in the pieces he introduced into the works of Anfossi, Paisiello and Cimarosa, produced by him as director of the Italian opera in Paris (established in 1789). In Paris Cherubini became a great composer. If his melodic invention had been as warm as Gluck's, his masterly technique would have made him one of the greatest composers that ever lived. But his personal character shows in its Johnsonian "anfractuosities" an un-Johnsonian "unclubability," which extends to the centre of his art and deprives even his finest music of the glow of inspiration that fears nothing.

With *Lodoiska* (1791) the series of Cherubini's master-pieces begins, and *Médée* (1797) shows his full powers. Cherubini's creative genius was never more brilliant than at this period, as the wonderful two-act ballet, *Anacreon,* shows; but his temper and spirits were not improved by a series of disappointments which culminated in the collapse of his prospects of congenial success at Vienna, where he went in 1805 in compliance with an invitation to compose an opera for the Imperial theatre. Here he produced, under the title of *Der Wasserträger,* the great work which, on its first production on January 7, 1801 (26 *Nivôse, An* 8) as *Les Deux Journées,* had thrilled Paris with the accents of a humanity restored to health and peace. It was by this time an established favourite in Austria. On February 25 Cherubini produced *Faniska,* but the war between Austria and France had broken out immediately after his arrival, and the run of *Faniska* was stopped by the bombardment and capitulation of Vienna.

His stay at Vienna is memorable for his intercourse with Beethoven, the most whole-hearted admirer he and his works have ever met in a century and a quarter. The mighty genius of Beethoven, which broke through all rules in vindication of the principles underlying them, was incomprehensible to Cherubini, in whose mind the creative faculties were finely developed, but whose critical faculty was supplanted by a mere disciplinary code inadequate even as a basis for the analysis of his own works. On the other hand, it would be impossible to exaggerate the influence *Les Deux Journées* had on the lighter parts of Beethoven's *Fidelio.* Cherubini's librettist was also the author of the libretto from which *Fidelio* was adapted, and Cherubini's score was a constant object of Beethoven's study, not only before the production of the first version of *Fidelio* (as *Leonore*) but also throughout Beethoven's life. Cherubini's record of Beethoven's character is contained in the single phrase, "Il était toujours brusque," a fine example of the pot's opinion of the kettle. The overture to *Leonore* merely puzzled Cherubini as to what key it might be in. Beethoven's brusqueness did not prevent him from assuring Cherubini that he considered him the greatest composer of the age and that he loved and honoured him. Cherubini's incapacity to understand Beethoven did not prevent him from working on the grand scale which Beethoven had by that time established as a permanent standard for musical art. The colossal breadth of the duet *Perfides ennemis* in *Médée* is almost inconceivable without the example of Beethoven's C minor trio, op. 1, No. 3, published two years before it. On the other hand the cavatina *Eterno iddio* in *Faniska* is of a terseness and depth not only worthy of Beethoven but surprisingly like him in style.

After Cherubini's disappointing visit to Vienna he did little until 1809 when his friends with much difficulty persuaded him to write a mass for the consecration of a church at the country seat of the prince de Chimay, where he was staying. With this mass (in F, for three-part chorus and orchestra), the period of his great Church music begins; although it was by no means the end of his career as an opera writer, which lasted as late as his 73rd year (1832). This third period is also marked by several instrumental compositions. An early event in the annals of the Philharmonic Society was the invitation of Cherubini to London in 1815 to produce a symphony, an overture and a vocal piece. The symphony (in D) was afterwards arranged, with a new slow movement, as the string quartet in C (1829), a curious illustration of Cherubini's notions of symphonic as well as of chamber-music style, for the quartet-writing is just like that of his other quartets; oil-painting restricted to black and white. Nevertheless the first three of the six string quartets written between 1814 and 1837 are interesting works performed with success at the present day, and the last three, discovered in 1889 are not without fine passages.

At the eleventh hour Cherubini received recognition from Napoleon, who, during the Hundred Days, made him chevalier of the Legion of Honour. Then, with the restoration of the Bourbons, Cherubini's position improved. He was appointed, jointly with Lesueur, as composer and conductor to the Chapel Royal, and in 1822 he obtained the permanent directorship of the conservatoire.

In 1833 Cherubini produced his last work for the stage, *Ali Baba,* adapted (with new and noisy features which excited Mendelssohn's astonished disgust) from a manuscript opera, *Koukourgi,* written 40 years earlier. It is therefore not one of the brighter rockets from what Mendelssohn called "the extinct volcano." But the requiem in D minor (for male voices), written in 1836, is one of Cherubini's greatest works, and, though not actually his last composition, is a worthy close to the long career of an artist of high ideals who, while neither by birth nor temperament a Frenchman, must yet be counted with a still greater foreigner, Gluck, as among the glories of French classical music. Cherubini's *Treatise on Counterpoint and Fugue* embodies his views as a theorist. Concerning one 16th century idiom, as natural in pure polyphony as "attraction of the relative" is in classical Greek. Cherubini remarks, "No tradition gives us any reason why the classics thus faultily deviated from the rule." On

another point where there is a fine opportunity for stimulating a sense of harmonic values, he inculcates a mechanical pseudo-logic with the remark that "The opinion of the classics appears to me erroneous, notwithstanding that custom has sanctioned it, for on the principle that the discord is a mere suspension of the chord, it should not affect the nature of the chord. But since the classics have pronounced judgment we must of course submit." On the whole Cherubini's career as a teacher did more harm than good in his lifetime, and his *Treatise on Counterpoint and Fugue* continues at the present day to invest disastrous misinterpretations of classical art forms with the authority of a great composer.

And yet as a composer Cherubini was no psuedo-classic but a really great artist. His purity of style rarely joined itself to matter that could express the ideals he kept always in view. In his love of those ideals there was too much fear: but Beethoven's estimate of him is more just than the contemptuous neglect with which his art is treated now.

His principal works are summarized by Fétis as 32 operas, 29 Church compositions, four cantatas and several instrumental pieces, besides the treatise on counterpoint and fugue.

Good modern full scores of the two Requiems and of *Les Deux Journées* (the latter unfortunately without the dialogue, which, however, is accessible in a careful German translation in the *Reclam Bibliothek*), and also of ten opera overtures, are current in the Peters edition. Vocal scores of some of the other operas are not difficult to get. The great Credo is in the Peters edition, but is becoming scarce. The string quartets are in Payne's *Miniature Scores*. It is very desirable that the operas, from *Démophon* onwards, should be republished in full score.

(D. F. T.)

BIBLIOGRAPHY.—D. Denne-Baron, *Cherubini* (1862); E. Bellasis, *Cherubini* (1874 and 1912); Crowest, *Cherubini*, 1890; R. Hohenemser, *Luigi Cherubini, sein Leben und Seine Werke* (Leipzig, 1913); M. Quatrelles l'Epine, *Cherubini 1760–1842; Notes et Documents inédits* (Lille, 1913).

CHÉRUEL, PIERRE ADOLPHE (1809–1891), French historian, was born at Rouen. His most important work was done on the history of France in the 17th century. Among his books are *Histoire de l'administration monarchique en France depuis l'avènement de Philippe-Auguste jusqu'à la mort de Louis XIV.* (1855); *Dictionnaire historique des institutions, moeurs et coutumes de la France* (1855); *Journal d'Olivier Lefèvre d'Ormesson* (1860–62); editions of the *Lettres du cardinal Mazarin pendant son ministère* (6 vols., 1870–91), continued by the vicomte G. d'Avenel; of the *Mémoires du duc de Saint-Simon* (1856–58 and 1878–81); *Notice sur la vie et sur les mémoires du duc de Saint-Simon* (1876); *Histoire de la France pendant la minorité de Louis XIV.* (4 vols., 1880) and *Histoire de la France sous le ministère de Mazarin* (3 vols., 1882–83).

CHERUSCI, an ancient German tribe occupying the basin of the Weser to the north of the Chatti (*q.v.*). Together with the other tribes of western Germany they submitted to the Romans in 11–9 B.C., but in A.D. 9 Arminius, one of their princes, rose in revolt, and defeated and slew the Roman General Quintilius Varus, annihilating his army. Germanicus Caesar (*q.v.*) made several unsuccessful attempts to bring them into subjection again. By the end of the 1st century A.D. their prestige had declined, and their territory was eventually occupied by the Saxons.

BIBLIOGRAPHY.—*See* Tacitus, *Annals*, i. 2, 11, 12, 13; *Germania*, 36.

CHERVONETZ, the new Russian monetary unit, instituted in 1922 as part of the New Economic Policy. The old pre-World War I rouble had, owing to heavy war expenditure, the military-Communist era of 1917–22 and to post-war heavy budget deficits (balanced deliberately by fresh note emissions), depreciated to vanishing point. When the Soviet Government realized the need of a stable currency they instituted the chervonetz.

The chervonetz equals 10 pre-war roubles of 2s. 1½d. Chervonetz notes were issued by the new State bank, having a backing of 25% in gold, platinum or stable foreign exchange, the remaining 75% cover to consist of marketable goods, short-term securities or approved bills of exchange. These notes were from their inception restricted in their issue, so as to maintain the above provisions, and in particular steps were taken to discourage them from entering into internal circulation. They were used as the basis of the nation's currency system and foreign exchange rates were quoted in chervontsi.

Side by side with the chervonetz a new series of rouble notes was issued intended for internal use. These had no fixed conversion ratio against the chervonetz, and for the two years immediately succeeding their first appearance they were issued freely to balance successive budget deficits. Hence they in turn rapidly depreciated until the conversion ratio reached the astronomical figure of 200,000,000,000 roubles to one chervonetz.

In 1924 it proved possible to balance the budget and so to reorganize the internal currency. New currency rouble notes were issued, their volume being limited to half that of the chervontsi in circulation. Simultaneously the old Soviet or 1923 roubles were gradually withdrawn. Since 1924 the internal currency has consisted of stable rouble, currency notes and subsidiary coins. (*See* also ROUBLE.)

CHESAPEAKE AND DELAWARE CANAL, in the United States, connects Chesapeake City, Md., and Delaware City, Del., and provides a water route directly across Delaware and Maryland from Delaware bay to Chesapeake bay. It is 14 m. long, 90 ft. wide and 12 ft. in depth. It cost about $10,000,000 and in 1937 had a traffic volume of 1,436,828 tons.

CHESAPEAKE AND OHIO CANAL, in the United States, between Cumberland, Md., and Washington, D.C., was used formerly for the transportation of coal from the Cumberland region to the Potomac river.

The cost of construction with improvements was about $14,000,000. It is 184mi. long, 68ft. wide and 6ft. in depth. The canal is no longer used for navigation.

CHESAPEAKE AND OHIO RAILWAY COMPANY is a modern day development of George Washington's plan for a transportation system to connect the waters of Chesapeake Bay with the Ohio and Mississippi valleys. Much of its line is laid on the original route of George Washington's canal companies and other parts parallel the routes which Washington surveyed for wagon roads. The present company was incorporated in 1868, a consolidation of two small lines—the Virginia Central and the Covington & Ohio, which were linked and pushed westward. In 1888 it absorbed the Richmond & Alleghany, and took title to all the "rights of way and appurtenances" of George Washington's James River Company, of which Richmond & Alleghany was possessor. Chesapeake and Ohio's eastern terminals are at Washington, D.C., and Hampton Roads, Va. One of the great east and west trunk lines, it pierces the heart of the rich bituminous fields of West Virginia and Kentucky and has western outlets at Louisville, Ky., at Toledo, Ohio, on Lake Erie, and through Cincinnati it reaches Chicago on Lake Michigan. It operates 3,117 miles of railroad. About three-fourths of its traffic originates on its own lines. Cost of road and equipment on Dec. 31, 1939, was $565,616,630.

In 1939 the operating revenues were $118,722,054; operating expenses, $68,859,622; operating ratio, 58·0%; net railway operating income, $36,354,138; other income, $650,918; total income, $37,005,056; fixed charges, $9,519,434; surplus after charges, $27,342,711. (G. D. BR.)

CHESELDEN, WILLIAM (1688–1752), English surgeon, was born at Somerby, Leicestershire, on Oct. 19, 1688. He studied anatomy in London under William Cowper (1666–1709), and in 1713 published his *Anatomy of the Human Body*. He became surgeon at St. Thomas's and St. George's hospitals, London. Cheselden is famous for his "lateral operation for the stone," which he first performed in 1727. He also effected a great advance in ophthalmic surgery by his operation of iridectomy, described in 1728, for the treatment of certain forms of blindness by the production of an "artificial pupil." He attended Sir Isaac Newton in his last illness, and was a friend of Alexander Pope and of Sir Hans Sloane. He died at Bath on April 10, 1752.

CHESHAM, an urban district and market town of Buckinghamshire, England, 26 mi. W.N.W. of London by the L.N.E. and Met. Joint railway. Pop. (est. 1938) 10,410. Area, 5 sq.mi. It

is pleasantly situated in the narrow valley of the river Chess, flanked by low wooded chalk hills. St. Mary's church, which has some ancient frescoes, is mainly Perpendicular in style. Dairy utensils, chairs, malt-shovels, etc., are made of beech. Shoemaking is also carried on. Waterside, adjoining the town, has duck farms and extensive watercress beds, for which the Chess is noted.

CHESHIRE, a north-western county of England, bounded north by Lancashire, north-east by Yorkshire and Derbyshire, south-east by Staffordshire, south by Shropshire, west by Denbighshire and Flint, and north-west by the Irish Sea. Area 1,014.6 sq. m. The coast-line is formed by the estuaries of the Dee and the Mersey, which are separated by the low rectangular peninsula of Wirral. The Dee forms a great part of the county boundary with Denbighshire and Flint, and the Mersey the boundary along the whole of the northern side. The principal river within the county is the Weaver, which crosses it on a north-westerly course, and receiving the Dane at Northwich, discharges into the estuary of the Mersey south of Runcorn. The surface of Cheshire is mostly low and gently undulating or flat: the broken line of the Peckforton hills, seldom exceeding 600 ft. in height, is conspicuous. The northern part of the hills coincides approximately with the district called Delamere Forest, formerly a chase of the earls of Chester, and finally disforested in 1812. Southwards, commanding the narrow gap of the Gowy river on the west stands the Norman castle of Beeston. Distributed over the county, but principally in the eastern half, are many small lakes or meres, such as Combermere, Tatton, Rostherne, Tabley, Doddington, Marbury and Mere.

With the exception of some Carboniferous rocks on the eastern border, and a small patch of Lower Lias near Audlem, the whole county is occupied by Triassic strata. The great central plain is covered by Keuper Marls, rich grassland loams with many beds of rock-salt, mostly thin, though two are from 75 ft. to over 100 ft. thick. Thin beds and veins of gypsum are common in the marls. The striking features of the Peckforton Hills, which run north and south, bordering the valley of the Weaver on the west, are due to the repeated faulting of the Lower Keuper Sandstone, which lies upon beds of Bunter Sandstone. Besides forming this well-marked ridge, the Lower Keuper Sandstone, which is quarried in several places, forms several ridges north-west of Macclesfield and appears along the northern border and in the neighbourhood of New Brighton and Birkenhead. It is a good building stone and an important water-bearing stratum. At Alderley Edge ores of copper, lead and cobalt are found. West of the Peckforton ridge, Bunter Sandstones and pebble beds extend to the border. They also form low foothills between Cheadle and Macclesfield. They fringe the northern boundary and appear on the south-eastern boundary as a narrow strip of hilly ground near Woore. From Macclesfield northward through Stockport is a narrow tongue of coal-measures—an extension of the Lancashire coalfield. Coal is mined at Neston in the Wirral peninsula from beneath the Trias; it is a connecting link between the Lancashire and Flintshire coalfields. Glacial drift with northern erratics is thickly spread over all the lower ground; at Crewe the drift is over 400 ft. thick. Patches of drift sand, with marine shells, occur on the high ground east of Macclesfield at an elevation of 1,250 ft. The Cheshire lowland filled with prehistoric swamp and forest has not yielded large finds of ancient objects. A list of perforated stone axes is given in *Trans. Lancs. and Ches. Ant. Soc.,* vol. v., p. 327 (*see* also vol. xi., p. 171). Tranmere has yielded a stone-celt retaining part of its wooden handle. Copper was mined at some early period at Alderley Edge and stone hammers with a groove for attachment occur here. The type occurs in Shetland, Wales, South-West Ireland, Brittany, the Iberian Peninsula, Savoy, Austria and Egypt; it is well-known in the New World and the Cambridge Museum has specimens from Australia. A flat celt of copper or bronze is known from Grappenhall. Broxton has yielded one of the few trunnion celts of Britain (*see* Hemp, W. J. *Antiq. Journ.,* vol. v. 1925, p. 51) together with two palstaves and a spearhead. A dagger blade and a pommel have been found at Wilmslow and the surface of the upper Forest bed at Meols has yielded antiquities apparently of the Early Iron Age.

History.—The earliest recorded historical fact is the capture of Chester by the Northumbrian king Aethelfrith about 614. After a period of incessant strife between Britons and Saxons the district was subjugated in 830 and incorporated in the kingdom of Mercia. During the 9th century Aethelwulf held his parliament at Chester, and received the homage of his tributary kings from Berwick to Kent, and in the 10th century Aethelflaed rebuilt the city, and erected fortresses at Eddisbury and Runcorn. Edward the Elder garrisoned Thelwall and strengthened the passages of the Mersey and Irwell. On the splitting up of Mercia in the 10th century the dependent districts along the Dee were made a shire for the fortress of Chester. The shire is first mentioned in the Abingdon *Chronicle,* which relates that in 980 Cheshire was plundered by a fleet of Northmen. At the time of the Domesday survey the county was divided into twelve hundreds, exclusive of the six hundreds between the Ribble and the Mersey, now included in Lancashire, but then a part of Cheshire. Of the seven modern hundreds Bucklow alone retains its Domesday name. The hundreds of Atiscross and Exestan have been transferred to the counties of Flint and Denbigh, with the exception of a few townships now in the hundred of Broxton. Cheshire put up a determined resistance to the Conqueror and no Englishman retained estates of importance after the Conquest. It was constituted a county palatine, with an independent parliament consisting of the barons and clergy, and courts and all lands except those of the bishop were held of the earl. During the 12th and 13th centuries the county was impoverished by the constant inroads of the Welsh. In 1264 the castle and city of Chester were granted to Simon de Montfort. Richard II., in return for support made the county a principality, but the act was revoked in the next reign. In 1403 Cheshire was the headquarters of Hotspur. At the beginning of the Wars of the Roses Margaret collected a body of supporters from among the Cheshire gentry, and Lancastrian risings occurred as late as 1464. In 1643, Chester was made the headquarters of the royalist forces, while Nantwich was garrisoned for the parliament, and the county became the scene of constant skirmishes until the surrender of Chester in 1646.

In the reign of Henry VIII. the distinctive privileges of Cheshire as a county palatine were abridged. The right of sanctuary attached to the city of Chester was abolished and justices of peace were appointed as in other parts of the kingdom. An impression of the wealth of the rich agricultural county is to be seen in the numerous half-timbered houses and ancient manor-houses such as Bramhall Hall, near Macclesfield and Moreton Old Hall, near Congleton. The former dates from the 13th and 14th centuries, and contains a handsome panelled hall. Moreton Hall and several others, such as Brereton and Dorfold Halls, are Elizabethan. Vale Hall near Winsford incorporates fragments of a Cistercian monastery founded in 1277. Ecclesiastical architecture is not well represented outside Chester (*q.v.*), but Lower Peover, near Knutsford has a notable half-timbered church of 13th century date, restored in 1852. There is also a fine late Perpendicular church (with earlier portions) at Astbury near Congleton, and the churches of Banbury and Malpas are Perpendicular and Decorated. St. Michael's church and the Rivers chapel at Macclesfield are noteworthy. In the market-place at Sandbach are two remarkable sculptured Saxon crosses.

Agriculture and Industries.—From earliest times the staple products of Cheshire have been salt and cheese. The salt-pits of Nantwich, Middlewich and Northwich were in active operation at the time of Edward the Confessor, and at that date the mills and fisheries on the Dee also furnished a valuable source of revenue. Twelfth century writers refer to the excellence of Cheshire cheese. The trades of tanners, skinners and glovemakers existed at the time of the Conquest, and the export trade in wool in the 13th and 14th centuries was considerable. The soil of the county is varied and irregular; a large proportion is clay. About 75½% of the total area of 638,960 ac. was under cultivation in 1939. Oats were the most important cereal, occupying 35,224 ac., and over 52% of the cultivated land was in permanent pasture. The vicinity of such populous centres as Liver-

pool and Manchester stimulates dairying. The name of the county is given to a particular brand of cheese. Potatoes are by far the most important rootcrop and occupied 16,416 ac. in 1939. The damson is common among fruit trees, while the strawberry beds near Farndon and Holt are celebrated. Market-gardening is pursued in the neighbourhoods of Chester, Wallasey and Altrincham. In the first half of the 19th century the condition of agriculture in Cheshire was notoriously backward. In 1865–66 the county suffered from cattle plague, and at various times since diseases introduced from overseas through Liverpool have ravaged the county. The manufacture of textiles extends from its seat in Lancashire into Cheshire; and the whole northeastern tongue of the county is engaged in branches of the industry, particularly cotton-spinning. Metalworking is important, and embraces shipbuilding (Birkenhead) and galvanized iron products (Ellesmere Port). At Crewe are situated the great workshops of the London, Midland and Scottish railway company, to which the town owes its origin and rise. Chemical industries are of special importance, and are found along the Mersey; they are closely related to the salt industry. The Mersey shore also has machinery and ironworks, flour mills, tobacco and soap-works (Port Sunlight). Much sandstone is quarried, but the mineral wealth of the county lies in coal (around Congleton and Macclesfield) and especially salt.

Some rock salt is obtained at Northwich and Winsford, but most of the salt is extracted from brine both here and at Lawton, Wheelock and Middlewich. Subsidences frequently occur after the brine is pumped out; walls crack and collapse, and houses are seen leaning far out of the perpendicular.

Communications.—The county is well served with railways. The main line of the L.M.S.R. runs north from Crewe to Warrington with branches from Crewe diverging fanwise to Manchester, Chester, North Wales and Shrewsbury. The G.W.R. passes northward from Wrexham to Liverpool and Manchester. The heart of the county is traversed by the Cheshire lines of the L.M.S.R., serving the salt district, and reaching Chester from Manchester by way of Delamere Forest. In the west, between Chester, Connah's Quay and Liverpool, the L.N.E.R. operates. Many experiments in road building have been made in the Wirral. The river Weaver is locked as far up as Winsford, and the transport of salt is thus expedited. In the salt district of the Weaver, subsidence has resulted in the formation of lakes of considerable extent, which act as reservoirs to supply the navigation. Inland navigation is also provided by the Grand Trunk, Shropshire Union and other canals, and many small steamers are in use. The Manchester Ship canal passes through a section of north Cheshire, entering from the Mersey estuary by locks near Eastham, and following its southern shore up to Runcorn, after which it takes a course more direct than the river, and finally enters Lancashire at the junction of the Irwell with the Mersey, near Irlam.

Population and Administration.—The area of the administrative county is 973 sq.mi.; pop. (1938) 729,400. Cheshire has been described as a suburb of Liverpool, Manchester and the Potteries, and has been freely colonized from these populous industrial centres. On the short seacoast of the Wirral are found the popular resorts of New Brighton and Hoylake. The movement of population and the importance of the industries of the county have brought about a vast increase of population in modern times. Further movements during World War II raised the population of the whole county by 2% between Sept. 1939 and Feb. 1941. The county contains seven hundreds and four county boroughs, which are Birkenhead, Chester (a city), Stockport and Wallasey. The municipal boroughs are Altrincham, Bebington, Congleton, Crewe, Dukinfield, Hyde, Macclesfield, Sale and Stalybridge. Chester is the county town. There are 24 urban districts and 10 rural districts.

The county is in the North Wales and Chester circuit, and assizes are held at Chester. It has two courts of quarter sessions, and is divided into 17 petty sessional divisions. Cheshire is almost wholly in the diocese of Chester, but small parts are in those of Manchester, St. Asaph and Lichfield. There are nine parliamentary divisions returning one member each, namely Macclesfield, Crewe, Eddisbury, Wirral, Knutsford, Altrincham, Northwich, City of Chester and Stalybridge and Hyde; the county also includes the parliamentary boroughs of Birkenhead and Stockport, returning two members, and Wallasey, which returns one member. The National Trust owned 496 ac. in Cheshire in 1942.

BIBLIOGRAPHY.—Sir John Doddridge, *History of the Ancient and Modern State of the Principality of Wales, Duchy of Cornwall, and Earldom of Chester* (London, 1630; 2nd ed. 1714); D. King, *The Vale-Royall of England, or the County Palatine of Cheshire Illustrated*, 4 parts (London, 1656); J. H. Hanshall, *History of the County Palatine of Chester* (Chester, 1817–1823); J. O. Halliwell, *Palatine Anthology* (London, 1850); G. Ormerod, *History of the County Palatine and City of Chester* (London, 1819; new ed. London, 1875–1882); J. P. Earwaker, *East Cheshire* (2 vols. London, 1877); J. Croston, *Historic Sites of Cheshire* (Manchester, 1883); and *County Families of Cheshire* (Manchester, 1887); W. E. A. Axon, *Cheshire Gleanings* (Manchester, 1884); Holland, *Glossary of Words used in the County of Cheshire* (London, 1884–1886); N. G. Philips, *Views of Old Halls of Cheshire* (London, 1893); *Land of Britain* (Report of Land Utilisation Survey) pt. 65 (London, 1941); *Survey of Merseyside* (Liverpool University Press, 1934). *See* also various volumes of the Chetham society and of the Record Society of Manchester, as well as the *Proceedings* of the Cheshire Antiquarian society, and *Cheshire Notes and Queries*.

CHESHUNT, an urban district of Hertfordshire, England, on the Lea, 16 mi. N. of London by the L.N.E.R. Pop. (1938) 16,940. Area 13.3 sq.mi. Finds indicate the presence of a Romano-British settlement. There was a Benedictine nunnery here in the 13th century. A mansion in the vicinity, the Great House, belonged to Cardinal Wolsey. Theobalds Park was built in the 18th century. James I died here in the original mansion in 1625, and Charles I set out from here for Nottingham in 1642 at the outset of the Civil War. One of the entrances to Theobalds Park is old Temple Bar, moved from Fleet street, London, 1878. The church of St. Mary is Perpendicular, with modern additions. Cheshunt college (1792) was the successor of a college founded by the countess of Huntingdon in 1768 at Trevecca in Brecknockshire for the education of ministers of the Methodist connection. In 1905 it was converted into a theological college of the Church of England and later became known as Bishop's college. Cheshunt is an important centre of market gardening.

CHESIL BANK (A.S., *ceosol,* pebble bank), a remarkable beach of shingle on the coast of Dorsetshire, England. It is separated from the mainland for 8 mi. by an inlet called the Fleet, famous for its swannery, and continues in all for 18 mi. southeastward from near Abbotsbury, terminating at the so-called isle of Portland. At the Portland end it is 35 ft. above springtide level, and 200 yd. wide; while at the landward end the width is 170 yd. and the pebbles decrease in size. This accords with the general movement of shingle along this coast from west to east.

CHESNELONG, PIERRE CHARLES (1820–1899), French politician, was born at Orthez, Basses Pyrénées. A member of the chamber of deputies from 1865–76, with a short interval in 1870–72, he was an uncompromising clericalist and, after 1870, a Legitimist. He was the soul of the reactionary opposition that led to the fall of Thiers; and in 1873 it was he who, with Lucien Brun, carried to the comte de Chambord the proposals of the chambers. Through some misunderstanding, he reported on his return that the count had accepted all the terms offered, including the retention of the tricolour flag; and the count published a formal denial. Chesnelong now devoted himself to the establishment of Catholic universities and to the formation of Catholic working-men's clubs. He continued his vigorous polemic against the secularization of the educational system of France from his place in the senate, to which he was elected in Nov. 1876.

See M. de Marcey, *Charles Chesnelong,* etc. 3 vols. (1908); Mgr. Laveille, *Chesnelong, sa vie, son action catholique et parlementaire* (1913).

CHESNEY, CHARLES CORNWALLIS (1826–1876), British soldier and military writer, the third son of Charles Cornwallis Chesney, Bengal artillery, and nephew of Gen. F. R. Chesney, was born in Co. Down, Ireland, on Sept. 29, 1826. Educated

at Blundell's school, Tiverton, and afterwards at the Royal Military academy, Woolwich, he passed out of the academy in 1845 at the head of his term. In 1858 Capt. Chesney was appointed professor of military history at Sandhurst. In 1864 he succeeded Col. (afterwards Sir Edward) Hamley in the corresponding chair at the Staff college. Chesney's first published work (1863) was an account of the civil war in Virginia, which went through several editions. But the work which attained the greatest reputation was his *Waterloo Lectures* (1868). Chesney's account illustrates both the strategy and tactics which culminated in the final catastrophe and the mistakes committed by Napoleon, and for the first time an English writer is found to point out that the dispositions of Wellington were far from faultless. In the *Waterloo Lectures* the Prussians are for the first time credited by an English pen with their proper share in the victory. In 1868 Chesney was appointed a member of the royal commission on military education, to whose recommendations were due the improved organization of the military colleges, and the development of military education in the principal military stations of the British army. In 1871 he was sent on a special mission to France and Germany, and wrote a series of valuable reports on the different siege operations during the war, especially the two sieges of Paris. He was consulted by officers of all grades on professional matters, and few have done more to raise the intellectual standard of the British officer. He died on March 19, 1876.

CHESNEY, FRANCIS RAWDON (1789–1872), British general and explorer, the son of Capt. Alexander Chesney, was born at Annalong, Co. Down, Ireland, on March 16, 1789. He received a cadetship at Woolwich, and was gazetted to the Royal Artillery in 1805. But though he rose to be colonel-commandant of the 14th brigade Royal Artillery (1864), and general in 1868, Chesney is chiefly remembered for his connection with the Suez canal, and with the exploration of the Euphrates valley. His report in 1830 on the feasibility of making the Suez canal was the basis of Lesseps' great undertaking. In 1831 he introduced to the home Government the idea of opening a new overland route to India by a daring journey along the Euphrates from Anah to the Persian gulf. In 1835 he was in command of a small expedition for which parliament voted £20,000 to test the navigability of the Euphrates. After encountering difficulties from the opposition of the Egyptian pasha, and from the need of transporting two steamers (one of which was lost) in sections from the Mediterranean over the hilly country to the river, they arrived by water at Bushire in the summer of 1836, and proved Chesney's view to be practicable. In 1847 his period of service was completed, and he went home to Ireland, but in 1856 and again in 1862 he went out to the East to take a part in further surveys and negotiations for the Euphrates valley railway scheme. He died on Jan. 30, 1872.

The chief works of Chesney are: *The Expedition for the Survey of the Rivers Euphrates and Tigris* (1850); *Observations on . . . Fire-arms* (1852); *The Russo-Turkish Campaigns of 1828 and 1829* (1854); *Narrative of the Euphrates Expedition* (1854). See *The Life of Gen. F. R. Chesney* by his wife and daughter, ed. S. Lane-Poole (1885).

CHESNEY, SIR GEORGE TOMKYNS (1830–1895), English general, brother of Col. C. C. Chesney, was born at Tiverton (Devon), on April 30, 1830. Educated at Blundell's school, Tiverton, and at Addiscombe, he entered the Bengal Engineers as second lieutenant in 1848. After some years in the public works department he earned distinction in the Indian Mutiny and was severely wounded in the assault of Delhi. The originator of the Royal Indian civil engineering college at Cooper's hill, Staines, he was also its first president (1871–80). In 1871 he contributed to *Blackwood's Magazine* "The Battle of Dorking," a vivid account of a supposed invasion of England by the Germans after their victory over France. This was republished in many editions and translations, and produced a profound impression. He was promoted major-general in 1886, and general in 1892. From 1886 to 1892, as military member of the governor-general's council, he carried out many much-needed military reforms. In that year he became Conservative M.P. for Oxford, and was chairman of the committee of service members of the House of Commons until his death on March 31, 1895. He wrote some novels, *The Dilemma, The Private Secretary, The Lesters,* etc., and a valuable book on *Indian Polity* (1868).

CHESS, once known as "checkers," a game played with certain "pieces" on a special "board" described below. It takes its name from the Persian word *shah,* a king, the name of one of the pieces or men used in the game. Chess is the most cosmopolitan of all games, invented in the East (see *History,* below), introduced into the West and now domiciled in every part of the world. As a mere pastime chess is easily learnt, and a very moderate amount of study enables a man to become a fair player, but the higher ranges of chess-skill are attained only by persistent labour. The real proficient or "master" not merely must know the subtle variations in which the game abounds, but must be able to apply his knowledge in the face of the enemy and to call to his aid, as occasion demands, all that he has of foresight, brilliancy and resource, both in attack and in defence. Two chess players fighting over the board may fitly be compared to two famous generals encountering each other on the battlefield, the strategy and the tactics being not dissimilar in spirit.

The Board, Pieces and Moves.—The chess-board is divided (*see* accompanying diagrams) into 64 chequered squares. In diagram 1 the pieces, or chessmen, are arranged for the beginning of a game, while diagram 2 shows the denomination of the squares according to the English and German systems of notation. Under diagram 1 are the names of the various "pieces"—each side, White or Black, having a King, a Queen, two Rooks (or Castles), two Knights, and two Bishops. The eight men in front are called Pawns. At the beginning of the game the queen always stands upon a square of her own colour. The board is so set that each player has a white square at the right-hand end of the row nearest to him. The rook, knight and bishop nearer to the king are known as King's rook, King's knight, and King's bishop; the other three as Queen's rook, Queen's knight and Queen's bishop.

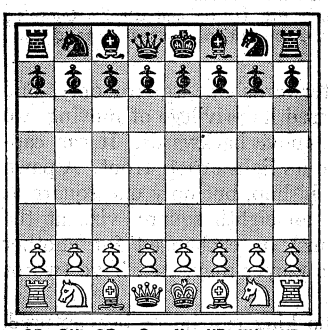


FIG. 1.—DIAGRAM SHOWING POSITION OF CHESSMEN AT BEGINNING OF GAME

Queen's Rook (QR); Queen's Knight (QKt); Queen's Bishop (QB); Queen (Q); King (K); King's Bishop (KB); King's Knight (KKt); King's Rook (KR). The pieces in front of the principal pieces are the pawns (P)

Briefly described, the powers of the various pieces and of the pawns are as follow:

The king may move in any direction, only one square at a time, except in castling. Two kings can never be on adjacent squares. The queen moves in any direction either diagonally or parallel to the sides of the board, whether forward or backward. There is no limit to her range over vacant squares; an opponent she may take; a piece of her own colour stops her. She is the most powerful piece on the board, for she can move either as a rook or a bishop.

The rooks (from the Indian *rukh* and Persian *rokh,* meaning a soldier or warrior) move parallel to the sides of the board—forward or backward—but they cannot move diagonally. Their range is like the queen's, unlimited, with the same exceptions.

The bishops move diagonally in any direction whether backward or forward. They have an unlimited range, with the same exceptions.

The knights' moves are of an absolutely different kind. They move from one corner of any rectangle of three squares by two to the opposite corner; thus, in diagram 3, the white knight can move to any square occupied by a black one, and vice versa. The move may be made in any direction, *e.g.,* a knight at the square *e*4 in diagram 2 can move to any one of the eight squares *f*6, *d*6, *c*5, *c*3, *d*2, *f*2, *g*3, *g*5. It is no obstacle to the knight's move if intervening squares are occupied. It will be perceived that the knight always moves to a square of a different colour.

The king, queen, rooks and bishops may capture any foeman which stands anywhere within their respective ranges; and the

knights can capture the adverse men which stand upon the squares to which they can leap. The piece which takes occupies the square of the piece which is taken, the latter being removed from the board. The king cannot capture any man which is protected by another man.

The moves and capturing powers of the pawns are as follow: Each pawn for its first move may advance either one or two

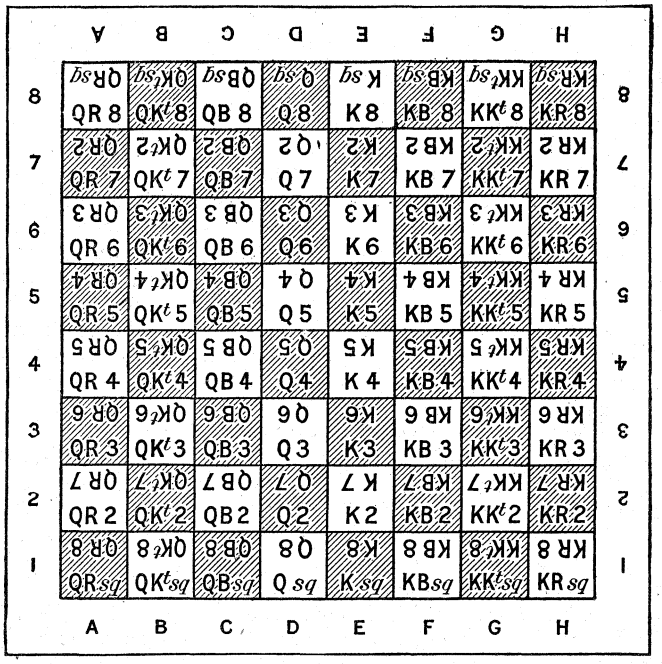


FIG. 2.—SHOWING ENGLISH AND GERMAN SYSTEMS OF NOTATION
The square C.6 is White's Queen's bishop's 6th (QB6) and Black's Queen's bishop's 3rd (QB3). In diagrams it is the convention to show white at the bottom of the board

squares straight forward, but afterwards one square only, and this whether upon starting it exercised its privilege of moving two squares or not. A pawn can never move backwards. It can capture only diagonally—one square to its right or left front. A pawn moves like a rook, captures like a bishop, but only one square at a time. When a pawn arrives at an eighth square, viz., at the extreme limit of the board, it must be exchanged for another piece of the same colour, so that a player may, *e.g.*, have two or more queens on the board at once.

"Check" and "Checkmate." The king can never be captured, but when any piece or pawn attacks him, he is said to be "in check," and the fact of his being so attacked should be announced by the adverse player saying "check," whereupon the king must move from the square he occupies, or be screened from check by the interposition of one of his own men, or the attacking piece must be captured. If, however, when the king is in check, none of these things can be done, it is "checkmate" (Persian, *shah mat*, the king is dead), known generally as "mate," whereupon the game terminates, the player whose king has been thus checkmated being the loser. When the adversary has only his king left it is very easy to checkmate him with only a queen and king, or only a rook and king. The problem is less easy with king and two bishops, and still less easy with king, knight and bishop, in which case the opposing king has to be driven into a corner square whose colour corresponds with the bishop's, mate being given with the bishop. A king and two knights cannot mate, if the opponent plays correctly. To mate with king and rook the opposing king must be driven on to one of the four side lines and kept there with the rook on the next line, till it is opposed by the other king, when the rook mates.

The pawn gives check in the same way as it captures, viz., diagonally. One king cannot give check to another, nor may a king be moved into check.

"Check by discovery" is given when a player, by moving one of his pieces, checks with another of them. "Double check" means attacking the king at once with two pieces—one of the pieces in this case giving check by discovery.

"Perpetual check" occurs when one player, seeing that he cannot win the game, finds the men so placed that he can give check *ad infinitum*, while his adversary cannot possibly avoid it. The game is then drawn. A game is also drawn "if, before touching a man, the player whose turn it is to play, claims that the game be treated as drawn, and proves that the existing position existed, in the game and at the commencement of his turn of play, twice at least before the present turn."

"Stalemate." When a king is not in check, but his owner has no move left save such as would place the king in check, it is "stalemate," and the game is drawn.

"Castling." This is a special move permitted to the king once only in the game. It is performed in combination with either rook, the king being moved two squares laterally, while the rook towards which he is moved (which must not have previously moved from its square) is placed next him on the other side; the king must be touched first. The king cannot castle after having been once moved, nor when any piece stands between him and the rook, nor if he is in check, nor when he has to cross a square commanded by an adverse piece or pawn, nor into check. It will be perceived that after castling with the king's rook the latter will occupy the KB square, while the king stands on the KKt square, and if with the queen's rook, the latter will occupy the queen's square while the king stands on the QB square.

"Taking *en passant*." This is a privilege possessed by any of the pawns under the following circumstances: If a pawn, say of the white colour, stands upon a fifth square, say upon K5 counting from the white side, and a black pawn moves from Q2 or KB2 to Q4 or KB4 counting from the black side, the white pawn can take the black pawn *en passant*. For the purposes of such capture the latter is dealt with as though it had only moved to Q3 or KB3, and the white pawn taking it diagonally then occupies the square the captured pawn would have reached had it moved but one square. The capture can be made only on the move immediately succeeding that of the pawn to be captured.

"Drawn Game." This arises from a stalemate (noticed above), or from either player not having sufficient force wherewith to effect checkmate, as when there are only two kings left on the board, or king and bishop against king, or king with one knight, or two knights against king, or from perpetual check. One of the players can call upon the other to give checkmate in 50 moves, the result of failure being that the game is drawn. But, if a pawn is moved, or a piece is captured, the counting must begin again.

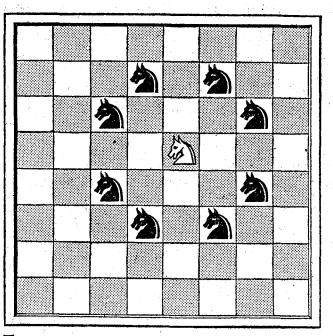


FIG. 3.—DIAGRAM SHOWING THE MOVE OF A KNIGHT. THE WHITE KNIGHT MAY MOVE ON TO ANY OF THE SQUARES OCCUPIED BY THE BLACK KNIGHTS

A "minor piece" means either a knight or a bishop. "Winning the exchange" signifies capturing a rook in exchange for a minor piece. A "passed pawn" is one that has no adverse pawn either in front or on either of the adjoining files. A "file" is simply a line of squares extending vertically from one end of the board to the other. An "open file" is one on which no piece or pawn of either colour is standing. A pawn or piece is *en prise* when one of the enemy's men can capture it. "Gambit" is a word derived from the Ital. *gambetto*, a tripping up of the heels; it is a term used to signify an opening in which a pawn or piece is sacrificed at the opening of a game to obtain an attack. An "opening," or *début*, is a certain set method of commencing the game. When a player can only make one legal move, that move is called a "forced move."

Value of the Pieces.—The relative worth of the chessmen cannot be definitely stated on account of the increase or decrease of their powers according to the position of the game and the pieces, but taking the pawn as the unit the following will be an

estimate near enough for practical purposes: pawn 1, bishop 3·25, knight 3·25, rook 5, queen 9·50. Three minor pieces may more often than not be advantageously exchanged for the queen. Two bishops are usually stronger than two knights, more especially in open positions.

Laws.—The laws of chess differ, although not very materially, in different countries. With few changes the laws laid down by the British Chess Federation in 1924 were adopted as the official code of the Fédération Internationale des Échecs in 1931.

First Move and Odds.—To decide who moves first, one player conceals a white pawn in one hand and a black pawn in the other, his adversary not seeing in which hand the different pawns are put. The other holds out his hands with the pawns concealed, and his adversary touches one. If that contains the white pawn, he takes the white men and moves first. If he draws the black pawn his adversary has the first move, since white, by convention, always plays first. Subsequently the moves are taken alternately. If one player, by way of odds, "gives" his adversary a pawn or piece, that piece is removed before play begins. If the odds are "pawn and move," or "pawn and two," a black pawn, usually the king's bishop's pawn, is removed and white plays one move, or any two moves in succession but must not pass beyond his fourth rank till his opponent has moved. "Pawn and two" is generally considered to be slightly less in point of odds than to give a knight or a bishop; to give a knight and a bishop is to give rather more than a rook; a rook and bishop less than a queen; two rooks rather more than a queen. The odds of "the marked pawn" can only be given to a much weaker player. A pawn, generally KKt's pawn, is marked with a cap of paper. If the pawn is captured its owner loses the game; he can also lose by being checkmated in the usual way, but he cannot give mate to his adversary with any man except the marked pawn, which may not be moved to an eighth square and exchanged for a piece.

Rules.—If a player touches one of his men he must move it, unless he says *j'adoube* (I adjust), or words of a similar meaning, to the effect that he was only setting it straight on its square. If he cannot legally move a touched piece there is no penalty. He must say *j'adoube* before touching his piece. If a player touches an opponent's piece, he must take it, if he can; if not, make a legal move with the piece by which he made the illegal capture. If he can do neither, no penalty. A move is completed and cannot be taken back as soon as a player, having moved a piece, has taken his hand off it. If a player is called upon to mate under the 50-move rule, "50 moves" means 50 moves and the 49 replies to them. A pawn that reaches an eighth square *must* be exchanged for some other piece of the same colour, the move not being complete until this is done; a second king cannot be selected.

Modes of Notation.—The English and German methods of describing the moves made in a game are different. According to the English method each player counts from his own side of the board, and the moves are denoted by the names of the files and the numbers of the squares. Thus when a player for his first move advances the king's pawn two squares, it is described as follows: "1. P–K4." The following moves, with the aid of diagram 2, will enable the reader to understand the principles of the British notation. The symbol × is used to express "takes"; a dash – to express "to."

White.	Black.
1. P–K4	1. P–K4
2. KKt–KB3 (*i.e.*, King's Knight to the third square of the King's Bishop's file)	2. QKt–QB3 (*i.e.*, Queen's Knight to the third square of the Queen's Bishop's file)
3. KB–QB4 (King's Bishop to the fourth square of the Queen's Bishop's file)	3. KB–QB4
4. P–QB3	4. KKt–KB3
5. P–Q4	5. P takes P (or P×P) (King's pawn takes White's Queen's pawn)
6. P takes P (or P×P) (Queen's Bishop's pawn takes pawn: no other pawn can, at the moment, capture a pawn)	6. KB–QKt5 (ch., *i.e.*, check)

It is now usual to express the notation as concisely as possible; thus, the third moves of White and Black would be given as 3 B–B4, because only the *king's* bishop and only the *queen's* bishop's fourth square can be intended.

The French names for the pieces are King, *Roi;* Queen, *Dame;* Rook, *Tour;* Knight, *Cavalier;* Pawn, *Pion;* for Bishop the French substitute *Fou,* a jester. Chess is *Les Échecs.*

The German notation employs the alphabetical characters *a, b, c, d, e, f, g* and *h,* proceeding from left to right, and the numerals 1, 2, 3, 4, 5, 6, 7 and 8, running upwards, these being always calculated from the white side of the board (see diagram 2). Thus the White Queen's Rook's square is *a*1, the White Queen's square is *d*1; the Black Queen's square, *d*8; the White King's square, *e*1; the Black King's square, *e*8, and so with the other pieces and squares. The German names of the pieces are as follow: King, *König;* Queen, *Dame;* Rook, *Turm;* Bishop, *Läufer;* Knight, *Springer;* Pawn, *Bauer.* Chess is *Schach.*

The initials only of the pieces are given, the pawns (*Bauern*) being understood. The Germans use the following signs in their notation, viz.: for "check" (†); "checkmate" (‡); "takes" (:); "castles on king's side" (o–o); "castles on queen's side" (o–o–o); for "best move" a note of admiration (!); for "weak move" a note of interrogation (?). The opening moves just given in the English will now be given in the German notation:

White.	Black.
1. e2–e4	1. e7–e5
2. S g1–f3	2. S b8–c6
3. L f1–c4	3. L f8–c5
4. c2–c3	4. S g8–f6!
5. d2–d4	5. e5–d4:
6. c3–d4:	6. L c5–b4†

In both notations the moves are often given in a tabular form, thus:

1. $\frac{\text{P–K4}}{\text{P–K4}}$ 1. $\frac{\text{e2–e4}}{\text{e7–e5}}$, the moves above the line being White's and below the line Black's.

In the German notation the moves are sometimes still further abbreviated, *e.g.*, the moves given above could also be given thus:

White.	Black.
1. e4	1. e5
2. Sf3	2. Sc6
3. Lc4	3. Lc5
4. c3	4. Sf6!
5. d4	5. ed:
6. cd:	6. Lb4†

THE OPENINGS

In a short article it is impossible to give even an attempt at an adequate description of the various openings, for on almost every one of them a book might be written. We give below a necessarily very brief *résumé* of the most important openings. For further details the student is recommended to refer to a text-book.

White usually opens with 1. P–K4 or 1. P–Q4. To 1. P–K4, Black has a choice of several replies, those most in favour at the present moment being P–QB4 (the Sicilian Defence), P–K3 (the French Defence) or P–K4. The student, as Black, is recommended to play 1 . . . P–K4 and stand up to whatever attack his opponent may have prepared for him. Fighting on ground chosen by his opponent he will lose games—but gain in experience. After 1. P–K4, P–K4, White has a choice of continuations, viz., 2. P–Q4, 2. P–KB4, 2. Kt–QB3 or 2. Kt–KB3, the last being the most popular. To this move (2. Kt–KB3) Black has several replies, viz., 2 . . . P–Q3 (Philidor's Defence), 2 . . . Kt–KB3 (Petroff's Defence) or 2 . . . Kt–QB3. Philidor's Defence gives Black a cramped game, for his pawn at Q3 obstructs the action of his King's Bishop. Petroff's Defence is quite playable but we recommend the student to play 2 . . . Kt–QB3—and face the music! To that move White has several replies and by defending the various attacks that White can institute Black will learn more than by playing a pet defence with which he is familiar. After 2 . . . Kt–QB3, White can play either 3. P–Q4 (the Scotch

Game), 3. P–B3 (Ponziani's Opening—not to be recommended), 3. B–B4 (the Giuoco Piano—recommended to the student) or 3. B–Kt5 (the Ruy Lopez). To 3. B–B4 Black has two good replies—3 . . . B–B4 or 3 . . . Kt–B3. 3. B–Kt5 is undoubtedly the strongest move for White. The beginner is not, however, recommended to adopt it. The resulting play is full of delicate finesse, having for its object the accumulation of minute advantages, and is not in the bold, attacking, open style that the young player should adopt in order to develop his imagination. The usual defences are 3 . . . P–QR3, 3 . . . Kt–B3 or 3 . . . P–Q3.

1. P–Q4, although very possibly the strongest opening move for White, is *emphatically* not to be recommended to the young player—in fact, we strongly advise him to play chess for several years before experimenting with that opening. The play arising from it is extremely difficult, delicate manoeuvring for slight advantages being the chief theme. It has been described as "classical music." The student adopting this opening at the beginning of his chess career will never go far. The profound character of the play will be entirely beyond his comprehension. He must learn to walk before he can run. After 1. P–Q4, the opening divides into several branches, according to Black's reply. If 1 . . . P–Q4, then 2. P–QB4 to which Black may reply either 2 . . . P×P, 2 . . . P–QB3 or 2 . . . P–K3 (probably best). If 1 . . . Kt–KB3 (much in favour at the moment) then 2. P–QB4 and again Black has a choice of replies. 2 . . . P–K4 is not to be recommended for, after 3. P×P, Kt–Kt5; 4. P–K4, Kt×KP; 5. P–B4, White commands more of the board than his opponent. 2 . . . P–KKt3 is quite playable and leads to a very interesting game. Very popular a few years ago, it is now out of favour, the continuation preferred being 2 . . . P–K3 followed, if 3. Kt–QB3, by 3 . . . B–Kt5 (pinning the Knight and preventing White from obtaining an imposing position in the centre by 4. P–K4), or, if 3. Kt–KB3, by either 3 . . . P–QKt3 or 3 . . . B–Kt5 ch.

Openings less frequently adopted are 1. P–QB4 (the English Opening), 1. Kt–KB3 followed by 2. P–QB4 and later on P–KKt3 (Réti's Opening) and 1. P–KB4 (Bird's Opening). The first two frequently turn by transposition of moves into variations arising from 1. P–Q4. Bird's Opening is not to be recommended for the move 1. P–KB4 weakens the position of White's King. Black has a solid reply in 1 . . . P–Q4 or an attacking one in 1 . . . P–K4, followed, if 2. P×P, by 2 . . . P–Q3; 3. P×P, B×P, giving up the pawn for an advantage in development.

ILLUSTRATIVE GAMES

The following is a selection of noteworthy games played by great masters:

RUY LOPEZ

White. Capablanca.	Black. Dus-Chotimirski.	White. Capablanca.	Black. Dus-Chotimirski.
1. P–K4	P–K4	24. R×R	R×R
2. Kt–KB3	Kt–QB3	25. P–K5 (*d*)	P–Kt3
3. B–Kt5	P–QR3	26. P–K6	R–B sq (*e*)
4. B–R4	Kt–B3	27. Kt–Kt3	Q–Kt2 (*f*)
5. Castles	B–K2	28. Kt–B5	P×P (*g*)
6. R–K sq	P–QKt4	29. P×P	Q–B2 (*h*)
7. B–Kt3	P–Q3	30. Q–B6	Q–Q sq (*i*)
8. P–B3	Kt–QR4	31. Kt×B ch	Q×Kt
9. B–B2	P–B4	32. B×QKt P	Kt–B6
10. P–Q4	Q–B2	33. Q–Q7	Q×Q
11. QKt–Q2	Kt–B3	34. B×Q	R–Kt sq
12. Kt–B sq	BP×P	35. P–K7	K–B2
13. P×P	B–Kt5	36. R–K sq	R–K sq
14. P–Q5	Kt–Q5	37. B×R ch	K×B
15. B–Q3	Castles (KR) (*a*)	38. R–K6	P–Q4
		39. K–B sq	Kt–Kt4
16. B–K3	QR–B sq	40. K–K2	Kt–B2
17. B×Kt	P×B	41. R–K5	Kt–R3
18. P–QR4	Q–Kt3	42. P–Kt5	Kt–Kt5
19. P×P	P×P	43. P–Kt6	P–Q6 ch
20. P–R3	B×Kt (*b*)	44. K–Q2	K–Q2
21. Q×B	Kt–Q2	45. P queens ch	K–Q3
22. KR–B sq	Kt–B4	46. Q–K7 ch	K–B3
23. P–QKt4	Kt–R5 (*c*)	47. Q×Kt	Resigns (*j*)

(*a*) Up to this point Black has played very well but now he should have played Kt–R4 in order, if possible, to obtain command of his opponent's KB4, *e.g.*, 15 . . . Kt–R4; 16. B–K3, B×Kt; 17. P×B, Kt–B5; 18. R–B sq, Q–Q sq; 19. B×QKt, P×B; 20. Kt–Kt3, P–Kt3, followed by playing his Bishop via B3 to K4. (*b*) This exchange leaves Black with a weak square at his KB4. (*c*) If 23 . . . Kt×B, then 24. Q×Kt, followed, if 24 . . . R–B6, by 25. R×R, P×R; 26. R–R5 and the weakness of Black's pawns would have cost him the game. (*d*) Threatening Q–B5. (*e*) If 26 . . . P×P, then 27. Q–Kt4. (*f*) Again, if P×P, then Q–Kt4 with a strong attack. (*g*) If 28 . . . P×Kt, then 29. Q×P and mate in two more moves. Black's best move was K–R sq, though White, after 29. Q–K4, would have had a great advantage. (*h*) If 29 . . . Q×Q, then 30. Kt×B ch, winning a piece. (*i*) Still the Queen cannot be taken. (*j*) Black might have resigned much earlier. This game was played at St. Petersburg (Leningrad) in 1913.

QUEEN'S PAWN OPENING

White. Dr. Lasker.	Black. Alekhine.	White. Dr. Lasker.	Black. Alekhine.
1. P–Q4	P–Q4	19. QR–B sq	KR–Q sq
2. P–QB4	P–K4 (*a*)	20. R–B2	P–B5
3. QP×P	P–Q5	21. P×P	B×P
4. Kt–KB3	Kt–QB3	22. R–Q sq	Kt–B4
5. P–QR3	B–Kt5	23. B–QB sq	Kt–K6 (*g*)
6. QKt–Q2	Q–K2	24. R–B5	Q–B3 (*h*)
7. P–R3	B×Kt	25. Q–K4 (*i*)	Kt×R (*i*)
8. Kt×B	Castles	26. B×B	Kt–B6 (*k*)
9. Q–Q3	P–KR3 (*b*)	27. B×R	Q×B (*l*)
10. P–KKt3	P–KKt3	28. Q–K5	Q–Kt3
11. B–Kt2	B–Kt2	29. Q–K7	Q–Q3
12. Castles	Kt×P	30. R–K5	P–Q6
13. Kt×Kt	B×Kt (*c*)	31. P×P	Q×QP
14. P–QKt4	P–KB4	32. R–K3	Q–Q8 ch (*m*)
15. P–B5	Q–K3 (*d*)	33. K–R2	Kt–Kt4
16. P–B6	Kt–K2 (*e*)	34. R–K6	Kt×P
17. P×P ch	K–Kt sq	35. R–KB6	Resigns (*n*)
18. B–Kt2 (*f*)	R–Q3		

(*a*) A risky move but giving Black chances of counter-attack. Either P–K3 or P–QB3 is safer. (*b*) If 9 . . . Kt×P, then 10. Q–B5 ch, Kt–Q2; 11. Kt×P, remaining a pawn ahead. (*c*) Black has certainly regained the pawn sacrificed on his second move but he has the inferior game. White's King's Bishop is very strongly posted, both for attack and defence. (*d*) If, to stop the further advance of the hostile Queen's Bishop's pawn, Black play P–B3, then P–Kt5, opening up lines of attack on the King. (*e*) If 16 . . . P×P, then 17. Q–R6 ch. (*f*) Preferable would have been B–Q2, to guard against the possibility of the further advance of Black's King's Bishop's pawn. (*g*) Very clever for, if 24. P×Kt, then 24 . . . P×P and Black wins. (*h*) If 24 . . . Kt×R, then 25. B×B and Black has two pieces *en prise*. (*i*) Having removed his Queen from the line of action of the hostile Rooks, White now threatens P×Kt. (*j*) It would have been better to play Kt×B. (*k*) Better would have been R (Q3)–Q2 but White's pieces were so well posted that he would still have had the better game. (*l*) White's last move was extraordinarily fine. If now 27 . . . Kt×Q, then 28. B×P ch, K×P; 29. B×Kt ch, K–B sq (if 29 . . . K–R3, then 30. R–R5 mate); 30. B–K5 ch, regaining the Queen and winning easily. If (instead of 27 . . . Kt×Q) Black play 27 . . . P×B, then 28. R–B8 ch, R×R; 29. P×R=Q ch, K×Q; 30. Q-R8 ch, followed by 31. Q×P, and White has a winning advantage. (*m*) If 32 . . . Q–Q5 or Q7, then 33. R×Kt. (*n*) For he has no reply to the threatened R–B8. This game was played in the great St. Petersburg tournament of 1914. Dr. Lasker was at that time champion of the world.

FRENCH DEFENCE

White. Lewitzky.	Black. Marshall.	White. Lewitzky.	Black. Marshall.
1. P–Q4	P–K3	13. B–R3	QR–K sq
2. P–K4	P–Q4	14. Q–Q2	B–Kt5
3. Kt–QB3	P–QB4 (*a*)	15. B×Kt	R×B
4. Kt–B3	Kt–QB3	16. QR–Q sq	Q–B4
5. KP×P	KP×P	17. Q–K2	B×Kt
6. B–K2	Kt–B3	18. P×B	Q×P
7. Castles	B–K2	19. R×P	Kt–Q5 (*c*)
8. B–KKt5	Castles	20. Q–R5 (*d*)	QR–KB sq
9. P×P	B–K3	21. R–K5	R–R3
10. Kt–Q4	B×P	22. Q–Kt5 (*e*)	R×B
11. Kt×B (*b*)	P×Kt	23. R–QB5 (*f*)	Q–KKt6
12. B–Kt4	Q–Q3	Resigns	

(*a*) Kt–KB3 first is the more approved continuation for Black. If 4 P×BP, the idea is to advance P–Q5, tempting him to play B–Kt5 ch. (*b*) Merely connecting Black's centre pawns. (*c*) The ideal post for an attacking Knight, which decides the issue. (*d*) Not 20 Q–K5, on account of 20 . . . Kt-B6 ch; 21 P×Kt, R–Kt3 ch, etc. (*e*) If 22 Q–Kt4, Kt–B6 ch, winning. (*f*) Hoping to reach the seventh rank. Black's reply is elegant and crushingly decisive. The astonishing sac-

rifice ranks with the greatest surprise moves in the history of tournament play. Played by the champion of the United States in the Breslau tournament (1912).

FRENCH DEFENCE

White. Bogoljubow.	Black. Réti.	White. Bogoljubow.	Black. Réti.
1. P–K4	P–K3	23. R–B2 (*f*)	Kt–K6
2. P–Q4	P–Q4	24. R–K sq	P–B5
3. Kt–QB3	Kt–KB3	25. P–QKt4	B–R5
4. P–K5	KKt–Q2	26. R(K sq)–K2	Kt–Q8
5. Q–Kt4	P–QB4	27. R–B sq	Kt–B6
6. Kt–Kt5	P×P	28. R(K2)–B2	Kt–Kt8
7. Kt–KB3 (*a*)	Kt–QB3	29. B–Kt2	P–B6
8. Kt–Q6 ch (*b*)	B×Kt	30. Kt–Kt3 (*g*)	B×Kt
9. Q×KtP	B×P	31. RP×B	Kt–Q7
10. Kt×B	Q–B3	32. R–K sq	KR–Q sq
11. Q×Q	Kt×Q	33. B–B sq	P–Q6
12. B–QKt5	B–Q2	34. P×P (*h*)	R×P
13. Kt–B3	Kt–K5	35. B×Kt	R×B
14. Castles	P–B3 (*c*)	36. R–R sq	K–K3
15. B×Kt	P×B	37. K–B sq	R×R ch
16. Kt×P	P–QB4 (*d*)	38. K×R	P–B7
17. Kt–K2	K–B2	39. R–QB sq	K–Q4
18. P–KB3	Kt–Q3	40. K–K3	R–B6 ch
19. P–QKt3	P–K4	41. K–Q2	K–Q5
20. B–R3	QR–QB sq	42. P–R4	R–Q6 ch (*i*)
21. QR–Q sq	P–Q5	Resigns	
22. Kt–B sq	Kt–B4 (*e*)		

(*a*) Not 7. Kt–Q6 ch, B×Kt; 8. Q×Kt P because of 8 . . . B×P and Black wins. (*b*) A premature attack which leaves White at a great disadvantage. (*c*) Threatening to maintain his extra pawn by P–K4. (*d*) White has recovered his pawn but Black has an overwhelming advantage in position on account of his tremendously strong centre of pawns. It will be seen that White, although he struggles on for another thirty moves, is all the time fighting a losing battle. (*e*) The Knight now starts on a remarkable tour. (*f*) Slightly better would have been K R–K sq, as then the Knight could not immediately go to K6 because of the reply R×Kt. (*g*) If 30. B–R sq, then 30 . . . Kt–Q7 followed by B×P. (*h*) If 31. B×Kt, then 31 . . . P×B; 32. R×QP, P×P; 33. R×R, R×R (threatening R–Q8) and White is helpless. (*i*) The simplest way—for, if 43 K×P, then 43 . . . R–B6 ch; 44. K–Q2, R×R; 45. K×R, K–K6 and Black's King eats up the King's side pawns. If 43 K–K2, then 43 . . . K–B6, threatening K–Kt7. This very instructive game was played in the Mährisch-Ostrau tournament (1923).

QUEEN'S PAWN OPENING

White. Dr. Tarrasch.	Black. Dr. Tartakower.	White. Dr. Tarrasch.	Black. Dr. Tartakower.
1. P–Q4	P–Q4	22. Kt×QBP	R×Kt
2. P–QB4	P–K4	23. Q×R ch	K–Kt sq
3. QP×P	P–Q5	24. Q–Kt5 ch	K–R sq
4. Kt–KB3	P–QB4	25. Q–B6 ch	K–Kt sq
5. P–K3	Kt–QB3	26. P–B5	P–Q7
6. P×P	P×P	27. KR–Q sq	B–B4
7. B–Q3 (*a*)	KKt–K2	28. Q–Kt5 ch	K–B2 (*c*)
8. QKt–Q2	B–Kt5	29. Q–R5 ch	K–Kt sq (*d*)
9. Q–Kt3	Q–B2	30. P–Kt5	B–B7
10. Castles	Castles	31. P–Kt6	R–Q2 (*e*)
11. R–K sq	Kt–Kt3	32. P×P ch	K–R sq (*f*)
12. P–KR3	B–K3	33. P–B6	R–Q4
13. B–K4	KKt×P	34. P–B7	B–B4 (*g*)
14. Kt×Kt	Q×Kt	35. P queens ch	B×Q
15. Kt–B3	Q–QB4	36. Q–B7	R–Q Kt4
16. B–B4 (*b*)	B–Q3	37. Q×B ch	K×P
17. B×Kt	P×B	38. P–QR4	R–QB4
18. B×B	R×B	39. Q–Kt4	Q×R
19. Kt–K5	KR–Q sq	40. R×Q	R–B8 ch
20. Q–R4	P–Q6	41. Q–Q sq	Resigns (*h*)
21. P–QKt4	Q–Q5		

(*a*) Setting a trap. If now 7 . . . Kt×P, then 8. Q–K2 (not 8. Kt×Kt because of 8 . . . Q–R4 ch), P–B3; 9. Kt×Kt, Q–R4 ch; 10. K–Q sq, P×Kt; 11. R–K sq, winning the King's pawn for, if 11 . . . B–Q3 then 12. P–B4. (*b*) A very beautiful move for, if now 16 . . . B×BP, then 17. Q×B, Q×Q; 18. B–B5 ch, R–Q2; 19. R–K8 ch, Kt–Q sq; 20. Kt–K5 and White wins. If (instead of 18 . . . R–Q2) Black play 18 . . . Q–K3, then 19. R×Q, P×R; 20. B×P ch, R–Q2; 21. Kt–K5, Kt×Kt; 22. B×Kt followed by B×R ch and the capture of the Queen's pawn. (*c*) If 28 . . . K–B sq, then 29. P–B6, threatening mate and so winning the Bishop, or, if 28 . . . K–R sq, then 29. P–B6, B–B sq; 30. P–B7 and White wins. (*d*) White's final attack is well worth very careful study. (*e*) If 31 . . . P×P, then 32. Q×P ch, K–B sq (32 . . . K–R sq; 33. Q–R6 ch gives the same result); 33. Q–B6 ch, K–Kt sq; 34 either R–Kt sq ch and mate in a few moves. If (instead of 31 . . . P×P) Black play 31 . . . Q–Q2, then 32 R×P and wins. (*f*) If 32 . . . R×P, then 33. Q×P and wins. (*g*) If 34 . . . R×Q, then 35. P queens ch, K×P; 36. Q×B. (*h*) This game, from the Berlin tournament (1920), is one of the prettiest ever played.

QUEEN'S PAWN OPENING

White. Gilg.	Black. Nimzowitsch.	White. Gilg.	Black. Nimzowitsch.
1. P–Q4	P–KB4 (*a*)	14. P×P	Q–R4
2. P–KKt3	P–Q3	15. Kt–B sq	B–QB4 (*e*)
3. B–Kt2	Kt–KB3	16. B–K3	B×B
4. P–QB3 (*b*)	Kt–B3	17. Kt×B	B–Q2
5. Kt–KR3	P–K4	18. Q–Q4	QR–K sq (*f*)
6. Castles	P–KR3 (*c*)	19. Kt–B sq (*g*)	P–KKt4
7. P–B3	P–Q4	20. Kt–Kt sq	Kt–K5 (*h*)
8. K–R sq	B–Q3	21. Kt–R3 (*i*)	Kt (Kt5)–B3
9. P×P	Kt×P	22. B×Kt (*j*)	Kt×B
10. Kt–Q2 (*d*)	Castles	23. Kt–Kt sq (*k*)	Kt–B7 ch
11. P–K4	BP×P	24. K–Kt2	B–R6 ch
12. P×P	QKt–Kt5	Resigns (*l*)	
13. R–K sq	Q–K sq		

(*a*) The Dutch defence. It is risky but gives chances of counter-attack. (*b*) Unnecessary, as the Queen's pawn was not attacked. Better would have been Kt–QB3 in order to play P–K4. (*c*) Leaving the hostile King's Knight without a move. (*d*) If 10. P–KB4, then 10 . . . Kt–B2; 11. B×P, Kt×B; 12. Q×Kt, Castles, and White, although a Pawn ahead, has a bad game as his King's position is weak and he has no good posts at which to place his pieces. (*e*) Threatening Q×Kt, *e.g.*, 16 . . . Q×Kt; 17. B×Q, Kt–B7 ch; 18. K–Kt sq (if 18. K–Kt2, then 18 . . . B×B ch), Kt×Q ch, and wins. (*f*) 18 . . . Kt×Kt looks tempting as White's Knight at R3 is then twice attacked. White, however, before recapturing at K3, plays Kt–B4, attacking the Queen. (*g*) A mistake. White should have endeavoured to break the hostile attack by exchanging pieces. The correct continuation was 19. Kt×Kt, Kt×Kt; 20. K–Kt sq. (*h*) Very neat, threatening 21 . . . either Kt–B7 ch; 22. Q×Kt, Kt×Q mate. (*i*) If, instead, 21. R–K2, Black wins by a pretty sacrifice of his Queen, *e.g.*, 21 . . . Q×P ch; 22. Kt×Q, Kt×P mate. (*j*) If, instead, White, to save his Knight at R3 (which is attacked) play 22. Kt–Kt sq, then 22 . . . Kt–B7 ch; 23. Q×Kt, Kt–Kt5; 24. Q–Q4, Kt–B7 ch, winning the Queen. (*k*) If 23. R×Kt, then 23 . . . Q–B6 ch. (*l*) For, if 25 Kt×B, then 25 . . . Q–B6 ch; 26. K–Kt sq, Q–R8 mate. Played in the Semmering tournament (1926).

INDIAN DEFENCE

White. Dr. Euwe.	Black. Keres.	White. Dr. Euwe.	Black. Keres.
1. P—Q4	Kt—KB3	19. B—K6 ch (*f*)	K—R sq
2. P—QB4	P—K3	20. R—Q sq	QP×B (*g*)
3. Kt—KB3	P—QKt3	21. Kt—Kt2	P—Q5
4. P—KKt3	B—Kt2	22. P—B4	P—Q6 (*h*)
5. B—Kt2	B—K2	23. R×P	Q×R
6. Castles	Castles	24. Q×Q	B—Q5 ch
7. Kt—B3	Kt—K5	25. R—B2 (*i*)	R×B
8. Q—B2	Kt×Kt	26. K—B sq	QR—K sq (*j*)
9. Q×Kt	P—Q3 (*a*)	27. P—B5	R—K4
10. Q—B2	P—KB4	28. P—B6	P×P
11. Kt—K sq	Q—B sq (*b*)	29. R—Q2	B—B sq
12. P—K4	Kt—Q2	30. Kt—B4	R—K6
13. P—Q5 (*c*)	BP×P	31. Q—Kt sq	R—B6 ch
14. Q×P	Kt—B4	32. K—Kt2	R×Kt (*k*)
15. Q—K2	B—KB3	33. P×R	R—Kt sq ch
16. B—R3 (*d*)	R—K sq	34. K—B3	B—Kt5 ch
17. B—K3 (*e*)	Q—Q sq	Resigns (*l*)	
18. B×Kt	P×P		

(*a*) B–K5 has also been played here, but it is properly met by 10 Kt–K sq. (*b*) Preferable to exchanging Bishops. (*c*) First 13 P×P, P×P; 14 Kt–Q3, B–KB3, and then P–Q5 would have been better, if only because of White's command of the square, K6. (*d*) Less conservative than 16 P×P, B×B; 17 Kt×B, Kt×P; 18 B–K3, etc. (*e*) Threatening B×Kt, followed by B×P ch. (*f*) A most natural move. (*g*) Simpler, possibly, might have been 20 . . . KtP×B. (*h*) At the cost of his Queen, for two pieces, Black opens the diagonal for the devastating attack by his KB. (*i*) If 25 K–R sq, R×B, after which Black doubles his Rooks. Nor will 25 Kt–K3 do. (*j*) His object achieved, Black needs merely to play the rest correctly to attain victory. (*k*) This *coup de grâce* supplies a fitting climax. (*l*) For if 35 K–K4, R–K ch; 36 K–Q5, B–B6 ch; 37 Q–K4, B×Q mate (or 36 K–Q3, B–B4 mate). If 35 K–Kt2 or Kt3, B–B4 dis ch, etc.

End Games.—A game of chess consists of three branches—the opening, the middle and the end game.

The *openings* have been analyzed and are to be acquired by the study of the books on the subject.

The *middle game* can only be acquired practically. The combinations being inexhaustible in their variety, individual ingenuity has its full scope. Those endowed with a fertile imagination will evolve plans and combinations leading to favourable issues.

The less endowed player, however, is not left quite defenceless; he has necessarily to adopt a different system, namely, to try to find a weak point in the arrangement of his opponent's forces and concentrate his attack on that weak spot. As a matter of fact, in a contest between players of equal strength, finding the weak point in the opponent's armour is the only possible plan, and this may be said to be the fundamental principle of the modern school. In the good old days the battles were mostly fought in the neighbourhood of the king, each side striving for a checkmate. Nowadays the battle may be fought anywhere. It is quite immaterial where the advantage is gained, be it ever so slight. Correct continuation will necessarily increase it, and the opponent may be compelled to surrender in the end game without being checkmated, or a position may be reached when the enemies, in consequence of the prolonged fight, are so reduced that the kings themselves have to take the field—the *end game*. The *end game,* therefore, requires a special study. It has its special laws and the value of the pieces undergoes a considerable change. The kings leave their passive rôle and become attacking forces. The pawns increase in value, whilst that of the pieces may diminish in certain cases. Two knights, for instance, without pawns, become valueless, as no checkmate can be effected with them, if the opponent play correctly. In the majority of cases the players must be guided by general principles, as the standard examples do not meet all cases.

HISTORY OF CHESS

The origin of chess is lost in obscurity. Its invention has been variously ascribed to the Greeks, Romans, Babylonians, Scythians, Egyptians, Jews, Persians, Chinese, Hindus, Arabians, Araucanians, Castilians, Irish and Welsh. Some have endeavoured to fix upon particular individuals as the originators of the game; amongst others upon Japheth, Shem, King Solomon, the wife of Ravan, king of Ceylon, the philosopher Xerxes, the Greek chieftain Palamedes, Hermes, Aristotle, the brothers Lydo and Tyrrhene, Semiramis, Zenobia, Attalus (d. *c.* 200 B.C.), the mandarin Hansing, the Brahman Sissa and Shatrenscha, stated to be a celebrated Persian astronomer. Many of these ascriptions are fabulous, others rest upon little authority, and some of them proceed from easily traceable errors, as where the Roman games of *Ludus Latrunculorum* and *Ludus Calculorum,* the Welsh recreation of *Tawlbwrdd* (throw-board) and the ancient Irish pastime of *Fithcheall* are assumed to be identical with chess; so far as the Romans and Welsh are concerned, the contrary can be proved, while from what little is known of the Irish game it appears not to have been a sedentary game at all. Mr. N. Bland, M.R.A.S., in his *Persian Chess* (London, 1850), endeavoured to prove that the Persians were the inventors of chess, and maintained that the game, born in Persia, found a home in India, whence after a series of ages it was brought back to its birthplace. The view, however, which has obtained the most credence, is that which attributes the origin of chess to the Hindus. Dr. Thomas Hyde of Oxford, writing in 1694 (*De Ludis Orientalibus*), seems to have been the first to propound this theory, but he appears to have been ignorant of the game itself, and the Sanskrit records were not accessible in his time. About 1783–89 Sir William Jones, in an essay published in the 2nd vol. of *Asiatic Researches,* argued that Hindustan was the cradle of chess, the game having been known there from time immemorial by the name of *chaturanga,* that is, the four *angas,* or members of an army, which are said in the *Amarakosha* to be elephants, horses, chariots and foot-soldiers. As applicable to real armies, the term *chaturanga* is frequently used by the epic poets of India. Sir William Jones's essay is substantially a translation of the *Bhawishya Purana,* in which is given a description of a four-handed game of chess played with dice. A pundit named Rhadhakant informed him that this was mentioned in the oldest law books, and also that it was invented by the wife of Ravan, king of Lanka (Ceylon), in the second age of the world in order to amuse that monarch while Rama was besieging his metropolis. This account claims for chess an existence of 4,000 or 5,000 years. Sir William, however, grounds his opinions as to the Hindu origin of chess upon the testimony of the Persians and not upon the above manuscript, while he considers the game described therein to be more modern than the Persian game. Though sure that the latter came from India and was invented there, he admits that he could not find any account of it in the classical writings of the Brahmans. He lays it down that chess, under the Sanskrit name *chaturanga,* was exported from India into Persia in the 6th century of our era; that by a natural corruption the old Persians changed the name into *chatrang,* but when their country was soon afterwards taken possession of by the Arabs, who had neither the initial nor final letter of the word in their alphabet, they altered it further into *shatranj,* which name found its way presently into modern Persian and ultimately into the dialects of India.

Van der Linde, in his exhaustive work, *Geschichte und Litteratur des Schachspiels* (1874), has much to say of the origin-theories, nearly all of which he treats as so many myths. He agrees with those who consider that the Persians received the game from the Hindus. The outcome of his studies appears to be that chess certainly existed in Hindustan in the 8th century, and that probably that country is the land of its birth. He inclines to the idea that the game originated among the Buddhists, whose religion was prevalent in India from the 3rd to the 9th century. According to their ideas, war and the slaying of one's fellow-men, for any purposes whatever, is criminal, and the punishment of the warrior in the next world will be much worse than that of the simple murderer; hence chess was invented as a substitute for war. Van der Linde is in agreement with Sir William Jones in taking the view that the four-handed game of the original manuscript is a comparatively modern adaptation of the Hindu chess, and he altogether denies that there is any proof that any form of the game has the antiquity attributed to it.

H. J. R. Murray, in his monumental work *A History of Chess* (*see* bibliography), comes to the conclusion that chess is a descendant of an Indian game played in the 7th century.

Altogether, therefore, we find the best authorities agreeing that chess existed in India before it is known to have been played anywhere else. In this supposition they are strengthened by the names of the game and of some of the pieces. *Shatranj,* as Forbes has pointed out, is a foreign word among the Persians and Arabians, whereas its natural derivation from the term *chaturanga* is obvious. Again *al-fil,* the Arabic name of the bishop, means the elephant, otherwise *alephhind,* the Indian ox. Our earliest authority on chess is Masudi, an Arabic author who wrote about A.D. 950. According to him, *shatranj* had existed long before his time; and though he may speak not only for his own generation but for a couple of centuries before, that will give to chess an existence of over 1,000 years.

Early and Mediaeval Times.—The dimness which shrouds the origin of chess naturally obscures also its early history. We have seen that chess crossed over from India into Persia, and became known in the latter country by the name of *shatranj.* Some have understood that word to mean "the play of the king"; but undoubtedly Sir William Jones's derivation carries with it the most plausibility. How and when the game was introduced into Persia we have no means of knowing. The Persian poet Firdousī, in his historical poem, the *Shāhnāma,* gives an account of the introduction of *shatranj* into Persia in the reign of Chosroes I. Anushirwan, to whom came ambassadors from the sovereign of Hind (India), with a chess-board and men asking him to solve the secrets of the game, if he could, or pay tribute. The king asked for seven days' grace, during which time the wise men vainly tried to discover the secret. Finally, the king's minister took the pieces home and discovered the secret in a day and a night. He then journeyed to India with a game of his own invention, *nard,* which the Indians were unable to reconstruct.

Other Persian and Arabian writers state that *shatranj* came into Persia from India and there appears to be a consensus of opinion that may be considered to settle the question. Thus we have the game passing from the Hindus to the Persians and thence to the Arabians, after the capture of Persia by the caliphs in the 7th century, and from them, directly or indirectly, to various parts of Europe, at a time which cannot be definitely fixed, but either in or before the 10th century. That the source of the European game is Arabic is clear enough, not merely from the words "check" and "mate," which are evidently from *Shah mat* ("the king is dead"), but also from the names of some of the pieces. There are various chess legends having reference to the 7th and 8th centuries, but these may be neglected as historically useless; and equally useless appear the many oriental and occidental romances which revolve around those two great central figures, Harun al-Rashid and Charlemagne. There is no proof that either of them knew anything of chess or, so far as the latter is concerned, that it had been introduced into Europe in his time. True, there is an account given in Gustavus Selenus, taken from various old chronicles, as to the son of Prince Okar or Otkar of Bavaria having been killed by a blow on the temple, struck by a son of Pippin after a game of chess; and there is another well-known tradition as to the magnificent chess-board and set of men said to have been sent over as a present by the empress Irene to Charlemagne. But both tales are not less mythical than the romance which relates how the great Frankish monarch lost his kingdom over a game of chess to Guérin de Montglave; for van der Linde shows that there was no Bavarian prince of the name of Okar or Otkar at the period alluded to, and as ruthlessly shatters the tradition about Irene's chess-men. With respect to Harun al-Rashid, among the various stories told which connect him with chess there is one that at first sight may seem entitled to some degree of credit. In the annals of the Moslems by Abulfeda (Abu'l Fida) there is given a copy of a letter stated to be "From Nicephorus, emperor of the Romans, to Harun, sovereign of the Arabs," which (using Professor Forbes's translation), after the usual compliments, runs thus: "The empress (Irene) into whose place I have succeeded, looked upon you as a *Rukh* and herself as a mere Pawn; therefore she submitted to pay you a tribute more than the double of which she ought to have exacted from you. All this has been owing to female weakness and timidity. Now, however, I insist that you, immediately on reading this letter, repay to me all the sums of money you ever received from her. If you hesitate, the sword shall settle our accounts." Harun's reply, written on the back of the Byzantine emperor's letter, was terse and to the point. "In the name of God the merciful and gracious. From Harun, the commander of the faithful, to the Roman dog Nicephorus. I have read thine epistle, thou son of an infidel mother; my answer to it thou shalt see, not hear." Harun was as good as his word, for he marched immediately as far as Heraclea, devastating the Roman territories with fire and sword, and soon compelled Nicephorus to sue for peace. Now the points which give authority to this narrative and the alleged correspondence are that the relations which they assume between Irene and Nicephorus on the one hand and the warlike caliph on the other are confirmed by the history of those times, while, also, the straightforward brevity of Harun's reply commends itself as what one might expect from his soldier-like character. Still, the fact must be remembered that Abulfeda lived about five centuries after the time to which he refers. Perhaps we may assume that it is not improbable that the correspondence is genuine; but that the words *rukh* and *pawn* may have been substituted for other terms of comparison originally used.

As to how chess was introduced into western and central Europe nothing is really known. The Spaniards very likely received it from their Moslem conquerors, the Italians not improbably from the Byzantines, and in either case it would pass northwards to France, going on thence to Scandinavia and England. Some say that chess was introduced into Europe at the time of the Crusades, the theory being that the Christian warriors learned to play it at Constantinople. This is negatived by a curious epistle of St. Peter Damian, cardinal bishop of Ostia, to Pope Alexander II. written about A.D. 1061, which, assuming its authenticity, shows that chess was known in Italy before the date of the first crusade. The cardinal, as it seems, had imposed a penance upon a bishop whom he had found diverting himself at chess; and in his letter to the pope he repeats the language he had held to the erring prelate, viz., "Was it right, I say, and consistent with thy duty, to sport away thy evenings amidst the vanity of chess, and defile the hand which offers up the body of the Lord, and the tongue that mediates between God and man, with the pollution of a sacrilegious game?" Among those who took an unfavourable view of the game may be mentioned John Huss, who, when in prison, deplored his having played at chess, whereby he had lost time and run the risk of being subject to violent passions. Among authentic records of the game may be quoted the *Alexiad* of the princess Anna Comnena, in which she relates how her father, the emperor Alexius, used to divert his mind from the cares of State by playing at chess with his relatives. This emperor died in 1118.

Concerning chess in England there is the usual confusion between legend and truth. Snorre Sturleson relates that as Canute was playing at chess with Earl Ulf, a quarrel arose, which resulted in the upsetting of the board by the latter, with the further consequence of his being murdered in church a few days afterwards by Canute's orders. Carlyle, in *The Early Kings of Norway,* repeats this tale, but van der Linde treats it as a myth. The *Ramsey Chronicle* relates how Bishop Utheric, coming to Canute at night upon urgent business, found the monarch and his courtiers amusing themselves at dice and chess. There is nothing intrinsically improbable in this last narrative; but Canute died about 1035, and the date, therefore, is suspiciously early. Moreover, allowance must be made for the ease with which chroniclers described other games as chess.

As regards the individual pieces, the king seems to have had the same move as at present; but it is said he could formerly be captured. His "castling" privilege is a European invention; but he formerly leaped two and even three squares, and also to his Kt2. Castling dates no farther back than the first half of the 16th century. The queen has suffered curious changes in name, sex and power. In *shatranj* the piece was called *farz* or *firz* (also *farzan, farzin* and *farzi*), signifying a "counsellor," "minister" or "general." This was latinized into *farzia* or *fercia.* The French slightly altered the latter form into *fierce, fierge,* and, as some say, *vierge,* which, if true, might explain its becoming a female. Another and much more probable account has it that whereas formerly a pawn on reaching an eighth square became a *farzin,* and not any other piece, which promotion was of the same kind as at draughts (in French, *dames*), so she became a *dame* or queen as in the latter game, and thence *dama, donna,* etc. There are old Latin manuscripts in which the terms *ferzia* and *regina* are used indifferently. The queen formerly moved only one square diagonally and was consequently the weakest piece on the board. The immense power she now possesses seems to have been conferred upon her so late as about the middle of the 15th century. It will be noticed that under the old system the queens could never meet each other, for they operated on diagonals of different colours. The bishop's scope of action was also very limited formerly; he could only move two squares diagonally, and had no power over the intermediate square, which he could leap over whether it was occupied or not. This limitation of their powers prevailed in Europe until the 15th century. This piece, according to Forbes, was called among the Persians *pil,* an elephant, but the Arabs, not having the letter *p* in their alphabet, wrote it *fil,* or with their definite article *al-fil,* whence *alphilus, alfinus, alifiere,* the latter being the word used by the Italians; while the French perhaps get their *fol* and *fou* from the same source. The pawns formerly could move only one square at starting; their powers in this respect were increased about the early part of the 16th century. It was customary for them on arriving at an eighth square to be exchanged only for a *farzin* (queen), and not any other piece; the rooks (so called from the Indian *rukh* and Persian *rokh,* meaning "a soldier") and the knights appear to have always had the same powers as at present. As to the chess-boards, they were formerly uncoloured, and it is not until the

13th century that we hear of chequered boards being used in Europe.

Development in Play.—The change of *shatranj* into modern chess took place most probably first in France, and thence made its way into Spain early in the 15th century, where the new game was called *Axedrez de la dama,* being also adopted by the Italians under the name of *scacci alla rabiosa.* The time of the first important writer on modern chess, the Spaniard Ruy Lopez de Segura (1561), is also the period when the latest improvement, castling, was introduced, for his book (*Libro de la invencion liberal y arte del juego del Axedrez*), though treating of it as already in use, also gives the old mode of play, which allowed the king a leap of two or three squares. Shortly afterwards the old *shatranj* disappears altogether. Lopez was the first who merits the name of chess analyst. At this time flourished the flower of the Spanish and Italian schools of chess—the former represented by Lopez, Ceron, Santa Maria, Busnardo and Avalos; the latter by Giovanni Leonardo da Cutri (il Puttino) and Paolo Boi (il Syracusano). In the years 1562–75 both Italian masters visited Spain and defeated their Spanish antagonists. During the whole 17th century we find but one worthy to be mentioned, Giacchino Greco (il Calabrese). The middle of the 18th century inaugurates a new era in chess. The leading man of this time was François André Danican Philidor. He was born in 1726 and was trained by M. de Kermar, Sire de Légal, the star of the Café de la Régence in Paris, which was the centre of French chess until early in the 20th century. In 1747 Philidor visited England, and defeated the Arabian player, Phillip Stamma, by eight games to one and one draw. In 1749 he published his *Analyse des échecs,* a book which went through more editions and was more translated than any other work upon the game. During more than half a century Philidor travelled much, but never went to Italy, the only country where he could have found opponents of first-rate skill. Italy was represented in Philidor's time by Ercole del Rio, Lolli and Ponziani. Their style was less sound than that of Philidor, but certainly a much finer and in principle a better one. As an analyst the Frenchman was in many points refuted by Ercole del Rio ("the anonymous Modenese"). Blindfold chess-play, already exhibited in the 11th century by Arabian and Persian experts, was taken up afresh by Philidor, who played on many occasions three games simultaneously without sight of board or men. These exhibitions were given in London, at the Chess club in St. James's street, and Philidor died in that city in 1795. As eminent players of this period must be mentioned Count Ph. J. van Zuylen van Nyevelt (1743–1826), and the German player J. Allgaier (1763–1823), after whom a well-known brilliant variation of the King's Gambit is named. Philidor was succeeded by Alexandre Louis Honoré Lebreton Deschapelles (1780–1847), who was also a famous whist player. The only player who is known to have fought Deschapelles not unsuccessfully on even terms is John Cochrane. He also lost a match (1821) to W. Lewis, to whom he conceded the odds of "pawn and move," the Englishman winning one and drawing the two others. Deschapelles' greatest pupil, and the strongest player France ever possessed, was Louis Charles Mahé de la Bourdonnais, who was born in 1797 and died in 1840. His most memorable achievement was his contest with the English champion, Alexander Macdonnell, the French player winning in the proportion of three to two.

The English school of chess began about the beginning of the 19th century, and Sarratt was its first leader. He flourished until 1820, and was followed by his great pupil, W. Lewis, who will be remembered for his writings. His literary career belongs to the period from 1817 to 1848 and he died in 1870. A. Macdonnell (1798–1835) has been already mentioned. To the same period belong also Captain Evans, the inventor of the celebrated "Evans Gambit" (1824), who died at an advanced age in 1872; George Perigal (d. 1854) who played in the correspondence matches against Edinburgh and Paris; George Walker (1803–1879), chess editor of *Bell's Life* from 1835 to 1873; and John Cochrane (1798–1878) who met every strong player from Deschapelles down. In the same period Germany possessed but one good player, J. Mendheim of Berlin. The fifth decade of the 19th century is marked by the fact that the leadership passed from the French school to the English. After the death of la Bourdonnais, Fournié de Saint-Amant became the leading player in France; he visited England in the early part of 1843, and successfully met the best English players, including Howard Staunton (*q.v.*); but the latter soon took his revenge, for in Nov. and Dec. 1843 a great match between Staunton and Saint-Amant took place in Paris, the English champion winning by 11 games to six with four draws. During the succeeding eight years Staunton maintained his reputation by defeating Popert, Horwitz and Harrwitz. Staunton was defeated by Anderssen at the London tournament in 1851, and this concluded his match-playing career.

In the ten years 1830–40 a new school arose in Berlin, the seven leaders of which have been called "The Pleiades." These were Bledow (1795–1846), Bilguer (1815–1840), Hanstein (1810–1850), Mayet (1810–1868), Schorn (1802–1850), B. Horwitz (1809–1885) and von Heydebrand und der Lasa, once German ambassador at Copenhagen. As belonging to the same period must be mentioned the three Hungarian players, Grimm, Szen and J. Löwenthal.

Among the great masters since the middle of the 19th century Paul Morphy (1837–1884), an American, has seldom been surpassed as a chess player. His career was short but brilliant. Born in New Orleans in 1837, he was taught chess by his father when only ten years of age, and in two years' time became a strong player. When not quite 13 he played three games with Löwenthal and won two of them, the other being drawn. He was 20 years of age when he competed in the New York congress of 1857, where he won the first prize. In 1858 he visited England, and there defeated Boden, Medley, Mongredien, Owen, Bird and others. He also beat Löwenthal by nine games to three and two draws. In the same year he played a match at Paris with Harrwitz, winning by five to two and one drawn; and later on he obtained a victory over Anderssen. On two or three occasions he played blindfold against eight strong players simultaneously, each time with great success. He returned to America in 1859 and continued to play, but with decreasing interest in the game, until 1866. He died in 1884.

Wilhelm Steinitz (1836–1900) took the sixth prize at the London congress of 1862. He defeated Blackburne in a match by seven to one and two draws. In 1866 he beat Anderssen in a match by eight games to six. In 1868 he carried off the first prize in the British Chess Association handicap, and in 1872 in the London grand tourney, also defeating Zukertort in a match by seven games to one and four draws. In 1873 he carried off the first prize at the Vienna congress; and in 1876 he defeated Blackburne, winning seven games right off. In Philidor's age it was considered almost incredible that he should be able to play three simultaneous games without seeing board or men, but Paulsen, Blackburne and Zukertort often played 10 or 12 such games, while as many as 28 and 29 were so played by Alekhine and Réti, respectively, in 1925. Again, in 1933, Alekhine played 32 and Koltanowski 34, in 1937. Then, in 1943, Najdorf exceeded all performances with 40 at Buenos Aires.

In 1876 England was in the van of the world's chess army. English-born players then were Boden, Burn, Macdonnell, Bird, Blackburne and Potter; while among naturalized English players were Löwenthal, Steinitz, Zukertort, who died in 1888, and Horwitz. This illustrious contingent was reinforced in 1878 by Mason, an Irish-American, who came over for the Paris tournament; by Gunsberg, a Hungarian; and later by Teichmann, who also made England his home. English chess flourished under the leadership of these masters, the chief prizes in tournaments being consistently carried off by the English representatives.

To gauge the progress made by the game since between 1875 and the end of the century it will suffice to give the following statistics. In London Simpson's Divan was formerly the chief resort of chess players; the St. George's Chess club was the principal chess club in the West End, and the City of London Chess club was the principal chess club in the east. Formerly only the British Chess Association existed; after its dissolution the now defunct Counties' Chess Association took its place, and this was

superseded by the re-establishment by Mr. Hoffer of the British Chess association, which again fell into abeyance after having organized three international tournaments—London, 1886; Bradford, 1888; and Manchester, 1890—and four national tournaments. There were various reasons why the British Chess association ceased to exercise its functions, one being that minor associations did not feel inclined to merge their identity in a central association. The London league was established, besides the Northern Counties' Chess union, the Southern Counties' Chess union, the Midland Counties' union, and associations in most of the counties. All these associations are supported by the affiliated chess clubs of the respective counties. Scotland (which has its own association), Wales and Ireland have also numerous clubs. All are affiliated with the British Chess federation. (*See below.*)

Tournaments

The first modern International Chess Tournament held in London in 1851 was the forerunner of various similar contests, the most important from 1929 being given below:

1929. Carlsbad. 1. Nimzowitsch, 2. Capablanca and Spielmann.
1929. Budapest. 1. Capablanca, 2. Rubinstein, 3. Tartakower.
1929. Barcelona. 1. Capablanca, 2. Tartakower, 3. Colle.
1929. Ramsgate. 1. Sultan-Khan, 2. Price and Michell.
1929. Bradley Beach. 1. Alekhine, 2. L. Steiner, 3. Kupchik and Turover.
1930. Hastings. 1. Capablanca, 2. Vidmar, 3. Yates.
1930. San Remo. 1. Alekhine, 2. Nimzowitsch, 3. Rubinstein.
1930. Frankfurt. 1. Nimzowitsch, 2. Kashdan, 3. Ahues and List.
1930. Liége. 1. Tartakower, 2. Sultan-Khan, 3. Ahues, Colle and Nimzowitsch.
1931. Hastings. 1. Dr. Euwe, 2. Capablanca, 3. Sultan-Khan.
1931. Bled. 1. Alekhine, 2. Bogoljubow, 3. Nimzowitsch.
1931. New York. 1. Capablanca, 2. Kashdan, 3. Kevitz.
1932. Hastings. 1. Flohr, 2. Kashdan, 3. Dr. Euwe.
1932. London. 1. Alekhine, 2. Flohr, 3. Sultan-Khan and Kashdan.
1932. Pasadena. 1. Alekhine, 2. Kashdan, 3. Dake, Reshevsky and Steiner.
1932. Mexico City. 1. Alekhine and Kashdan, 3. Capt. Araiza.
1932. Bern. 1. Alekhine, 2. Dr. Euwe and Flohr.
1933. Hastings. 1. Flohr, 2. Pirc, 3. Sultan-Khan and L. Steiner.
1934. Hastings. 1. Flohr, 2. Alekhine and Lilienthal.
1934. Zurich. 1. Alekhine, 2. Euwe and Flohr.
1935. Hastings. 1. Euwe, Flohr and Thomas.
1935. Moscow. 1. Botwinnik and Flohr, 3. Lasker.
1935. Margate. 1. Reshevsky, 2. Capablanca and Thomas.
1935. Orebro. 1. Alekhine, 2. Lundin, 3. Stahlberg and Stoltz.
1936. Hastings. 1. Fine, 2. Flohr, 3. Tartakower.
1936. Bad Nauheim. 1. Alekhine and Keres, 3. Ahues.
1936. Moscow. 1. Capablanca, 2. Botwinnik, 3. Flohr.
1936. Zandvoort. 1. Fine, 2. Dr. Euwe, 3. Keres and Tartakower.
1936. Podebrad. 1. Flohr, 2. Alekhine, 3. Flotys.
1936. Nottingham. 1. Botwinnik and Capablanca, 3. Euwe, Fine and Reshevsky.
1936. Amsterdam. 1. Fine and Euwe, 3. Alekhine.
1936. Margate. 1. Flohr, 2. Capablanca, 3. Stahlberg.
1937. Hastings. 1. Alekhine, 2. Fine, 3. Eliskases.
1937. Margate. 1. Fine and Keres, 3. Alekhine.
1937. Ostend. 1. Fine, Grob and Keres.
1937. Kemeri. 1. Flohr, Petrow and Reshevsky.
1937. Semmering-Baden. 1. Keres, 2. Fine, 3. Capablanca and Reshevsky.
1938. Holland (A.V.R.O. tournament). 1. Keres, 2. Fine, 3. Botwinnik.
1939. Leningrad-Moscow. 1. Flohr, 2. Reshevsky, 3. Lilienthal, Loewenfisch, Makagonoff and Ragosin.
1939. Hastings. 1. Szabo, 2. Dr. Euwe, 3. Landau and Pirc.
1939. Margate. 1. Keres, 2. Capablanca and Flohr.
1940. Salzburg. 1. Alekhine, 2. Keres, 3. Schmidt.
1941. Mar del Plata. 1. Stahlberg, 2. Najdorf, 3. Eliskases.
1942. Buenos Aires. 1. Najdorf and Stahlberg, 3. Frydman.
1942. Munich. 1. Stoltz, 2. Alekhine and Lundin.

SCHOOLS OF PLAY

Chess has developed various schools of play from time to time. The theory of the game, however, did not advance in proportion to the enormous strides in its popularity. Formerly the theory of play had been enriched by such enthusiasts as Dr. Max Lange, Louis Paulsen, Professor Anderssen, Neumann, Dr. Suhle, Falkbeer, Kieseritzki, Howard Staunton, Dr. Zukertort, W. N. Potter and Steinitz. The most permanent influence on chess theory was exercised by Steinitz. In the days of Morphy and Anderssen players invariably strove for an attack on the king's position at any cost. Steinitz, however, realized that such attacks were, generally speaking, successful only against inferior opposition and came to the conclusion that the correct strategy was to strive to create weaknesses, however slight, in the hostile position, and by the accumulation of these weaknesses to obtain an opportunity for a decisive combination. This new method he not only preached but practised, and thus was founded the modern school. If to Steinitz credit must be given for founding this school, to other players credit must be given for combining the theory of minute advantages with the old method of rapid development adopted by Morphy and Anderssen. Steinitz preferred a slow development and the building-up of an unassailable (if cramped) position. Dr. Tarrasch, however, had no liking for cramped positions and so strove for rapid development (as Morphy), not to essay a violent and hazardous attack (as Morphy) but to use his rapid development and greater control of space to force his opponent to create those weaknesses which Steinitz had shown how to exploit. This may be said to be the method of the modern school.

In 1913, however, a young Russian master, A. Nimzowitsch, published some articles assailing some of the cardinal points of the Tarrasch creed. Their importance was not sufficiently estimated at the time, for Nimzowitsch had already a reputation for a bizarre style of play, and the outbreak of war the following year put an end to discussion of chess theories. But to Nimzowitsch must be given the credit (if credit it be) of founding what is now known as the hypermodern school. The teachings of this school, which came into prominence after World War I, may be roughly summarized as follows: (1) "the golden rule is that there is no golden rule"—in other words, the hypermoderns view generalizations with suspicion. As Richard Réti, one of the most ardent advocates of this school, said in his *Modern Ideas in Chess,* "The hypermoderns are the greatest opponents of routine play." (Richard Réti died June 6, 1929.) (2) Tarrasch had laid down the importance of being strong in the centre, holding that a player who has control of the four squares in the centre ($e4$, $e5$, $d4$, $d5$) has an advantage in that he can prevent the deployment of his opponent's pieces from one wing to the other via those squares—the most natural and effective route. The hypermoderns do not, however, immediately hasten to seize control of those squares, preferring to delay that occupation until it can be done (as they consider) more effectively. To that purpose they hold back the centre pawns somewhat in the beginning and develop their bishops in posts where they will be likely to aid the subsequent investment of the centre (*e.g.*, at KKt2 and QKt2 or KKt2 and K3).

The World's Championship.—In the absence of any authority to confer the title of world's champion, it was assumed by Steinitz—and rightly, for he was undoubtedly the strongest player of his day. In his old age, however—in 1894—he was beaten in a match for the championship by a young German player, Dr. Emanuel Lasker.

Lasker held the title for 26 years, during which time he defeated redoubtable opponents in Steinitz (a return match), Marshall, Janowsky (twice) and Dr. Tarrasch, and drew with Schlechter. In 1921 a match was arranged at Havana between Lasker and J. R. Capablanca—a Cuban who was on all sides admitted to be Lasker's most dangerous antagonist. Capablanca won by four games to none, with ten draws, Lasker resigning after the 14th game. Capablanca, however, did not hold the title for long. In the autumn of 1927, after a struggle lasting nearly three months, he was defeated at Buenos Aires by the Russian master, Dr. Alekhine, who won 6 games to 3, no fewer than 25 being drawn. In 1935 Dr. Max Euwe of Amsterdam became champion when he defeated Dr. Alekhine by winning 9 games, losing 8 and drawing 13. Dr. Alekhine regained the title in a return match (1937) in which the score was Dr. Alekhine, 11; Dr. Euwe, 6; drawn, 13.

Fédération Internationale des Échecs.—This body is the central authority for chess matters. Most of the European countries and the U.S.A. are members. A tournament under the auspices of the federation was held at Budapest in 1926, and the following year a tournament was held at London between teams, each of four players, representing 16 nations attached to the fed-

eration. The tournament was won by Hungary with a score of 40 points out of a possible 60. Close behind came Denmark (second) and Great Britain (third). Hungary also won a similar tournament held at The Hague in 1928. The United States won at Prague, 1931; at Folkestone, 1933; at Warsaw, 1935; at Stockholm, 1937. The U.S. was not represented in 1939 at Buenos Aires, where Germany finished first.

Modern British Chess.—The British Chess federation was instituted in 1904, its first congress being held at Hastings in that year, when a British championship, a ladies' championship and a first-class amateur tournament were played. These competitions have been continued annually at the congresses of the federation, with the exception of the World War I period and the years 1922 and 1927, when international tournaments were held in England. The holders of the British championship have been W. E. Napier, H. E. Atkins, R. C. Griffith, F. D. Yates, R. H. V. Scott, Sir G. A. Thomas, Sultan-Khan, W. Winter and W. A. Fairhurst.

In 1896 and following years matches between representative players of Great Britain and the United States respectively were played by cable, with the following results:

1896. U.S.	won by	$4\frac{1}{2}$	games	to	$3\frac{1}{2}$
1897. Great Britain	"	$5\frac{1}{2}$	"	"	$4\frac{1}{2}$
1898. Great Britain	"	$5\frac{1}{2}$	"	"	$4\frac{1}{2}$
1899. U.S.	"	6	"	"	4
1900. U.S.	"	6	"	"	4
1901. Drawn		5	games	each.	
1902. U.S.	won by	$5\frac{1}{2}$	games	to	$4\frac{1}{2}$
1903. U.S.	"	$5\frac{1}{2}$	"	"	$4\frac{1}{2}$
1907. Great Britain	"	$5\frac{1}{2}$	"	"	$4\frac{1}{2}$
1908. U.S.	"	$6\frac{1}{2}$	"	"	$3\frac{1}{2}$
1909. Great Britain	"	6	"	"	4
1910. Great Britain	"	$6\frac{1}{2}$	"	"	$3\frac{1}{2}$
1911. Great Britain	"	6	"	"	4

By winning three consecutive matches Great Britain obtained permanent possession of the trophy. In England chess matches have been played annually since 1873 between the universities of Oxford and Cambridge, seven players on each side. Up to 1939 Oxford won 26 matches, Cambridge 29, and 8 were drawn.

Literature of the Game.—The most ambitious of early European writings on chess was the work of a Lombard, Jacobus de Cessolis (Jacopo Dacciesole), whose main object, however, though he gives the moves, etc., was to teach morals rather than chess. He was a Dominican friar and his treatise, *Liber de Moribus Hominum et Officiis Nobilium,* was written before the year 1300. It was afterwards translated into several European languages, and in the year 1474 Caxton, under the title of *The Game and Playe of Chesse,* printed an English translation of the French version.

About 1500 we have the *Göttinger Handschrift,* a work containing 12 different openings and 30 problems. The author of this manuscript is not known. Of Lucena, a Spanish author who wrote in or about 1497, we are better informed. His treatise, *Repeticion des Amores e Arte de Axedres,* comprises various practical chess matters, including 150 positions, illustrated by 160 well-executed woodcuts. Various of these positions are identical with those in the *Göttinger Handschrift.*

In the 16th century works upon the game were written by Damiano, Ruy Lopez and Horatio Gianutio della Mantia; in the 17th century by Salvio, Polerio, Gustavus Selenus, Carrera, Greco, Fr. Antonio and the authors of the *Traité de Lausanne;* in the 18th century by Bertin, Stamma, Ercole del Rio, Lolli, Cozio, Philidor, Ponziani, Stein, Van Nyevelt, Allgaier and Peter Pratt; in the 19th century by J. F. W. Koch and C. F. Koch, Sarratt, John Cochrane, Wm. Lewis, Silberschmidt, Ghulam Kassim and James Cochrane, George Walker, A. Macdonnell, Jaenisch, Petroff, Von Bilguer, Von der Lasa, Staunton, Kling and Horwitz, Bledow, Dubois, Kieseritzki, Max Lange, Löwenthal, Dufresne, Neumann, Suhle, Zukertort, Preti, Steinitz and others.

English chess owes much to W. Lewis and George Walker. But to Howard Staunton must be ascribed the most important share in creating the later popularity which the game achieved in England. Staunton's first work, *The Chess Player's Handbook,* was published in 1847, and again (revised) in 1848. His other works are: *The Chess Player's Text-Book* and *The Chess Player's Companion* (1849) (the latter being a collection of his own games); the *Chess Praxis* (1860, republished in 1903); his posthumous work, *Chess Theory and Practice,* edited by R. B. Wormald (1876), and various smaller treatises. The laws of the game as laid down in the *Praxis* formed the basis of the rules adopted by the British Chess Association in 1862. Besides editing the *Chess Player's Chronicle* and the *Chess World,* he was the chess editor of the *Illustrated London News* from 1844 till his death in 1874.

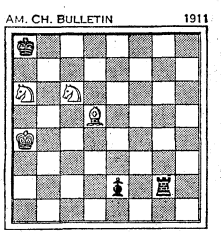
BIBLIOGRAPHY.—*Elements of the Game*—Rev. E. E. Cunnington, *The Modern Chess Primer* (1920) gives a very good grounding in the elements of the game and the student should master its contents. *General Treatises*—(*a*) Elementary: Lawrence H. Dawson, *A Short Guide to Chess* (1923); E. A. Greig, *Pitfalls of the Chess-Board* (revised by W. A. Fairhurst, 1927). (*b*) Fairly advanced: J. Mason, *The Art of Chess* (1913) and *The Principles of Chess* (1923); Dr. Emanuel Lasker, *Common Sense in Chess* (1896) and *Chess Strategy* (1922). (*c*) More advanced: Capablanca, *Chess Fundamentals* (1921); Znosko-Borowsky, *The Middle Game in Chess* (1922); Réti, *Modern Ideas in Chess* (1923); Aron Nimzowitsch, *Die Blockade* and *Mein System* (1925); Kmoch, *Die Kunst der Verteidigung* (The Art of Defence) (1927); Dr. Emanuel Lasker, *Lasker's Manual of Chess* (1927). *End Games*—The elements of the endings are dealt with in both *The Modern Chess Primer* and *The Art of Chess.* Other works which may be recommended to the more advanced student are: Mieses, *Chess Endings from Modern Master-Play;* Tattersall, *A Thousand End-Games;* Rinck, *700 Fins de Partie* (1926), and Berger's monumental work, *Theorie und Praxis der Endspiele* (2nd ed. 1921). *Openings*—The best work in English is undoubtedly Griffith and White's *Modern Chess Openings* (1925), revised by Reuben Fine (1939), upon the theory of the openings. The *Handbuch des Schachspiels* (8th ed. 1916, by Schlechter, with supplement, 1921, by Mieses) and *Lärobok i Schack* (1921) are decidedly more voluminous but less up-to-date. A mine of information is Tartakower's *Die Hypermoderne Schachpartie* (1924). Of works dealing with only one opening the following are very useful: J. du Mont, *The Centre Counter* and *The Centre Game;* Maróczy, *Die Französische Partie* (The French Defence) (1924); Tarrasch, *Die Verteidigung des Damengambits* (The Defence of the Queen's Gambit) (Gouda, 1924) and Tartakower, *Die Zukunftseröffnung* (The Opening of the Future, *i.e.,* Réti's Opening) (1924); Fine, *Basic Chess Endings* (1943), *Ideas Behind the Chess Openings* (1943); J. du Mont, *The Basis of Combination in Chess* (1942).

Collections of Games—A very valuable—and, perhaps, the most enjoyable—form of chess study is the careful playing over of well-annotated master games. The following books are recommended: *Mr. Blackburne's Games at Chess* (1899); P. W. Sergeant, *Morphy's Games of Chess* (1916), and *Charousek's Games of Chess* (1919); P. W. Sergeant and W. H. Watts, *Pillsbury's Chess Career* (1923); Maróczy, *Hundert Schachpartien* (1921); Capablanca, *My Chess Career* (1920); Tarrasch, *Dreihundert Schachpartien* (1916) and *Die Moderne Schachpartie* (1916); Dr. Alekhine, *My Hundred Best Games of Chess* (1927); Dr. Alekhine and H. Helms, *New York Tournament* (1924); Reinfeld, *Keres' Best Games of Chess* (1942); Dr. Alekhine, *The Nottingham Tournament Book* (1936); F. J. Wellmuth, *The Golden Treasury of Chess* (1943).

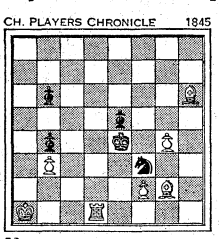
History—The best book on the history of the game is H. J. R. Murray, *A History of Chess* (1913). (G. E. S.; H. Hs.)

PROBLEMS

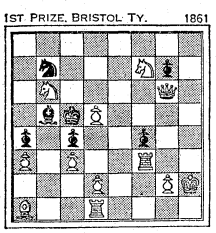
Chess problems are artificial positions, permitting mate in a specified number of moves, with play involving elements of strategy or beauty. In No. 1, by C. S. Kipping (1891–), player and problemist alike would see the need of advancing the white king to Kt6. The player would be satisfied to win easily in four moves, by 1.K-Kt5, avoiding black's promotion check; whereas the problemist would play 1.K-R5, welcoming check. Early manuscripts contain fine works by Arabians, 9th century; by Italians, 13th century. The modern period, however, dates only from 1840, when the problems of an Englishman, Rev. H. Bolton (1793–1873), a Belgian, A. d'Orville (1813–), and the German master player, A. Anderssen (1818–79), heralded a great revival of interest. A collection published in Paris, 1846,



No. 1.—MATE IN THREE



No. 2.—MATE IN THREE



No. 3.—MATE IN THREE

by A. Alexandre (1766–1850), contained 2,000 problems and seemed to leave little for the future to attempt. Yet at this very time the establishment of many chess magazines and columns proved a sufficient stimulus to encourage the study of problems on unprecedented lines.

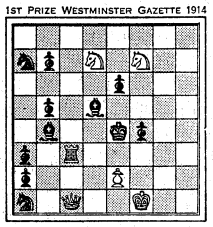
The years 1845–61 marked the discovery of many important themes. Rev. H. A. Loveday (1815–48), English chaplain at Delhi,



No. 4.—MATE IN THREE



No. 5.—MATE IN THREE



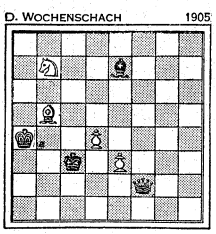
No. 6.—MATE IN THREE

published the famous Indian Problem (No. 2) in 1845. The ambush, 1.B-B1, 2.R-Q2, by which stalemate is avoided and mate attained, trite as it appears to-day, took the problem world by storm. (Originally published as a four-mover, this had black Pawn at Kt4 instead of Kt5, with very inaccurate play.) W. Grimshaw (1832–90) of England, A. Novotny (1829–71) of Austria and J. Plachutta (1883–) of Germany experimented with the interference themes which today bear their names, while F. Healey (1828–1906), England, published his Bristol Problem, No. 3, in 1861, with its surprising clearance key, 1.R-KR1, preparing for 2.Q-Kt1 and 3.Q-KKt1 mate.

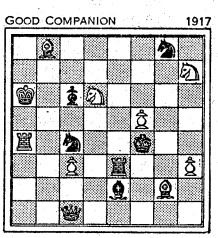
In America, Sam Loyd (1841–1911) composed a great number of celebrated problems, such as No. 4: 1.B-R7,2.KtKt6. Here the ambush resembles Loveday's, but its purpose is not to prepare for a discovered mate, as in the Indian theme, but to remove once for all the bishop's guard. This way of preventing stalemate has been aptly called a Passive Sacrifice.

The themes of these early problems were little appreciated during the next quarter century, a time of solid but dull growth, when intricacy was being cultivated to the exclusion of strategy. Striking figures were Ph. Klett (1833–1910) in Germany and C. Bayer (1828–97) in Austria. Presently, however, appeared several important problem collections, expounding varied technical views and opening the way to a new era: *The Chess Strategy,* 1881, by Loyd (*cf.* the later: *Sam Loyd and his Chess Problems,* Leeds, 1913); *Das Schachproblem,* 1884, by J. Berger (1845–1933); *The Chess Problem Text-Book,* 1886, by B. G. Laws (1861–1932) and C. Planck (1856–1935); and *Ceske Ulohy Sachove,* 1888, by J. Pospisil (1861–1916).

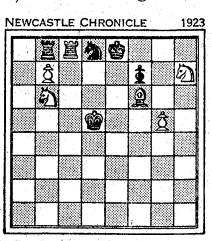
Stimulated by Pospisil's book and the influence of J. Dobrusky (1853–1907), the Bohemians increasingly emphasized purity of mate, economy of force and the echo or repeated mate. The list of Bohemian composers is a splendid one, including G. Chocholous (1856–1930) and L. Vetesnik (1857–). More recently Z. Mach (1877–), F. Dedrle (1878–) and others have carried these elements to further refinement, culminating in M.



No. 7.—MATE IN FOUR



No. 8.—MATE IN TWO



No. 9.—MATE IN THREE

Havel (1881–). In No. 5, 1.R-K1, Kt-Kt 2; 2.Q-Kt4+. K-B6; 2.Q-B5+ and P-Q7; 2.R-B3, all lead to "model," or pure and economical, mates, while the two first form a beautiful echo.

Following the teachings of Berger, a kindred interest in mating pictures was cultivated in Germany, but with greater complexity of structure and play. From this developed the "grand manner" of the Old German school and of the related Austrian school, still represented by the veterans K. Erlin (1856–) and M. Feigl (1871–). In England the standards of purity, exemplified by Laws and Planck in their individual styles, developed into the magnificent works of the blind Jamaican composer, A. F. Mackenzie (1861–1905), and so into the problems of G. Heathcote (1870–) and P. F. Blake (1873–1936). No. 6 is a splendid example of Heathcote's four-movers. The key is 1.R-KKt3, and white continues 2.Q-Q2, Kt-B6+, Q-K3+, Kt-R6+ or Q-B3 according to black's play. Again an echo.

In the United States, Loyd had a worthy successor in W. A. Shinkman (1847–1933), while other admirable U.S. composers have been H. W. Bettmann (1868–1935) and O. Wurzburg (1875–). Loyd's style has influenced composers in many other countries, including notably the celebrated Rumanian, W. Pauly (1876–1934) and several of the Scandinavians.

A school sprang up in Germany, after the publication in 1903 of *Das Indische Problem,* by J. Kohtz (1843–1918). He drew attention to the thematic problems of 1845–61 and encouraged fresh study of all the interference themes. This German problem renaissance has had many distinguished members: W. von Holzhausen (1876–1935), F. Kohnlein (1879–1916), F. Sackmann (1888–1926) and more recently A. Kraemer (1898–), F. Palatz (1896–) and others. No. 7 is an example of Kohtz's work. The sacrifice key, 1.Kt-Q6, decoys the black bishop, so it can no longer play to Kt4. When it now defends against 2.Q-K2 by 2.---, B-B5, white is enabled to capture it. This decoy to a vulnerable point on a line Kohtz called the Roman Theme.

While of less depth than longer problems, two-movers have enjoyed increasing popularity since the admirable productions of T. Taverner (1856–1928) appeared in England in the '80s and '90s. Mackenzie gave two-movers fresh vitality at the end of the century, drawing attention to the cross-check theme, where black checks, such as those of the knight in No. 8 (Key: 1.B-K4) are countered without recapture of the checking piece. More recently, interferences and pinnings and unpinnings, and then the changed mate, have provided the two-mover with original material. The establishment, 1913–24, by J. F. Magee, Jr. (1867–) of the Good Companion club of Philadelphia, encouraged these new two-move forms widely, calling into action many younger men, such as G. Guidelli (1897–1924) and A. Mari (1892–) of Italy, A. Ellerman (1893–) of Argentine Republic, and C. Mansfield (1896–) of England. The changed mate, brought into vogue in England by P. H. Williams (1873–1922), has had an interesting growth, extending more recently to the domain of three-movers. G. Hume's No. 9 is an example of changed promotions, the apparent 1.---,RxR; 2PxR(B) of the set position being replaced by 1.Kt-R8,RxR; 2.PxR(R) in the real solution.

In general, modern interest in composition and solving no longer centres only on the difficulty, strategy or beauty of individual problems, but embraces the study of whole groups of problems and the classification of their themes. There exist large classified collections, such as that in the custody of G. Hume (1862–1936), Nottingham, England, with its 150,000 problems and 8,000 thematic subdivisions, and there are many noteworthy books on themes, such as *Simple Two-Move Themes,* Stroud, 1924, by F. B. Feast (1872–1941) of England, *The Chess Problem,* Stroud, 1926, by H. Weenink (1892–1931) of Holland and *The Enjoyment of Chess Problems* (1943) by K. S. Howard, U.S.A.

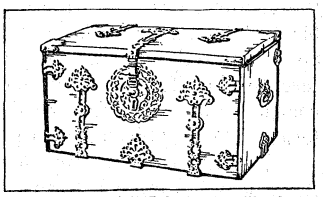
Note: This article has not attempted to trace the story of problems other than direct-mates. But the existence should not be overlooked of such important forms as the self-mate (in which the loser wins) or the many original "fairy" types invented and popularized by T. R. Dawson and others. (A. C. W.;X.)

CHEST, a large box of wood or metal with a hinged lid. The term is used for many kinds of receptacles; and in anatomy indicates the portion of the body covered by the ribs and breastbone (*see* RESPIRATORY SYSTEM, ANATOMY OF). Chests as articles of furniture are of the greatest antiquity. The chest was the common receptacle for clothes and valuables, and was the direct ancestor of the "chest of drawers," which was formed by enlarging the chest and cutting up the front. It was also frequently used as a seat. Indeed, in its origin it took in great measure the place of the chair, which, although familiar enough to the ancients, was

a luxury in the days when the chest was already an almost universal possession. In the early middle ages the rich possessed them in profusion, used them as portmanteaux, and carried them about from castle to castle. These portable receptacles were often covered with leather and emblazoned with heraldic designs. As houses gradually became more amply furnished, chests and beds and other movables were allowed to remain stationary; and the chest finally took the shape in which we best know it—that of an oblong box standing upon raised feet. As a rule it was made of oak, but sometimes of chestnut or other hard wood.

Types.—There are, properly speaking, three types of chest—the domestic, the ecclesiastical and the strong box or coffer. Old domestic chests still exist in great number and some variety, but the proportion of those earlier than the latter part of the Tudor period is very small; most of them are Jacobean in date. Very frequently they were made to contain the store of house-linen which a bride took to her husband upon her marriage. In the 17th century Boulle and his imitators glorified the marriage-coffer until it became a gorgeous casket, almost indeed a sarcophagus, inlaid with ivory and ebony and precious woods, and enriched with ormolu, supported upon a stand of equal magnificence. The Italian marriage-chests (*cassone, q.v.*) were also of a richness which was never attempted in England. The main characteristics of English domestic chests (which not infrequently are carved with names and dates) are panelled fronts and ends, the feet being formed from prolongations of the "stiles" or side posts. A certain number of 17th-century chests, however, have separate feet, either circular or shaped after the indications of a somewhat later style.

There is usually a strong architectural feeling about the chest, the front being divided into panels, which are plain in the more ordinary examples, and richly carved in the choicer ones. The plinth and frieze are often of well-defined *guilloche* work, or are carved with arabesques or conventionalized flowers. Architectural detail, especially the detail of wainscoting, has indeed been followed with considerable fidelity, many of the earlier chests being carved in the linenfold pattern, while the Jacobean examples are often mere reproductions of the pilastered and recessed oaken mantlepieces of the period.



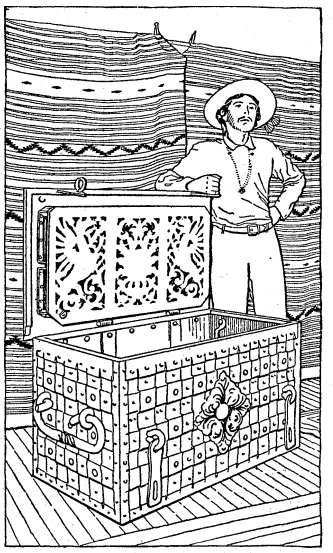
BY COURTESY OF THE VICTORIA AND ALBERT MUSEUM

A SPANISH TREASURE CHEST OF THE 17TH CENTURY

Occasionally a chest is seen which is inlaid with coloured woods, or with geometrical parquetry. Perhaps the most elaborate type of English parquetry chest is that named after the vanished Palace of Nonesuch. Such pieces are, however, rarely met with. The entire front of this type is covered with a representation of the palace in coloured woods. Another class of chest is incised, sometimes rather roughly, but often with considerable geometrical skill.

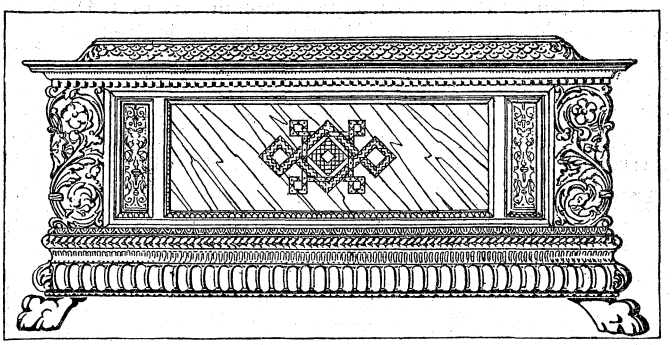
The more ordinary variety has been of great value to the forger of antique furniture, who has used its carved panels for conversion into cupboards and other pieces, the history of which is not easily unravelled by the amateur who collects old oak. Towards the end of the 17th century chests were often made of walnut, or even of exotic woods such as cedar and cypress, and were sometimes clamped with large and ornamental brass bands and hinges. The chests of the 18th century were much larger than those of the preceding period, and as often as not were furnished with two drawers at the bottom—an arrangement but rarely seen in those of the 17th century—while they were often fitted with a small internal box fixed across one end for ready access to small articles. The chest was not infrequently unpanelled and unornamented, and in the latter period of its history this became the ruling type.

Ecclesiastical Chests.—These appear to have been used almost entirely as receptacles for vestments and church plate, and those which survive are still often employed for the preservation of parish documents. A considerable variety of these interesting and often exceedingly elaborate chests are still left in English churches. They are usually of considerable size, and of a length disproportionate to their depth. This no doubt was to facilitate the storage of vestments. Most of them are of great antiquity. Many go back to the 14th century, and here and there they are even earlier, as in the case of the coffer in Stoke d'Abernon church, Surrey, which is unquestionably 13th-century work. One of the most remarkable of these early examples is in Newport church, Essex. It is one of the extremely rare painted coffers of the 13th century, the front carved with an upper row of shields, from which the heraldic painting has disappeared, and a lower row of roundels. Between is a belt of open tracery, probably of pewter, and the inside of the lid is decorated with oil paintings representing the Crucifixion, the Virgin Mary, St. Peter, St. John and St. Paul. The well-known "jewel chest" in St. Mary's, Oxford, is one of the earliest examples of 14th century work. Many of these ecclesiastical chests are carved with architectural motives—traceried windows most frequently, but occasionally with the linenfold pattern. There is a whole class of chests known as "tilting coffers," carved with representations of tournaments or feats of arms, and sometimes with a grotesque admixture of chivalric figures and mythical monsters. Only five or six examples of this type are known still to exist in England, and two of them are now in the Victoria and Albert museum, London. It is not certain that even these few are of English origin—indeed, very many of the chests and coffers of the 16th and 17th centuries are of foreign make. They were imported into England chiefly from Flanders, and were subsequently carved by native artisans, as was the case with other common pieces of furniture of those periods. The *huche* or "hutch" was a rough type of household chest.



TYPE OF CHEST USED IN THE DAYS OF THE STAGE COACH FOR TRANSPORTING VALUABLES ACROSS THE AMERICAN PRAIRIES

Coffer is the word properly applied to a chest which was intended for the safe keeping of valuables. As a rule the coffer is much more massive in construction than the domestic chest; it is clamped by iron bands, sometimes contains secret receptacles opening with a concealed spring, and is often furnished with an elaborate and complex lock, which occupies the whole of the underside of the lid. Pieces of this type are sometimes described as Spanish chests, from the belief that they were taken from ships belonging to the Armada. However, these strong boxes are frequently of English origin, although the mechanism of the locks may have been due to the subtle skill of foreign locksmiths. A typical example of the treasure chest is that which belonged to Sir Thomas Bodley, and is preserved in the Bodleian



VENETIAN CHEST OF THE 16TH CENTURY, IN THE MUSEO NAZIONALE OF FLORENCE, ITALY

library at Oxford. The locks of this description of chest are of steel, and are sometimes richly damascened.

Another kind of chest in use in earlier days was that signified in the expression a "chest of viols." This took the form of a solidly-constructed, baize-lined press or cupboard, designed to accommodate stringed musical instruments—in the case of a "chest of viols," six viols of varying sizes.

CHESTER, EARLS OF. The important palatine earldom of Chester was first held by a Fleming named Gherbod (fl. 1070), and then from 1071 by Hugh of Avranches (d. 1101), a son of Richard, viscount of Avranches. As the friend of St. Anselm, Hugh showed the customary liberality to religious houses. His life was spent in fighting in Wales and Normandy, and he died on July 27, 1101. Hugh's only son Richard, who was childless, was drowned in the White Ship, in Nov., 1120. Among subsequent holders were Ralph, or Randulph, de Gernon (d. 1153), prominent in the civil wars under Stephen, fighting first on one side and then on the other; and his son Hugh de Kevelioc (1147–81), who shared in the rising against Henry II in 1173. The most celebrated of the earls was Ralph, Ranulf or Randulph, de Blundevill (*c.* 1172–1232), who succeeded his father Hugh de Kevelioc in 1181, and was created earl of Lincoln in 1217. He married Constance, widow of Henry II.'s son, Geoffrey, of Brittany, and is sometimes called duke of Brittany and earl of Richmond. He fought in Wales, sided with John against the barons, and fought for Henry III. against the French invaders and their allies. In 1218 he went on crusade to the Holy Land and took part in the capture of Damietta. He died at Wallingford, in Oct. 1232. Stubbs calls him "almost the last relic of the great feudal aristocracy of the Conquest." In the *Vision of Piers Plowman* Ranulf's name is linked with that of Robin Hood. Ranulf being childless, in Nov. 1232 the earldom was granted to his nephew John the Scot, earl of Huntingdon (*c.* 1207–1237). In 1246 it was annexed to the English crown.

In 1254 Prince Edward, afterwards Edward I., was created earl of Chester, and since then the earldom has always been held by the heirs apparent to the English crown. Since 1399 the earls of Chester have been also princes of Wales, although the act of Richard II. (1398), which created Chester into a principality to be held by the king's eldest son, was revoked by Henry IV.

CHESTER, county borough, city, seaport and the county town of Cheshire, England, 16 mi. S. of Liverpool. Pop. (1938) 44,360. Area, 6.5 sq.mi. It lies in a low plain on the Dee, principally on the north (right) bank, 6 mi. above the point at which the river opens out into its wide shallow estuary. It is an important railway centre, being served by three of the four British companies.

History.—The Roman station of Deva was founded about A.D. 48 by Ostorius Scapula, and from its key position in relation both to the North Wales coastal route and to the northward avenue past the Mersey, it became an important military and commercial centre. In A.D. 78–79 it was the winter-quarters of Agricola, and later became the permanent headquarters of Legio XX. Valeria Victrix. Many inscriptions and remains of the Roman military occupation have been found, and the north and east walls stand in great part on Roman foundations. The Saxon form of the name was Leganceaster. About 614 the city was destroyed by Aethelfrith, and lay in ruins until 907, when Aethelflaed rebuilt the walls and restored the monastery of St. Werburgh. In the reign of Aethelstan there was a mint at Chester, and in 973 it was the scene of Edgar's triumph when, it is said, he was rowed on the Dee by six subject kings. It resisted the Conqueror, and did not finally surrender until 1070. On the erection of Cheshire into a county palatine after the Conquest, Chester became the seat of government of the palatine earls. The Domesday account of the city includes a description of the Saxon laws under which it had been governed in the time of Edward the Confessor. All the land, except the bishop's borough, was held of the earl, and assessed at fifty hides.

The earliest extant charter, granted by Henry II. in 1160, empowered the burgesses to trade with Durham as freely as they had done in the reign of Henry I. From this date a large collection of charters enumerates privileges granted by successive earls and later sovereigns. Three from John protected the trade with Ireland. Edward I. granted the citizens the fee-farm of the city at a yearly rent of £100. In the 14th century Chester began to lose its standing as a port through the gradual silting up of the Dee estuary, and the city was further impoverished by the inroads of the Welsh. Continued misfortunes led to reductions of fee-farm by Richard II. and by Henry VI., who also made a grant for the completion of a new Dee bridge, the old one having been swept away by an unusually high tide. Henry VII. reduced the fee-farm to £20, and in 1506 granted "the Great Charter," which constituted the city a county by itself, and incorporated the governing body under the style of a mayor, twenty-four aldermen and forty common councilmen. This charter was confirmed by James I. and Charles II. The charter of Hugh "Le Gros" to the abbey of St. Werburgh includes a grant of the tolls of the fair at the feast of St. Werburgh for three days, and a subsequent charter from Ranulf de Blundevill (12th century) licensed the abbot and monks to hold their fairs and markets before the abbey gates. Friction between the abbot and civic authorities lasted until, in the reign of Henry VIII., it was decreed that the right of holding fairs was vested exclusively in the citizens. Charles II. in 1685 granted a cattle-fair to be held on the first Thursday in February. The city is divided into four principal blocks by the four principal streets—Northgate Street, Eastgate Street, Bridge Street and Watergate Street, which radiate at right angles from the Cross, and terminate in the four gates. These four streets exhibit in what are called "the Rows" a characteristic feature of the city. In Eastgate Street, Bridge Street and Watergate Street, the Rows exist on each side of the street and form continuous galleries open to the street, from which they are approached by flights of steps. The Rows are flagged or boarded under foot and ceiled above, thus forming a covered way, standing in the same relation to the shops, which are at their back, as the foot pavement does in other towns. On the west side of Northgate Street, on the other hand, the Row is formed out of the ground floor of the houses, having cellars beneath. The Rows and the old half-timbered houses combine to give the city a picturesque and individual character. Among the ancient houses are Derby House, bearing the date 1591, Bishop Lloyd's house, and God's Providence House in Watergate Street, and the Bear and Billet in Lower Bridge Street; the last three date from the 17th century. A mortuary chapel of the early part of the 13th century exists in the basement of a house in Bridge Street.

Chester is the only city in England that still possesses its walls perfect in their entire circuit of 2 mi. The gateways have all been rebuilt at various dates: the north and east gates on the site of the Roman gates. The Grosvenor bridge (1832), a single span of stone 200 ft. in length, one of the largest in Europe, carries the road to Wrexham and Shrewsbury over the Dee on the southwest; while there is also an old bridge of seven arches. The castle, with the exception of "Caesar's Tower," and a round tower with adjacent buildings, was taken down about 1790, and replaced by a barracks, county hall, jail and assize courts.

The cathedral church of Christ and the Virgin Mary stands towards the north of the city within the walls on an ancient site. In 1093 Hugh "Le Gros," earl of Chester, richly endowed the original foundation as a Benedictine monastery. The bishops of Mercia had apparently a seat at Chester, but the city had ceased to be episcopal, until in 1075 Peter, bishop of Lichfield, removed his seat thence to Chester, having for his cathedral the collegiate church of St. John (*see* below). The see, however, was moved again to Coventry (1102), but Cheshire continued subject to Lichfield until in 1541 Chester was erected into a bishopric by Henry VIII, the church of the dissolved abbey of St. Werburgh becoming the cathedral. The diocese covers nearly all Cheshire, with small portions of Flintshire, Lancashire and Staffordshire. The cathedral, while not of first rank architecturally, gains in beauty from the tones of its red sandstone walls and from its picturesque close. It is cruciform with a central tower 127 ft. high. The nave is short (145 ft.), being of six bays; the southern arcade is Decorated; while the northern differs in detail. The basement of the north-western tower is Norman and formed part

of Hugh "Le Gros's" church. The north transept also retains Norman work, and its size shows the original plan, limited by the existence of the conventual buildings to the north. The south transept has aisles, with Decorated and Perpendicular windows. The fine organ stands on a screen across the north transept. The choir is a fine example of transitional Early English Decorated enhanced by the ancient carved wooden stalls unsurpassed in England. The Lady Chapel, east of the choir, is of rich Early English workmanship. Of the conventual buildings the cloisters are Perpendicular. The chapter-house, entered by a beautiful vestibule from the east cloister, is Early English (*c.* 1240). The refectory, adjoining the north cloister, is of the same period, with Perpendicular insertions; it retains its beautiful Early English lector's pulpit. An early Norman chamber, with massive pillars and vaulting, adjoins the west cloister, and may be the substructure of the abbot's house. The domestic buildings have been completely restored, the work being finished in 1928. The abbey gateway is of the 14th century. Within the walls there are several churches of ancient foundation: St. Peter's is said to occupy the site of a church erected by Aethelflaed, queen of Mercia, and St. Mary's dates from the 12th century. The church of St. John, outside the walls, which became the cathedral in 1075, is a massive early Norman structure, with later additions and restorations. It was a collegiate church until 1547. The Grosvenor Museum and School of Art, the foundation of which was suggested by Charles Kingsley the novelist, when canon of Chester cathedral, contains local antiquities and a fine collection of the fauna of Cheshire. The King's school, founded by Henry VIII (1541), was reorganized on the lines of a public school in 1873. Other educational institutions include the diocesan training college. Roodee, a level tract by the river at the base of the city wall, is appropriated as a race-course. An annual race-meeting is held in May. The town gains in prosperity from its large number of tourists. Manufactures are shot, white lead and paint, and tobacco and snuff. There is some shipping on the Dee but the river is principally used for pleasure vessels and rowing. The city of Chester parliamentary division, returning one member, includes the rural district of Chester and the urban district of Hoole. From 1553 Chester returned two members until 1885, when the representation was reduced to one member. The trades of tanners, skinners and glove-makers existed at the time of the Conquest, and the importation of marten skins is mentioned in Domesday. In the 14th century the woollen trade was considerable, and in 1674 weavers and wool-combers were introduced into Chester from Norwich. The restoration of the channel of the Dee opened up a flourishing trade in Irish linen, which in 1786 was at its height, but from that date gradually diminished.

See *Victoria County History, Cheshire;* R. H. Morris, *Chester in the Plantagenet and Tudor Reigns* (Chester, 1894); Joseph Hemingway, *History of the City of Chester* (2 vols., Chester, 1831).

CHESTER, a city of Delaware county, Pennsylvania, U.S.A., on the Delaware river, 13m. S.W. of Philadelphia. It is on Federal highway 13, and is served by the Baltimore and Ohio, the Pennsylvania and the Reading railways. The population in 1920 was 58,030, of whom 11,292 were foreign-born white and 7,125 were Negroes; and was 59,285 in 1940 federal census. Chester has a good harbour, with considerable commerce. Chester is in an intensively industrialized area, with enormous shipbuilding plants, steel mills, munition works and locomotive works. Other manufactures of importance are cotton, silk and woollen goods, paper, plaster, iron, cutlery, lace, hosiery and steel tubing. At the city of Chester is the Pennsylvania Military college, the second oldest military college in the United States. On the edge of the city is Crozer Theological seminary (Baptist), founded in 1867 by the family of John P. Crozer (1793–1866). Settled about 1645 by the Swedes, who called it Upland, Chester is the oldest town in Pennsylvania. It was the seat of the Swedish courts until 1682, when William Penn arrived. The spot where he landed is marked by a memorial stone, and the house he occupied for a time (built in 1683) still stands. The old city hall (1724) is one of the oldest public buildings in the country. After the battle of Brandywine Washington retreated to Chester, and here wrote his account of the battle. Soon after that it was occupied by the British. It was incorporated as a borough in 1701, and received a city charter in 1866. Its period of rapid growth began with the introduction of large manufacturing interests about 1850. In 1850 the population was 1,667; in 1880, 14,997; in 1900, 33,988. Between 1910 and 1920 it increased 50·6%. Annexations of territory have brought the land area to 4.5 sq.mi.

CHESTER, a city of South Carolina, U.S.A., in the foothills of the Blue Ridge mountains, 65 mi. N.W. of Columbia; the county seat of Chester county. It is on federal highways 21 and 321, and is served by the Southern, Seaboard, Carolina and Northwestern, and the Lancaster and Chester railways. The population in 1920 was 5,557, of whom 2,153 were Negroes, and was 6,392 in 1940 by federal census. Chester is advantageously situated between the hydro-electric developments of the Broad and the Catawba rivers. It has three textile mills, a wood novelty plant, milk plant, two bottling plants, cotton oil mill, fertilizer plant, planing mill and granite monument works. It was settled about 1732, was incorporated as a town in 1849 and as a city in 1893.

CHESTERFIELD, PHILIP DORMER STANHOPE, 4th EARL OF (1694–1773), son of Philip Stanhope, 3rd earl (1673–1726), and Elizabeth Savile, daughter of George Savile, marquess of Halifax, was born in London on Sept. 22, 1694. The care of the boy devolved upon his grandmother, the marchioness of Halifax. His education, began under a private tutor, was continued (1712) at Trinity Hall, Cambridge; here he remained little more than a year, but seems to have acquired a considerable knowledge of ancient and modern languages. His university training was supplemented (1714) by a continental tour, untrammelled by a governor; at The Hague his ambition for the applause awarded to adventure made a gamester of him, and at Paris he began, from the same motive, that worship of the conventional Venus, the serious inculcation of which has earned for him the largest and most unenviable part of his reputation.

The accession of George I. brought him back to England. His relative, James Stanhope (afterwards 1st Earl Stanhope), the king's favourite minister, procured for him the place of gentleman of the bedchamber to the prince of Wales. In 1715 he entered the House of Commons as Lord Stanhope of Shelford and member for St. Germans. In 1726 his father died, and Lord Stanhope became earl of Chesterfield. He took his seat in the Upper House, and his oratory, never effective in the Commons by reason of its want of force and excess of finish, at once became a power. In 1728 Chesterfield was sent to The Hague as ambassador. In this place his tact and temper, his dexterity and discrimination, enabled him to do good service, and he was rewarded with Walpole's friendship, a Garter and the place of lord high steward. In 1732 there was born to him, by a certain Mlle. du Bouchet, the son, Philip Stanhope, for whose advice and instruction were afterwards written the famous *Letters.* He negotiated the second treaty of Vienna in 1731 and in the next year, being somewhat broken in health and fortune, he resigned his embassy and returned to England. A few months' rest enabled him to resume his seat in the Lords, of which he was one of the acknowledged leaders. He supported the ministry, but his allegiance was not the blind fealty Walpole exacted of his followers. The Excise bill, the great premier's favourite measure, was vehemently opposed by him in the Lords and by his three brothers in the Commons. Walpole bent before the storm and abandoned the measure; but Chesterfield was summarily dismissed from his stewardship. For the next two years he led the opposition in the Upper House, leaving no stone unturned to effect Walpole's downfall. In 1741 he signed the protest for Walpole's dismissal and went abroad on account of his health. He visited Voltaire at Brussels and spent some time in Paris, where he associated with the younger Crébillon, Fontenelle and Montesquieu. In 1742 Walpole fell, and Carteret was his real, though not his nominal, successor. Although Walpole's administration had been overthrown largely by Chesterfield's efforts the new ministry did not count Chesterfield either in its ranks or among its supporters. He remained in opposition, distinguishing himself by the courtly bitterness of his attacks on George II., who learned to hate him

violently. In 1743 a new journal, *Old England; or, the Constitutional Journal,* appeared. For this paper Chesterfield wrote under the name of "Jeffrey Broadbottom." A number of pamphlets, in some of which Chesterfield had the help of Edmund Waller, followed. His energetic campaign against George II. and his government won the gratitude of the dowager duchess of Marlborough, who left him £20,000 as a mark of her appreciation. In 1744 the king was compelled to abandon Carteret, and the coalition or "Broad Bottom" party, led by Chesterfield and Pitt, came into office. In the troublous state of European politics the earl's conduct and experience were more useful abroad than at home, and he was sent to The Hague as ambassador a second time. The object of his mission was to persuade the Dutch to join in the War of the Austrian Succession and to arrange the details of their assistance. The success of his mission was complete; and on his return a few weeks afterwards he received the lord-lieutenancy of Ireland—a place he had long coveted.

Short as it was, Chesterfield's Irish administration was of great service to his country, and is unquestionably that part of his political life which does him most honour. To have conceived and carried out a policy, which, with certain reservations, Burke himself might have originated and owned, is no small title to regard. The earl showed himself finely capable in practice as in theory, vigorous and tolerant, a man to be feared and a leader to be followed; he took the government entirely into his own hands, repressed the jobbery traditional to the office, established schools and manufactures, and at once conciliated and kept in check the Orange and Roman Catholic factions. In 1746, however, he had to exchange the lord-lieutenancy for the place of Secretary of State. With a curious respect for those theories which his familiarity with the secret social history of France had caused him to entertain, he hoped and attempted to retain a hold over the king through the influence of Lady Yarmouth. The influence of Newcastle and Sandwich, however, was too strong for him; he was thwarted and over-reached; and in 1748 he resigned the seals. He declined any knowledge of the *Apology for a late Resignation, in a Letter from an English Gentleman to his Friend at The Hague,* which ran through four editions in 1748, but there is little doubt that he was, at least in part, the author.

The dukedom offered him by George II., whose ill-will his fine tact had overcome, was refused. He continued for some years to attend the Upper House and to take part in its proceedings. In 1751, seconded by Lord Macclesfield, president of the Royal Society, and Bradley, the eminent mathematician, he distinguished himself greatly in the debates on the calendar, and succeeded in making the new style a fact. Deafness, however, was gradually affecting him and he withdrew little by little from society and the practice of politics. In 1755 occurred the famous dispute with Johnson over the dedication to the *English Dictionary.* In 1747 Johnson sent Chesterfield, who was then Secretary of State, a prospectus of his *Dictionary,* which was acknowledged by a subscription of £10. Chesterfield apparently took no further interest in the enterprise, and the book was about to appear when he wrote two papers in the *World* in praise of it. It was said that Johnson was kept waiting in the anteroom when he called while Cibber was admitted. In any case the doctor had expected more help from a professed patron of literature, and wrote the earl the famous letter in defence of men of letters. Chesterfield's "respectable Hottentot," now identified with George, lord Lyttelton, was long supposed, though on slender grounds, to be a portrait of Johnson. During the 20 years of life that followed this episode, Chesterfield wrote and read a great deal, but went little into society.

In 1768 died Philip Stanhope, the child of so many hopes. His death was an overwhelming grief to Chesterfield, and the discovery that he had long been married to a lady of humble origin must have been galling in the extreme to his father after his careful instruction in worldly wisdom. Chesterfield, who had no children by his wife, Melusina von Schulemberg, illegitimate daughter of George I., whom he married in 1733, adopted his godson, a distant cousin, named Philip Stanhope (1755–1815), as heir to the title and estates. His famous jest (which even Johnson allowed to have merit) "Tyrawley and I have been dead these two years, but we don't choose to have it known"—is the best description possible of his humour and condition during the latter part of this period of decline. To the deafness was added blindness, but his memory and his fine manners only left him with life; his last words, "Give Dayrolles a chair," prove that he had neither forgotten his friend nor the way to receive him. He died on March 24, 1773.

As a politician and statesman, Chesterfield's fame rests on his short but brilliant administration of Ireland. As an author he was a clever essayist and epigrammatist. But he stands or falls by the *Letters to his Son,* first published by Stanhope's widow in 1774, and the *Letters to his Godson* (1890). The *Letters* are brilliantly written—full of elegant wisdom, of keen wit, of admirable portrait-painting, of exquisite observation and deduction. Against the charge of an undue insistence on the external graces of manner Chesterfield has been adequately defended by Lord Stanhope (*History,* iii. 34). Against the often iterated accusation of immorality, it should be remembered that the *Letters* reflected the morality of the age, and that their author only systematized and reduced to writing the principles of conduct by which, deliberately or unconsciously, the best and the worst of his contemporaries were governed.

See Chesterfield's *Miscellaneous Works* (2 vols. 1777); *Letters to his Son,* etc. ed. by Lord Mahon (5 vols. 1845–53, re-issued by the Navarre Society in 1926); and *Letters to his Godson* (1890) (ed. by the earl of Carnarvon). There are also eds. of the first series of letters by J. Bradshaw (3 vols. 1892) and Mr. C. Strachey (2 vols. 1901). In 1893 a biography, including numerous letters first pub. from the Newcastle Papers, was issued by Mr. W. Ernst; and in 1907 appeared an elaborate *Life* by W. H. Craig. *See* also *The Letters of Lord Chesterfield to Lord Huntingdon,* with intro. by A. F. Steuart (1923); R. Coxon, *Chesterfield and His Critics,* with selected essays and unpublished letters by Chesterfield (1925).

CHESTERFIELD, a market town and municipal borough in the Chesterfield parliamentary division of Derbyshire, England, 24 mi. N.E. of Derby by the L.M.S.R. and L.N.E.R. Pop. (1938) 64,730. Area 13.2 sq.mi. It is doubtful whether it was a Roman station. Chesterfield (Cestrefeld) owes its present name to the Saxons. It is mentioned in Domesday only as a bailiwick of Newbold. In 1204 John granted to the town all the privileges of a free borough enjoyed by Nottingham and Derby; but before this is seems to have had prescriptive borough rights. In 1598 it was incorporated by Elizabeth under the style of a mayor, six brethren and 12 capital burgesses, and was so governed till the Municipal act, 1835. In 1204 John granted two weekly markets and an annual fair of eight days at the feast of the Exaltation of the Holy Cross (Sept. 14). This fair, which is still held, is mentioned in the *quo warranto* roll of 1330. In 1266 the town was the scene of a battle between the royal forces and the barons. In 1586 it suffered from the plague, and the parliamentary forces were overthrown here during the Civil War.

Chesterfield lies at the junction of the Rother and Hipper, in an industrial district. The church of St. Mary and All Saints belongs principally to the Decorated period. It has a wooden spire, covered with lead, 230 ft. high, and possesses also an apsidal Decorated chapel. The Stephenson Memorial hall (1879) commemorates George Stephenson, the engineer. A new town hall was completed in 1938. The grammar school was founded in 1594. A technical college was opened in 1927. The industries of the town include mining, mechanical engineering, iron and brass founding and tanning. In the neighbourhood are ironstone and coal mines and sandstone quarries. There is also a manufactory of lint, cotton-wool, bandages, etc.

CHESTER-LE-STREET, urban district in the county of Durham, England, near the river Wear, where the latter changes its northward course and turns eastward to the sea. The town is 6 mi. north of Durham on the L. N. E. R. Pop. (1938) 17,080. Area 4.1 sq.mi. Chester-le-Street was a station on a branch of the Roman north road. Under the name of *Cunecastre* it was made the seat of a bishop in 883, and continued to be the head of the diocese until 995. During that time the church was the repository of the shrine of St. Cuthbert, which was then removed to Durham. The church of SS. Mary and Cuthbert has a remarkable

series of monumental tombs. The proximity of the Durham coalfield and iron works gives employment to a large section of the population, but dependence upon these industries caused considerable unemployment during the depression of the 1930s.

CHESTERTON, GILBERT KEITH (1874–1936), English journalist and author, was born in London on May 29, 1874. He was educated at St. Paul's school, where, at an unusually early age, he gained the "Milton" prize for English verse. He left school in 1891 with the idea of studying art. But though he early developed, and indeed retained, a talent for draftsmanship of a very distinctive kind, his natural bent was literary, and he went through the usual apprenticeship of free-lance journalism, occasional reviewing and work in a publisher's office.

In 1901 he married Frances Blogg. In 1900 after having produced a volume of poems, *The Wild Knight* (1900), which led good critics to expect great things of him as a poet, he became a regular contributor of signed articles to *The Speaker* and the *Daily News*. From the first he stood out as the protagonist of revolt against the *fin-de-siècle* egotism and the weary omniscience of the previous generation, expressing for it the virile contempt of normal platitudinous man in a style unconventional, swashbuckling and dogmatic. As Addison turned the weapons of fashionable folly against itself by making vice ridiculous, so Chesterton laughed loud and long at the *blasé* self-sufficiency and the dingy little failings of the late Victorian wits. Never was conventionality defended in a manner so unconventional. Hence the legend of Chesterton as a "master of paradox," which originated among older Victorian contemporaries and persisted far longer than it was reasonable to expect, partly perhaps because the subject of the legend was more tickled by it than he need have been. Chesterton's early studies in this vein were reprinted in a series of volumes, *The Defendant* (1901), *Twelve Types* (1902), and *Heretics* (1905). Meanwhile he had laid the foundations of a more enduring reputation as a literary critic by his brilliant study of Browning in the "English Men of Letters" series (*Robert Browning*, 1903). This was followed (1906) by *Charles Dickens*, which has been described as "one of the best critical studies in the language." *Orthodoxy* (1908) and *What's Wrong with the World* (1910) succeeded *Heretics* as essays in religious thought and contemporary politics. To his hatred of the Victorian pessimists there had by now been added a hatred of Victorian economics. He had begun life as an orthodox Liberal but was seized with a growing distrust of the reality of modern party politics, coupled with a fierce dislike of the industrial capitalism which he found dominant in the two old parties. He reacted, however, ultimately as fiercely from Socialism, and, in company with Hilaire Belloc and others, propagated the Distributist theories with which his name is associated.

In fiction his fancy found free play, and the medium was well suited to the expression of his ideas. He produced *The Napoleon of Notting Hill* (1904), a fantastic dream-history of civil wars between the suburbs of London, in which the shattering sanity of romantic man is once more vindicated; *The Club of Queer Trades* (1905), wherein the germs of his later success in detective fiction may be noticed; *The Man Who was Thursday* (1908), and *The Ball and the Cross* (1909). In these works the tendency to commingle his philosophy with his fiction became even greater. An earlier generation than Chesterton's would have called the books allegories, probably with the enthusiastic assent of the author. During the same period Chesterton produced a quantity of verse, some good, some bad—none of it indifferent. At its best it is very good indeed. A well-known English critic once observed of his light verse that, whereas there had been many in all ages who could write comic verse, Chesterton was one of the very few who could write comic poetry. The compliment was deserved. His more serious verse has been held to give him rank as the last of the great rhetorical poets. Like all rhetorical poets he is sometimes tinselly, but his best poems show what rhetoric can be at its best. Of these are "Lepanto" (1911) and "A Song of the Wheels," written during the railway strike of 1911. *The Ballad of the White Horse* (1911) is uneven, but contains some of his finest work.

The year before the World War saw the issue of his *Victorian Age in Literature* (1913), in which he showed that he could write a hand-book without loss of those qualities of penetrating analysis and generous appreciation which he had already brought to the work of literary criticism. An excellent example is the way in which he put the case for Swinburne, a poet with whom fundamentally he had little in common. In the same year he produced *Magic*, a fanciful play in three acts, which was deservedly successful. It is a matter for surprise and regret that he never, until 1927, followed up this initial attempt at play-writing. Detective fiction claimed him for her own, and his "Father Brown" series (1911, 1914, 1926 and 1927) and *The Man Who Knew Too Much* (1922) showed that he could couple even the writing of sensational mystery stuff with an expression of the views which he had made peculiarly his own. *The Flying Inn* (1914) is yet another of his socio-political "allegories," interspersed with what are perhaps the most charming of his light verses, afterwards republished in *Wine, Water and Song* (1915). Another work of the same kind is *Manalive* (1915).

In 1922 an event happened which was of the utmost moment in Chesterton's life. He was received into the Roman Catholic Church. It was the natural result of a spiritual and intellectual development such as his had been; and it cannot be said profoundly to have modified this development, of which it was the outcome. For the student of his works in the future it will not be necessary sharply to divide, as has to be done in some cases, his "Catholic" from his "pre-Catholic" writings. The general doctrines which he was preaching in 1927 he was preaching in 1906. *Charles Dickens* might have been written by a Catholic, and *St. Francis of Assisi* (1923) by the "pre-Catholic" Chesterton.

During the War Chesterton published little of permanent value. His volume of suggestive and brilliant historical essays, called by some strange oversight *A Short History of England* (1917), is most worthy of note. Of his later works, *The Superstition of Divorce* (1920), *The New Jerusalem* (1920), *What I saw in America* (1922), *St. Francis of Assisi* (1923), *William Cobbett* (1925), *The Everlasting Man* (1925), *The Judgment of Dr. Johnson* (1927), *R. L. Stevenson* (1927), *Generally Speaking* (1929), and *The Poet and the Lunatics* (1929) are the chief.

It is difficult in the limits of such an article to appraise Chesterton's work adequately; but it is not difficult to see how his early reaction against the ideals (or lack of ideals) of the materialist civilization of the 19th century led him inevitably to champion the causes, lost or other, which he has championed (and here, be it said, that it is difficult to imagine that any cause is lost when Chesterton is defending it). He objected not so much to the civilization (for him, too, "Romance brought up the 9.15") as to the complacency of those who thought it the only, or the highest, form of civilization. And yet he could appreciate the great Victorians as could few of his contemporaries. The generation after the War returned to Trollope and Wilkie Collins. But it was Chesterton who was showing them the way 15 years earlier. Indeed, it is this quality of appreciating his opponent, which he himself so praises in Pope, which makes the literary Chesterton at once so lovable a personality and so deadly an antagonist.

If a prediction may be ventured, Chesterton will be remembered longest by his poems and his work in literary criticism. Many will regret that he tried his hand so little at play-writing, and spent so much time on polemical journalism. Nearly all will deplore the volume of his output. None will question the reality of his achievement at its highest, or the strength and purity of his influence. He died on June 14, 1936.

See *G. K. Chesterton: a Criticism* (published anonymously, 1908); "A Canterbury Pilgrim" in John Freeman, *English Portraits and Essays* (1924). (E. I. J.)

CHESTERTON, a suburb in the northeast of Cambridge borough, Cambridgeshire, England, on the river Cam. Pop. (1931) about 16,000. The church of St. Andrew is Decorated and Perpendicular, with remains of frescoes. The Cambridge university boat club and the various college boat clubs have boat-houses along the river. Market gardening is carried on in the neighbourhood. Pop. of rural district (est. 1938) 31,080.

CHESTNUT. In its true sense, this name applies only to the genus *Castanea,* which includes the following four species: (1) European chestnut, *C. sativa;* (2) American chestnut, *C. dentata;* (3) Japanese chestnut, *C. crenata,* and (4) Chinese chestnut, *C. mollissima.* Chinkapins also are members of the genus and therefore are closely related to chestnuts. There are a number of hybrids, of which none are well-known.

Chestnuts are deciduous, catkin-bearing trees of much value for many purposes. They produce food for man and many forms of animal life, tannin for the leather industry and firewood of certain value. The largest growers furnish excellent timber, much used for telephone poles, fence rails and posts, railroad ties, mine props, building material and to some extent material for interior finishing, although the grain is coarse and does not take a high polish. All species have remarkable capacity for self-replacement; that is, coppice growth springs up quickly when tops die because of disease or when trees are cut. The wood is outstanding in its resistance to decay either when exposed to weather or when in contact with soil.

There are two kinds of chestnut catkins, some of which are entirely staminate while a few others, in the upper parts of the clusters, have pistillate flowers at the base. Chestnut fruits develop from the latter as single or multiple spiny burs, with the usual number being three. Each normal bur contains three nuts, although here also there are freakish formations. All species thrive best in soils which are acid or neutral rather than strongly alkaline, loose and porous and somewhat dry. The trees are deep-rooted, and while many may die because of drought during the first one or two seasons after being transplanted, once they are well established they endure lack of soil moisture better than most species with which they are commonly associated. All occur in the less severe regions of the north temperate zone somewhat away from the seacoast. They seldom grow at altitudes of more than 4,000 ft. in Europe or the United States, 3,000 ft. in Japan or 8,000 ft. in China. No figures of nut production are available from any country.

The European chestnut is first in economic importance as its indigenous range includes much of southern Europe, northern Africa and southern Asia east to the Caucasus. It has long been grown successfully in England, Scotland, India and Australia. During the 19th century, it became widely established in the eastern parts of the United States and on the Pacific coast. It practically disappeared from the east during the first third of the 20th century, but in 1943 it was still being grown in California and the Pacific northwest. This species is probably the most massive grower of the genus, and few British writers on chestnut trees fail to mention certain individual specimens having tremendous crowns and trunks. The greatest of those so reported appears to have been the largest in a group of huge chestnut trees at the foot of Mount Etna in Sicily; this tree was estimated to have been possibly 2,000 yrs. old when it was finally destroyed by volcanic eruption. It was reported to have had a girth of 204 ft. in 1850.

The European chestnut is the principal source of chestnuts consumed in Europe and the United States. Of an average of 16,085,400 lbs. imported into the United States during the 5-year period ending June 30, 1941, 12,663,600 lbs. yearly came from Italy and 2,921,200 lbs. from Portugal. During the 5-year period ending June 30, 1936, an average of 819,000 lbs. were imported from Spain and 96,000 lbs. from France. The largest European chestnuts are called marrons. These are eaten raw, roasted or boiled. In many regions, chestnuts of secondary sizes are allowed to harden by becoming dry, after which they are ground into flour and substituted for cereals in making soups, breads and other foods. Chestnuts of the smallest sizes are used as food for livestock and wild life.

The American chestnut was once one of the nation's most valuable trees. Its original range extended from southern Maine, west to southeastern Michigan, south and west to southern Illinois, south and east to western Florida and northeast to New England, without reaching the Atlantic coast. It grew thickly over vast stretches of mountain land but thinned out rapidly at lower levels. In forests, trees often grew to 100 ft. in height and in open spaces, trunk diameters of 6–8 ft. were frequent. Maximum diameters of more than 12 ft. are authentic.

Nuts of the American chestnut are usually small in comparison with European chestnuts and less attractive in appearance because of being partially or completely covered by a gray tomentum. Among true chestnuts, however, the flavour of the American chestnut is equalled only by the Chinese chestnut, which rivals it closely. A number of varieties were named during the last decade of the 19th century, but only one—Hathaway of Michigan—was propagated to any extent.

Trees of both American and European species were largely killed throughout the entire east during the period 1900–35 by chestnut blight, a virulent fungus disease (*Endothia parasitica*) which was inadvertently introduced into the United States from the orient at the beginning of the century. Early efforts at control were made but with no practical success.

The Japanese chestnut is indigenous to Japan and Chosen. In the former country, chestnuts were important articles of food probably as early as 1700. The tree is usually a small grower, but heights of 60 ft. and trunk diameters of 3 ft. are on record. As most commonly known in the United States, where the species was introduced in 1876, the trees are precocious and prolific, and the nuts attractive in appearance, but rarely of fine texture or best flavour. Their eating qualities are much improved by boiling or roasting.

The Chinese chestnut grows to about the same size as the Japanese. Records show that it was introduced into the United States as early as 1853, but large importation and distribution of seed did not begin until the U. S. Department of Agriculture became active in this field in 1906. Between that time and the outbreak of World War II, many importations were made, and the species became well established in many quarters. The seedling trees vary greatly in form and general habit of growth, some being squat and awkward while others are tall and erect. Many are of intermediate form and therefore of the shape most desired by orchardists. As a rule the nuts are not so large as Europeans but they are of attractive, glossy appearance and very sweet. This chestnut appears to offer considerable inducement to conservative planters. The leading varieties are Bartlett, Carr, Hobson, Milford, Reliance, Stoke, Yankee and Zimmerman.

Chinkapin plants range from low shrubs to large trees, some species of which occasionally reach a height of 90 ft. The group differs from that of the chestnut mainly in that the nuts are small and single in the bur, and the burs form in racemes instead of clusters. Six species are known in the United States from middle Pennsylvania southward and two in China. (C. A. Rd.)

CHETTLE, HENRY (*c.* 1560–1607), English dramatist. In 1592 he published Robert Greene's *Groatsworth of Wit.* In the preface to his *Kind Herts Dreame* (end of 1592) he admits his editorship of that pamphlet, and incidentally he apologized to three persons (one of them commonly identified with Shakespeare) who had been abused in it. As early as 1598 Francis Meres includes him in his *Palladis Tamia* as one of the "best for comedy," and between that year and 1603 he wrote or collaborated in some 48 pieces. Of the plays usually attributed to Chettle's sole authorship only one was printed. This was *The Tragedy of Hoffmann: or a Revenge for a Father* (played 1602; printed 1631), a share in which Mr. Fleay assigns to Thomas Heywood. It has been suggested that this piece was put forward as a rival to Shakespeare's *Hamlet. The Pleasant Comedie of Patient Grissill* (1599), in which he collaborated with Thomas Dekker and William Haughton, was reprinted by the Shakespeare society in 1841. In Nov. 1599 Chettle received ten shillings for mending the first part of "Robin Hood," *i.e. The Downfall of Robert, Earl of Huntingdon,* by Anthony Munday; and in the second part, which followed soon after and was printed in the year 1601, *The Death of Robert, Earle of Huntingdon,* he collaborated with Munday. Both plays are printed in Dodsley's *Select Collection of Old English Plays* (edited by W. C. Hazlitt, volume viii). Chettle died before the appearance of Dekker's *Knight's*

Conjuring in 1607, for he is there mentioned as a recent arrival in limbo.

Hoffmann was edited by H. B(arrett) L(ennard) (1852), by Richard Ackermann (Bamberg, 1894), and J. S. Farmer in *Old English Plays, Students' Facsimile Edition* (1913).

CHETWODE, SIR PHILIP WALHOUSE (1869–), British soldier, was born on Sept. 21, 1869, and in Nov. 1889 was commissioned to the 19th Hussars from the militia. He saw active service in Burma and South Africa, and later became assistant military secretary to Sir John French at Aldershot. In 1905 he succeeded his father as 7th baronet. Promoted to the command of the 5th Cavalry Brigade in May 1914, his brigade accompanied the Expeditionary Force to France and helped to cover the retreat from Mons, bringing off at Cérizy one of the rare cavalry charges of the World War. He went to Egypt to command the Desert column in 1916, and won distinction by the decisive surprise attack at Rafah, which finally freed Sinai from the Turks. After the second battle of Gaza in April 1917 he succeeded Gen. Dobell in command of the whole eastern force. When Gen. Allenby came out to take over the supreme command he based his plan on Chetwode's plans, and the latter, commanding the XX. Army Corps after the reorganization of the forces, played a distinguished part in the advance to Jerusalem and in the crowning victory in Sept. 1918. In Sept. 1920 Chetwode succeeded Gen. Harington as deputy chief of the imperial staff, and two years later became adjutant-general to the forces. He was appointed commander-in-chief of the Army in India from 1930 to 1935. Sir Philip was gazetted field-marshal in 1933 and holds many English and foreign decorations, including the O.M. (1936).

CHEVALIER, ALBERT (1861–1923), English music-hall artist, began his connection with the variety stage while still a child. In 1869 he appeared at a "penny-reading" at Cornwall Hall, Notting Hill. After a brief experience as a clerk in a newspaper office, and as a pupil teacher, he appeared for a short time in 1877 with the Kendals and the Bancrofts. For some time he played "legitimate" parts with Hare (*q.v.*), Willie Edouin and others, and during his association with Edouin (1888–89) at the Strand theatre he introduced in burlesque his first cockney song, "Our 'armonic Club." The year 1891 was the turning point of his career, when he deserted the "legitimate" stage and appeared at the London Pavilion as a music-hall entertainer. Thereafter he speedily won the place to which his genius entitled him, among the first artistes of his generation. He toured throughout Great Britain and the United States, and in addition gave over 1,000 special recitals at the small Queen's Hall. As singer, composer or part composer, his name is associated with between 70 and 80 songs. In addition he wrote some 14 plays and sketches. In 1906 he appeared with Yvette Guilbert at the Duke of York's theatre, and in the name part of Sir James Barrie's *Pantaloon.* His last appearance was in Nov. 1922, in a play, *My Old Dutch,* written by himself and Arthur Shirley on the basis of his own famous song. He died on July 10, 1923. Chevalier's best known songs are: "Mrs. 'Enery 'Awkins," "Knocked 'em in the Old Kent Road," "My Old Dutch," "A Fallen Star," "Our Little Nipper," "Fair Flo." He wrote two records of his own experiences, *Before I Forget* (1901), and *Uninitiated* (1906).

In his own special line Chevalier is generally recognized as being an artist of the first rank. While not possessing the vast range of a Marie Lloyd, he yet developed his own specialty as it had never before been developed, and presented real character sketches of the life of the people, emphasizing the grave as well as the gay and bringing tears as readily as laughter. Subsequent cockney comedians have imitated his humour. None has even endeavoured to compete with him in the delineation of the pathetic. Another striking feature of his songs was the tuneful and haunting melodies to which they were set. This was a real feature of the music-hall stage in an era when the comedian tended to sing his patter to the baldest of extemporizations. (E. I. J.)

CHEVALIER, MICHEL (1806–1879), French economist, was born at Limoges. In his early manhood, while employed as an engineer, he became a convert to the theories of Saint-Simon; these he ardently advocated in the *Globe,* the organ of the Saint Simonians, which he edited until his arrest in 1832 on a charge of outraging public morality by its publication. He was sentenced to a year's imprisonment, but was released in six months through the intervention of Thiers, who sent him on a special mission to the United States to study the question of land and water transport. In 1836 he published the letters he wrote from America to the *Journal des Débats,* as *Lettres sur l'Amérique du Nord,* and in 1838 published *Des intérêts matériels de la France.* In 1850 he became a member of the Institute, and in 1851 published his *Examen du système commercial connu sous le nom de système protecteur.* He played an important part in bringing about the conclusion of the Cobden commercial treaty between France and Great Britain in 1860. He became a member of the Senate in 1860.

Among his other works are: *Cours d'économie politique* (1842–50); *Essais de politique industrielle* (1843); *De la baisse probable d'or* (1859, translated into English by Cobden, *On the Probable Fall of the Value of Gold,* Manchester, 1859); *L'Expédition du Mexique* (1862); *Introduction aux rapports du jury international* (1868).

CHEVALIER, ULYSSE (1841–1923), French bibliographer, was born at Rambouillet on Feb. 24, 1841. He published a great number of documents relating to the history of Dauphiné, *e.g.,* the cartularies of the church and the town of Die (1868), of the abbey of St. André-le-Bas at Vienne (1869), of the abbey of Notre Dame at Bonnevaux in the diocese of Vienne (1889), of the abbey of St. Chaffre at Le Monestier (1884), the inventories and several collections of archives of the dauphins of Viennais, and a *Bibliothèque liturgique* in six volumes (1893–97), the third and fourth volumes of which constitute the *Repertorium hymnologicum,* containing more than 20,000 articles. But his principal work is the *Répertoire des sources historiques du moyen âge.*

The first part of the *Répertoire Bio-bibliographie* (1877–86; 2nd ed., 1905), contains the names of all the historical personages alive between the years 1 and 1500 who are mentioned in printed books, together with the precise indication of all the places where they are mentioned. The second part, *Topo-bibliographie* (1894–1903), contains not only the names of places mentioned in books on the history of the middle ages, but, in a general way, everything not included in the *Bio-bibliographie.* The *Répertoire* is one of the most important bibliographical monuments ever devoted to the study of mediaeval history.

CHEVALIER, literally, a horseman. In feudal times the term was equivalent to knight (*see* KNIGHTHOOD AND CHIVALRY), and later it was also employed in France for the cadets of noble families, where it is still used for the lowest rank of certain orders, as Chevalier of the Legion of Hanover. The appellation of *Chevalier of St. George* was given to James Stuart, son of James II., the Old Pretender, and that of *The Young Chevalier* to Prince Charles Edward Stuart, the Young Pretender. The Seigneur de Bayard (*q.v.*) was known as the *Chevalier sans peur et sans reproche.*

CHEVAUX-DE-FRISE, a military obstacle, originating apparently in the Dutch War of Independence, and used to close the breach of a fortress, streets (French for "Friesland horses"; the Dutch *Vriesse ruyters,* "Frisian horsemen," and German *Spanische Reiter,* "Spanish horsemen"), etc. It was formerly often used in field operations as a defence against cavalry; hence the name, as the Dutch were weak in the mounted arm and had therefore to check the enemy's cavalry by an artificial obstacle. Chevaux-de-frise form an obstacle about 4 feet high, made of beams in which are fixed a number of spears, sword-blades, etc., with the points projecting outwards on all sides.

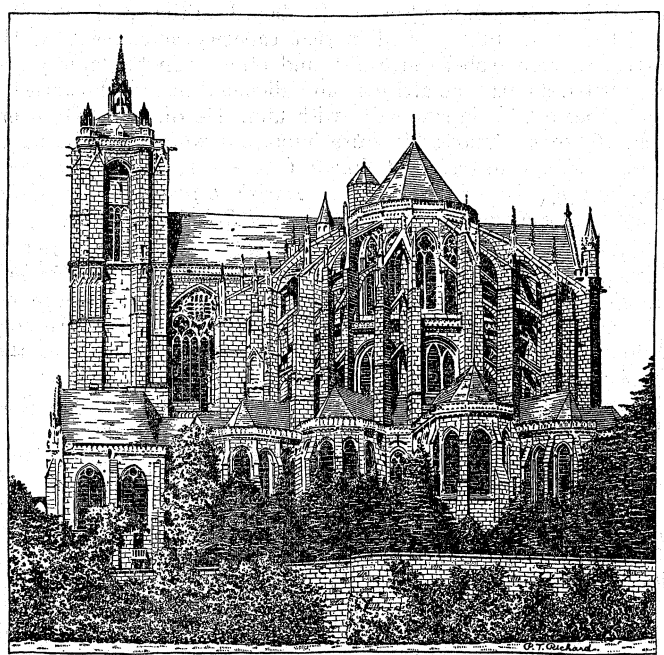
CHEVERUS, JEAN LEFEBVRE DE (1768–1836), French ecclesiastic, was born on Jan. 28, 1768, in Mayenne, France. He was made canon of the cathedral of Le Mans and began to act as vicar to his uncle in Mayenne, but owing to the Revolution he emigrated in 1792 to England, and thence in 1796 to Boston (Mass.). He spent several months in the Penobscot and Passamaquoddy missions and visited scattered Catholics. During the epidemic of yellow fever in 1798 he won great praise for his courage and charity; and his preaching attracted many

Protestants. In 1808 the pope made Boston a bishopric, suffragan to Baltimore, and Cheverus its bishop. Ill-health caused him to resign his bishopric, and in 1823, Louis XVIII. having insisted on his return to France, Cheverus became bishop of Montauban. He was made archbishop of Bordeaux in 1826; and in Feb. 1836, in accordance with the wish of Louis Philippe, he was made a cardinal, only five months before his death, which took place in Bordeaux on July 19, 1836.

See J. Huen-Dubourg, *Vie du cardinal de Cheverus* (Bordeaux, 1838); Eng. version by E. Stewart (Boston, 1839).

CHEVÉ SYSTEM. A method of teaching music to children in wide use in France. It is somewhat akin to the Tonic Sol-fa system, being based, like that, on the principle of a movable tonic, as opposed to the older "fixed Do" method, but employs numerals for the written signs of the different notes instead of the sol-fa syllables, although the latter are retained for vocal purposes. The system was invented by a French mathematical professor, Pierre Galin (1786–1821); developed and advocated by one of his followers, Aimé Paris (1798–1866), and perfected and popularized, after much controversy and opposition, by the latter's brother-in-law, Émile Joseph Maurice Chevé (1804–64).

CHEVET, in architecture, the entire eastern termination of a church choir (*q.v.*), a term used especially for churches with apses (*q.v.*); also an ambulatory (*q.v.*) from which a series of radiating chapels open. It is a distinctly French development, appearing in a highly organized form in many 12th century Romanesque churches; *e.g.,* Notre Dame du Port, Clermont-Ferrand and St. Paul, Issoire. It resulted from attempts to place as many subsidiary altars in chapels as possible, in close association with the high altar and the procession path around it. The development of the chevet produced many spaces of unusual shape whose vaulting was one of the great incentives toward the evolution of the ribbed and pointed vault; the chevet, therefore, plays an important part in the transition from Romanesque to



EXTERIOR VIEW OF LE MANS CATHEDRAL SHOWING ITS MAGNIFICENT FRENCH GOTHIC CHEVET OF THE 13TH CENTURY

Gothic. The radiating chapels are usually uneven in number, and the central one is frequently much larger than the others, dedicated to the Virgin Mary and known as the Lady-Chapel.

CHEVIOT, an incorporated city of Hamilton county, Ohio, U.S.A., adjoining Cincinnati to the west, on the Chesapeake and Ohio of Indiana railway. Pop. (1940) was 9,043. It is a residential suburb. The village was incorporated in 1901. It was laid out in 1818 by John Craig, Sr., and was named after his native Cheviot hills of Scotland. It was first settled in 1805 by Enoch Carson.

CHEVIOT CLOTH. A woollen fabric made originally from the wool of the well-known breed of Cheviot sheep, and now made from other types of wool. Cheviot wool possesses good spinning qualities, owing to the staple being of a fine, soft and pliable character. The true Cheviot type of fabric has a crispness of texture similar to serge cloth (*q.v.*) except that it is of a slightly rougher and heavier type. Cheviot fabric may be produced either from woollen or worsted yarns according to the character and texture or feel desired in the finished fabric. Some qualities are produced from cross-bred worsted yarns which are adapted for furnishing the crispness of texture which is one of the distinguishing characteristics of the true Cheviot type of fabric.

Cheviot suitings for sports wear are made from the harder spun worsted yarns, while some qualities are also made from Botany worsted. So-called Cheviot suitings of inferior quality contain an admixture of cotton, whilst other low-grade Cheviots are weighted with flocks. A stout, twilled, cotton fabric made from cotton warp and weft of coarse counts of yarn and woven with small dobby patterns or with fancy warp stripes, of brown or blue, with bleached weft, is also described as "Cheviot shirting."

(H. N.)

CHEVIOT HILLS, a range forming about 35 m. of the border between England and Scotland. The boundary generally follows the line of greatest elevation, but as the slope is more gradual southward than northward the larger part of the range is in Northumberland, England, and the lesser in Roxburghshire, Scotland. The axis runs from north-east to south-west, with a northward tendency at the eastern end, where the ridge culminates in the Cheviot, 2,676 ft. Its chief elevations from this point south-westward fall abruptly to 2,034 ft. in Windygate hill, and then more gradually to about 1,600 ft. above the pass, followed by a high road from Redesdale. Beyond this are Carter Fell (1,815 ft.) and Peel Fell (1,964 ft.), after which two lines of lesser elevation branch westward and southward to enclose Liddesdale. The rocks include Silurian, Old Red Sandstone (with lavas) and Carboniferous strata, and the hills are finely grouped, of conical and high-arched forms, and generally grass-covered. Their flanks are scored with deep narrow glens in every direction, carrying the headwaters of the Till, Coquet and North Tyne on the south, and tributaries of the Tweed on the north. The range is famous for a valuable breed of sheep. It was the scene of many episodes of border warfare, and its name is associated with the ballad of *Chevy Chase.* The main route into Scotland from England lies along the low coastal belt east of the Till; the Till itself provided another, and Redesdale a third. There are numerous ruins of castles and "peel towers" or forts on the English side in this district.

CHEVREUL, MICHEL EUGÈNE (1786–1889), French chemist, was born, on Aug. 31, 1786, in Angers, where his father was a physician. At about the age of 17 he went to Paris and entered L. N. Vauquelin's chemical laboratory, afterwards becoming his assistant at the natural history museum in the Jardin des Plantes. In 1813 he was appointed professor of chemistry at the Lycée Charlemagne, and subsequently undertook the directorship of the Gobelins tapestry works, where he carried out his researches on colour contrasts (*De la loi du contraste simultané des couleurs,* 1839). In 1826 he became a member of the Academy of Sciences, and in the same year was elected a foreign member of the Royal Society of London, whose Copley medal he was awarded in 1857. He succeeded his master, Vauquelin, as professor of organic chemistry at the natural history museum in 1830, and was its director (1860–79). He died in Paris on April 9, 1889, at the age of 103. Chevreul's name is best remembered for the classical researches he carried out on animal fats, published in 1823 (*Recherches sur les corps gras d'origine animale*). He determined the composition of stearin and olein, and isolated stearic and oleic acids. This work led to important improvements in the processes of soap and candle manufacture.

CHEVRON, any ornament formed of two slanting lines meeting at an angle. In heraldry it is a bent bar. It is also one of the most common distinguishing marks for military and naval uniforms, where it is placed on the sleeves and serves either as a

mark of honour or to indicate a special function. In architecture, the term is sometimes applied to the angle formed by the meeting rafters of a roof, but it is more commonly used for the purely decorative form. Chevrons joined together zigzag are one of the commonest of Romanesque geometric ornaments, especially in areas under Norman influence. It is a frequent decoration for arch mouldings and column shafts. The chevron appears early in primitive work and is found on pottery all over the world. It also occurs frequently in textiles, on Egyptian walls and ceilings, and in Aegean art as a column decoration (*e.g.*, Tholos of Atreus at Mycenae, *c.* 1200 B.C.). (For military use *see* INSIGNIA, MILITARY.)

CHEVROTAIN or MOUSE DEER, the representatives of the family Tragulidae. These tiny animals are not true deer, but constitute a special section of artiodactyles known as Tragulina (*see* ARTIODACTYLA). The typical genus *Tragulus*, which is Asiatic, contains the smallest representatives of the family, the animals having more of the general aspects and habits of rodents than of ruminants. A number of species are known, inhabiting the Malay Peninsula, the Indo-Malay Archipelago, Ceylon, and India. The second genus, *Hyemoschus*, is African, and distinguished by the feet being stouter and shorter, the outer toes better developed, and the two middle metacarpals not welded together. The only existing species, *H. aquaticus*, is rather larger than any of the Asiatic chevrotains, which it otherwise much resembles, but is said to frequent the banks of streams, and have much the habits of pigs. It is of a rich brown colour, spotted and striped with white. Remains of a form chiefly differing in size (*Dorcotherium*) have been found in the Miocene deposits of France.



BY COURTESY OF THE LONDON ZOOLOGICAL SOCIETY

CHEVROTAIN, OR MOUSE DEER, A TINY ANIMAL ABOUT THE SIZE OF A RABBIT

CHEYENNE. This Algonkin tribe of the Plains, in Minnesota in the 17th century, drifted gradually westward through South Dakota to Wyoming and Colorado, and is now on reservations in Montana and Oklahoma. Their speech is much closer than either Blackfoot or Arapaho to the central Algonkin dialects, so that their divergence from the main body of the family is evidently relatively late. Since about 1850 the Sutaio, speaking a Cheyenne dialect, have been part of the tribe, though in 1804 they were still separate. The Cheyenne took a leading part in the Custer massacre of 1876. They were a typical Plains tribe—brave, warlike, non-agricultural, roving after the buffalo or for adventure; and they show the physical type at its best, being perhaps the tallest tribe in the area. The tribal fetish was a set of four sacred arrows. In 1922 the population was 3,200.

See Mooney, *Am. Anthr. Ass. Mem.* vol. i. (1907); G. B. Grinnell, *The Cheyenne Indians* (1923).

CHEYENNE (shī'ĕn), the capital of Wyoming, U.S.A., and county seat of Laramie county; near the south-eastern corner of the State, on rolling plains east of the Laramie range, at an altitude of 6,058ft. It is on Federal highways 30 (the Lincoln), 85 and 87; is served by the Burlington, the Colorado and Southern and the Union Pacific railways; and is an important point on the transcontinental air-mail route, with one of the best equipped airports in the country. The population of the city in 1930 was 13,202, and in 1940 was 22,474 Federal census. The Union Pacific has extensive shops here, and there are meat-packing plants, brick-yards and various other industries. The city is a supply point for an extensive grazing and dry-farming area, and ships large quantities of cattle. The Frontier Days Celebration, held for five days each summer, is a picturesque festival at which Indians, cowboys and plainsmen from Canada to Texas gather to give exhibitions of bronco-busting, steer-tying, Indian dances and other characteristic features of life in the old "wild west." Just north-west is Fort F. E. Warren and its manoeuvre reserve of 52,000 acres. Cheyenne was founded in 1867, when the Union Pacific reached the spot. It was made the capital of the State and was incorporated in 1869.

CHEYNE, SIR WILLIAM WATSON, 1ST BART. (1852–1932), British surgeon, was born in the Shetland islands on Dec. 14, 1852, and was educated at Edinburgh, where he took his degrees in surgery and medicine in 1875. He also studied at Vienna, Paris and Strasbourg. In 1880 he was appointed to the chair of surgery at King's college, London, and from 1888 to 1890 was Hunterian professor of surgery at the royal college of surgeons. From 1900 to 1901 he was consulting surgeon to the South African forces. In 1914 he became consulting surgeon to the royal navy; he accompanied the British forces to Gallipoli, subsequently becoming surgeon-rear-admiral. He was created a baronet in 1908, and in 1916 received the K.C.M.G. In 1919 he was appointed lord lieutenant of Orkney and Shetland.

His published works include *Antiseptic Surgery* (1882); *The Antiseptic Treatment of Wounds* (1885); *Lectures on Suppuration and Septic Disease* (1889); *Objects and Limits of Operations for Cancer* (1896); *Manual of Surgical Treatment* (7 vols. 1899–1903); besides various papers on the treatment of wounds in war.

CHEYNE, THOMAS KELLY (1841–1915), English biblical scholar, was born in London on Sept. 18, 1841. Educated at Merchant Taylor's school and Worcester college, Oxford, he spent some time at Göttingen, where he heard Ewald lecture, and acquired an outlook on questions of biblical criticism then quite new in England. He made English readers familiar with the results of German biblical research, and laid the foundation of a new school of criticism in England. This was accomplished partly by his lectures, partly by a series of articles contributed to the 9th edition of the *Encyclopædia Britannica*, and to the *Academy*, where he was in charge of the biblical department, and by a series of independent works. After taking orders in 1864 he became vice-principal of St. Edmund hall, fellow of Balliol (1868–82), rector of Tendring, Essex (1880–85), Oriel professor of the interpretation of scripture at Oxford and canon of Rochester (1885–1908). He was appointed one of the board on the revision of the Old Testament (1884), and in that capacity acted with A. H. Sayce, William Robertson Smith and others. In his later years he adopted an extreme attitude, and alienated many scholars who had hitherto been in sympathy with him. He died at Oxford on Feb. 16, 1915. Among his more important works may be mentioned: *The Prophecies of Isaiah* (1880–81); *The Origin and Contents of the Psalter* (1891); *Jewish Life After the Exile* (1898); *The Reconciliation of Races and Religions* (1914).

CHÉZY, ANTOINE LÉONARD DE (1773–1832), French orientalist, was born at Neuilly on Jan. 15, 1773. He was the first occupant of the chair of Sanskrit in the Collège de France (1815), at that time the only chair of Sanskrit in Europe. Among his works were *Medjouin et Leila* (1807), from the Persian; *Yadjanadatta Badha* (1814) and *La Reconnaissance de Sacountala* (1830), from the Sanskrit; *L'Anthologie érotique d' Amrou* (1831), published under the pseudonym d'Apudy.

See the *Mémoires* of the Académie des Inscriptions (new series, vol. xii.), where there is a notice of Chézy by Silvestre de Sacy.

CHHATARPUR, an Indian state in the Bundelkhand agency of Central India. Area 1,170 sq.mi.; pop. (1941) 184,720. The chief, whose hereditary title is maharaja, is a Rajput of the Ponwar clan, whose ancestor dispossessed the descendant of Chhatar Sal, the founder of Bundelkhand independence, towards the end of the 18th century. The state was guaranteed to Kunwar Sone Sah Ponwar in 1806. In 1854 it would have lapsed to the British government for want of direct heirs, but was conferred on Jagat Raj as a special act of grace. The maharaja has a salute of 11 guns.

The town of Chhatarpur, which is named after Chhatar Sal, and contains his cenotaph, is 70 mi. by road southwest of Banda. Pop. (1931) 10,305. There are manufactures of paper and coarse cutlery. The state also contains the British cantonment of Nowgong.

CHHATTISGARH, a division of the Central Provinces of India. Fifty years ago it was the most remote and isolated quarter of the Provinces, being shut off by the Maikal range from the Nagpur division on the west and by miles of hills and forests

in the wilder states bordering it on the north, east and south. It is a huge, undulating laterite plain, treeless except for the mango groves planted by generations of villagers round the village sites. It includes the five districts of Raipur, Bilaspur, Drug, Bhandara and Balaghat.

Outside the central plain are several feudatory states as well as large Zamindari properties.

The Chhattisgarh States Agency, comprising 16 states—Bastar, Changbhakar, Chhuikhadan, Jashpur, Kalahandi, Kanker, Kawardha, Khairagarh, Korea, Nandgaon, Patna, Raigarh, Sakti, Sarangarh, Surguja and Udaipur—with an area of 37,688 sq.mi. and a population (1941) of 4,050,000, forms part of the Eastern States Agency and has no connection with this division of the Central Provinces. The Mahanadi is the "Great River" which traverses Chhattisgarh on its way to the Bay of Bengal.

The formation of the country and the soil are distinct from all other parts of the Central Provinces. On the crests of the undulations the red laterite, locally known as "bhâtâ," emerges to the surface. In the depressions between these crests is black soil, gradually turning into brown and then into yellow as the ground rises.

The laterite ridges are either barren or produce nothing but catch-crops of coarse rice when the rains are favourable. The depressions between are more fertile and often rich. The rich soils also are mainly under rice, but produce a second crop of pulses and oil seeds if the late rains are propitious. The western portion of the plain produces a fair amount of wheat and cold weather field crops.

Sir Richard Temple described Chhattisgarh as "the last stronghold of cheapness." Indeed, before 1860 rice was selling at 120 seers (240 lb.) to the rupee, and a labourer could feed himself on a shilling a month.

In bad years there was scarcity, in good seasons a glut of grain, which rotted away for want of export facilities. This old-time isolation permitted a very ancient dynasty, the Hai Hai Bansis of Raipur and Ratanpur, to remain undisturbed for some seven centuries, but in 1743 Mahratta forces took the country without a blow.

Aboriginals occupied the hilly and jungly surroundings of the great plain. The open country is populated by Hindu castes and outcasts, of whom the Chamars, originally leatherworkers but now cultivators, in the 19th century under reforming leaders revolted against the oppression of the Brahmins and high caste Hindus.

The "Satnami" Chamars, as they are called, worshippers of the "true Name" (Satnam) are monotheists and total abstainers from liquor, some sections also prohibiting tobacco. They freely slaughter cattle and have other customs repugnant to Hindus, between whom and them there is hereditary hostility. There are also in Chhattisgarh many disciples of the saint Kabir (Kabirpanthis), but this sect is not peculiar to the division.

The great rice crop of Chhattisgarh was almost at the mercy of a droughty season, being broadcasted and unirrigated. It is a country with thousands of shallow village tanks unsuited for irrigation, wells are comparatively few and tank water is used indiscriminately for men and cattle, both for drinking and washing purposes. Wells are sparingly used, even when constructed at the expense of public funds, as the water is pronounced "tasteless." As a consequence, cholera is apt to be rife in the hot season and at its worst in times of drought and famine. The Bengal Nagpur railway and government irrigation works have worked wonders in improving the country, and education has made considerable though slow progress. The Chhattisgarh peasant (ryot) speaks a corrupt dialect of Hindi, akin to the dialect of Baghalkund.

Chhattisgarh has often been described as one of the granaries of India, but lack of irrigation, rough cultivation and excessive fragmentation of holdings, whereby one man holds numbers of tiny scattered rice plots instead of compact holding, has resulted in precarious and most uneconomical agriculture. Many storage tanks have been constructed by government in the Raipur and Drug districts and a few in Bilaspur, and after 1914 two major works, the Mahanadi and Tendula canals, enabled very large areas to receive protection. Large works were also under construction at Bilaspur, but the people are very slow in learning how to utilize irrigation to the best purpose. In time the agriculture should so improve that the "granary" of Chhattisgarh will justify that designation.

The division covers an area of 27,742 sq.mi. and has a pop. (1941) of 5,592,621. In the decade of the great famine (1891–1901) it decreased by 9%, but by 1911 the lost ground had been recovered. Satnami Chamars number nearly half a million. Hindus proper and Animists preponderate. Mohammedans are insignificant in numbers, being less than $1\frac{1}{2}$% of the whole population. (*See* BILASPUR; RAIPUR.) (R. H. C.; X.)

CHHINDWARA, a town and district in British India, in the Nagpur division of the Central Provinces. The town is situated on the Satpura plateau about 2,000 ft. high. There are low hills in the neighbourhood and it is a pleasant station with a fairly temperate climate. The extension of the Satpura narrow gauge system of the Bengal Nagpur railway from Seoni to Chhindwara was opened in 1905. Some years later the town was connected with Nagpur, and some small coal branches extended to the Pench valley coalfield. The town had a population of 8,626 in 1872, which had slightly increased to 9,736 in 1901; since the railways were constructed the population has grown, the figure in 1941 being 21,916.

It is just a market town with small local industries, and a trading centre for the open plateau lying mid-way between Nagpur on the south and Piparia on the G.I.P. Railway on the north. The town has the ordinary institutions of a district headquarters, and the Swedish Lutheran mission also has a station there.

District of Chhindwara.—The district has an area of 7,933 sq.mi. and consists of three distinct types of country. On the north, bordering the Hoshungabad and Narsinghpur districts, are high hills, and rugged country constituting the *Jagirs* or feudal estates, held by old Gond chiefs, who were at one time marauders levying blackmail on travellers and raiding the open country on their borders. South of the *Jagirs* is the more level Satpura plateau extending from Betul on the west to Seoni on the east, and drained by the Pench and Kanhan rivers. The southern and eastern portions of the plateau are level, and include the fertile wheat plain of Chaurai. On the south again the country drops into the Nagpur plain, to which it geographically belongs. This is a rich cotton and juar (big millet) growing area, where the language is Marathi, and is the richest and most populous part of the district. On the southeast the plateau, here called the Lahmarpani, projects into the plain country, and this portion is noted for its breed of cattle. There are fairly extensive coalfields to the north of Chhindwara, connected by narrow gauge railway with Chhindwara town and by broad gauge line with Betul. In the south of the district, near the Nagpur border, are some valuable deposits of manganese.

The lowlands of the district are hot and the uplands have a temperate climate. The *Jagir* hills bordering the Mahadeo range just outside the district, rise to about 3,000 ft. These hills contain some sal forest. The government forests on the southern slopes of the plateau and in the west of the district contain teak and other timber, but they are not very valuable.

The pop. of the district was (1941) 1,034,040. It suffered decline in the influenza decade, but showed a large increase on the 1872 figure of 316,000. About 75% are Hindus and most of the rest Gonds and other aboriginal tribes. Mohammedans are less than 16,000. The literate population is small in the district as a whole, but the portion adjacent to Nagpur is the most advanced. (R. H. C.; X.)

CHIABRERA, GABRIELLO (1552–1638), Italian poet, was born at Savona on June 8, 1552. He studied philosophy at the Jesuits' college in Rome, and entered the household of a cardinal. He mixed in the literary society of his day, but presently was drawn into a quarrel which compelled him to leave Rome. He retired to Savona, where he read Pindar and Anacreon, and, no doubt, Ronsard. He determined to enrich Italian poetry with new forms, and his imitations from the classics include some

successful innovations in Italian verse, which were adopted by the lyrists of the next century. The mass of Chiabrera's work is very great, epics, pastorals, odes, lyrics, satires. But his best poetry is not to be found in his more ambitious works, but in the *canzonette* and *scherzi,* written to be set to music.

His autobiographical sketch is also extremely interesting. The simple old poet, with his adoration of Greek (when a thing pleased him greatly he was wont to talk of it as "Greek Verse"), his delight in journeys and sight-seeing, his dislike for literary talk save with intimates and equals, his vanities and vengeances, his pride in the memory of favours bestowed on him by popes and princes, his *infinita maraviglia* over Virgil's versification and metaphor, his fondness for masculine rhymes and blank verse, his quiet Christianity, is a figure deserving perhaps of more study than is likely to be bestowed on that "new world" of art which it was his glory to fancy his own, by discovery and by conquest.

BIBLIOGRAPHY.—Editions of Chiabrera's works are those of Rome (3 vols., 1718); Venice (4 vols., 1730); Leghorn (5 vols., 1781); Milan (3 vols., 1807); selection by F. Polydori (1865). *See* also G. Taccetta, *Gabriello Chiabrera e la sua produzione epica* (Catania, 1921); F. Neri, *Il Chiabrera e la Pléiade française* (Turin, 1920).

CHIANA (anc. CLANIS), a river which rises in the Apennines south of Arezzo, runs through the valley of Chiusi, and after receiving the Paglia just below Orvieto, falls into the Tiber after a course of 60 miles. In Roman times it often caused floods in the valley of Clusium. In the middle ages the whole of its valley from Arezzo to Chiusi was an uninhabitable swamp; but at the end of the 18th century the engineer, Count Fossombroni, moved the watershed some 25 mi. farther south, so its waters now flow partly into the Arno and partly into the Tiber.

CHIANG KAI-SHEK, otherwise CHIANG CHUNG-CHENG (1887–), Chinese general, a native of Ningpo, province of Chekiang. At an early age he joined the Kuomintang and in 1920 became head of the Whampoa Military academy, then lately founded under the advice of Michael Borodin, unofficial agent of the Soviet government. Under Borodin's ascendancy Sun Yat-sen and the Kuomintang leaders obtained control of the government of Canton and, with Soviet training and assistance, the Whampoa cadets developed into the mainstay of Sun's army. At Sun's death in March, 1925, Canton city and neighbourhood were completely under the control of the Kuomintang army, and in September Chiang secured the appointment of Commander-in-chief, with the Soviet General Galen as his unofficial chief of staff. By the end of the year, having defeated Chên Chiung-ming, he had brought Kwangtung and Kwangsi provinces under the control of the Kuomintang "Executive Committee." This body, a development due to Borodin's remodelling of the party on Soviet lines, converted Sun's former semblance of government into the eventually successful Nationalist Government of China.

In 1926 Chiang made his amazing advance through Hunan to the Yangtsze and established an administration at Wuchang. Thereafter a break with the extremists of the party caused the transfer of the seat of government to Nanking. Early in 1927 Chiang Kai-shek, restive under growing Soviet domination, embarked upon an anti-communist campaign throughout central and southern China. The result was the complete withdrawal of Borodin, Galen and the other Russian advisers. In August, 1927, he announced his retirement and later in the year visited Japan. In December he married Miss Mayling Soong, the sister-in-law of Sun Yat-sen, thus identifying himself with the constitutional element in the Kuomintang. Early in 1928 he resumed his post at the head of the Nanking army, which bore its part in the northern advance, and final occupation of Peking. Chiang Kai-shek was president of the Chinese National Government from 1928 till 1931, when he was succeeded by Lin Sen. He was several times premier; but in 1938 decided to devote himself to his military duties as national leader against Japanese aggression. In Jan. 1942 he was named supreme commander of all Allied forces fighting in the Chinese theatre of World War II. In Sept. 1943, after Lin Sen's death, he was elected by the central executive committee of the Kuomintang president of China for a term of three years, subject to reappointment. (W. E. L.; X.)

CHIAPAS, a Pacific coast state of southern Mexico on the Guatemalan frontier, bounded by the states of Tabasco on the north and Veracruz and Oaxaca on the west. Pop. (1940) 679,885, largely Indians; area, 28,724 sq.mi., largely forested. The Sierra Madre crosses the southern part of the state parallel with the coast, separating the low, humid, forested districts on the frontier of Tabasco from the hot, drier, coastal plain on the Pacific. The mountain region includes a plateau of great fertility and temperate climate, which is one of the best parts of Mexico and contains the larger part of the population of the state, but isolation and lack of transportation facilities have retarded its development.

The extension of the Pan-American railway across the state, from Ixtepec, on the Tehuantepec National line, to the Guatemalan frontier, improved the industrial and social conditions of the people. The principal industries are agriculture, which is very backward, stock raising, timber-cutting, fruit farming and saltmaking. Coffee is cultivated on the Pacific slope of the Sierra Madre at elevations of 2,000 to 4,000 ft., and production has met with considerable success. Rubber plantations have also been laid out, principally by U.S. companies. The exports include mahogany, dyewoods, cattle, hides, coffee, rubber, fruit and salt. The mineral resources include gold, silver, copper and petroleum. The capital, Tuxtla Gutierrez (pop. 15,883), is on the plateau, 3½ mi. from the Rio Sabinas, and 138 mi. N.E. of the Pacific port of Tonala. The former capital, San Cristobal (pop. 11,768), about 40 mi. E. of Tuxtla, is an interesting old town and the seat of the bishopric of Chiapas, founded in 1525 and made famous through its associations with Las Casas. Tapachula (pop. 15,187), the capital of the department of Soconusco, 18 mi. from the Guatemalan frontier, is a commercial town of the coffee district. It is 24 mi. inland from the small port of San Benito, is 559 ft. above sea level, and has a healthful climate.

CHIAROSCURO, the disposition of light and shade in a painting (Ital. *chiaro,* light, *oscuro* shade); the term is applied to an early method of printing wood-engravings from several blocks, and also to a picture in black and white, or brown and white only. It has also come to mean the atmospheric effect produced by the handling of high lights and shadows.

CHIAVARI, a town near the mouth of the Entella, Liguria, Italy, province of Genoa, 24 mi. S.E. by rail from Genoa. Pop. (1936) 14,042 (town), 17,520 (commune). It is in a fertile plain surrounded by mountains except on the southwest where it comes down to the sea. It trades in farm products, and makes lace, light wicker-seated bentwood chairs and silk.

CHIAVENNA (anc. *Clavenna*), a town of Lombardy, Italy, in the province of Sondrio, 17 mi. by rail north of Colico, which lies at the north end of the Lake of Como. Pop. (1936) 3,803 (town); 5,379 (commune). It is on the right bank of the Mera, at the mouth of the Val Bregaglia, through which the road to the Maloja pass and the Engadine runs to the east. This line was followed by a Roman road, which took the Julier route to Coire (anc. *Curia*). The Splügen route, also used by the Romans, runs north from Chiavenna to Coire: the modern road was constructed by the Austrians in 1819–21. Chiavenna's ruined castle was the seat of the counts who ruled the valley from the time of the Goths till 1194, when the district was handed over to the bishops of Coire. In the 14th century the Visconti, as masters of the Valtellina, bought the "county" of Chiavenna from the bishop of Coire; but it was taken by the canton of the Grisons in 1525, and the castle dismantled. In 1797 Chiavenna became part of the Cisalpine republic, and thenceforward followed the fortunes of Lombardy. Chiavenna has cotton factories and breweries, and is a depot for the wine of the district owing to the coolness of the caves which are used as cellars.

CHIBCHAN, an important linguistic stock of South American and Central American Indians. The tribes to be included within this stock and its precise geographic limits are still open to discussion. Beginning with the Ulvan tribes along the Honduras-Nicaragua border southward and eastward through Nicaragua, Costa Rica and Panama, the larger proportion of all the tribes belonged to Chibchan stock. In Colombia they probably

held most of the drainage basins of the Magdalena and Cauca rivers. The region of the Cordillera Central, between these streams, was, however, held by tribes classed as Paniquitan (*q.v.*), who are regarded by some as constituting a distinct stock. Rivet would include as Chibchan also the Barbacoan (*q.v.*) and Coconucan (*q.v.*) tribes farther south, extending as far as the equator in western Ecuador. There has been considerable difference of opinion as to whether the direction of movement of the stock has been southward into South America or from the southern continent into North America. The more recent opinion seems to favor the former view, but the question cannot by any means be regarded as settled. The stock has received its name from the Chibchas (*q.v.*), the most important tribe of the stock at the time of the Spanish conquest.

See H. Beuchat and P. Rivet, *Affinités des langues du sud de la Colombie et du nord de l'Equateur* (Museon, 1910, vol. xi.); W. Lehmann, *Zentral Amerika* (Berlin, 1920).

CHIBCHAS, a small group of tribes of South American Indians, occupying at the time of the Spanish conquest the high valleys in the vicinity of Bogota and Tunja in Colombia. In their culture the Chibchas and other related tribes in the vicinity ranked next to that developed by the Inca and their predecessors in Peru and Bolivia. They were, however, on a distinctly lower level, for although a sedentary, agricultural folk, skilful weavers and artificers in gold, they had little copper and no bronze. They were also much inferior in pottery making, had no knowledge of stone or sun-dried brick construction, and had no means of record, such as the Peruvian quipu. Just prior to the advent of the Spanish, the Zipa or chief of the Chibchas at Bogota had been successful in extending his political control over several of the tribes further north, and seems to have initiated a movement which, but for the Spanish conquest, might have paralleled the military expansion of the Aztecs in Mexico. Like the latter, the Chibchas employed human sacrifice in their religious ceremonials. In one of these, the chief or "king" was smeared with a sticky substance and then powdered with gold dust, which was subsequently washed off by bathing in a sacred lake. It was this practice which, at least in part, gave rise to the legend of "El Dorado." The dead were buried in well-graves which sometimes attained a depth of 30 or 40 ft.

See L. F. de Piedrahita, *Historia General de las Conquistas del Nuevo Reyno de Granada* (Verdussun, 1688); P. Simon, *Noticias Historiales,* etc. (Bogota, 1882); P. de Aguado, *Historia de Santa Marta y Nuevo Reino de Granada* (new edition, Madrid, 1916).

CHIBOUQUE or **CHIBOUK,** a long Turkish pipe (Fr. form of the Turk. *chibūk,* a stick), often ornamented with precious stones.

CHIC, in French artistic slang, the quality of facile but superficial brilliance in a work of art, or an effect produced by imagination without reference to a model; in its general sense, it connotes smartness in dress. The use of the word in France dates from Louis XIV.'s reign when it denoted a lawyer who was master of "chicane" or legal trickery.

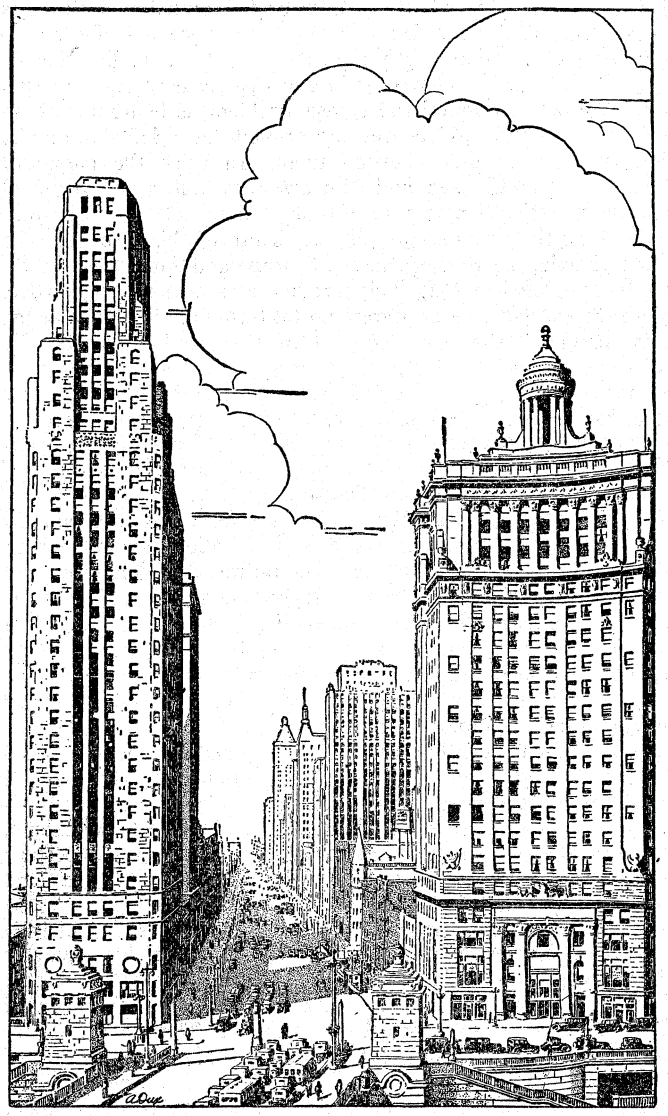
CHICA, a fermented liquor resembling beet made by the natives of South America from Indian corn; also an orange-red pigment or dye stuff obtained from the leaves of *Bignonia chica* by the Orinoco Indians.

CHICACOLE, a town of British India in the Ganjam district of Madras, situated on the right bank of the river Languliya, here crossed by a bridge, 4 mi. from the sea. Pop. (1941) 22,249. Under Mohammedan rule it was the capital of one of the Northern Circars, and afterwards of a British district. Several old mosques remain. The town was formerly famous for its muslins. The roadstead and lighthouse of Calingapatam are about 16 m. to the north, and the Bengal-Nagpur east coast railway has a station 8 m. inland.

CHICAGO, a city, a port of entry and the county seat of Cook county, Illinois, the second city of the United States in population, commerce and manufacture; pop. (1910) 2,185,283; (1920) 2,701,705; (1930) 3,376,438; (1940) 3,396,808. The increase in the decade, 1920–30, partly as a result of annexations, was 674,733, the largest gross gain in the history of the city. The percentage of increase was 25·0, the smallest, except for the decades of 1910–20 and 1930–40, in the city's history.

The population of the metropolitan district of Chicago, embracing suburbs of the city both in Illinois and Indiana, but excluding adjacent communities in Wisconsin, was 4,445,338 in the year 1940.

As is the case with most American cities, the growth of the population of Chicago has decreased relatively to the growth



LOOKING SOUTH ON MICHIGAN BOULEVARD FROM THE LINK BRIDGE. TO THE LEFT, THE 333 N. MICHIGAN AVENUE BUILDING; ACROSS FROM IT, THE LONDON GUARANTEE BUILDING

of the outlying communities of its metropolitan area. The rate of regional growth about the city seems to be increasing as the rate of strictly urban growth declines, largely because of the extension of motor traffic and hard-surfaced highways. The almost negligible increase of the population of the city of Chicago proper from 1930 to 1940 represented a net balance of gains in half the city's wards and losses in the other half. Chicago is situated at the south-west corner of Lake Michigan (lat. 41° 50′ N., long. 87° 38′ W.), about 913m. distant by railway from New York, 912m. from New Orleans, 2,265m. from Los Angeles and 2,330m. from Seattle. The climate is very changeable and is much affected by the lake; changes of more than 30° in temperature within 24 hours are not rare, and changes of 20° are common. Chicago is 598 ft. above sea level.

The city is the greatest railway centre of the United States; and was for several decades practically the only commercial outlet of the great agricultural region of the northern Mississippi

valley. Trunk-lines reach east to Montreal, Boston, New York, Philadelphia, Baltimore (the nearest point on the Atlantic coast, 854m.); south to Charleston, Savannah, Florida, Mobile, New Orleans, Port Arthur and Galveston; west to the Pacific at Los Angeles, San Francisco, Seattle and Vancouver, and to most of these by a variety of routes. Thirty-two trunk-lines operated by 22 railway companies enter the Chicago terminal district. In this terminal system about 4½% of the total freight tonnage of the United States is loaded and 6¼% unloaded annually. Chicago is also the greatest Canadian railway centre from a traffic standpoint. The Canadian National lines and the Canadian Pacific enter it through subsidiaries. Chicago's passenger terminal situation, like her intramural rail transit problem, is being altered to fit the great city, which grew up around the original railheads and then passed miles beyond them. In 1911 the passenger station of the Chicago and Northwestern railway, a dignified structure costing $20,000,000, was opened for service. The railways using the union station directly south of this terminal—the Pennsylvania, the Burlington, the Chicago and Alton and the St. Paul—completed in 1925 their terminal at a cost of $75,000,000. With the construction of a great postal terminal building near by, this completed the rearrangement of the terminals of the six railroads on the west side of the Chicago river. But the far more numerous railways entering four passenger terminals on the south side, have spent years working out a plan for consolidation and rearrangement among themselves. Decline of railway passenger traffic because of automotive and aerial competition and weakened railway finances have diminished interest in these projects. But the straightening of the Chicago river followed by the building of through streets through the area foreshadows its better use. Building of industrial structures over railway tracks and lease of railway "air rights" has begun. It is hoped that this will accelerate the electrification of the railway terminals. The first railway electrification was completed July 21, 1926, when the Illinois Central railway opened its electrified suburban passenger service over the 30m. from Matteson, Ill., to Randolph street at a total cost of $40,000,000.

With its suburbs within the area of the Chicago railway terminal district, Chicago occupies a crescent-shaped area, the concave side of which is the shore of Lake Michigan. This Chicago district is 1,119.29 sq.mi. in extent, about the size of Rhode Island, and lies along the lake shore for about 55 mi. (the incorporated city proper for 26.5 mi.). The city proper has a land area of 206.7 sq.mi. It spreads loosely and irregularly backward from the lake over a shallow alluvial basin, which is rimmed to the west by a low moraine water-parting that separates the drainage of the lake from that of the Mississippi valley. The city site has been built up out of the Lake Chicago of glacial times, which exceeded in size Lake Michigan. Three lakes—Calumet, 3,122ac.; Hyde; and part of Wolf—with a water-surface of some 4,100ac., lie within the municipal limits. The original elevation of what is now the business heart of the city was only about 7ft. above the lake, but the level was greatly raised—in some places more than 10ft.—over a large area, between 1855 and 1860. The west side, especially the north-west near Humboldt park, is much higher (highest point, 75ft.). A narrow inlet from the lake, the Chicago river, runs west from its shore about a mile, dividing then into a north and south branch, which run respectively to the north-west and the south-west, thus cutting the city into three divisions known as the north, the west and the south "sides," which are united by three car-tunnels beneath the river as well as by the bridges across it. The river no longer empties into Lake Michigan since the completion of the drainage canal. Its commercial importance is yet very great, but with the change in the character of lake traffic it is diminishing, and this stream and harbour upon which Chicago's history and greatness were based are now looked upon primarily as an obstruction to urban street traffic. Agitation for the abolition of the river as a shipway and for the substitution of fixed bridges for the draw, lift and bascule types which now span it, is active. Ship traffic on the lake has become principally a matter of the transport of bulk cargoes of iron ore, coal, coke and limestone direct from mine rail terminals to the great iron, steel and cement plants with their own docks on the south shore of Lake Michigan. Traffic has shifted to the ports on the southern extremities of the city, Calumet, Indiana Harbour, etc.; and steamers formerly docking in the river call at the municipal pier or dock in the outer harbour. Some lake cargo destined for Chicago is landed at Milwaukee and comes in by rail.

Upon the completion of the Illinois waterway, connecting Chicago, through the Illinois and Mississippi rivers, with New Orleans by a barge route of 9ft. draft, the Chicago river became an important link for through water traffic, but it is proposed to obviate this by widening a direct canal to connect the south lake harbour with the drainage canal, which will constitute a link of the waterway. The improvement of the outer harbour by the Federal Government was begun in 1833. Great breakwaters protect the river mouth from the silting shore currents of the lake and afford secure shelter in an outer roadstead from its storms, and there is a smaller inner basin (about 450ac., 16ft. depth) as well. The river itself has about 15m. of navigable channel, in part lined with docks. Its channel has been repeatedly deepened and, especially since 1896, after its control as a navigable stream passed (1890) to the Federal Government, widened and straightened by the removal of jutting building constructions along its shores. Grain elevators of enormous size, coal-yards and once warehouses crowded close upon it. In 1927 the south bank of the river from the Michigan avenue bridge to Lake street, which is the northern boundary of the Loop business district, was completely denuded of abutting buildings by the opening of the two-level Wacker drive, a broad boulevard upon a gigantic concrete structure occupying the space of former blocks of buildings and streets. This construction, which cost about $28,000,000, and which connects with the new Michigan avenue bridge and the two-level boulevards approaching it, is the first item of a programme designed to convert the entire south and east banks of the river into broad traffic arteries. Farther south, under an agreement of the railways, property owners and the city, the south branch of the river which curves to the east for about a mile of its length was moved westward for a maximum distance of a quarter of a mile, to allow of the construction of four wide streets leading from the south into the Loop district. This plan, which is also an aid to the reconstruction and electrification of the south side railways, is estimated to have cost $8,000,000, with an ultimate expenditure of $162,000,000 by the railroads affected, in the reconstruction of the south side railway terminals.

The plan of the city was originally regular, *i.e.*, rigidly rectangular, and the original streets were wide according to the standards of the days of horse-drawn traffic. The original plan has been altered by the construction of a great number of boulevards in the outer areas, which in connection with the growth of the park system and the construction of driveways in the parks have provided numbers of diagonal traffic arteries. The recovery of land from the lake and the construction of a great parkway system along the lake front have also led to the belting of the down town areas on the east with a number of north and south boulevards not in keeping with the original plan of the city. The initiation and completion of these projects have been so rapid and the number of new plans in various stages of execution is so great that the older parts of Chicago have been profoundly altered, especially since the beginning of the great building boom in 1922.

Rapid transit by rail has not kept pace with these improvements in streets. One result of this is that a number of outlying business, hotel and apartment centres have grown up, which are beginning in the aggregate to rival the Loop, the former business, financial, theatrical and hotel centre. Chicago has begun to develop into a series of urban centres rather than a centralized city on the usual American model. Notwithstanding the growth of these outlying centres, however, the construction of great buildings within the Loop from 1922 to 1928 proceeded at a pace never approached before, while the opening of Wacker drive and the Michigan avenue bridge enabled the business district to break out of the narrow confines of the former Loop district—the 1·5 sq.m. lying between the lake, the main Chicago river and the south branch of

the river. This northward advance of the business district was accompanied by the construction of numbers of the tower type of office building. This forest of bold and graceful towers has relieved the former drab monotony of down town Chicago. The construction of so many great office buildings and hotels in the down town district has made the problem of street congestion increasingly acute despite the enormous expenditures upon new boulevards. Hope for any material relief from the construction of the freight tunnels vanished with the advent of the popular priced automobile, and the capacity of these underground freight arteries is such that they can handle only a trifling percentage of the movement of goods in the district. A belt of "bad lands"—deteriorated residence, shop and factory property, surrounds the business district except on the north-east. Here a great section crowded with expensive family and apartment hotels has grown up on the lands reclaimed from the lake in the section called "Streeterville"—named from a belligerent old squatter, who long claimed title to these accretions, because his schooner had stranded on that shore. Chicago's architectural achievements are yet blighted by the use of soft coal which after a time smears a drab colour on the finest structures. Vigorous efforts to combat this nuisance have had small results. Yet the skyline, the immensity of the traffic movement and the massiveness of its central district give the city a distinct tone, found nowhere else.

The unstable soil of sand, clay and boulders that underlies the city is unfavourable to tall constructions, and necessitates extraordinary attention to foundations. The bed-rock lies, on an average, 50ft. below the level of the lake (in places more than 100). The foundations are often sunk to the rock in caissons, the buildings resting on monster columns of concrete and steel. In other cases great "pads" of the same materials, resting or "floating" upon the clay, sustain and distribute the weight of the building.

Buildings notable for their architectural boldness and the beauty which has resulted from the conversion of the economics of the tall structure to aesthetic purposes are the Chicago temple, a spire above an office pile, the Tribune tower distinguished for its flying buttresses, the Wrigley building with its campanile tower, the Civic Opera building which faces across the river, the ultra modern Daily News building and Plaza.

A large part of the business of the former dry goods wholesale district is now housed in the huge Merchandise Mart on the north bank of the river which could hold the entire population of the city standing.

The new Board of Trade building topped by a statue of Ceres poised 612 feet in the air towers over a forest of towers in the financial district of LaSalle street.

Older buildings associated with the city's history or notable architectural triumphs of their day are the Auditorium containing a hotel and a theatre which seats 5,000, long the home of Grand opera, the Continental Bank, the Monadnock, the People's Gas building, the La Salle, Blackstone and Sherman hotels and the Marquette building. There are a number of enormous retail stores. The largest, and one of the finest in the world, is that of Marshall Field and Co.

The city hall and county court house (cost $4,500,000) is an enormous double building in a free French Renaissance style, with columned façades.

The Federal building (finished in 1905; cost, $4,750,000) is a massive edifice (a low rectangle surmounted by a higher inner cross and crowned with a dome). The public library (1893–97, $2,125,000), constructed of dark granite and limestone, with rich interior decorations of varied frescoes, mosaics, ornamental bronze and iron work, and mottoes, is one of the handsomest libraries of the country. The Chicago Art Institute, the Chicago Orchestra building, and the Rosenwald Museum of Science and Industry, are also noteworthy. The Field museum completed in 1920 at a cost of $6,000,000 is a white marble structure in Ionic style, 350ft. wide and 700ft. long.

Navy pier, completed in 1915, projects 3,000ft. into Lake Michigan, north of the mouth of the Chicago river and combines the functions of an enormous dock and a playground; the outer portion, 660ft. long, is a three-decked structure devoted to amusement and recreation purposes. The movement of wealthier residents to surrounding communities has left the city proper without any notable street of private homes, although many of the older boulevards are fringed by dignified houses. The physical growth of Chicago in the 27-year period prior to 1936, was guided by a definite plan laid down by the Chicago plan commission, created by the city council during the administration of Mayor Fred A. Busse. The plan had its genesis in a report of Daniel H. Burnham and was submitted by the Commercial club to the city and adopted as an enduring policy. It took cognizance of the natural features of Chicago's site and environs and proposed the gradual adaptation of the city then existing, and the city as it grew, to the best uses of its natural setting—from a commercial, industrial, social and cultural standpoint. Eighteen of the major projects of the Chicago plan have already been realized. In its original entirety the plan will probably be completed in 1950, but it has been constantly modified and expanded to keep pace with new conditions and problems. Railroads, public utility companies and industrialists have co-operated to carry out its designs. The Chicago plan has demonstrated that the most intensive modern industrialism and commercial activity can be profitably harmonized with beauty, social welfare and ample recreational and cultural centres for the people of a metropolitan city.

Public Works and Communications.—Local transit is provided for by suburban railway service, motor buses, elevated electric roads, and a system of electric surface cars. Two great public works demand notice: the water system and the drainage canal. Water is pumped from Lake Michigan through several tunnels connecting with cribs located from 2 to 5m. from shore. The cribs are heavy structures of timber and iron loaded with stone and enclosing the in-take cylinders, which join with the tunnels well below the bottom of the lake. The first tunnel was completed in 1867. They now form a 100-mile labyrinth under the lake and city. The average amount of water pumped per day is 917,874,122 gallons. Because of pollution of lake water from the wastes of Indiana cities, not participating in the drainage system of the Chicago sanitary district, this water has been chlorinated at the in-takes. The wastes of the city—street washings, building sewage, the offal of slaughter-houses, and wastes of distilleries and rendering houses—were originally turned into the lake, but before 1870 it was discovered that the range of impurity extended a mile into the lake, half-way to the water crib, and it became evident that the lake could not be indefinitely contaminated. The Illinois and Michigan canal was once thought to have solved the difficulty. It is connected with the main (southern) branch of the Chicago river, 5m. from its mouth and with the Illinois river at La Salle, and is the natural successor in the evolution of transportation of the old Chicago portage, ½m. in length, between the Chicago river and the headwaters of the Kankakee. It was so deepened as to draw water out from the lake, whose waters thus flowed toward the Gulf of Mexico, but it proved inadequate for the disposal of sewage. A solution of the problem was imperative by 1876, but almost all the wastes of the city continued nevertheless to be poured into the lake. In 1890 a sanitary district, including part of the city and certain suburban areas to be affected, was organized, and preparations made for building a greater canal that should do effectively the work it was once thought the old canal could do. The new drainage canal, one of the greatest sanitary works of the world, constructed between 1892 and 1900 under the control of the trustees of the sanitary district of Chicago, joins the south branch of the Chicago with the Des Plaines river, and so with the Illinois and Mississippi. The canal, or sewer, is flushed with water from Lake Michigan, and its waters are pure within a flow of 150 miles. Its capacity, which was not at first fully utilized, is 600,000 cu.ft. per minute, sufficient to renew entirely the water of the Chicago river daily. A system of intercepting sewers to withdraw drainage from the lake was begun in 1898; and the construction of a canal to drain the Calumet region was begun in 1910. This system is now being changed and extended to deliver all sewage to plants for oxidation and chemical treatment. The drainage canal is the backbone of a great system of feed

water lateral canals and underground sewers. The drainage canal became the nucleus of the Lakes to the Gulf waterway, under construction by the State of Illinois to connect the drainage canal with the Illinois river, the Federal Government undertaking the improvement of the rivers to the gulf. The canal also made possible the development of hydro-electric power at Lockport, which is used by the sanitary district and for street lighting in Chicago. The total cost of construction of the works of the sanitary district up to 1924 was $94,371,038. However, this great investment by Chicago appears to have been only a beginning. The lowering of lake levels which resulted brought protests and litigation from other lake cities. Shipping interests blamed the drainage canal for the lowering of lake levels and the shoaling of port and dock channels. The sanitary district denied responsibility for more than 6in. of the fall in the levels of Lakes Michigan, Huron and Erie, and offered to construct compensating weirs to retain levels in the St. Clair river, connecting Lakes Huron and Erie, and in the Niagara river. Litigation against the sanitary district by the other lake States was defended in the United States Supreme Court by the State of Illinois, assisted by other States of the Mississippi valley interested in maintaining the diversion of lake water into the Mississippi drainage system in aid of navigation.

The first adverse decision by the Supreme Court was handed down Jan. 5, 1925. Finally that tribunal decreed that the diversion of water should be reduced to 1500 cu.ft. per second by 1938. The sanitary district was given time to construct sewage purification works, but its extravagance and depleted resources would have made that impossible had it not been for the aid of the federal treasury extended as grants to relieve unemployment. The works (in 1941 nearly completed) cost $177,000,000.

Chicago was early a centre of aerial transport. The municipal airport was established in 1927 and is now the busiest in the U.S. In 1940 the average arrivals and departures of regular scheduled planes per day was slightly in excess of 140. In 1940, 309,075 passengers arrived at and 312,449 departed from the port. Auxiliary airports available for both military and civil purposes are located at convenient points throughout the metropolitan district and lighted routes make night flying possible from Chicago to the Atlantic and Pacific coasts. Regular flying time to New York has been cut to three hours. Overnight schedules to the Pacific ports are maintained by the air lines.

Atrophy of the city's internal traction and elevated systems during the period 1907–27 was partially compensated for by the establishment of numerous motor bus lines on the boulevards and parkways, and by the extension and modernization of electric railways in the outlying regions. Numerous bus lines connecting Chicago with other towns and cities have come into competition with the railways. Another great improvement was begun in 1901 by a private telephone company. This is an elaborate system of freight subways, more than 65m. of which, underlying the entire business district, had been constructed before 1909. It is the only subway system in the world that seeks to clear the streets by the lessening of trucking, in place of devoting itself to the transportation of passengers. Direct connection is made with the freight stations of all railways and the basements of important business buildings, and coal, building materials, ashes and garbage, railway luggage, heavy mail and other kinds of heavy freight are expeditiously removed and delivered. Telegraph and telephone wires are carried through the tunnel, and can be readily repaired. The subway was opened for partial operation in 1905. However, street traffic growth has been so great and the capacity of the tunnels so small, that the 120 locomotives and 3,000 cars operated in the tunnels handle less than 10% of railway freight loaded or unloaded in the business district.

Parks.—The park system may be said to have been begun in 1869, and in 1870 aggregated 1,887 acres. Chicago then acquired the name of the "Garden City," still emblazoned on the municipal coat of arms. But other cities later passed her, and in 1904 she ranked only 32nd among American cities of over 100,000 population in *per capita* holdings of park acreage. The area of the city's parks is 7,327ac. but this is being rapidly extended all along the lake front by the reclamation of land from the lake for parks, bathing beaches and another municipal air-port adjacent to the business district. Eventually the entire lake front, except for the relatively small areas devoted to port purposes, will be a line of parks available for recreational purposes, including the island created for the use of the 1933 Centennial exposition. In addition to the city park system, the Cook county forest preserves, a broad belt of wooded lands, 33,000 ac. in extent, acquired over many years, form a belt north, south and west of the city. The value of this great playground is attested by a census of visitors for one year which totalled 5,500,000. In the same year 4,582,000 persons bathed at the city's supervised bathing beaches and 3,700,000 children were counted at the city's playgrounds. The large and small parks number 208. There are 71 bathing beaches and public pools, 25 free public golf courses and 98 public playgrounds. The park in each district, usually located near a school, is almost all-inclusive in its provision for all comers, from babyhood to maturity, and is open all day. There are sand gardens and wading ponds and swings and day nurseries, gymnasiums, athletic fields, swimming pools and baths, reading-rooms—generally with branches of the city library—lunch counters, civic club rooms, frequent music, assembly halls for theatricals, lectures, concerts or meetings, penny savings banks, and in the winter skating ponds.

The older parks include several of great size and beauty. Lincoln park, on the lake shore of the north side, has been much enlarged by an addition reclaimed from the lake. It has fine monuments, conservatories, a zoological garden and the collections of the Academy of Sciences. Jackson park, on the lake shore of the south side, was the main site of the World's Columbian Exposition of 1893. It is joined with Washington park by the Midway Plaisance, a wide boulevard. Along the Midway are the greystone buildings of the University of Chicago, and of its (Blaine) School of Education. On the west side are three large parks—Douglas, Garfield (with a fine conservatory) and Humboldt, which has a remarkable rose garden, and in the extreme south side several others, including Calumet, by the lake side, and Marquette. Jackson boulevard, Western avenue boulevard and Marshall boulevard join the south and the west park systems. The shore of the north side is quite free, and beginning a short distance above the river is skirted for almost 30m. by Lake Shore drive, Lincoln park and Sheridan Road. In Grant park is the building of the Art Institute, the Shedd Aquarium, the Adler Planetarium, the Field Museum of Natural History and Soldier field, a great stadium devoted to sports and pageants, with a capacity of about 200,000. About two-thirds of the city's frontage on the lake was composed of parks or boulevards in 1941. The inner boulevards and the drives through the lake front parks are parked ways ranging from 150 to 300ft. in width.

Art.—A city art commission approves all works of art before they become the property of the city, and at the request of the mayor acts in various ways for the city's aesthetic betterment. The Architectural club labours for the same end. A municipal art league (organized in 1890) has done good work in arousing civic pride; it has undertaken, among other things, campaigns against bill-board advertisements and against the smoke nuisance. The Art Institute of Chicago contains valuable collections of paintings, reproductions of bronzes and sculpture, architectural casts and other objects of art. Connected with it is the largest and most comprehensive art school of the country—including classes in newspaper illustration and a normal school for the training of teachers of drawing in the public schools. The courses in architecture are given with the co-operation of the Armour Institute of Technology. The Kenneth Sawyer Goodman memorial theatre, associated with the institute, opened its first season of endowed repertory in 1925. A school of the drama is conducted in connection with the theatre. The trustees of the Art Institute administer the Ferguson monument fund, left by the will of Benjamin Franklin Ferguson, to be used for the erection of statuary and monuments in Chicago. Among others, two notable pieces by Lorado Taft have been purchased: "The Fountain of the Great Lakes" stands just to the south of the Art Institute; "The Fountain of Time," at the head of the Midway, between Washington

and Jackson parks. The Chicago Natural History museum, formerly the Field Museum of Natural History, established (1894) largely by Marshall Field, is mainly devoted to anthropology and natural history. The nucleus of its great collection was formed by various exhibits of the Columbian exposition which were presented to it. Its collections of American ethnology, of exceptional richness and value, are constantly augmented by research expeditions.

The Chicago Grand Opera company organized in 1910 was reorganized in 1915 as the Chicago Opera association and in 1921 as the Chicago Civic Opera company. Heavy deficits and a precarious life have been characteristic of the art, but the Chicago City Opera survives. The Chicago Symphony orchestra was founded in 1891 by Theodore Thomas, who conducted it until his death on Jan. 4, 1905. He was succeeded by Frederick A. Stock (1872–1942). Late in 1904 Orchestra hall was built from money raised by popular subscription; this building made the orchestra self-supporting. The orchestra plays from 110 to 120 concerts each season. In addition Chicago has dozens of lesser orchestras, choral organizations, and many musical schools of large membership.

The oldest choral organization is the Apollo Musical club which dates back before the great fire of 1871.

Libraries.—At the head of the libraries of the city stands the public library established in 1872, the nucleus of which was a collection of books from England made by Thomas Hughes, author of *Tom Brown's School Days,* after the great Chicago fire of 1871, a collection to which Queen Victoria and other contemporary British notables made contributions. The library was opened in 1874. The main library has 1,907,685 volumes, in addition to independent collections ranging from 5,000 to 50,000 in 45 general branches, 30 high school branches and 12 sub-branches.

The circulation of books in 1940, in addition to those used on the main shelves of the central library, was about 12,500,000. The John Crerar library, endowed in 1889 by John Crerar, wealthy manufacturer of railway supplies, had in 1933, 575,000 volumes and 300,000 pamphlets on social, physical, natural and medical sciences and their applications. It occupies a large building across the street from the main building of the public library at Randolph street and Michigan avenue. The Newberry library, endowed by a bequest of Walter L. Newberry, in 1933 contained 493,549 volumes, chiefly in the field of the humanities, history and literature. These three libraries co-operate to avoid useless duplication and each has certain special fields. Other important collections are the library of the University of Chicago, the Burnham library of Architecture and the Ryerson library in the Art Institute, devoted to fine arts and travel, the library of Northwestern university, the Chicago Natural History museum, the Rosenwald Museum of Science and Industry, the Virginia, the Illinois Institute of Technology, the Elbert H. Gary law library, the Loyola university, the Garrett Biblical institute and the municipal reference library containing a great collection of documents and data on municipal government in Chicago and elsewhere. Many trade, engineering and professional organizations maintain special libraries at their national or sectional headquarters in Chicago.

Universities and Colleges.—The leading university is the University of Chicago (*see* CHICAGO, UNIVERSITY OF). The professional departments of Northwestern university are mostly located in Chicago while the academic and theological departments are in the suburb of Evanston. Northwestern university was organized in 1851 by the Methodist Episcopal Church and still sustains nominal relations with the denomination. In 1941 it had a student enrolment of 15,400 with 962 instructors. Roman Catholic institutions of importance in Chicago include Loyola university, chartered in 1870, with a department of law called Lincoln college and a medical department; and De Paul university. The College of Physicians and Surgeons is the medical department of the University of Illinois, at Champaign-Urbana. Theological schools independent of the universities include the Presbyterian Theological seminary, the Chicago Theological seminary (Congregational, opened 1858, and including German, Danish-Norwegian and Swedish institutes), the Seabury-Western Theological seminary at Evanston, a German Lutheran Theological seminary and an Evangelical Lutheran Theological seminary. There are a number of independent medical schools and schools of dentistry and veterinary surgery. The Lewis institute (bequest 1877, opened 1896), designed to give a practical education to boys and girls at a nominal cost, and the Armour Institute of Technology, one of the best technical schools of the country, were consolidated into the Illinois Institute of Technology in 1940. The Armour institute was founded in 1892 by Philip D. Armour, and was opened in 1893.

Newspapers.—The morning newspapers published in English are the *Tribune* and the *Sun,* established in 1941.

The afternoon papers are the *Daily News,* the *Herald-American* and the *Daily Times,* an illustrated tabloid. The last two publish an edition Sunday mornings. Formerly supporting upward of a dozen dailies, many of pronounced partisan affiliations, the city of Chicago has no daily newspapers that have other than nominal political party connections. In the number of publications, though not in circulation, the foreign language press outstrips the English publications—foreign language dailies including publications in Polish, Yiddish, German, Swedish, Czech, Greek and Italian. The city is the largest American printing centre in point of volume of output, and many trade, labour, scientific and religious publications are included in its total of approximately 800 periodicals. In 1920 the city's first financial daily, the Chicago *Journal of Commerce,* was established. The Joseph S. Medill School of Journalism named after the founder of the Chicago *Tribune* was opened as a part of Northwestern university in 1921, the *Tribune* underwriting any deficits for a period of years.

Industry and Commerce.—Chicago's situation at the head of the most southwestern of the Great Lakes has given it great importance in trade and industry. The growth of its trade has been marvellous. After the beginning of the 20th century, however, Chicago underwent an industrial and commercial transformation roughly parallel to that of the U.S. as a whole. The city's paramount position as a great market in the 19th century was associated with the extractive industry of the U.S. economy of that day, and Chicago's trade consisted principally in the assembly and distribution of the raw crops and resources of fields and forests—her industries were mainly processing raw products, such as meat packing, woodworking, flour milling, tanning, etc. While these great industries remain important, Chicago's leading position in regard to them, except in meat packing, has disappeared, but this has been made up many times by the growth of an intensive industrialism. The city has made great strides as a centre of the iron and steel industry, including many other products such as cement. The Calumet steel and iron region south of the city made tremendous progress after the founding of the steel city of Gary in 1906 just across the Indiana state boundary, and in manufacturing plants for heavy iron and steel products the Chicago region now stands to the Pittsburgh district—U.S. leading steel region—in the ratio of 10 to 13, while the operations are more continuous in the Chicago district.

The last years of the 19th century showed, however, an inevitable loss to Chicago in the growth of Duluth, Kansas city and other rivals in strategic situations. In particular the struggle of the north and south railway lines in the Mississippi valley to divert grain and other freight to ports on the Gulf of Mexico caused great losses to Chicago. An enormous increase in the cereal trade of Philadelphia, Baltimore, Newport News and Norfolk was partly due to the traffic eastward over lines south of Chicago. The traffic of the routes through Duluth and Canada does not, indeed, represent actual losses, for the traffic is largely a new growth; but there has been nevertheless a considerable drain to these routes from U.S. territory which was once tributary to Chicago. Altogether the competition of the gulf roads and the lines running southwest from Duluth had largely excluded Chicago by 1899 (according to its Board of Trade) from the grain trade west of the Missouri river, its facilities for receiving and distributing remained nevertheless unequalled, and it still practically monopolizes the traffic between the northern Atlantic seaboard and the central west. The city's position as a gateway for passing trade is indicated by the fact that one-eighth of the traffic of its

railway terminals is through traffic.

With the completion of the Lakes to the Gulf waterway, and the conversion of Chicago into a virtual seaport by the construction of a shipway through the lakes and the St. Lawrence river to the Atlantic, Chicago may again become relatively as important as it was in the 19th century, as an outlet for the midwest and the mountain states. New York alone among American cities has a greater trade. Chicago is the greatest railway centre, the greatest grain market, the greatest livestock market and meat-packing centre in the world and holds world primacy in a large number of smaller manufacturing industries.

Chicago has never participated to a great extent in international finance. The collapse of the speculative boom of 1929 and the bankruptcy of the Insull utility investment corporations checked a promising growth of domestic finance and investment banking.

Annual bank clearings for 1940 totalled $16,684,672,188, or about a half of the clearings of 1928. In April 1941 Chicago banks had loans and discounts of $905,546,000, deposits of $4,107,986,000, cash resources of $1,438,296,000 and savings deposits of $635,153,000.

The city's wholesale trade was estimated in 1875 at $293,900,000. In dollar value it reached a peak of $5,870,166,410 net sales disclosed by the census of distribution for 1929. In the ensuing depression money value declined greatly, physical volume to a lesser extent. The retail trade of the city reported by the census of 1939 amounted to $1,514,829,000 in net sales, the wholesale trade to $4,080,415,000 in 1939.

Although the Chicago board of trade remains the greatest speculative grain market in the world, governmental regulations of increasing stringency have restricted trading upon the board.

The grain elevators are yet among the sights of Chicago. They are enormous storehouses into which the grain is elevated from ships and cars, sorted into grades and reloaded for shipment, all the work being done by machinery. America has almost ceased to be an exporter of beef, but shipment of pork products—mostly hams, shoulders, bacon and lard—is yet an important item in Chicago's foreign trade. Chicago's direct foreign trade is mostly by rail through other ports, although vessels of less than 14 ft. draught come in from the Atlantic on special trade voyages. Imports for the fiscal year 1940 (mostly in bond by rail) amounted to $30,980,317. Direct exports for the fiscal year 1940 were valued at $19,867,524.

The Chicago industrial district comprising the counties of Cook, Du Page, Kane, Will and Lake in Illinois and Lake in Indiana is the second largest in the United States. In 1929 the district had 11,774 manufacturing establishments, 550,903 factory wage earners and produced goods valued at $5,558,331,242. In 1937 economic depression had reduced the number of establishments to 9,019. The number of wage earners was 538,775 and the value of goods produced was $4,711,428,323. Substantial recovery began in 1933 but in both manufacturing and trade the depressed condition persisted through 1935. As high as 192,000 families were on public relief rolls in Cook county at one time at a monthly expense of $6,063,207.

Products of manufacturing establishments of the city of Chicago proper in 1937 included meat packing $406,899,668, railway cars $48,656,645, men's clothing $48,725,401, bread and bakery products $94,770,376, foundry products $15,994,832, iron and steel works products $163,961,730, motor vehicles, bodies and parts $14,706,701, paints and varnishes $67,509,197, printing and publishing $230,459,614, furniture $40,756,185, confectionery $80,749,971, radio and phonographs $69,490,588, machine shop products $87,419,280, soap $24,880,925, malt liquors $18,600,014, refrigerators $13,771,039. The International Harvester company, successor to the McCormick Harvester company, is the largest manufacturer of agricultural machinery in the world and the Western Electric company holds the same position in the manufacture of telephone equipment. The Pullman company not only manufactures railway freight and passenger cars but operates sleeping and drawing-room cars on practically all the railways of the country. Meat-packing, for which Chicago is best known, is the greatest local industry. In the enormous stockyards (about 500 ac. in area) from two-thirds to four-fifths of the cattle and hogs received are killed, and sent out in various forms of prepared meats and by-products (lard, fertilizers, glue, butterine, soap, candles, etc.).

Public Utilities.—The development of manufacturing in Chicago has gone hand in hand with an equally remarkable development of public utility services, without which Chicago's industrialism would be impossible, for much of its factory industry is due to an abundance of cheap electric power, supplied by a highly efficient system of interconnected generating stations. The electrical output was 5,574,961,000 kw.hrs. in 1929; in 1939 7,550,378,224 kw.hrs. There are 1,368,163 consumers of electric light and power in Chicago.

The company serving the incorporated city consumes about 3,500,000 tons of coal annually and for condensing purposes alone pumps an average of 1,220,000,000 gallons of water per day; more than the daily pumpage of the city water works. The local gas industry serves 862,930 consumers within the incorporated city and is interconnected by pipe lines with the natural gas fields of Texas and with producing plants and consumers within a wide radius of the city.

It makes use of surplus by-product gases generated in the steel and iron industry. Telephonic communication is in almost universal use by householders and in 1940 the work of converting the telephone system to the automatic switching type was almost completed.

Administration.—Chicago is governed under a general city charter law of Illinois of 1872, accepted by the city in 1876, but the charter has been amended in some minor particular at every biennial session of the Illinois state legislature since that date. The essential framework of government, however, remains as it was originally adopted, and the efforts of municipal reformers to institute a complete new system of local government have been defeated, even when submitted to a referendum of the voters. Although the government remains apparently archaic and highly complicated, it really works about as well as that of the average American municipality, and the faults of municipal government and politics in Chicago relate rather to the polyglot character of the population, than to the forms of government. Chicago remains a good example of the "councilmanic" form of municipal government, once almost universal in the U.S., but the legal and *de facto* powers and influence of the mayor have grown, even as the power of the presidential office has grown at the expense of congressional prestige and effectiveness in the federal government. A common council consisting of one alderman from each of the 50 wards is elected quadrennially. It controls the budget, police, excise (which is of renewed importance since repeal of national prohibition), city contracts and franchises. The latter are subject to popular referendum however. The council confirms appointments by the mayor and may pass legislation in spite of his veto, by a two-thirds vote. The mayor, selected every four years, is the executive head of the city. He appoints a cabinet, consisting of the heads of city departments, but most city employees are under a civil service law and are removable only under processes and tribunals provided by that law. There are several commissions in charge of city functions—such as the school board, the public library commission, the commission in charge of elections, and that in charge of the municipal tuberculosis sanatorium. Administration of several pension funds for city employees is also committed to a number of commissions.

Like most U.S. cities Chicago has a dual city and county government. Cook county, which contains Chicago, retains practically all of the extensive government functions of rural counties of the type which arose in Virginia and the southern colonies, and in which the county was the real unit of local government. This complication of dual government in Cook county extends to the suburbs of Chicago, which have separate municipal organizations, while the county itself was laid out after 1848 in townships, somewhat on the New England town model. It was not until 1900 that the town organizations within the territory gradually annexed to the original village of Chicago were deprived of their politi-



PHOTOGRAPH, CHICAGO AERIAL SURVEY CO.

CHICAGO FROM THE LAKE

Showing the water front view of buildings along Michigan Avenue and the mouth of the Chicago river spanned by the Outer Drive bridge

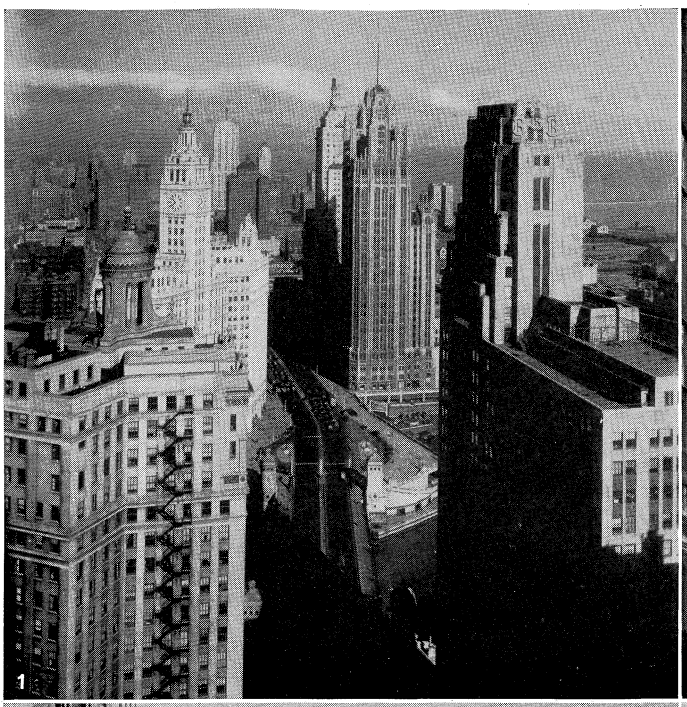


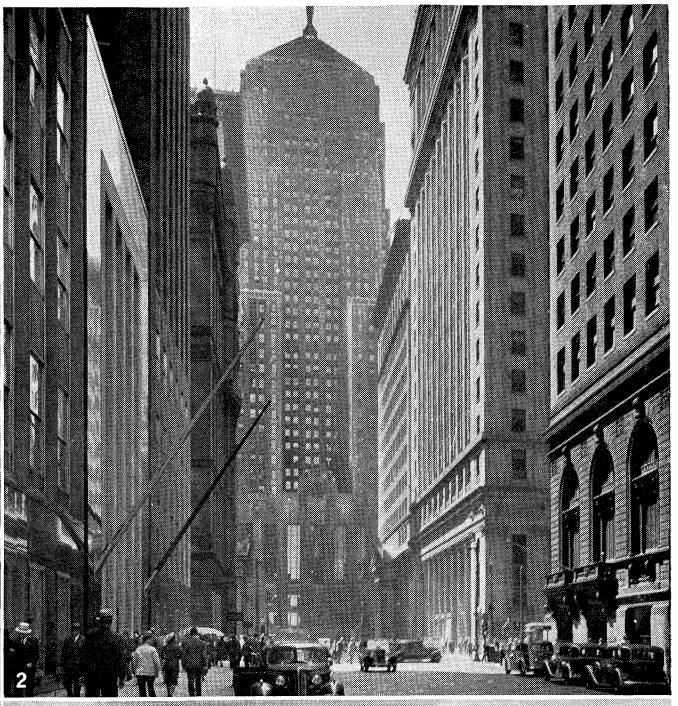
BY COURTESY OF CHICAGO AERIAL SURVEY CO.

CHICAGO FROM THE AIR

A view of the great water front city, looking northward from a point over the Rosenwald Museum in Jackson Park

CHICAGO

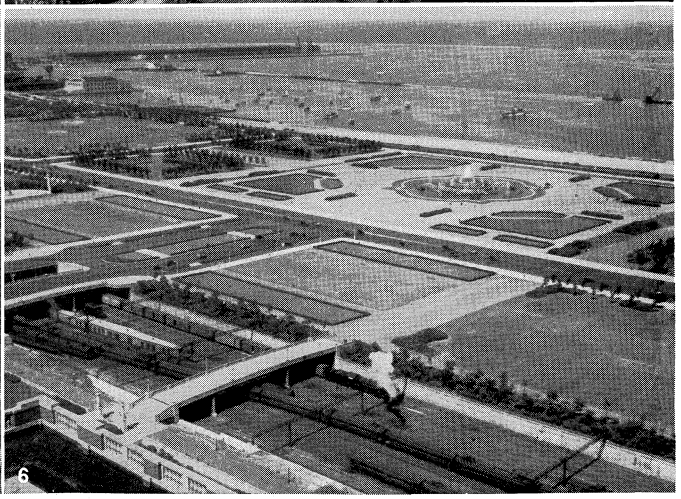












PHOTOGRAPHS, (1-5) KAUFMANN-FABRY PHOTOS, (6) EWING GALLOWAY

DOWNTOWN CHICAGO

1. Michigan avenue, looking north toward the clock tower of the Wrigley building (in the middle distance, left), across the avenue from the Tribune tower
2. La Salle street, in the financial district. In the background is the Board of Trade building
3. A view along Michigan avenue. The low building at the right is the Art institute
4. The lake front, looking toward the south. At the left are Adler planetarium and Shedd aquarium. At right centre is the Chicago Natural History museum behind which is Soldier field
5. The 'gold coast" residential section of downtown Chicago, and Oak street beach
6. View to the north along the lake front, with Navy pier in the distance, and Buckingham fountain at right centre

cal structure and divested of governmental functions within the city, and as late as 1903 ten townships exercised taxing power within the municipal area. A plan for the consolidation of local government was rejected by the people in 1920. In addition to the original duplications of government, new quasi-governmental bodies have been set up for special purposes and in some cases granted police and tax powers.

There are 410 distinct political units in Cook county, empowered to levy 600 different sorts of taxes. The average citizen of Chicago is under the jurisdiction of or in contact with 25 different kinds of governments. But in 1934 the voters approved the consolidation of 22 formerly independent park districts, and these great properties with annual budgets of many millions are now under a board of five appointed by the mayor. Formerly they were a species of independent principalities within the city. Officials of some were appointed by the governor of Illinois, some were elected by the judges of the courts, some by the voters of the districts. They had powers of police, taxation and debt incurment.

In 1906 the archaic system of administering petty justice through the justices of the peace was abolished and a co-ordinated municipal court with numerous judges and a chief justice was established. The juridical system is complicated by the fact that the circuit court is a constitutionally established court of the state of Illinois. The superior, municipal and other special courts are created by statute. The sanitary district, practically an independent government in itself, with powers of tax levy and debt making, is superimposed over the territory of Chicago and Cook county. Both the state of Illinois and the federal government have also extended the legislative and administrative regulation of industry and commerce, and maintain large staffs of officials and inquisitors in Chicago. The school board has been nominally separate from and almost independent of the city government in its powers since 1857. The forest preserves adjacent to the city's boundaries are also quasi-governmental bodies exercising some sovereign powers.

The initiative and referendum in local matters have been made possible by the state, and this power has been frequently exercised. Increases of the public debt are subject to popular vote, but financial arrangements under such a complex system of government are naturally loose and inefficient—co-ordinated budgeting being virtually impossible. The grant of independent taxing power to so many governmental bodies, in the Chicago area, as elsewhere in the U.S., is one result of state constitutional limitations upon the public debt. Chicago, as a municipal corporation, is prohibited from incurring debt in excess of 5% of the value of the property within the city. The inevitable result of such a restriction, when a great public necessity has arisen, is the creation of another taxing body not limited by pre-existing debt limits covering a given territory, within the jurisdiction of an existing governmental body.

Finances.—The budget for the city of Chicago proper for 1941 called for the expenditure of $163,534,844: $15,040,789 by the water department, $2,940,320 by the municipal tuberculosis sanatorium, $2,300,000 by the public library board, $2,750,000 by the board in charge of firemen's pensions, $2,950,000 by the board administering police pensions, and $2,126,711 by the board in charge of pensions for other municipal employees. Other funds in the budget out of which a variety of expenses are met, such as police, fire department and street and bridge maintenance, are the corporation fund of $54,576,941 and the debt service funds, amounting to $13,155,435. The separate school board budget totalled $71,423,286; the park budget, $11,514,136; county budget, $20,828,282. In 1935 Chicago's revenues were disorganized and sadly deficient as the result of the worst financial crisis in the city's history. The full effect of the economic depression of 1929 struck the city in the midst of a general reassessment of real property to adjust gross inequalities of tax burdens. Taxpayers refused or were unable to pay their taxes. Forty-one per cent of taxes due were delinquent in 1933. Teachers and other public employees went for months without pay. Subventions from the federal government in the form of relief allotments and make work grants helped the city tide over its crisis while rigid retrenchments were instituted. On January 1, 1940 the gross city debt was reckoned at $385,264,000 or $113 per capita, not a heavy burden as compared with New York or Philadelphia, but grievous because of demoralized revenues. During the crisis the city sold tax anticipation warrants and practically lived on future revenues, the collection of much of which was dubious.

Transit Problems.—Chicago's conspicuous failure as a city has been in the lack of providing adequate rapid transit facilities.

In 1941 the traction question remained unsettled and was still a "football of politics," although the more recent popular temper was manifested at the referendum election of 1925, when a compromise plan for instituting municipal ownership was defeated by a large majority.

At the mayor's election in 1905 the successful political party stood for municipal acquisition of all roads. Meanwhile, under the State Referendum act, the city in 1902 voted overwhelmingly for municipal ownership and operation (142,826 to 27,990); the legislature in 1903 by the Meuller law gave the city the requisite powers; the people accepted the law, again declared for municipal ownership, and for temporary compulsion of adequate service, and against granting any franchise to any company, by four additional votes similarly conclusive. At last, after tedious negotiations, a definite agreement was reached in 1906 assuring an early acquisition of all roads by the city. The issue of bonds for municipal railways was, however, declared unconstitutional that year. At the municipal elections of 1907 there was a complete reversal of policy; a large majority voted this time against municipal ownership in favour of leaving the working of the street railways in private hands and strengthening the powers of municipal control. For 20 years after 1907 the surface car lines of Chicago were operated under unified management and rendered excellent service. The system was completely rebuilt, and that work led to the repaving of the city, so that the coming of the automobile age found Chicago comparatively well equipped for motor transport. But with the growth of the city and the congestion of the streets by motor traffic, transportation by surface electric railways became too slow to meet the demands of the population. In the meantime the construction of elevated railway lines practically ceased, except for extensions outside the incorporated city limits where the political factor did not enter into calculations. But construction of a subway did not begin until Dec. 17, 1938 when boring of 8·75 mi. of tube 40 to 50 ft. under State, Dearborn, Lake and other streets was begun. In two years the tubes were virtually completed to their connections with the elevated system outside the congested districts, but construction of stations and equipment remained to be done. Money from the city's accumulated traction fund was supplemented by a grant from the Federal Public Works administration to defray the cost of the project. It is planned to make the subway the physical basis for a reorganization of the whole transit system.

Under the franchise arrangement of 1907 the city received 55% of the divisible net receipts of the surface lines—after payment of 5% on agreed capital which with interest earned on the fund amounted to $68,730,228 January 1, 1933. The city also has power to subject adjacent property to special assessments in aid of subway construction. When the 1907 franchise expired in 1927 no agreement was reached.

The lines are operated under temporary agreements pending an adjustment of the conflicting claims and proposals. The state of Illinois has enacted legislation to empower the city of Chicago to take the necessary steps toward a re-organization of the entire transit system. The surface lines, consisting of 1,360 mi. carried 676,335,000 revenue passengers in 1940.

The elevated system operates 231 mi. of track, in double, triple and four track sections, and carried 145,394,000 passengers in 1940. Motorbuses carried 57,893,000.

Education and Charity.—The school board is appointed by the mayor. Since 1904 a merit system has been applied in the advancement of teachers; civil service rules cover the rest of the employees. Free evening schools, very practical in their courses,

are utilized mainly by foreigners. Vacation schools were begun in 1896. As far as possible the school buildings are kept open for school lectures and entertainments, serving as social centres; thus a more adequate use is made of the large investment which they represent. In all the public schools manual training, household arts and economy, and commercial studies are a regular part of the curriculum.

A department of scientific pedagogy and child study (1900) seeks to secure a development of the school system in harmony with the results of scientific study of children (the combination of hand and brain training, the use of audito-visual methods, an elastic curriculum during the adolescent period, etc.). Enrolment in the schools in 1940 totalled 457,433.

The teaching staff numbered 14,500. In 1940 the sum of $6,029,000 was devoted to new school buildings. There were 42 high schools, and 337 grade schools in 1940.

Hospitals, infirmaries, dispensaries, asylums, shelters and homes for the defective, destitute, orphaned, aged, erring, friendless and incurably diseased; various relief societies, and associations that sift the good from the bad among the mendicant, the economically inefficient and the viciously pauper, represent the charity work of the city. The most important charitable societies of the city are the United Charities of Chicago (1909), the United Hebrew Charities (1857), and the Associated Jewish Charities (1900). A famous institution is Hull House, a social settlement of women, which aims at being a social, charitable and educational district centre. It was established in 1889 by the late Jane Addams, who became the head-worker, and Miss Ellen Gates Starr. It includes an art building, a free kindergarten, a fine gymnasium, a crèche and a diet kitchen; and supports classes, lectures and concerts. It has had a very great influence throughout the United States. The major portion of social work in Chicago is performed by 38 general welfare agencies, 24 general health agencies, 110 hospitals and 73 dispensaries, 55 infant welfare centres, 34 agencies for family relief and rehabilitation, 148 child-caring institutions, 70 boarding clubs and hotels for men and women, 29 employment and vocational guidance organizations, 60 homes and emergency shelters for adults, 49 summer camps, 60 institutions for civic, legal and protective work. There are also institutions for the shelter of abandoned and stray dogs, cats and other animals. The total financial outlay, public and private for such work has been estimated by the Chicago Council of Social Agencies at $50,000,000 per year, and it is increasing much faster than the rate of population growth. One of the most important municipal undertakings is the municipal tuberculosis sanatorium, erected after 1909, in which year a site of 164ac. was acquired in the north-western part of the city.

Population.—Of the total population of Chicago as counted in the census of 1930, 842,057 out of a total of 3,376,438 were foreign-born immigrants, 1,006,920 were children of immigrants, and 325,453 were of mixed parentage, 943,301 native white of native parentage, 232,903 negro, and 12,352 were of other races including Chinese, Japanese and American Indian. The effect of the restrictive immigration laws enacted after the war of 1914–18 is notable in the population of Chicago. A heavy influx of native-born white population from the farms and smaller cities, the growth of the negro population and an increased influx of Mexicans, not subject to the quota restrictions imposed upon Europe and the Eastern hemisphere, have already had discernible effects, but the business and political life of the city is still largely coloured by the influence of national and racial blocs. There are over 42 nationalistic and racial organizations of one kind or another, which maintain secretariats in the business district, and many others with headquarters in outlying parts of the city. The largest, most completely organized and politically influential nationalistic groups are the Germans and Irish—very much "Americanized" and losing cohesion—Poles, Swedes, Czechs, Italians, Yiddish speaking Jews. There are still some 40 or more languages spoken in Chicago, and many sections of the city are to all intents and purposes foreign quarters, but the process of assimilation has made the city much more homogeneous than it was at the beginning of the 20th century. In 1920 the negro population was 109,594, an increase of 148·5% over the preceding census. The influx of negroes was due to the demand for unskilled labour, especially in the packing industry, during the period of the World War, when European immigration was slight. A shortage of housing facilities for these negro labourers was one of the underlying causes of the race riots of 1919. The negro influx slackened during the industrial depression of 1920–21, to be resumed in 1923. In the depression years it again declined, and with the rapid development of conveyor and construction machinery to displace manual labour the movement has probably passed its crest.

Partly because of the high percentage of youthful adults in the population of Chicago, drawn to the city from other lands and from the rural districts and smaller cities of the United States, the death rate of the city is among the lowest urban rates in the U.S. In 1939 the death rate was 10 per 1,000 of population. Births maintain a lead over deaths, so that the city has a substantial, natural rate of increase of population, irrespective of immigration. The growth of Chicago has been remarkable even for American cities. Any resident of four-score years living in 1900 had seen it grow from a frontier military post among the Indians, to a great metropolis, fifth in size among the cities of the world. In 1828 what is now the business centre was fenced in as a pasture; in 1831 the Chicago mail was deposited in a dry-goods box; the tax levy of 1834 was $48.90, and a well which constituted the city water-works was sunk at a cost of $95.50; in 1843 pigs were barred from the town streets. Such facts impress upon one, as nothing else can, the marvellously rapid growth of the city.

History.—The river Chicago (an Indian name of uncertain meaning, but possibly from Ojibwa she-kag-ong, "wild onion place") was visited by Joliet and Marquette in 1673, and later by La Salle and others. It became a portage route of some importance, used by the French in their passage to the lower Illinois country. In 1804 the United States established here Ft. Dearborn. In 1812, during the Indian War of Tecumseh, the garrison and settlers, who had abandoned the fort and were retreating toward safety, were attacked and overpowered by the savages at a point now well within the city. The fort was re-established and fitfully occupied until its final abandonment in 1837.

When Cook county was organized in 1831, Chicago, then a tiny village, became the seat of justice. It became a town in 1833 and a city in 1837. By that time Chicago was confident of its future. The Federal Government had begun the improvement of the harbour, and the State had started the Illinois and Michigan canal. There was a Federal land-office also, and the land speculator and town promoter had opened a chapter of history more picturesque, albeit sordid, than in any of the old French days. The giant growth of the lake trade had drawn attention before railway connection was secured with the east in 1852, making progress even more rapid thereafter. During the Civil War a large prison-camp for Confederate prisoners, Camp Douglas, was maintained at Chicago. In 1870 the city had 306,605 inhabitants and was already a commercial centre of immense importance. In 1871 it suffered a terrible calamity. On Oct. 8, a fire broke out near the lumber district on the west side. Two-thirds of the city's buildings were wood, and the summer had been excessively dry, while to make conditions worse a high and veering wind fanned the flames. The conflagration leaped the river to the south and finally to the north side, burned over an area of 3¼m., destroyed 17,450 buildings and property valued at $196,000,000 and rendered almost 100,000 people homeless; 250 lost their lives. The flames actually travelled 2¼m. in an air-line within 6½ hours. Thousands of persons, fleeing before the flames and fire-brands, sought refuge on the shore and even in the waters of the lake. Robbery, pillage, extortion, orgies and crime added to the general horror. In the south side the fire was checked on the 9th by the use of gunpowder; in the north (where the water-works were early destroyed) it had extended almost to the prairie when rainfall finally ended its ravages, after about 27 hours of destruction. A vast system of relief was organized and received generous aid from all parts of the world.

The money contributions from the United States and abroad were $4,996,782; of this foreign countries contributed nearly $1,000,000 (England half of this). These funds, which were over and above gifts of food, clothing and supplies, were made to last till the close of 1876. Out of them temporary homes were provided for nearly 40,000 people; barracks and better houses were erected, workmen were supplied with tools, and women with sewing-machines; the sick were cared for and the dead buried; and the poorer classes of Chicago were probably never so comfortable as during the first two or three years after the fire. The rebuilding of the city was accomplished with wonderful rapidity. The business district was largely rebuilt within a year, and within three there were few scars of the calamity. Wood was barred from a large area (and subsequently from the entire city), and a new Chicago of brick and stone, larger, finer and wealthier, had taken the place of the old. Business and population showed no set-back in their progress. The solidity and permanence of this prosperity were confirmed during the financial panic of 1873, when Chicago banks alone, among those of the large cities of the country, continued steadily to pay out current funds.

In its later history Chicago has been a storm centre of labour troubles, some of them of specially spectacular character. There were great strikes in the packing industry in 1886, 1894 and 1904. But more noteworthy are the railway strike of 1894 and the unsuccessful teamsters' strike of 1905. The former began in the works of the Pullman Car Company, and its leader was Eugene Victor Debs. When the contentions of the Pullman employees were taken up by the American Railway union the strike immediately extended to tremendous proportions. Chicago, as the greatest railway centre of the country and the home of the strike, was naturally the seat of the most serious complications. There was much rioting and destruction of property, and the railway service was completely disorganized. President Cleveland, on the ground of preventing obstruction of the mail service, and of protecting other Federal interests, ordered a small number of Federal troops to Chicago. Governor Altgeld denied the inability of the State to deal with the difficulty, and entered a strong protest against Federal interference; but he did nothing to put down the disorder. Federal troops entered the State, and almost immediately the strike collapsed. The high officials of the Railway union, for ignoring a court injunction restraining them from interfering with the movement of the mails, were imprisoned for long terms for contempt of court.

Out of the strike in the McCormick works in 1886 there sprang another famous incident in Chicago's history. The international anarchists of Chicago had been organized in groups about two years earlier, and were very active. They were advocating a "general strike" for an eight hour day, and the tense excitement among the labourers of the city, owing to the McCormick strike, induced unusually extreme utterances. There was a riot at the McCormick works on May 3, in which several men were killed by the police. An anarchist meeting was called for the next day at the Haymarket, a square in Randolph street, and when the authorities judged that the speeches were too revolutionary to be allowed to continue, the police undertook to disperse the meeting. A bomb was thrown, and many policemen were injured, seven fatally. No person could be proved to have thrown the bomb, or to have been directly implicated in its throwing; but on the ground that they were morally conspirators and accomplices in the killing, because they had repeatedly and publicly advocated such acts against the servants of government, seven anarchists were condemned to death. An application to the United States Supreme Court for a writ of error was unanimously refused.

Four were hanged, one committed suicide, two had their death sentence commuted to life imprisonment, the eighth was sentenced to imprisonment for 15 years. Governor J. P. Altgeld in 1893 pardoned the three in prison on the ground that the jury was "packed" and consequently incompetent, that no evidence connected the prisoners with the crime, and that the presiding judge was prejudiced (*see* an article by Judge J. E. Gary, who presided at the trial, in the *Century Magazine,* April, 1893).

Chicago is still what is known as a union town. Organization of unskilled workers gained after 1936 causing one bitter riot with 10 deaths in 1937. After the war of 1914–18 the effect of the greater mechanization of industry, the increased productivity of labour, the immigration restrictions and the maintenance of high wage rates without strikes, was evidenced in greater industrial tranquillity. In the building trades, however, labour unionism remained a powerful factor, despite a great deal of faction and many charges of corruption and of collusion between labour leaders and gangsters pursuing unlawful avocations. A later phase of trade-union organization has been the extension of unionism among small merchants and shop-owners, for purposes of price maintenance and limitation of competition. The extension of this form of organization has been linked with bombing, terrorism and extortion, but the greater part of the trade-union movement in Chicago has not been affected by such methods.

The 400th anniversary of the discovery of America was commemorated by a World's Columbian Exposition held at Chicago. The site was in Jackson park and the adjoining Midway, and included 686ac., of which 188 were covered by buildings. On Oct. 21, 1892—corresponding to Oct. 12, 1492, O.S.—the grounds were formally dedicated, and on the following May 1, opened to the public, continuing open for six months. The number of paid admissions was 21,500,000; of total admissions 27,539,521. The buildings, planned by a commission of architects—of whom John W. Root and Daniel H. Burnham of Chicago were responsible for the general scheme—formed a collection of remarkable beauty.

Forty years later Chicago threw open the gates of her second international exposition—A Century of Progress, celebrating the centennial of the incorporation of the municipality. In the 1933 period the paid attendance was 22,320,456 and in 1934, 16,314,480. Bold experimental architecture and startling effects in color and lighting were the dominant features of the exposition which laid emphasis upon scientific and technological development. The success of the exposition in the midst of a world wide depression had a stimulating effect upon the city's morale as well as its business.

In the late '90s the city began a great civic awakening. A civil service system was inaugurated in 1895. The salaries of the councilmen were raised with good results. Numerous reform associations were started to rouse public opinion, such as the Citizens' Association of Chicago, organized in 1874, the Civic Federation (1894), the Municipal Voters' League (1896), the Legislative Voters' League (1901), the Municipal Lectures Association (1902), the Referendum League of Illinois (1901), the Civil Service Reform Association of Chicago, the Civil Service Reform Association of Illinois (1902), the Merchants' Club, the City Club (1903), and Law and Order League (1904), Society of Social Hygiene (1906); and many of the women's clubs took an active part. They stood for effective enforcement of the laws, sanitation, pure food, public health, the improvement of the schools and the widening of their social influence, and (here especially the women's clubs) aesthetic, social and moral progress. The Merchants' Club reformed the city's book-keeping, and secured the establishment (1899) of the first State pawnbrokers' society. The Civic Federation demonstrated (1896) that it could clean the central streets for slightly over half what the city was paying (the city has since saved the difference); it originated the movement for vacation schools and other educational advances, and started the Committee of One Hundred (1897), from which sprang various other reform clubs. The Municipal Voters' League investigated and published the records of candidates for the city council, and recommended their election or defeat. Moreover, a municipal museum was organized in 1905, mainly supported by private aid, but in part by the board of education, in order to collect and make educational use of materials illustrating municipal administration and conditions, physical and social.

The reform movement in its various phases came to its full tide under the administration of Carter H. Harrison, Jr., who was elected in his fifth term in 1911, thereby equalling his father's record of elections to the highest office within the gift of the people of the city. In 1912 District Attorney Wayman closed the

city's tolerated vice district, and it has never been allowed to operate openly since.

With the adoption of the prohibition amendment to the Federal Constitution in Jan. 1919, and the flocking to the city of many adventurous characters attracted by the building boom and the prosperity following the war, there was a growth of violent crime in Chicago. The huge profits of the illicit liquor trade led to the organization of powerful criminal gangs to exploit the traffic, and competition between these organizations led to murder and banditry, which attracted world-wide attention.

Growth of the gang system coincided with an era of spoils politics under Mayor William Hale Thompson, Republican—1915–1923 and 1927–1931. The reformist interlude of Mayor William E. Dever, Democrat, 1923–1927 did not abate growing disorders. In 1931 Chicago returned to its normal Democratic moorings under Mayor Anton J. Cermak a machine politician but a man of forceful character who began a clean up of the city. He was shot by a criminal anarchist who was attempting to kill President-elect Franklin D. Roosevelt and hit Cermak by mistake at Miami, Fla.

Cermak died March 6, 1933 but his organization remains firmly entrenched under Mayor Edward J. Kelly, Democrat. Repeal of national prohibition in 1933 followed by vigorous police and court offensives have quelled the organized criminal elements.

Under the centralized regime introduced by Cermak, Chicago politics, long a quasi tribal and feudal system under ward and district leaders, is developing along the lines which Tammany long since laid down in New York—domination by a powerful organization which brooks no rebellion within its ranks. In this change Chicago witnesses the passing of the last of its frontier town characteristics, which persisted for a century.

Because of its central location, Chicago has been America's most famous convention city and the scene of much national political history. Lincoln (1860), Grant (1868), Garfield (1880), Cleveland (1884 and 1892), Harrison (1888), Roosevelt (1904), Taft (1908), Harding (1920) and F. D. Roosevelt (1932, 1940) were all nominated for president in Chicago in addition to a number of unsuccessful candidates nominated in stirring conventions.

BIBLIOGRAPHY.—Annual reports of city departments, school board, park commissioners, etc. Reports of the bureau of the census. Files of the Chicago press. Report of the Committee on Co-ordination of Chicago railway terminals, Engineers' reports on Chicago traction situation. Corporation statements of public utility companies. Reports of the Chicago board of trade. Documents in the Municipal Reference Library of Chicago. A. T. Andreas, *History of Chicago* (1884–86); R. Blanchard, *Discovery and Conquest of the North-west with the History of Chicago* (1898–1903); J. Kirkland, *Story of Chicago* (1892); issues of the *Fergus Historical Series* (1876, ff.); S. E. Sparling, *Municipal History and Present Organization of the City of Chicago* (University of Wisconsin, doctoral dissertation, Madison 1898); T. J. Riley, *A Study of the Higher Life of Chicago* (Chicago university, doctoral dissertation, 1905). Periodical literature contains a vast amount of information on Chicago's progress and conditions that is elsewhere unobtainable; exact references may be obtained in Poole's *Index to Periodical Literature* and *Reader's Guide to Periodical Literature*.

(L. H. L.)

CHICAGO, BURLINGTON AND QUINCY RAILROAD COMPANY, popularly known as the "Burlington Route," incorporated in Illinois Feb. 12, 1849 as the Aurora Branch Railroad Company, and adopted its present name Feb. 14, 1855. The railroad commenced operation in 1850 over 12mi. of track between Aurora and West Chicago. Since then, by construction and by acquisition of other lines, it has grown to about 9,000mi., extending from Chicago and St. Louis to Minneapolis, Omaha, Kansas City, Denver and Billings, Mont. Over 97% of the capital stock of the Burlington is owned in equal parts by the Northern Pacific and Great Northern railways, with which it connects at St. Paul and Billings to form through routes to the Pacific Northwest. The Burlington, in turn, controls the Colorado and Southern railway which provides a rail route from Wyoming to the Gulf of Mexico. The Burlington system, including the Colorado and Southern and subsidiaries, totals about 11,000mi. in 14 States.

The present company, excluding its interest in subsidiary companies, has an investment in railway operating property of about $600,000,000 and has $231,000,000 of funded debt and $171,000,000 par value capital stock outstanding. The railroad handles upwards of 29,000,000 tons of commercial freight each year, of which approximately 40% is mine products, 20% agricultural products, 5% livestock and animal products, 5% lumber and forest products, and 30% manufactures and miscellaneous freight. It carried 3,215,113 passengers during 1939, besides a heavy commutation traffic in Chicago suburban territory. April 9, 1934, the Burlington inaugurated America's first diesel-powered streamline train, the "Zephyr," and now operates a fleet of Zephyrs in high-speed passenger service. (R. Bu.)

CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC RAILROAD COMPANY, successor (Jan. 14, 1928) through reorganization to Chicago, Milwaukee and St. Paul Railroad Company (in receivership after March 18, 1925); owns one of the oldest and largest railroads north and west of Chicago, Illinois. The predecessor company was incorporated in 1863 as Milwaukee and St. Paul Railway Co.—"Chicago" being prefixed in 1874. The oldest part of the present system is the first railroad built west from Milwaukee, Wis. (1851), then the Milwaukee and Mississippi railroad. The "Milwaukee" entered Chicago, Ill., over its own rails in 1873. It had reached, and was the first direct railroad to, St. Paul and Minneapolis, Minn. (1867). Omaha, Neb., was reached in 1882 and Kansas City, Mo., in 1887 and by this latter date the north-west line had been extended to the Missouri river near Mobridge, South Dakota. Further extension westward was begun in 1906, and in 1909 the road was opened for operation to Seattle and Tacoma, Wash., on Puget Sound; 656mi. of this extension across the mountains were subsequently electrified. In 1921 the Chicago, Terre Haute and Southeastern railway tapping the southern Indiana coal fields was acquired under a 999-year lease. In 1922 the stock of Chicago, Milwaukee and Gary railway was acquired and this road (82mi.) was separately operated until 1930, when its property was acquired by the "Milwaukee." Gross revenue from all sources in 1939 was $106,875,380. "Milwaukee" serves 12 States from Indiana to Washington on the North Pacific coast with 10,890 roadway miles. Investment in railroad property and equipment as of Dec. 31, 1939, was $701,219,152. Its capital structure consists of $295,202,483 of fixed interest bearing funded debt; $182,873,693 of contingent interest bearing debt (income bonds), $119,307,300 of preferred stock and 1,174,060 shares of no par common stock. On June 29, 1935, the company filed a petition in bankruptcy. Three trustees, appointed effective Jan. 1, 1936, were (1940) operating the property. Hearings were had before the Interstate Commerce Commission in connection with these proposed plans and the Commission made an order dated Feb. 12, 1940, approving a plan of reorganization set forth in the order. (H. A. Sca.)

CHICAGO, ROCK ISLAND AND PACIFIC RAILWAY, an American railroad extending from Chicago westward, north-westward and southward. It dates from a special Act of the Illinois State legislature, approved Feb. 27, 1847, and amended Jan. 27, 1851. Construction began in Chicago Oct. 1, 1851, and the first train ran from Chicago to Joliet, Ill., a distance of 40mi., on Oct. 10, 1852. The road reached the Mississippi river on Feb. 22, 1854, and there was constructed the first bridge over that river between Rock Island, Ill. and Davenport, Ia., which was opened on Sept. 1, 1854. Since that date the growth of the Rock Island has steadily progressed. At the close of 1938 it comprised about 8,000mi. through 14 Middle Western States, traversing a greater number of commonwealths than any other railroad in the whole United States, and extending from Chicago to Denver and Colorado Springs, Colorado, and Santa Rosa, New Mexico, and from St. Paul, Minnesota, to Fort Worth and Dallas, Texas, with lines into St. Louis, Memphis, Kansas City, Omaha, Des Moines, Oklahoma City, Topeka, Alexandria, Louisiana, and the principal Mississippi valley centres. The total capitalization of all the Rock Island lines as of Dec. 31, 1939, was approximately $517,257,494, including $129,426,689 of capital stock. The charter of the Rock Island and Pacific railway includes the Chicago Rock Island and Pacific and the Chicago Rock Island and Gulf railways. The railroad is noted for the large amount of agricultural and oil traffic it handles. (J. E. G.)

CHICAGO, UNIVERSITY OF, an American university, in Chicago, opened in 1892, privately endowed, co-educational, non-sectarian, although about one-third of its 30 trustees must be Baptists. Its presidents have been William Rainey Harper (Sept. 16, 1890–Jan. 10, 1906), Harry Pratt Judson (Feb. 20, 1907–Jan. 9, 1923), Ernest DeWitt Burton (July 12, 1923–May 26, 1925), Max Mason (Oct. 1, 1925–resigned May 7, 1928), and Robert M. Hutchins (July 1, 1929–).

The aims of the university have been research, advanced education and improvement of general education. These ideals were set up by its first president and expressed in its earliest organization. It has continuously had on its staff men eminent in American letters and science. On its first faculty were nine former presidents of other institutions of higher learning. About 10% of the degrees granted have been doctorates of philosophy.

The university is composed of a College division, devoted to general education; four upper divisions in arts and sciences, namely the Physical Sciences, Biological Sciences, Social Sciences and Humanities; and a group of professional schools, including law, medicine, divinity, business, library science and social service administration. Nearly half of the members of the student body hold the bachelor's degree. The university maintains a branch in Chicago's business district, and a home-study department, for the convenience of those who cannot enroll on the quadrangles.

Guided in its early development by the genius of William Rainey Harper and supported by the generosity of John D. Rockefeller, its founder, and the citizens of Chicago, the university has shown a remarkable growth and has continued through its history to expand and intensify its efforts.

The list of donors of buildings and endowment includes a large group of the public-spirited citizens of Chicago. The grounds of the university include about 160ac., and the university holdings front on both sides of the Midway Plaisance (which joins Washington and Jackson parks) for nearly three-quarters of a mile. On these grounds stands the main part of the university, including some 80 structures. The buildings are of grey limestone, of English Gothic style, and are grouped in quadrangles. Astronomical research is conducted at Yerkes Observatory, Williams Bay, Wis., and, with the University of Texas, at McDonald Observatory, Mt. Locke, Tex. Expedition headquarters for various of the Oriental Institute's expeditions are maintained in the Near East.

In the year ending in June 1939, the enrolment was above 12,500, exclusive of home-study registration. This enrolment is distributed over the four quarters of the normal academic year, about 6,000 being in residence at the quadrangles at any one time and 2,000 at the downtown branch. The University of Chicago was the first American university to adopt the summer quarter as a regular part of the academic program, thus increasing opportunities for teachers in other schools to do scholarly work in their summer vacations and increasing by one-third the usefulness of the academic plant.

The University of Chicago Press, the oldest university press in continuous publication in the United States, publishes the results of scholarly effort at this and other universities. The press publishes from 80 to 90 books annually, in addition to 16 journals, most of which are edited at the university. These journals are: *Astrophysical Journal, Botanical Gazette, Journal of Business, Classical Philology, Ethics, Journal of Geology, University of Chicago Law Review, Library Quarterly, Journal of Modern History, Modern Philology, Physiological Zoology, Journal of Political Economy, Journal of Religion, American Journal of Semitic Languages and Literatures, Social Service Review,* and *American Journal of Sociology.*

A striking revision of the university's organization, made in 1931, has been one of the most significant developments of recent years.

Supplanting the undergraduate college and the graduate schools, which had been organized chiefly according to some 40 departments, there was established a College division, devoted to general education, and four upper divisions for advanced study and research in arts and sciences. Time and course-credit requirements, required class attendance and other forms of routine were largely abolished, and comprehensive examinations, which the student might take when he felt himself ready, were substituted for course-examinations.

Completion of the College division examinations normally requires two years of preparation. The upper divisions, which grant all academic degrees, were organized partly for the purpose of fostering inter-departmental research.

The period 1924–32 saw a remarkable expansion of the physical plant, which involved the expenditure of some $30,000,000 and trebled the available floor-space.

Among new structures are those for physics and mathematics, chemistry, botany, physiology, zoology, physiological chemistry, modern languages, theology, oriental studies, educational research, and social science research; and the University Chapel, student residence halls, gymnasia, service buildings and the International House, a 500-room residence hall and clubhouse intended primarily for use by foreign students of the Chicago region.

Largest of the building projects has been the erection of the hospitals, clinics and laboratories of the South Side medical development.

This enterprise envisages closer co-operation between clinical and basic sciences; medical students are trained in scientific methods and medical teachers and investigators are full-time members of the university staff. Much of the university's clinical teaching, however, continues to be carried on at Rush Medical College on the West Side.

The financial history of the university is in large part that of the liberality of the founder, John D. Rockefeller. His personal contributions amounted to $35,000,000, and the grants of the Rockefeller boards for capital purposes and the subvention of research totalled about $41,700,000 by April 1, 1940.

Total funds of the university on June 30, 1939, were $125,835,441, of which $70,944,248 was endowment fund. Income for the fiscal year 1938–39 was $10,567,953. In that year the number of bound volumes in the university library exceeded 1,271,000 and the number of periodical and serial subscriptions exceeded 5,000.

The faculty of 965 offers some 3,500 courses. By July 1, 1939, the university had granted 45,137 academic and professional degrees, of which 4,059 were doctorates of philosophy.

(J. P. H.; X.)

CHICAGO ACADEMY OF SCIENCES, THE, an institution organized at Chicago, Ill., on Jan. 13, 1857, "to promote and diffuse scientific knowledge," and one of the oldest scholarly bodies existing in Illinois. The collections of the academy, considered at the time among the most valuable in America, were in the Chicago fire of 1871.

With the erection of the new building in Lincoln park in 1893 by Mathew Laflin, a new impetus was given to the establishment of a fine scientific museum. Exhibits featuring the wild life, flora and physical characteristics of the Chicago region are open daily to the public. The academy possesses the Atwood Celestial Sphere, a unique apparatus for demonstrating elementary principles of astronomy. The academy also maintains a public reading room, conducts researches and issues publications on the natural history of the Chicago region, and publishes *The Chicago Naturalist,* a non-technical periodical devoted to natural history.

Free public lectures are given weekly throughout the fall and winter months, and the academy serves as a meeting place for various Chicago societies interested in science and conservation.

The academy is financed through memberships and endowment funds, plus a regular contribution from the Chicago Park District.

(H. K. G.)

CHICAGO AND NORTH WESTERN RAILWAY COMPANY, comprising 8,327mi. operated as of Dec. 31, 1939, in Illinois, Iowa, Nebraska, Wyoming, Wisconsin, Michigan, Minnesota, South and North Dakota. It owned (1939) 1,453 locomotives, 1,394 passenger cars, and 49,846 freight train cars. The balance sheet, as of Dec. 31, 1939, showed fixed property of $555,317,398; investments of $78,753,984, and total assets of $687,853,847. Capital stock consisted of $158,440,300 common and $22,-

395,000 preferred.

Its funded debt held by the public was $332,881,700. The Interstate Commerce Commission's Bureau of Valuation reported, as of Dec. 31, 1935, that cost of reproduction less depreciation, value of lands and rights, working capital and material and supplies aggregated $590,514,094.

It is one of the leading railroads serving the agricultural territory west and northwest of Chicago, as well as large manufacturing districts and markets. Gross operating revenue for 1939 was $87,250,460 and net railway operating income was $5,722,260. It was the first railroad to operate into the city of Chicago, commencing in Oct. 1848, and expanding from that date to its present proportions. (B. Co.)

CHICAGO HEIGHTS, a city of Cook county, Illinois, U.S.A., on Federal highway 30, 28mi. S. of Chicago. It is served by the Chicago and Eastern Illinois, the Chicago, Milwaukee and St. Paul, the Elgin, Joliet and Eastern, the Michigan Central, the Baltimore and Ohio Chicago Terminal, and the Chicago Heights Terminal Transfer railways. In 1900 the population was 5,100; in 1920, 19,653 (31·3% foreign-born white); and in 1940 it was 22,461 by the federal census. Chicago Heights is an important industrial centre, manufacturing chemicals, alloy and steel products, glass specialties, roofing, textiles, school supplies, fertilizers, paints and various other commodities. The city was incorporated in 1901.

CHICAGO SANITARY AND SHIP CANAL, in the United States, is an engineering development of special importance to the city of Chicago and surrounding districts. It was first opened in 1900 and the cost of construction with improvements has been about $70,000,000. Before the construction of the canal Chicago discharged sewerage into Lake Michigan, which was also the source of the water-supply. Such serious contamination resulted that ultimately the extension of water intake pipes for a distance of 4mi. out into Lake Michigan failed to avoid dangerous pollution.

A few miles west of the city, a low limestone ridge marks the division of the watersheds leading to the Des Plaines and Chicago rivers. The Des Plaines, to the west of the ridge, flows southwest to the Illinois river and thence to the Mississippi river. The Chicago river, to the east of the ridge, normally drains into Lake Michigan. A canal channel was dug through the ridge by which the Chicago was connected with the Des Plaines river and at the same time the flow in the Chicago river was reversed from east to west. The sewage of the city is collected in great central city mains, passed through sewage treatment plants and the purified effluent turned into the canal and carried down to the Gulf of Mexico. The canal is 34mi. long, 160ft. wide and 24ft. in depth. In 1939 an average of 1,500 cu.ft. per second was being drawn from Lake Michigan to carry away the drainage of Chicago. Another phase of the project, completed in 1933, was the creation of an all-water route with a minimum depth of 9ft. between the Great Lakes and the Gulf of Mexico.

CHICANE, the pettifogging subterfuge and delay of sharp law-practitioners, also any attempt to gain unfair advantage by petty tricks. A more common English form of the word is "chicanery." Chicane was also used until recent years as a term in the game of bridge for the points a player might score if his hand contained no trumps. Chicane is no longer scored, but the term is still used. The word is French, derived either from *chaugān,* Persian for the stick used in the game of polo, still played on foot and called *chicane* in Languedoc (*cf.* the military use of *chicaner,* to take advantage of slight variations in ground), or from *chic,* meaning little or petty, from the Spanish *chico,* small.

CHICHELEY, HENRY (1364–1443), English archbishop, founder of All Souls college, Oxford, was born, the son of a yeoman, at Higham Ferrers, Northamptonshire. He seems to have passed from Winchester college to New college, Oxford, where he took his B.A. in 1392. He was then ordained sub-deacon, but he already held the living of Llanvarchell, in the diocese of St. Asaph. About 1394 he went up to London to practise as an advocate in the principal ecclesiastical court, the court of arches, and from that time an extraordinary number of posts fell to him. In 1396 he was presented to the rectory of St. Stephen's, Walbrook, and, being ordained deacon and priest later on in the year, he was made archdeacon of Dorset in 1397, and in 1399, canon of the collegiate church of Abergwili, North Wales. In Feb. 1402, he was allowed to use a bull of the pope "providing" him to the chancellorship of Salisbury cathedral and canonries in the nuns' churches of Shaftesbury and Wilton, and in Jan. 1402–3 he became archdeacon of Salisbury. In May 1404, Boniface IX. provided him to a prebend at Lincoln, notwithstanding that he already held prebends at Salisbury, Lichfield, St. Martin's-le-Grand and Abergwili, and the living of Brington.

In July 1405, Chicheley began his diplomatic career by a mission to the new Roman pope, Innocent VII., who was professing his desire to end the papal schism by resignation, if his French rival at Avignon would do likewise. In 1406 he was appointed to treat for peace with the French king, and in the following year he was sent to the new pope, Gregory XII., to end the schism. The pope provided him to the bishopric of St. David's and gave him a bull granting him the right to hold all his benefices with the bishopric.

In Jan. 1409, Chicheley was chosen by the convocation of Canterbury to attend the Council of Pisa, which withdrew obedience from both existing popes and in June elected a new pope. Chicheley now became the subject of a leading case, the court of king's bench deciding, after three successive terms, that he could not hold his previous benefices with the bishopric, and that a papal bull could not supersede the law of the land (*Year-book* ii. H. iv. 37, 59, 79). Accordingly he had to resign livings and canonries wholesale (April 28, 1410), and was enthroned at St. David's in May, 1411. He was with the English force under the earl of Arundel which accompanied the duke of Burgundy to Paris in Oct. 1411, and there defeated the Armagnacs; and in July 1413 was sent by Henry V., with the earl of Warwick, to France to conclude peace. On the death of Archbishop Arundel he was nominated to the archbishopric.

These dates are important as they save Chicheley from the charge, versified by Shakespeare (*Henry V.* act i. sc. 2) from Hall's *Chronicle,* of having tempted Henry V. into the conquest of France for the sake of diverting parliament from the disendowment of the Church. As a matter of fact, the parliament at Leicester, in which the speeches were supposed to have been made, began on April 30, 1414 before Chicheley was archbishop, and the rolls of parliament show that he was not present in parliament. Moreover, parliament was so far from pressing disendowment that on the petition of the Commons it passed a savage act against the heresies "commonly called Lollardry" which "aimed at the destruction of the king and all temporal estates," making Lollards felons and ordering every justice of the peace to hunt them down.

Chicheley was present at the siege of Rouen, and the king committed to him the negotiations for the surrender of the city in Jan. 1419 and for the marriage of Katherine. He crowned Katherine at Westminster (Feb. 20, 1421), and in Dec. baptized her child, Henry VI.

Chicheley is renowned chiefly for his educational foundations. He endowed a chest or loan fund for poor scholars at New college, and another for the university at large. He founded at least three colleges, one at Higham Ferrers and two at Oxford. The licence for the first was given by Henry V. in May 1422. It was closely modelled on Winchester college, and to it was attached an almshouse for 12 poor men. His first Oxford college, St. Bernard's, was founded under licence in mortmain in 1437 for Cistercians. It was suppressed with the Cistercian abbeys in 1539 and granted in 1546 to Christ Church, Oxford, who sold it to Sir Thomas Pope in 1553 for the present St. John's college. The patent for All Souls college, dated May 20, 1438, is for a warden and 20 scholars, to be called "the Warden and College of the souls of all the faithful departed," to study and pray for the souls of Henry V. and Henry VI. and all Englishmen who had died in the wars with France. A papal bull for the college was obtained on June 21, 1439; and further patents for endowments from May 11, 1441, to Jan. 28, 1443, when a general confirmation charter was obtained, for which £1,000 (£30,000 at least of our money) was paid. Only about a quarter of the whole endowment was derived

from alien priories bought by Chicheley from the crown. The rest, particularly the manor of Edgware, which made the fortune of the college, was bought from private owners. Early in 1443 the college was opened by Chicheley with four bishops in state. The statutes, not drawn up until April 2, 1443, raised the number of the college to 40, 16 of whom were to be "jurists" and 24 students of arts and philosophy or theology.

Chicheley died on April 12, 1443, and was buried in Canterbury cathedral.

CHICHEN-ITZÁ or **CHICHEN,** the ruins of an ancient Mayan city of that name, in the south-central part of the State of Yucatán, Mexico, near the boundary of Quintana Roo, about 20° 30′ N. lat. and 88° 30′ W. longitude. The dry, waterless region round about Chichen-Itzá is of limestone formation, with only an underground water supply, available in but a few places called *cenotes* by the Mayans, where the limestone cap has fallen into the caves through which the water flows. Two large *cenotes* determined the location of the city and gave it its distinctive name, *Chi,* which in Mayan means mouths, *chen,* wells, and *Itzá* the name of the particular Mayan tribe or group which first settled there, the whole meaning the "Mouths of the Wells of the Itzá."

Founded not later than A.D. 530, the settlement for about the first century constituted but a frontier post of a Mayan civilization, "The Old Empire," which at that time was flourishing in the much greater centres to the southward—Copan, Tikal, Quiriqua, Palenque and a dozen other equally important cities. When about a century later these great flourishing southern cities were finally abandoned, Chichen-Itzá was also temporarily abandoned, A.D. 668, and the Itzá trekked westward across Yucatán to a new capital, Chakanputun, south of the modern Campeche. Chakanputun was burned in A.D. 944 and the "Holy Men of the Itzá" led their people back to the "Mouths of the Wells of the Itzá" where, in A.D. 964 they re-established their *lares* and *penates* and rebuilt their shrines and altars.

It was the period of the founding of "The New Empire" with Uxmal, Mayapan, and a group of satellite cities, sharing with Chichen-Itzá a superb renaissance of Mayan culture and power. In A.D. 1004 the three greater cities formed an alliance, the League of Mayapan, and the calm and order and prosperity that followed gave rise to a golden age of Mayan religion, science and art, with majestic temples and superb sculptures scattered about the land. At Chichen most of the middle section of the city lying south and west of the Thousand Columns, was built at this time, graced by the Akab'tzib (House of the Dark Writing), the Chichanchob (Red House), the House of the Deer, and parts of the Monjas (Monastery).

In 1201 the League of Mayapan was disrupted by an attack of the Mayapan people upon the Chichen-Itzá because of conspiracies against the League by Chac Xib Chac (The Very Red Man), the Itzan ruler. With the aid of Toltec and Aztec allies from Central Mexico the Mayapan people conquered the Itzans. Henceforth the city was held in thrall by the Toltec-Aztec allies of the Mayapan group. These Toltec-Aztec conquerors brought with them the worship of the fair, golden-haired god, Quetzalcoatl, the "Feathered Serpent," who became "Kukulcan," the Itzan equivalent. During this period Chichen-Itzá rose to heights of prosperity, prominence and architectural development surpassing anything in its earlier history, and highly adorned temples, sanctuaries and shrines rose as if by magic; the principal temple, the so-called Castillo, covering an acre of ground and rising 100 ft. above the plain; the Thousand Columns enclosing a central plaza of more than 5 ac. with pyramid temples, colonnaded halls, sunken courts, terraces and theatres; the Tlachtli-ground or Ball Court; the Temple of the Jaguars; the Temple of the Tables; the Astronomical Observatory; the High Priest's grave; and a host of others.

The two *cenotes,* or wells, upon which the city depended for its very life, constituted the religious, as well as the economic, centre of the city and its culture. Young Itzan maidens were sacrificed to the gods of the wells, as were all kinds of valuables, in gruesome spectacles that drew thousands to share in the ceremonies and the rites, and gave to the city its "holy" character. The natural setting of the wells, the grandeur of the temples built beside them, the austerity and dignity of the rites, all contributed to the lure, and made Chichen-Itzá the Mecca of the Mayan world for almost two and one-half centuries until about the middle of the 15th century when it was rather suddenly and finally abandoned, only a few stragglers making their homes there and doing homage to the old gods.

See S. G. Morley, "Chichen-Itzá, An Ancient American Mecca," *Natl. Geog. Mag.,* vol. xlvii., No. 1, pp. 63–95 (Jan. 1925). (W. E. E.)

CHICHERIN, GEORGHY VASILIEVICH (1872–1936), Russian statesman, the son of an official in the ministry for foreign affairs, was born in Karaul, province of Tambov. He was educated at a Russian Higher school, and at St. Petersburg (Leningrad) university, and entered the diplomatic service in the archives department of the foreign office. From 1897 onward he was gradually drawn into the revolutionary movement. He resigned from the diplomatic service in 1904, renouncing his estates, and went to Berlin, where he followed closely the German Social-Democratic movement. He was at first attached to the Russian socialist-revolutionary party, but later joined the social-democratic party. He was prevented by illness from taking part in the revolution in 1905. He spent 12 years in revolutionary activities in London, Paris and Berlin, being elected secretary of the foreign central bureau of the Russian Social-Democratic party in 1907. In the same year he was arrested in Berlin for the possession of a false passport, and banished from Prussia. During the World War he assisted the anti-war Labour elements in Great Britain, and organized the relief of Russian political refugees, a philanthropic work which had a revolutionary aspect in maintaining contact with Russian revolutionaries. After the Bolshevik revolution in November, when Russia was no longer considered an ally, but an enemy, Chicherin was imprisoned in Brixton gaol on the ground of "enemy associations." On Jan. 3, 1918 he was exchanged for Sir George Buchanan by the Soviet Government, and banished from England. He returned to Russia, and was appointed People's Commissary for foreign affairs in March 1918. In 1922 he headed the Soviet delegation to the conference at Genoa (April 10–May 19) (*q.v.*), of which the unexpected result was a separate treaty between Soviet Russia and Germany. Chicherin conducted Russian policy continuously, from 1918 to 1930, having a longer tenure of office than any contemporary European foreign minister. (For the policy for which he was responsible during this period, *see* RUSSIA.)

CHICHESTER, a city and municipal borough in the Chichester parliamentary division of Sussex, England, 69 mi. S.W. of London by the Southern railway. Pop. (est. 1938) 16,460. Area, 4.48 sq.mi. It lies in the coastal plain at the foot of a spur of the South Downs, a mile from the head of Chichester harbour, an inlet of the English channel. The Romano-British town on this site was perhaps Regnum or Regni. Situated on one Roman road in direct connection with London and another leading from east to west, Chichester (*Cesseceastre, Cicestre*) remained of considerable importance under the South Saxon kings and it had a mint in 928. Domesday book speaks of 97½ haws, or building plots, in Chichester and a charter of Henry I mentions the borough, but the earliest extant charter is that of Stephen, about 1135, granting the burgesses the rights of a borough and gild merchant, as they held them in the time of William I. This grant shows the Chichester gild merchant to be possibly the oldest in the country. This was confirmed by Henry II *c.* 1155. By a charter of Edward II, the customs of wool, hides and skins were reserved to the king. Edward III directed that the Sussex county court should be held at Chichester. Confirmations of the previous charters were granted by many later sovereigns. James II in 1685 granted the charter now in force. Chichester returned two members to parliament from 1295 to 1867, and one member from then until 1885. Throughout the middle ages Chichester was a place of great commercial importance, Edward III establishing a wool staple there in 1348. Chichester had five fairs in 1889; all but Sloe fair (*c.* 1107–08) were abolished. Fuller mentions the Wednesday market as being famous for corn, while Camden speaks of that on Saturday as the greatest for fish in the county.

The cathedral church of the Holy Trinity was founded towards the close of the 11th century, after the see had been removed to Chichester from Selsey in 1075. It was consecrated in 1108; Bishop Ralph Luffa (1091–1123) was the first great builder, followed by Seffrid II (1180–1204), but disastrous fires led to further building throughout the 13th century. Norman work appears in the nave (arcade and triforium), choir (arcade) and elsewhere; but there is much very beautiful Early English work, as in the choir above the arcade. The nave is remarkable in having double aisles on each side, the outer pair being of the 13th century. The church is also unique among English cathedrals for its detached campanile, a massive and beautiful Perpendicular structure with the top story octagonal. Modern restorations, which include the fine central tower and spire (originally 14th century), the Decorated Lady Chapel and the Perpendicular cloisters, have been effected with great care. The library is a fine late Norman vaulted room; and the bishop's palace retains an Early English chapel. The cathedral is 393 ft. long within, 131 ft. across the transepts, and 90 ft. across the nave with its double aisles. The height of the spire is 277 feet. At the junction of the four main streets of the town, which preserves its Roman plan, stands an octagonal market cross, in ornate Perpendicular style, built by Bishop Story, *c.* 1500, perhaps the finest of its kind in the United Kingdom. The hospital of St. Mary was founded in the 12th century, but the existing buildings are transitional from Early English to Decorated. Its use as an almshouse is maintained. Other ancient buildings are St. Olave's church, in the construction of which Roman materials were used; the Guildhall, formerly a Grey Friars' chapel, of the 13th century; the Canon gate leading into the cathedral close; and the Vicars college. The city retains a great part of its ancient walls, which have a circuit of about a mile and a half, and at least in part, follow the line of Roman fortifications. There is a theological college, a women teachers' training college and a blue-coat school. A new county office building was opened in 1938. The town has a large cattle market and a considerable agricultural trade, but no outstanding industry. A canal connects with Chichester harbour. The diocese includes the whole county of Sussex except a few parishes, with very small portions of Kent and Surrey.

See *Victoria County History*, "Sussex"; Alexander Hay, *History of Chichester* (Chichester, 1804).

CHICHESTER OF BELFAST, ARTHUR CHICHESTER, Baron (1563–1625), lord-deputy of Ireland, second son of Sir John Chichester of Raleigh, Devonshire, was educated at Exeter college, Oxford. He commanded a ship against the Spanish Armada in 1588, and is said to have served under Drake in his expedition of 1595. Having seen further service abroad, he was sent to Ireland at the end of 1598 and was appointed by the earl of Essex to the governorship of Carrickfergus. When Essex returned to England Chichester served under Mountjoy in the war against the rebellious earl of Tyrone, and in 1601 Mountjoy recommended him to Cecil as the fittest person to be entrusted with the government of Ulster. On Oct. 15, 1604, Chichester was appointed lord-deputy of Ireland. He announced his policy in a proclamation wherein he abolished the semi-feudal rights of the native Irish chieftains, substituting for them fixed dues, while their tenants were to become dependent "wholly and immediately upon his majesty." Tyrone and other Irish clan chieftains resented this summary interference with their ancient social organization, and their resistance was strengthened by the ill-advised measures against the Roman Catholics which Chichester was compelled to take by the orders of the English ministers. He himself was moderate and enlightened in his views on this matter, and it was through his influence that the harshness of the anti-Catholic policy was relaxed in 1607. Meantime his difficulties with the Irish tribal leaders remained unsolved. But in 1607, by "the flight of the Earls," he was relieved of the presence of the two formidable Ulster chieftains, the earls of Tyrone and Tyrconnell. Chichester's policy for dealing with the situation thus created was to divide the lands of the fugitive earls among Irishmen of standing and character; but the plantation of Ulster as actually carried out was much less favourable and just to the native population than the lord-deputy desired. In 1613 Chichester was raised to the peerage as Baron Chichester of Belfast, and in the following year he went to England to give an account of the state of Ireland. On his return to Ireland he again attempted to moderate the persecuting policy against the Irish Catholics which he was instructed to enforce; and although he was to some extent successful, it was probably owing to his opposition to this policy that he was recalled in Nov. 1614. The king, however, told him, "You may rest assured that you do leave that place with our very good grace and acceptation of your services"; and he was given the post of lord-treasurer of Ireland. After living in retirement for some years, Chichester was employed abroad in 1622; in the following year he became a member of the Privy Council. He died on Feb. 19, 1625, and was buried at Carrickfergus.

CHICHIBU, PRINCE: *see* Yoshihito.

CHICKADEE, common American name (derived from the call-note) for the black-throated, black-capped titmouse (*Parus atricapillus*), of the northern states and Canada. The brown-capped chickadee (*P. hudsonicus*) is resident in Canada and northern New England. The smaller Carolina chickadee (*P. carolinensis*) breeds in the southeastern states. The mountain chickadee (*P. gambeli*) is resident in the Rocky Mountains and westward, and has a white stripe over the eye. The Alaska chickadee (*P. cinctus alascensis*) is also found in eastern Siberia. The chestnut-backed chickadee (*P. rufescens*) lives on mountains from Alaska to Montana and California. Others are found in Mexico. All are closely allied with the old world titmice, but have no crest. (*See* Titmouse.) (G. F. Ss.)

CHICKAMAUGA. The battle of Chickamauga was fought (Sept. 19–20, 1863) in northern Georgia between the Federal army of the Cumberland under Rosecrans and *Bragg's* Confederate army. It was the one great Confederate victory in the West, rendered indecisive by subsequent events. *Bragg*, afraid of being surrounded in Chattanooga, evacuated the town, which Rosecrans occupied (Sept. 9), and withdrew to Lafayette, where he awaited reinforcements from Virginia under *Longstreet* before fighting a pitched battle. Rosecrans, when *Bragg* was found not to be retreating on Rome, hastily concentrated his three corps (Sept. 17), his left (Crittenden) on West Chickamauga creek at Lee and Gordon's mills, 12 m. S. of Chattanooga, and his right (McCook) at Stevens' gap in Lookout mountain. *Hood* with three brigades joined *Bragg* (Sept. 18), who that day had begun to move down the east bank of the creek to outflank Crittenden at the mills. His right column crossed 4 m. below, and the movement was to be taken up by the other columns in succession from right to left. *Bragg* expected to envelop Crittenden and drive Rosecrans back upon Lookout mountain, cutting him off from Chattanooga. Only two Confederate columns crossed that day; three more divisions followed early next morning. But during the night Rosecrans, who had been shifting his army all day to the left, moved Thomas's corps from the centre to the extreme left, to secure his line of retreat to Chattanooga. Thomas's night march defeated *Bragg's* plan. He was now forced to deliver battle north of the mills, to prevent his own right from being turned. Thick woods concealed the movements of both armies, and the fighting consisted of a series of independent engagements, in which each side alternately outflanked and was outflanked by the other. The battle began (Sept. 19) with Thomas sending a division on a reconnaissance towards the creek. It encountered dismounted cavalry. Both sides hurried up reinforcements and the fighting spread southward, until the whole of Rosecrans' and the greater part of *Bragg's* forces had been drawn in. The general result was favourable to Rosecrans. He had strengthened his hold on the roads in his rear, but he had put in all his forces, except three brigades of Granger's reserve corps, which were holding Rossville gap, whereas *Bragg* had still three divisions in hand and during the night was joined by three fresh brigades.

For the morrow's battle *Bragg* reorganized his army in two wings, the right under *Polk*, the left under *Longstreet*, who arrived at 11 P.M., and decided to persevere with his progressive order of attack. *Polk* was ordered to advance at sunrise (Sept. 20), but the battle only began some hours later. Thomas had strengthened

his line during the night with breastworks. *Polk's* right overlapped Thomas's left, and two brigades worked round the breastworks into his rear, but were driven out by his reserves. *Polk's* frontal attacks were repulsed, but Thomas urgently called for reinforcements to secure his left. Rosecrans, believing that *Bragg* was massing all his troops against Thomas, ordered the best part of three divisions to the left. The withdrawal of a fourth (Wood's), due to a misunderstanding, opened a gap in the Federal line, into which *Longstreet* stepped. He had organized a heavy column of attack with eight brigades in three lines and another division forming a flankguard on his left. The Federal right wing, now numbering less than 7,000 men, was swept off the field, but not being pursued, rallied in McFarland's gap. Rosecrans, McCook and Crittenden were all caught in the rout and went to Chattanooga. The break in the Federal line occurred about noon. Thomas was left with five divisions (including one from each of the other two corps) and two or three brigades to withstand *Bragg's* whole army. *Longstreet,* swinging to the right, endeavoured to reach Thomas's rear. Four of Thomas's divisions continued to hold the breastworks in *Polk's* front, but Brannan's division and part of Wood's formed a fresh line nearly at right angles with Thomas's main position along Horseshoe ridge, a spur projecting from Missionary ridge. *Longstreet* had almost enveloped Brannan's right, when two of Granger's brigades under Steedman came to the rescue, and after a desperate struggle dislodged the attacking force, and the Federals held the ridge against renewed assaults, until *Longstreet,* having vainly called for reinforcements from *Polk's* wing, put in his reserve division. The Federals were then driven back from the ridge, with the loss of three regiments captured, to the Snodgrass hill, an elevation 50 ft. lower and over 200 yd. to the rear. Thomas, on receiving an order about 4.30 P.M., had already ordered his left wing to withdraw. *Polk,* who had remained inactive since his repulse in the morning, about 4 P.M. had recommenced his attacks, but the four Federal divisions succeeded in extricating themselves. The right, on Snodgrass hill, was then withdrawn, before *Longstreet* could renew the attack. The Confederate pursuit was halted at 6 P.M., at which hour the whole field was in their possession. Thomas took up a position for the night covering Rossville, and *Bragg's* army being too exhausted to attack next day, after dark (Sept. 21) the Federals withdrew unmolested to Chattanooga. The two armies were probably of about equal strength, from 60,000 to 65,000 each. The percentage of losses was heavier than in any other battle of the Civil War, the casualties on either side exceeding 16,000.

See Gracie, *Truth about Chickamauga* (1911); Geer, *Campaigns of the Civil War* (1926). For a very different version, claiming a Federal victory, *see* Massachusetts Military Historical Society, vol. vii.

(W. B. Wo.)

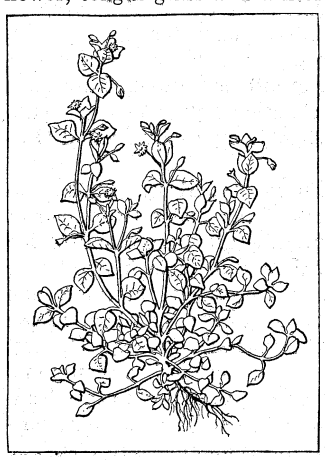
CHICKASAW, an American Indian people of Muskogi stock for long resident in northern Mississippi, and later forming one of the "five civilized tribes" of Oklahoma. They were foes of the French, friends of the British, and fierce fighters. They never numbered more than about 5,000, which is also their present population, although this comprises many individuals of mixed blood. (*See* MUSKOGIAN INDIANS.)

See Adair, *History of the American Indians* (1775).

CHICKASHA, a city of Oklahoma, U.S.A., on the Washita river, 45 mi. S.S.W. of Oklahoma City; the county seat of Grady county. It is on federal highways 81 and 277, and is served by the Rock Island, the Frisco and the Santa Fe railways. In 1930 the population was 14,099. By the federal census of 1940 it was 14,111. Chickasha is the trade centre of a diversified farming, livestock and dairy region. The city has cotton gins, compresses, flour and oil mills. The Chickasha natural gas field is one of the largest in the world. The Oklahoma College for Women, one of the highest ranking colleges of its kind, is located there. Chickasha was founded in 1892. In Indian language Chickasha means rebel.

CHICKEN-POX or varicella, a specific contagious disease characterized by an eruption of vesicles in the skin. The disease usually occurs in epidemics, and the patients are generally between two and six years old. The incubation period is from ten to 15 days; there are practically no prodromal symptoms, though slight fever for some 24 hours may precede the eruption. A number of raised red papules appear on the back or chest; in from 12 to 24 hours these develop into tense vesicles filled with a clear fluid, which in another 36 hours or so becomes opalescent. During the fourth day these vesicles shrivel up, and the scabs fall off, leaving as a rule no scar. Fresh spots appear during the first three days, so that at the end of that time they can be seen in all stages of growth and decay. The eruption is most marked on the chest, but it also occurs on the face and limbs, and on the mucous membrane of the mouth and palate. The temperature begins to fall after the appearance of the rash, but may sometimes persist slightly after the disappearance of all symptoms. It rarely rises above 102° F. The disease runs a very favourable course in most cases, and after-effects are rare. One attack does not give immunity. The diet should be light, and the patient should be prevented from scratching the spots, which would lead to ulceration and scarring. After the first few days there is no necessity to confine the patient to bed. In the large majority of cases, it is easy to distinguish the disease from smallpox, but sometimes it is very difficult. The chief points in the differential diagnosis are as follows: (1) In chickenpox the rash is chiefly on the trunk, and less on the limbs and face; (2) some of the vesicles are oval, whereas in smallpox they are always hemispherical. They have not at the outset the hard shotty feeling of the more virulent disease; (3) the vesicles attain their full growth within 12 to 24 hours; (4) the rash appears "in crops"; (5) there is no prodromal period. No doubt the disease is caused by a micro-organism, but so far this has not been determined with certainty. The tendency is to ascribe it to a filter-passing virus (*q.v.*).

CHICKWEED (*Stellaria media* or *Alsine media*), an annual herb of the pink family (Caryophyllaceae), called also satin-flower, tongue-grass and winter weed. It is native to Europe and Asia and widely naturalized throughout North America and other regions. The plant has weak, reclining, much-branched stems, oval or ovate leaves about 2 in. long and small white flowers. In mild climates it is found blooming throughout the year; in colder regions, as in the north-eastern U.S., it withstands severe frosts and may be discovered blossoming under light snow in midwinter. Various other species of *Stellaria* and also of *Arenaria* are known as chickweeds. Closely allied are the mouse-ear chickweeds (*Cerastium* sp.), various species of which are found in Great Britain, North America and other temperate regions. Most plants called chickweed, though abundant as weeds, are readily eradicated by cultivation. Perennial species are sometimes persistent in lawns.



BY COURTESY OF IOWA GEOLOGICAL SOCIETY

CHICKWEED, A COMMON GARDEN WEED USED AS FOOD FOR CAGED BIRDS

CHICLANA DE LA FRONTERA, a town of southern Spain, in Cádiz province, 12 mi. S.E. of Cádiz. Pop. (1940) 14,337 (mun., 17,047). Owing to its position in the fertile valley of the Irio, facing the Gulf of Cádiz, 3 mi. W., Chiclana is the centre of a great fruit and vine growing district, and is the favourite summer residence of wealthy Cádiz merchants. Its hot mineral springs also attract many visitors. About 5 mi. S. is Barrosa, where the British under Sir Thomas Graham (Lord Lynedoch) defeated the French under Marshal Victor, March 5, 1811.

CHICLE or **CHICLE-GUM,** the coagulated milky juice (latex) of the sapodilla or naseberry (*Sapota achras*), a tropical American tree of the family Sapotaceae, the fruit of which is widely used in all tropical regions. The latex was first taken to the United States as a substitute for rubber or balata, but be-

ginning about 1890 was imported in increasing quantities, being the basic ingredient of modern commercial chewing gum. The latex is collected by tapping the trunk after the manner followed for gathering balata and gutta percha (*qq.v.*); zigzag deep cuts are made to a height of 30 ft. or more up the trunk. The very viscous "milk" oozes out and runs slowly down to a receptacle placed at the base of the tree, the flow lasting for hours and amounting at times to many quarts. The *chicelero* collects the chicle from his "walk" of trees once a day, gathering about a ton per season from 200 to 300 or more trees, which are rested from four to seven years between tappings, about 15% being lost by this treatment. Practically all the gum comes from Yucatan and adjacent El Petén in Guatemala from wild trees, but attempts to grow it in plantations have been started in British Honduras. The coagulated raw gum is boiled in large kettles until a water content of about 33% is attained; the semisolid mass is then poured into wood forms and moulded into *marquetas* or blocks of about 25 lb. weight, which are packed for transportation in bales of four blocks each. For manufacture into chewing gum the grayish-brown blocks are re-melted, foreign matter is removed, sugar and flavouring substances are added, and the finished product moulded and wrapped in packages. After 1924, the scarcity of chicle resulted in the importation into the U.S. of jelutong from the East Indies, a gum derived from *Dyera costulata* (family Apocynaceae), often called wild rubber. It is mixed with chicle to make chewing gum.

CHICO, the largest city of Butte county, Calif., U.S.A., 96 mi. N. of Sacramento on the Southern Pacific railway. The population in 1930 was 7,961; in 1940, 9,287. Almonds, prunes and other fruits, alfalfa, rice and other grains are produced in the region. The city has a match factory, flour and rice mills, fruit packing houses, creameries; and manufactures electrical railroad cars, packing cases, millwork, concrete pipe, beet sugar, matches, brooms, soap and sheet metal work. A state college and a federal plant-introduction station are situated there. In Bidwell park (2,400 ac.) is the Hooker oak which has a diameter of 9 ft. and a spread of 150 ft. Lassen peak (10,465 ft.), the only active volcano in the U.S.A., which had 220 eruptions between May 1914 and Jan. 1916 is 65 mi. N.E., in a national park of 125 sq.mi. Gold and silver are mined in the county, especially around Oroville, the county seat.

CHICOPEE, a city of Hampden county, Mass., U.S.A., just north of Springfield, on the east bank of the Connecticut river at the mouth of the Chicopee, and served by the Boston and Maine railroad. It has an area of 22.9 sq.mi., and includes five villages: Chicopee Center, Chicopee Falls, Willimansett, Fairview and Aldenville. The population in 1920 was 36,214, of whom 12,182 were foreign-born white (4,669 from Poland); in 1940 (federal census) 41,664. The Chicopee falls 70 ft. there in less than 3 mi., furnishing power for numerous factories. Among the other leading manufactures are firearms, swords, automobiles and tires, agricultural implements, gymnasium apparatus and lodge regalia. The assessed valuation of property in 1940 was $41,000,000.

Chicopee was settled about 1638; was set off from Springfield as an independent town in 1848; and was chartered as a city in 1890. The name is an Indian word meaning "cedar tree" or "birchbark place." Chicopee Falls was the home of Edward Bellamy. The bronze-casting industry (not now carried on) was founded there by Nathan Peabody Ames (1803–47), a sword-maker, who in 1836 began the manufacture of cannon balls and church bells. Some of the finest bronze work in the country has been done here including the doors of the national capitol.

CHICORY, *Cichorium intybus* (family Compositae), in its wild state is a native of Great Britain, occurring most frequently in dry chalky soils and by roadsides. It has a long fleshy taproot, a rigid branching hairy stem rising to a height of 3 to 5 ft., the leaves around the base being lobed and toothed, not unlike those of the dandelion. The flower heads are of a bright blue colour, few in number, and measure nearly an inch and a half across. Common chicory is cultivated extensively on the continent of Europe—the Netherlands, Belgium, France, Germany. Its roots roasted and ground are used as a substitute for, adulterant of, or addition to coffee; both roots and leaves are employed as salads; and the plant is grown as a fodder or herbage crop for cattle. In Great Britain it is chiefly in connection with coffee that chicory is employed. A large proportion of the chicory root used for this purpose is obtained from neighbouring continental countries; but a considerable quantity is cultivated in England, chiefly in Yorkshire. It gives the coffee additional colour, bitterness and body.

The blanched leaves are much esteemed by the French as a winter salad, *Barbe de capucin.* In Belgium a variety of chicory called *Witloef* (or witloof) is preferred. There, also, the fresh roots are boiled and eaten with butter, and throughout the continent the roots of witloof are stored for use as salads during winter.

In North America chicory is an introduced weed which has become widely distributed. It is abundant in pastures and along roadsides in the eastern United States and Canada, and is usually considered a pest. As a cultivated crop common chicory is grown to some extent for its root. Witloof chicory (French endive) is grown to some extent as a forcing crop. The roots are grown in the open during the summer and are taken up in the fall to be forced during the winter. If the seed is sown early in the spring in temperate regions having a growing season of five and one-half to six months, the plants may go to seed instead of forming large storage roots suitable for forcing. In such regions seed should be sown in June. The roots may be forced under greenhouse benches, in cellars or out of doors. (*See* also ENDIVE.)

CHICOUTIMI, industrial town and capital of Chicoutimi county, Quebec, Canada, on the Saguenay river (*q.v.*), 227 mi. N. by E. from Quebec, on the Canadian National, and Roberval and Saguenay railways; it is also connected with Quebec by regular steamship lines. Pop. (1941) 16,040. It is the centre for one of the greatest hydro developments on the North American continent. The district also has pulp and paper developments.

CHIDAMBARAM, a town of British India, in the South Arcot district of Madras, 7 mi. from the coast and 151 mi. S. of Madras by rail. Pop. (1941) 26,212. The fine pagodas at Chidambaram are the oldest in the south of India. Here is supposed to have been the northern frontier of the ancient Chola kingdom. The principal temple is sacred to Siva, and is visited by huge numbers of pilgrims.

CHIEF, the head or upper part of anything, and so, in heraldry, the upper part of the escutcheon, occupying one-third of the whole (Fr. *chef,* head, Lat. *caput*). The phrase "in chief" (Med. Lat. *in capite*) is used in feudal law of the tenant who holds his fief direct from the lord paramount (*see* FEUDALISM).

CHIEF JUSTICE. In the various states of the United States there is uniformly some constitutional provision for a court of last resort, but the organization of that court varies materially. In the older states, notably those in existence at the time of the adoption of the federal constitution, the provisions of the constitution are very sparse in detail, though ample in scope, leaving all elaboration and the establishment of inferior courts to legislative action. In the newer states, the constitutions frequently outline the judicial system at some length from the highest to the lowest court, leaving little to statutory enactment.

The highest court in any state is almost universally presided over by a chief justice, vested with authority over the ordering of the business of the court. His selection may follow one of several modes:—(1) In states where judges are appointed, as in Massachusetts, the chief justice is himself chosen by the appointing authority, usually the governor, who acts sometimes with the consent of the governor's council and sometimes with the advice and consent of the upper house of the legislature, as in the case of the Maryland court of appeals. (2) In a large number of states the judges are elected by the people for terms varying from 6 to 12 years, and there are regular elections of new judges at intervals shorter than the term of office, usually every two years. The chief justice in such instances is the judge whose term is most nearly at an end, providing he has not been specially appointed or elected to fill a vacancy. Thus the judge who has been longest on the court is its leader. This principle, applied sometimes in slightly different ways, is followed, for example, in

Arizona, Colorado, Idaho, Iowa, Nevada, Missouri, Pennsylvania and other States. (3) In Illinois the Supreme Court judges, after election, select one of their own number as chief justice. (4) In Florida the chief justice is selected by lot from the judges elected to the highest court.

The chief justice in the highest State courts is not only the presiding judge when the court is sitting in banc. He likewise has charge of the distribution of the work of the court among its several judges. In some States, such as California, where the State is divided into departments and the work of the judges of the court of last resort consists both in hearing cases in the various judicial departments and also in hearing cases appealed to the court sitting as a whole, the chief justice frequently has authority to apportion business among the departments, may order any cause to be heard and decided by the court in banc, and may convene the full court at any time.

In Delaware a somewhat specialized system is in operation. There a chancellor, chief justice and four associate judges are appointed by the governor with the consent of a majority of the senate. The chancellor, as the name implies, exercises a final authority over equity matters in all equity cases except those which are appealed to the court of last resort. In that event the chief justice sits with associate judges to hear the appeal, the chancellor always being absent. Where, however, law, as opposed to equity matters come before the final court, the chief justice yields his place to the chancellor, who in turn sits with the associate judges as the court of last resort. A somewhat similar differentiation between law and equity exists in New Jersey.

Through the promulgation of rules the courts of last resort in the various States frequently exercise an important regulatory power over the inferior courts, in that way marking the course of procedure in the handling of judicial business. But this regulation is normally only of the more general type and the inferior courts themselves, being more intimately acquainted with their own problems, are usually given considerable freedom in the ordering of their affairs through the establishment of their own rules.

(R. P. B.)

CHIEF RENT, the annual rent paid by the freeholders of an English manor to its lord. It is a payment which clears the freeholder from all obligations and dues to the lord of the manor. (*See* QUIT RENT.)

CHIEFS. Chieftainship occurs among many but not all primitive peoples at all levels of culture. Its essential feature is the fact that there is always some individual person who is regarded as the official head of the community, and who acts as its leader, ruler and representative. Almost everywhere he bears some distinctive title; and by virtue of his office he frequently enjoys special rights and privileges, and is held in a high degree of honour and appreciation by the other members of the community.

Forms of Chieftainship.—The institution varies according to the size and structure of the community. Among the lower hunting peoples, where the political unit is a small local group, there is generally only a single chief; and this is also the case even among such relatively advanced peoples as the Bantu tribes of South Africa. Elsewhere there may be found a dual chieftainship, as, *e.g.,* under the dual organization (*q.v.*), where each moiety often has a chief of its own. Or, as among many North American and Melanesian tribes, there may be a division of functions resulting in the occurrence of two chiefs, one of whom is generally associated with the economic and religious side of tribal life, while the other is associated with the military and profane aspects. Thus, among the Mekeo peoples of New Guinea, each clan possesses two chiefs, the high chief and the war chief, while among the neighbouring Roro peoples, the high chief is associated with another, whose business it is to see that the orders of the high chief are carried out. In both cases the functions of the high chief are mainly of a sacred kind. Again, as in Polynesia and parts of Africa, where the community is divided into a number of distinct social classes, there may be several chiefs or grades of chiefs. In general, with the advance in political organization, political powers and functions are multiplied and diversified, and this increasing complexity of duties and functions requires the existence of different grades of officers. Thus, the highly organized Iroquois and Creek of North America have civil chiefs and sub-chiefs, chosen for personal merit, and permanent and temporary war chiefs. These several grades of chiefs bear distinctive titles, indicative of their diverse jurisdiction.

In most communities the office of chief is hereditary within a certain family or group of families, so that only members of this family or group of families can become chiefs. Where inheritance is thus recognized it is almost always reckoned in the male line. The chieftainship goes only exceptionally to a woman, and then usually only in default of a suitable male successor. Female chiefs occur sporadically, especially in parts of Africa, but there is hardly a single people among whom the chiefs are regularly women. The rule of descent generally follows that of the community. Where it is patrilineal, the chief is usually succeeded by one of his sons, most frequently the eldest, but primogeniture is by no means universal. In matrilineal societies, the successor is normally a brother of the chief, or one of his sister's sons. Even where the office is thus inherited, however, the succession is often dependent upon the fulfilment of certain conditions. If the rightful heir is regarded as incompetent, or is physically unsound, or suffers from some other disability, he may be passed over. Sometimes he is required to pass through certain tests before he is allowed to take up office.

In other communities the chief is elected. Where this is the case, the choice is often determined by personal qualities or attributes, such as bravery in war, skill in hunting, fishing or some other occupation, ability in council or debate, knowledge of tribal lore and tradition, wealth, generosity, character and so on. Sometimes the chief is elected for a certain period only, as among certain North American tribes, where special war chiefs are chosen to hold office only as long as the war lasts.

Powers and Functions.—These vary considerably; in many parts of the world the office is unaccompanied by the exercise of authority or political functions; at any rate, as far as the administration of justice is concerned. This is the case especially in Oceania and America; in Africa, on the other hand, the chief is often not only the chief judge of his people, but also the law-giver. But his other activities extend over a very wide range. He is often a prominent figure in the economic life of the tribe, and directs hunting, fishing, planting, harvesting, pastoral migrations and trading, according to the mode of life of the people. In many tribes he is regarded as the owner of the tribal land, and regulates its distribution and tenure. He is generally the wealthiest man in the tribe, and often has a very definite function as a sort of tribal banker, providing his people with feasts and, if need be, with the necessities of life, in return for the tribute which they pay him. In war, he is often the actual leader, fighting at the head of the tribe, and where he is too old or too sacred to do that, he plans campaigns and creates *morale* by incantations and medicines. In a number of cases he assigns wives, manages marriages, confirms inheritances, and otherwise makes his influence felt at many junctures of family life.

The chief plays an extremely important part in the religious life of the community. He acts as priest in public rites, prayers and sacrifices; he is frequently the chief magician of his people, and is often held responsible for the weather and the crops, for the health of his subjects and the fertility of their herds. So that, especially among the more highly organized peoples, he is often regarded as sacred or even divine, both during his lifetime and after his death. There are almost always special prohibitions and obligations regulating the relations between him and his subjects, and some form of etiquette and ceremonial to be observed in approaching him. His own health and soundness are in some cases of vital importance to the community. For their sake he must observe many irksome rules of conduct and diet, neglect of which is regarded as harmful not only to himself but also to his people; and bodily weakness may render him liable to deposition and even death.

Origin.—Of the various theories put forward to explain the existence of chiefs, one of the most famous is that in which Sir

James Frazer argues that the chief developed out of the medicine man, and was primarily a magician, his juridical and other functions being a subsequent development. By Davy's theory the chieftainship arose through the concentration of wealth in the hands of one man, whose superior economic position gave him authority over the rest. Rivers, again, stresses the fact that chiefs usually have customs peculiar to themselves, frequently with a similarity between the functions of chiefs in different societies widely separated; and he therefore thinks that the strong basis of "group sentiment" in the government of early societies changes to that of individual authority by the advent of a race of rulers, "enterprising strangers," imposing their ideas upon a community, and becoming chiefs.

There is something to be said for each of these theories, but while each of them lays stress upon a factor of great importance, none of them is exclusive. There is no single factor which can be regarded as having produced chieftainship, which is probably the resultant of a whole series of different factors acting in different combinations in different parts of the world. The essential fact about chieftainship, wherever it occurs, is that it serves as a means of concentrating the activities of the community under the direction of one person. The chief is not merely the representative and leader of the community; he is also frequently the symbol of its corporate unity.

See J. G. Frazer, "The Magic Art and the Evolution of the Kingship" (*The Golden Bough*, vols. i and ii, 1911); R. H. Lowie, *Primitive Society* (1920); G. Davy, *La Foi Jurée* (1922); W. H. R. Rivers, *Social Organisation* (1924). (I. S.)

CHIEMSEE, also called *Bayrisches Meer,* the largest lake in Bavaria, lies 1,600 ft. above the sea, between the rivers Inn (to which it drains through the Alz) and Salzach. With a length of 6 and a breadth of 9 mi., it has an area of about 33 sq.mi., and contains three islands, Herrenwörth, Frauenwörth and Krautinsel. The first is beautifully wooded; it was the seat of a bishop from 1215 to 1805, until 1803 it contained a Benedictine monastery, and today it is remarkable for its castle. The shores of the lake are flat on the north and south sides, but its other banks are flanked by undulating hills. The waters are clear and well stocked with trout and carp; but the fishing is strictly preserved, and steamers ply on the lake.

CHIENGMAI, chief city of northern Thailand (Siam) and terminus of the 467-mi. railway from Bangkok. Pop. (est. 1937) 60,000. The massive but decaying walls of the old city enclose an area of about .4 sq.mi. on the bank of a tributary of the Menam Chao Phya river. The rather fertile valley is 20 mi. wide by 80 mi. long, and is surrounded by high, wooded mountains, inhabited by tribesmen, chiefly Karens. The city has outgrown the walls, and the business district is outside the walled area The last *chao,* or hereditary chief, died in 1939. His son received a pension but did not succeed him. The population consists of Laos (closely related to the Thai), Thai, Chinese and Shans. The American Presbyterian mission commenced work in 1867, its chief local institutions having been Prince Royal college, McCormick hospital, Dara academy and the Chiengmai Leper asylum. Leprosy abounds there, and the asylum had 1,200 outpatients. The Roman Catholic mission had two schools.

From the 13th century until its absorption in the 18th century, the Lao or northern Thai kingdom of Chiengmai fought chronic wars with its ambitious southern Thai neighbour. Twice it was conquered and ruled by Burma, but regained its independence when Burmese rule subsided. The distinction between the Lao of Thailand and the Thai has been almost obliterated. Chiengmai was broken up into a number of tribal states, each with a hereditary chief, co-operating with Thai officials. The small surrounding states of Nan, Prè, Lampun, Lampang and Tern also had hereditary chiefs, but only Lampun has a surviving ruler of the old type. Chiengmai was a provincial or circle headquarters for northwestern Thailand until about 1932, when the circles were abolished.

Roads and trails radiate in several directions and Chiengmai has long been the trading centre of this area—meeting place of Chinese, Burmese, Shan and Thai merchants. The hills are rich in teak, and two large British companies extracted large quantities of this valuable wood. Rice is the chief crop, minor crops being legumes, tobacco and cotton.

CH'IEN LUNG or **K'IEN LUNG** (1711–1799), Chinese emperor, the fourth of the Ch'ing dynasty, was born Sept. 25, 1711. He succeeded his father, Yung Ch'eng, as emperor in 1736. At that time he dropped the name Hung-li, which he had previously borne, and was thereafter known as Ch'ien Lung. When he first came to the throne, Ch'ien Lung was much influenced by his ministers but by 1750 he was in almost complete personal control of the imperial power. About this time he began a succession of wars and campaigns which had substantially increased the territory under Chinese domination by the time of his retirement. Rebellions were put down in several parts of the empire during his reign; the territories of Ili, Turkistan, Kuldja and Kashgaria were conquered; and Tibet, Burma, Nepal and Annam were scenes of successful military ventures, some of these territories paying tribute to China for many years afterward. Ch'ien Lung is perhaps best known as a patron of the arts. He himself was a poet, the author of some thousands of verses, but he encouraged not only writers but painters, pottery makers, musicians and scholars. In 1772 he authorized the collection of all important writings extant in the kingdom This collection he ordered housed and catalogued in the Imperial library, together with a history and criticism of each work. During Ch'ien Lung's reign attempts were made by the British to increase trade with China. A mission for this purpose, sent in 1793 under the leadership of Lord George Macartney, came to nought, however, and trade with a number of countries continued, as before, exclusively at the port of Canton. In 1796, having reigned 60 years, Ch'ien Lung voluntarily abdicated, not wishing to rule a greater length of time than his illustrious grandfather, K'ang Hsi. It is probable, however, that he continued to have much influence over his son and successor, Chia Ch'ing, until his death on Feb. 7, 1799.

CHIERI, a town and episcopal see of Piedmont, Italy, province of Turin, 13 mi. S.E. by rail and 8 mi. by road from the town of Turin. Pop. (1936) 9,601 (town); 13,736 (commune). Its Gothic cathedral (1037, rebuilt 1405), is the largest in Piedmont, and has a 13th-century octagonal baptistery. Subject to the bishop of Turin in the 9th and 10th centuries, it became independent in the 11th century. In 1347 it submitted voluntarily to Count Amedeus VI of Savoy and finally came under Savoy in the 16th century. In 1785 it was made into a principality of the duke of Aosta. It was an early centre of trade and manufacture; and in the middle of the 15th century produced about 100,000 pieces of cotton goods per annum.

CHIETI, a city of the Abruzzi, Italy, the capital of the province of Chieti, and the seat of an archbishop, 140 mi. E.N.E. of Rome by rail, and 9 mi. W. of Castellammare Adriatico. Pop. (1936) 17,575 (town), 30,266 (commune). It is situated at a height of 1,083 ft. above sea level, 3 mi. from the railway station, from which it is reached by an electric railway. It commands a splendid view of the Apennines on every side except the east, where the Adriatic is seen. It is an active modern town, upon the site of the ancient Teate Marrucinorum, the chief town of the Marrucini. Some scanty remains of the theatre, of a temple (?) and some large reservoirs exist. The Gothic campanile of the cathedral is fine. Close by is the town hall, which contains a small picture gallery. The de Laurentiis family possesses a private collection of some importance. To the north of Chieti is the octagonal church of S. Maria del Tricaglio, erected in 1317. The order of the Theatines, founded in 1524, takes its name from the city. Under the Lombards Chieti formed part of the duchy of Benevento; it was destroyed by Pippin in 801, but was soon rebuilt and became the seat of a count. The Normans made it the capital of the Abruzzi.

CHIFFON. In dress fabrics, one of the most delicate, gauze-like and transparent of all silk tissues. Chiffon consists of a plain woven texture produced from very fine and hard-twisted warp and weft of corresponding denier (counts), with a corresponding number of warp threads and picks per inch, and a soft dull finish. So very delicate and flimsy is the chiffon texture, that

it is easily distorted and pulled out of shape.

The term chiffon has different meanings in different countries. Thus, in France, it signifies a rag; in Rumania, a bleached cotton shirting; in Germany it means a stout, fine, plain woven linen fabric with a smooth finish, and used for shirtings and other garments for underwear; in England, chiffon net (also nun's veiling) signifies a very fine and delicate quality of silk net used as lace and for veils. Chiffon twist signifies a hard-twisted silk thread spun with about 50 or more twists per inch, and used in the production of chiffon tissues.

CHIFFONIER, a piece of furniture differentiated from the sideboard by its smaller size and by the enclosure of the whole of the front by doors. Its name (which comes from the French for a rag-gatherer) suggests that it was originally intended as a receptacle for odds and ends which had no place elsewhere, but it now usually serves the purpose of a sideboard. It is a remote and illegitimate descendant of the cabinet; it has rarely been elegant and never beautiful. It was one of the many curious developments of the mixed taste, at once cumbrous and bizarre, which prevailed in furniture during the Empire period in England. The earliest chiffoniers date from that time; they are usually of rosewood; their "furniture" (the technical name for knobs, handles and escutcheons) was most commonly of brass, and there was very often a raised shelf with a pierced brass gallery at the back. The doors were well panelled and often edged with brass-beading, while the feet were pads or claws, or sphinxes in gilded bronze.

CHIGGER. A name used for a mite (*see* HARVEST-BUG) and for a flea (*see* JIGGER, CHIGGER or CHIGOE).

CHIGI-ALBANI, a Roman princely family of Sienese extraction descended from the counts of Ardenghesca. The earliest authentic mention of them is in the 13th century, and they first became famous in the person of Agostino Chigi (d. 1520), a banker who built the palace and gardens afterwards known as the Farnesina, decorated by Raphael. Pope Julius II made him practically his finance minister. Fabio Chigi, on being made pope (Alexander VII) in 1655, conferred the Roman patriciate on his family, and created his nephew Agostino prince of Farnese and duke of Ariccia, and the emperor Leopold I created the latter *Reichsfürst* (prince of the Holy Roman empire) in 1659. In 1712 the family received the dignity of hereditary marshals of the Church and guardians of the conclaves, which gave them a very great importance on the death of every pope.

See A. von Reumont, *Geschichte der Stadt Rom,* vol. iii. (1868); *Almanach de Gotha;* V. Frittelli, *Albero genealogia della nobile famiglia Chigi* (1922).

CHIGWELL, an urban district of Essex, England, with stations (Chigwell Lane and Chigwell) on the L.N.E.R., 13 mi. N.E. of London. Pop. (1938) 23,750. Area 14 sq.mi. The village, which is mentioned in Domesday, lies in a branch of the Roding valley, fragments of Hainault forest lying to the south and east, bordering the village of Chigwell Row. The scenery of the neighbourhood is described in Dickens's *Barnaby Rudge,* and the King's Head inn, Dickens's "Maypole," still stands. The old grammar school was founded by Samuel Harsnett, archbishop of York (d. 1631), whose fine memorial brass is in St. Mary's church, a Perpendicular structure with a Norman south door.

CHIHLI: *see* HOPEI.

CHIHUAHUA, a northern frontier state of Mexico, bounded N. and N.E. by the United States (New Mexico and Texas), E. by Coahuila, S. by Durango, and W. by Sinaloa and Sonora. The population in 1940 was 623,944, and the area, 94,806 sq.mi. The surface of the state is in great part an elevated plain, sloping gently toward the Rio Grande. The western side, however, is much broken by the Sierra Madre and its spurs, which form elevated valleys of great fertility. An arid sandy plain extending from the Rio Grande inland for 300 to 350 mi. is quite destitute of vegetation where irrigation is not used. The more elevated plateaus and valleys have the heavier rainfall, but over most of the state it is less than 20 in.; an impermeable clay substratum prevents its absorption by the soil, and the bare surface carries it off in torrents. The great Bolsón de Mapimí, an enclosed depression, in the southeastern part of the state, was once considered to be an unreclaimable desert, but experiments with irrigation have shown its soil to be highly fertile. The only river of consequence is the Conchos, which flows north and northeast into the Rio Grande across the whole length of the state. In the north there are several small streams flowing northward into lakes. Agriculture has made little progress in Chihuahua, and the scarcity of water has been a serious obstacle to its development outside the districts where irrigation is practicable. Stock-raising is an important industry in the mountainous districts of the west, where there is excellent pasturage for the greater part of the year. The principal industry of the state, however, is mining—its mineral resources including gold, silver, copper, mercury, lead, zinc and coal.

The silver mines of Chihuahua are among the richest in Mexico and include the famous mining districts of Batopilas, Chihuahuilla, Cosihuiriachic, Jesús María, Parral and Santa Eulalia or Chihuahua el Viejo. There are more than 100 of these mines. The state is well served by trunk-line railways and by several short branches to the mining districts.

Chihuahua originally formed part of the province of Nueva Viscaya, with Durango as the capital. In 1777 the northern provinces, known as the Provincias Internas, were separated from the viceroyalty, and in 1786 the provinces were reorganized as intendencias, but Chihuahua was not separated from Durango until 1823.

An effort was made to overthrow Spanish authority in 1810, but its leader Hidalgo and two of his lieutenants were captured and executed, after which the province remained passive until the end of the struggle.

The people of the state have been active partizans in most of the revolutionary outbreaks in Mexico, and in the war of 1862–66 Chihuahua was loyal to Juárez. The principal towns are the capital Chihuahua, pop. (1940) 56,805; Parral, 120 mi. S.S.E. of the state capital, in a rich mining district, with a population (1940) of 24,231; Ciudad Juárez across the Rio Grande from El Paso, pop. (1940) 48,881; Camargo, pop. (1940) 7,705; Santa Barbara (1940) 13,902; and Jiménez, 120 mi. S.E. of Chihuahua, pop. (1940) 5,175.

CHIHUAHUA, a city of Mexico, capital of Chihuahua state, about 1,000 mi. N.W. of Mexico City and 225 mi. S. by E. of El Paso. Pop. (1930) 59,607; (1940) 56,805. The city stands in a beautiful valley opening northward and hemmed in on all other sides by spurs of the Sierra Madre. It is 4,635 ft. above sea level, and its climate is mild and healthful. The city is laid out regularly, with broad streets, and a handsome plaza with a monument to Hidalgo and his companions of the revolution of 1810, who were executed there. The most noteworthy of its public buildings is the fine old parish church of San Francisco, begun in 1717 and completed in 1789, one of the best specimens of 18th-century architecture in Mexico. It was built, it is said, with the proceeds of a small tax on the output of the Santa Eulalia mine. Other prominent buildings are the Government palace, the Porfirio Díaz hospital, the old Jesuit college (now occupied by a modern institution of the same character), the mint, and an aqueduct built in the 18th century. Chihuahua is served by the Mexican National, the Kansas City, Mexico and Orient (Santa Fe) and the Mexico North-Western railways. Mining is the principal occupation of the surrounding district, the famous Santa Eulalia or Chihuahua el Viejo mines being about 12 mi. from the city. Manufacturing is making good progress, especially the weaving of cotton fabrics by modern methods. The manufacture of gunpowder for mining operations is another old industry.

Chihuahua was founded between 1703 and 1705 as a mining town, and was made a villa in 1715 with the title San Felipe el Real de Chihuahua. Because of the rich mines in its vicinity it soon became one of the most prosperous towns in northern Mexico, although the state was constantly raided by hostile Indians. In 1763 it had a population of nearly 5,000. The war of independence was followed by a period of decline, owing to political disorder and revolution, which lasted until the presidency of Gen. Porfirio Díaz. In the war between Mexico and the United States, Chihuahua was captured on March 1, 1847, by Col. A. W.

Doniphan, and again on March 7, by Gen. Price. In 1864 President Juárez made the city his provisional capital for a short time.

CHILACHAP or TJILATJAP, a port in Java, Netherland Indies, on the S. coast, in the residency of Banjumas, west of Schildpadden bay. Its harbour, the most favoured by nature in the whole of Java, is formed by the island of Nusa Kambangan, which is long and narrow, and lies close to the shore opposite Chilachap, beyond which it projects for a considerable distance and thus protects it from the heavy monsoon seas and swell of the Indian ocean. With the exception of Segoro Wedi bay, Chilachap is the only harbour on the south coast of Java which affords protection during the south-east monsoon, and it is the most important. The town of Chilachap, which has a population of 28,309, including 670 Europeans and Eurasians, and 1,626 foreign Asiatics, stands on a tongue of land flanked on the east by Schildpadden bay, and on the west by the estuary of the river Donan. The entrance to the harbour is between a projecting headland of Nusa Kambangan and South Point, on the tongue of land opposite, and is one and a half miles wide, but owing to a sandbank, the navigable channel, which varies in depth from 29 ft. to 48 ft., is narrow. The port has two concrete wharves, 1,350 ft. and 400 ft. in length, respectively, affording mooring-places for vessels drawing up to 30 ft. of water at low tide.

Chilachap is connected by rail with Batavia, Surabaya, Surakarta and Samarang by a junction with the main Batavia-Surabaya line at Maos. In 1939, 1,229,000 cu.m. net of shipping cleared the port. Imports and exports, respectively, were, for Chilachap in 1939, 1,179,000 and 8,345,000 guilders. Japanese troops occupied Chilachap shortly after their invasion of Java in World War II.

CHILAS, a hill village far up the Indus gorges in the North-West Frontier Province of India. It is dominated by a fort on the left bank of the Indus, about 50 m. below Bunji, 4,100 ft. above sea-level. It was occupied by a British force early in 1893, and was the scene of sharp fighting with local tribes. Its importance lies in its position with reference to the Kashmir-Gilgit route via Astor. It is now connected with Bunji by a metalled road. Chilas is also important from its position on a shorter route to Gilgit from the Punjab frontier than that of Kashmir and the Burzil pass. By the Kashmir route Gilgit is 400 m. from the rail-head at Rawalpindi. The Kagan route via Chilas would bring it 100 m. nearer, but the unsettled condition of the country through which the road passes has been a bar to its general use.

CHILBLAINS (or KIBE; *Erythema pernio*), a mild form of frostbite, affecting the fingers or toes and other parts, and causing a painful inflammatory swelling, with redness and itching of the affected part. The chief points in its aetiology are (1) the lesions occur in the extremities of the circulation, and (2) they are usually started by rapid changes from heat to cold or vice versa. The treatment is both general and local. In the general treatment, if a history of blanching fingers (fingers or hands going "dead") can be obtained, the chilblains may be regarded as mild cases of Raynaud's disease, and these improve markedly under a course of nitrites. Cardiac tonics are often helpful. Most cases improve under treatment with calcium lactate or chloride, 15 grains three times a day. Locally, ichthyol and formalin are of great value in the early congestive stage. Ichthyol, 10 to 20% in lanoline spread on linen and worn at night, often dispels an attack at the beginning. Formalin is equally efficacious, but requires more skill in its use. It can be used as an ointment, 10 to 50%, weaker for delicate skins, stronger for coarser skins. It should be replaced occasionally by lanoline. For broken chilblains a paste made from the following prescription, spread thickly on linen and frequently changed, soon cures:—Hydrarg. ammoniat. gr. v., ichthyol Mx, pulveris zinci oxidi 3iv. vaseline 3ss. Recently repeated very small doses of ultra-violet radiation have been given locally with beneficial results, but great care must be taken as the affected part reacts very readily to the rays.

CHILD, SIR FRANCIS (1642–1713), English banker, was a Wiltshire man who became a London goldsmith in 1664. In 1671 he married Elizabeth Wheeler and with his wife's stepfather, Robert Blanchard (d. 1681), took over about the same time the business of goldsmiths hitherto carried on by the Wheelers. This was the beginning of Child's Bank. Child soon gave up the business of a goldsmith and confined himself to that of a banker. He was jeweller to the king, and lent considerable sums of money to the Government. He served as sheriff of London in 1691 and as lord mayor in 1699. In 1698 he was elected M.P. for Devizes and in 1702 for the City of London, and was again returned for Devizes in 1705 and 1710. He died on Oct. 4, 1713, and was buried in Fulham churchyard. Child had twelve sons. One, Sir Robert, an alderman, died in 1721. Another, Sir Francis (*c.* 1684–1740), was lord mayor of London in 1732, and a director of the East India Company. He was elected M.P. for the City of London in 1722, and was member for Middlesex from 1727 until his death. After the death of the younger Sir Francis at Fulham on April 20, 1740, the banking business passed to his brother Samuel, and the bank passed to his descendants, retaining its identity until May 1924, when it was absorbed by Glyn Mills and Co.

CHILD, FRANCIS JAMES (1825–1896), American scholar and educator, was born in Boston (Mass.), Feb. 1, 1825. He graduated at Harvard in 1846, taking the highest rank in his class; was a tutor in various subjects, and after two years of study in Europe succeeded Edward T. Channing in 1851 as Boylston professor of rhetoric, oratory and elocution, and in 1876 became professor of English. Child studied the English drama and Germanic philology, the latter at Berlin and Göttingen during a leave of absence, 1849–53; and he took general editorial supervision of a large collection of the British poets. He edited Spenser (5 vols., 1855), and published an important treatise in the *Memoirs of the American Academy of Arts and Sciences* for 1863, entitled "Observations on the Language of Chaucer's Canterbury Tales." His largest undertaking, however, grew out of an original collection of *English and Scottish Ballads* (8 vols., 1857–58). He accumulated, in the university library, one of the largest folk-lore collections in existence, studied manuscript rather than printed sources, and carried his investigations into the ballads of all other tongues, meanwhile giving a sedulous but conservative hearing to popular versions still surviving. His final collection was published as *The English and Scottish Popular Ballads,* first in ten parts (1882–98), and then in five quarto volumes, which remain the authoritative treasury of their subject. Professor Child worked—and overworked—to the last, dying in Boston Sept. 11, 1896, having completed his task save for a general introduction and bibliography. A sympathetic biographical sketch was prefixed to the work by his pupil and successor George L. Kittredge. (*See* also F. P. Stearns, *Cambridge Sketches,* 1905.)

CHILD, SIR JOHN (d. 1690), governor of Bombay, and in fact if not in name the first governor-general of the British settlements in India, was born in London. He was sent as a little boy to his uncle, the chief of the factory at Rajapur, and in 1682 was appointed chief of the East India Company's affairs at Surat and Bombay, while at the same time his brother, Sir Josiah Child, was governor of the company at home. The two brothers showed themselves strong men and guided the affairs of the company through the period of struggle between the Moguls and Mahrattas. They have been credited by history with the change from unarmed to armed trade on the part of the company, but as a matter of fact both of them were loth to quarrel with the Mogul. War broke out with Aurangzeb in 1689, but in the following year Child had to sue for peace, one of the conditions being that he should be expelled from India. He escaped this expulsion by his death in 1690.

CHILD, SIR JOSIAH (1630–1699), English merchant, economist and governor of the East India Company, was born in London in 1630, the second son of Richard Child, a London merchant of old family. After serving his apprenticeship in the business to which he succeeded, he started on his own account at Portsmouth, as victualler to the navy under the Commonwealth, when about 25. He amassed a comfortable fortune and became a considerable stockholder in the East India Company, his interest in India being accentuated by the fact that his brother John

(*q.v.*) was making his career there. He was returned to parliament in 1659 for Petersfield; and in later years sat for Dartmouth (1673–78) and for Ludlow (1685–87). He was made a baronet in 1678. His advocacy, both by speech and by pen, under the pseudonym of Philopatris, of the East India Company's claims to political power, as well as to the right of restricting competition with its trade, brought him to the notice of the shareholders, and he became a director in 1677, and, subsequently, deputy-governor and governor. He was for a considerable time virtually the sole ruler of the company, and directed its policy as if it were his own private business. He and his brother have been credited with the change from unarmed to armed traffic; but the actual renunciation of the Roe doctrine of unarmed traffic by the company was resolved upon in Jan. 1686, under Gov. Sir Joseph Ash, when Child was temporarily out of office. He died on June 22, 1699. Child made several important contributions to the literature of economics; especially *Brief Observations concerning Trade and the Interest of Money* (1668), and *A New Discourse of Trade* (1668 and 1690). He made various proposals for improving British trade by following Dutch example, and advocated a low rate of interest as the "*causa causans* of all the other causes of the riches of the Dutch people." This low rate of interest he thought should be created and maintained by public authority. Child, whilst adhering to the doctrine of the balance of trade, observed that a people cannot always sell to foreigners without ever buying from them, and denied that the export of the precious metals was necessarily detrimental. He had the mercantilist partiality for a numerous population, and propounded a new scheme for the relief and employment of the poor; he advocated the reservation by the mother country of the sole right of trade with her colonies.

See Macaulay, *History of England*, vol. iv.; D. Macpherson, *Annals of Commerce* (1805); R. Grant, *Sketch of the History of the East India Company* (1813); B. Willson, *Ledger and Sword* (1903).

CHILD, LYDIA MARIA (1802–1880), American author and reformer, was born at Medford, Mass., Feb. 11, 1802, and died at Wayland, Mass., Oct. 20, 1880. One of the most prominent women of her day, Mrs. Child's present claims to remembrance are the contemporaneous popularity of her stories *Hobomok* (1824), *The Rebels* (1825) and *Philothea* (1836); her editorship of the *Juvenile Miscellany*, the first children's monthly periodical in the United States; and her efforts in behalf of the slaves, freedmen and Indians, including her stirring *Appeal for That Class of Americans Called Africans* (1833) and her editing of the *Anti-Slavery Standard* (1840–44) in association with her husband. In spite of the 35 editions of her *Frugal Housewife* (1829) and the German, the eight American and the 12 English editions of her *Mother's Book* (1831), these and her many other stories and books on feminism, religion, biography and history have been superseded by later works.

Bibliography: *See* the *Letters of Lydia Maria Child* (1882), with a biographical introduction by J. G. Whittier; appendix by Wendell Phillips; also, a chapter in T. W. Higginson's *Contemporaries* (1899).

CHILDEBERT, the name of three Frankish kings.

Childebert I. (d. 558) was one of the four sons of Clovis. In the partition of his father's realm in 511 he received as his share the town of Paris, and the country to the north as far as the river Somme, and to the west as far as the English channel, with the Armorican peninsula. In 524, after the murder of Chlodomer's children, Childebert annexed the cities of Chartres and Orleans. He took part in the various expeditions against the kingdom of Burgundy, and in 534 received as his share of the spoils of that kingdom the towns of Mâcon, Geneva and Lyons. When Vitiges, the king of the Ostrogoths, ceded Provence to the Franks in 535, the possession of Arles and Marseilles was guaranteed to Childebert by his brothers. Childebert also made a series of expeditions against the Visigoths of Spain. In 542 he took possession of Pampeluna with the help of his brother Clotaire I., and besieged Saragossa, but was forced to retreat. From this expedition he brought back to Paris a precious relic, the tunic of St. Vincent, in honour of which he built at the gates of Paris the famous monastery of St. Vincent, known later as St. Germain-des-Prés. He died without issue in 558, and was buried in the abbey he had founded, where his tomb has been discovered.

See "Nouveaux documents sur le tombeau de Childebert à Saint-Germain-de-Prés," in the *Bulletin de la Société des Antiquaires* (1887).

Childebert II. (570–595), king of Austrasia, was a son of Sigebert. When his father was assassinated in 575, Childebert was taken from Paris by Gundobald, one of his faithful *leudes*, to Metz, where he was recognized as sovereign. He was then only five years old, and during his long minority the power was disputed between his mother Brunhilda and the nobles. Chilperic, king at Paris, and King Gontran of Burgundy, sought alliance with Childebert, who was adopted by both in turn. But after the assassination of Chilperic in 584, and the dangers occasioned to the Frankish monarchy by the expedition of Gundobald in 585, Childebert threw himself unreservedly into the arms of Gontran. By the pact of Andelot in 587 Childebert was recognized as Gontran's heir, and with his uncle's help he quelled the revolts of the nobles and succeeded in seizing the castle of Woëwre. Many attempts were made on his life by Fredegond, who was anxious to secure Gontran's inheritance for her son Clotaire II. On the death of Gontran in 592, Childebert annexed the kingdom of Burgundy, and even contemplated seizing Clotaire's estates and becoming sole king of the Franks. He died, however, in 595. Childebert II. had had relations with the Byzantine empire, and fought in 585 in the name of the emperor Maurice against the Lombards in Italy.

Childebert III. was one of the last and feeblest of the Merovingians. A son of King Theuderich III., he succeeded his brother Clovis III. in 695, and reigned until 711.

See B. Krusch, "Zur Chronologie der merowingischen Könige," in *Forschungen zur deutschen Geschichte*, xxii. 451–490. (C. Pf.)

CHILDERIC, the name of three Frankish kings.

Childeric I. (*c.* 437–481), king of the Salian Franks, succeeded his father Merwich (Merovech) as king about 457. With his tribe he was established around the town of Tournai, on lands which he had received as a *foederatus* of the Romans, and for some time he kept the peace with his allies. About 463, in conjunction with the Roman general Egidius, he fought against the Visigoths, who hoped to extend their dominion to the banks of the Loire; after the death of Egidius he assisted Count Paul in attempting to check an invasion of the Saxons. Paul having perished in the struggle, Childeric defended Angers against the Saxons, recovered from them the islands they had seized at the mouth of the Loire, and destroyed their forces. The Saxon chief, Odoacer, now agreed to serve the Romans and the two chieftains, now reconciled, intercepted a band of the Alamanni. These are all the facts known about him. The stories of his early life by the Franks, of his stay of eight years in Thuringia with King Basin and his wife (or sister) Basine, of his return when a faithful servant advised him that he could safely do so by sending to him half of a piece of gold which he had broken with him, and of the arrival at Tournai of Queen Basine, whom he married, are preserved by Gregory of Tours, and have found a place in French epic poetry. After the fall of the Western empire in 476 there is no doubt that Childeric regarded himself as freed from his engagements towards Rome. He died in 481 and was buried at Tournai, leaving a son Clovis (*q.v.*), afterwards king of the Franks. His tomb was discovered in 1653, when numerous precious objects, arms, jewels, coins and a ring with his name and the image of a long-haired warrior, were found.

Childeric II. (*c.* 653–675), king of Austrasia, was a son of the Frankish king Clovis II., and in 660, although a child, was proclaimed king of Austrasia, while his brother, Clotaire III., ruled over the rest of the dominions of Clovis. After the death of Clotaire in 670 he became ruler of the three Frankish kingdoms, Austrasia, Neustria and Burgundy. He was murdered in 675 whilst hunting. He was buried at St. Germain near Paris.

Childeric III. (d.*c.* 751), king of the Franks, was the last of the *fainéant* Merovingian kings. The throne had been vacant for seven years when the mayors of the palace, Carloman and Pippin the Short, decided in 743 to recognize Childeric as king. We cannot say whose son he was, or what bonds bound him to the Mero-

vingian family. He took no part in public business, which was directed, as before, by the mayors of the palace. When in 747 Carloman retired into a monastery, Pippin resolved to take the royal crown for himself. Childeric was dethroned in 751 and placed in the monastery of St. Omer. (C. PF.)

See J. J. Chiflet, *Anastasis Childeric I. Francorum regis* (1655); W. Junghans *Kritische Untersuchungen zur Geschichte der fränkischen Könige Childerich und Clodovech* (1857); J. B. D. Cochet, *Le Tombeau de Childeric I., roi des Francs* (1859); G. Kurth, *Histoire poétique des Merovingiens* (1893); and E. Lavisse, *Histoire de France*, tome 6. (Paris, 1903) and authorities quoted under GREGORY OF TOURS.

CHILDERMAS: *see* INNOCENTS' DAY.

CHILDERS, HUGH CULLING EARDLEY (1827–1896), British statesman, was born on June 25, 1827. On leaving Cambridge he went out to Australia in 1850. In 1852 he was appointed auditor-general in Melbourne, and in 1853 collector of the customs; he carried through a bill for the establishment of the University of Melbourne, and was its first vice-chancellor. In 1856 he represented Portland in the new parliament of Victoria, and was commissioner of trades and customs in its first cabinet. In 1857 Childers returned to England as agent-general of the colony, and in 1860 entered parliament as liberal member for Pontefract. In 1865 he became financial secretary to the Treasury. He occupied various posts in the Gladstone ministries. As secretary for war from 1880 to 1882 he was responsible for the administration of the Transvaal War in 1881 and the Egyptian War in 1882. During his term of office the territorial system was introduced, with other administrative reforms of the army. From 1882 to 1885 he was chancellor of the Exchequer, and the beer and spirit duty in his budget of 1885 was the occasion of the Government's fall. In 1886 he was returned as a Home Ruler (one of the few Liberals who adopted this policy before Gladstone's conversion) for South Edinburgh, and was home secretary in Gladstone's ministry of 1886. The withdrawal of the financial clauses of the first Home Rule bill was largely due to his threat of resignation. He retired from parliament in 1892, and died on Jan. 29, 1896.

See the *Life of Childers*, by his son (1901).

CHILDERS, ROBERT CAESAR (1838–1876), English oriental scholar, son of the Rev. Charles Childers, English chaplain at Nice, studied Pāli during his residence (1860–64) as a civil servant in Ceylon. In 1869 he published the first Pāli text ever printed in England, and began to prepare a Pāli dictionary (2 vols., 1872–75), which was awarded the Volney prize by the Institute of France. In the Journal of the Royal Asiatic Society he published the *Mahā-parinibbāna Sutta*, the Pāli text giving the account of the last days of Buddha's life. In 1872 he was appointed sub-librarian at the India Office, and in 1873 first professor of Pāli and Buddhist literature at University college, London. He died in London on July 25, 1876.

CHILDERS, ROBERT ERSKINE (1870–1922), Irish politician, the son of Prof. Robert C. Childers of London, was educated at Haileybury and Trinity college, Cambridge. From 1895 to 1910 he was a clerk in the British House of Commons. He served as a trooper in the South African War in 1900 and from 1910 to 1914 was engaged in political work and writing for Irish Home Rule. During the World War he served in the Royal Naval Air Service and in the Royal Air Force, in which he attained the rank of major and won the D.S.C. From 1917 to 1918 he served on the secretariat of the Irish Convention. On his demobilization he returned to Ireland and was elected to Dail Eireann as deputy for Wicklow in May 1921. He was principal secretary to the Irish delegation of plenipotentiaries to Westminster, Oct.–Dec. 1921. He afterwards opposed the Anglo-Irish Treaty of 1922, supported De Valera in the Dail and joined the Republicans when they again took up arms. He was captured in Wicklow Nov. 10, 1922, and tried by military court martial on Nov. 17, on the technical charge of having possession of an automatic pistol without proper authority. He was found guilty of treason, and executed on Nov. 24, 1922.

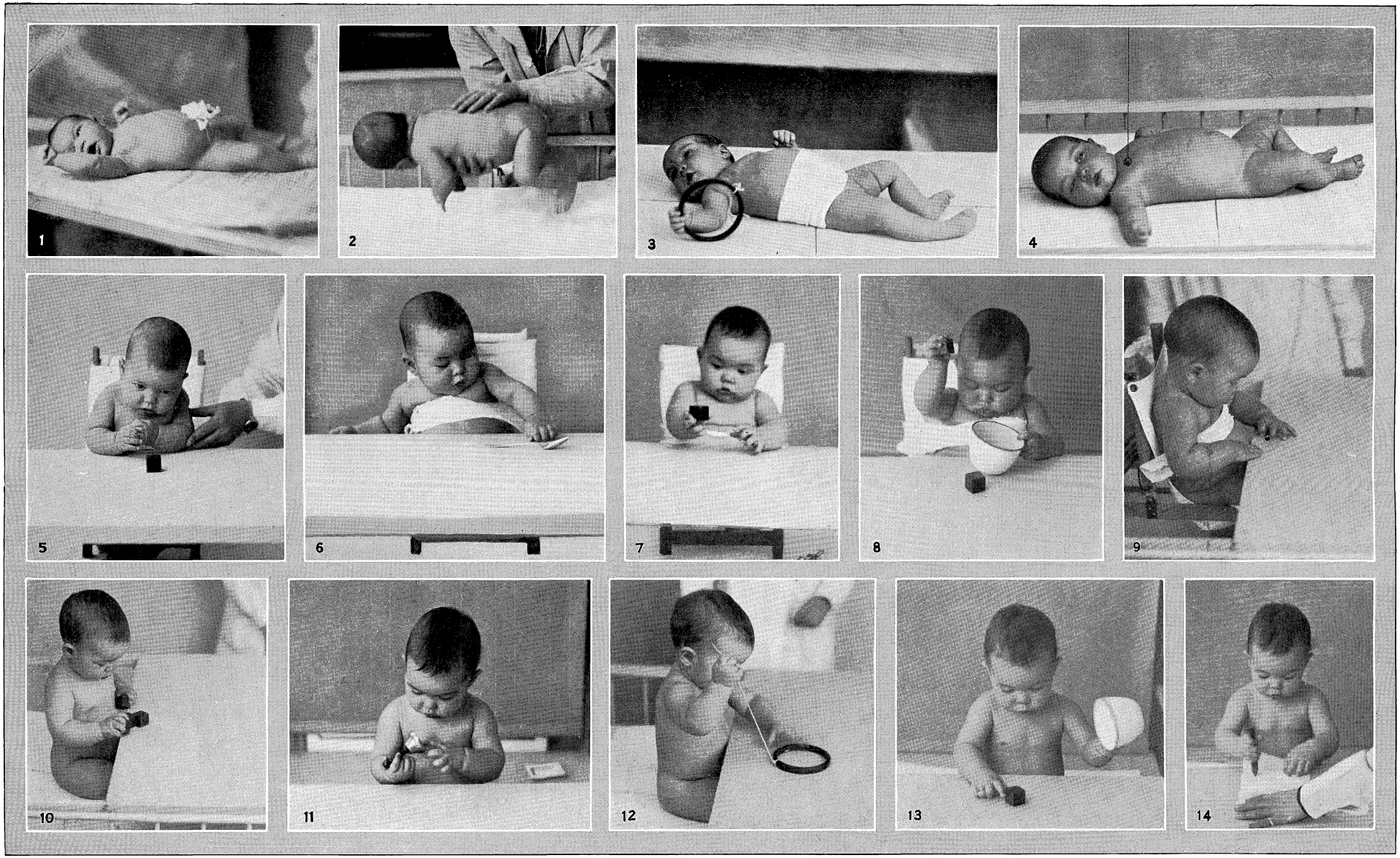
Among his publications are: vol. v. of *The Times* History of the South African War, dealing with the guerilla campaigns; a brilliant story, *The Riddle of the Sands* (1903); *The Framework of Home Rule* (1911); *Military Rule in Ireland* (1920).

CHILD PSYCHOLOGY. General psychology is concerned chiefly with the mental life of human beings. Child psychology considers the complicated course of mental development which precedes maturity, and embraces newborn infancy as well as childhood and youth. Adolescence, the complex period of transition which begins with puberty in the early teens and extends into the middle twenties, presents important psychological problems relating to the attainment of maturity, but the term, child psychology, is ordinarily restricted largely to the pre-adolescent period.

The Problems of Child Psychology.—The central scientific problem of child psychology is the delineation and interpretation of the growth of the mind, or, in other words, of the ontogenesis of human behaviour. It is impossible to describe the child mind as though it were a fixed entity, for the gamut of growth is too wide. From the mewling infant to the whining schoolboy, "with satchel and shining morning face," the mental life of the child is changing constantly. Psychologically, it is necessary to reckon even with the behaviour differences between the four-months and the six-months old infant. Function in relation to age, the nature of individual differences in children of precisely the same age, the relations between age and maturity, are basic problems in a systematic psychology of child development.

Methods of Investigation.—The growth of the mind can be traced only by observation of the child's characteristic behaviour. There is no possibility of observing his consciousness in any immediate way, and there is meagre possibility of enlisting the child's introspection. It remains, therefore, to note scientifically the growth of behaviour itself by any or all of the following methods: (a) Naturalistic observation takes account of the child as he is in his ordinary surroundings. It reports episodes and phases of his life; or it records in a biographical manner, as in Shinn's classical notes. (b) Experimental observation limits and controls its data by devices and instrumental technique. (c) Psycho-metric and normative studies aim to define behaviour in quantitative and orientational terms so that children of varying ages, capacities and conditions may be compared through standardized tests and statistically derived norms. (d) Clinical investigation combines two or more of the above methods, and focuses intensively on selected individuals, correlating data from a variety of angles. Psycho-analysis is a special type of clinical method, which serves in some instances to reveal the psycho-genetic importance of infantile behaviour events in determining deviations in adult conduct. (e) Co-operative child research, in recent years, has developed so extensively as to deserve special mention. It is exemplified in university research centres like those at Iowa, Chicago, Minnesota, California, Yale, Berlin, Vienna and Geneva, where investigations in genetic psychology, biometrics, anthropometry and pediatrics, as well as clinical, educational and child guidance activities, are co-ordinated. There is an increasing tendency to widen the scope of child psychology so as to include all the phases of child development, and to incorporate the outlook of the medical and biological sciences, including biochemistry, developmental physiology and animal psychology. In this sense the study of child development becomes a subdivision of the science of psychobiology.

The Beginnings of Child Behaviour.—From the standpoint of developmental psychology, the whole life cycle is a continuum, and the growth of the mind begins with the growth of individual behaviour. Minkowski, and others, have found evidences of such behaviour throughout most of the prenatal period. Two months after conception, rudimentary body reflexes appear; the elements of the spinal reflex arc are already found in the foetus of that age. In the third month, mouth movements are evident. In the fourth, fifth and sixth months, deep cervical reflexes and labyrinth reflexes, involving head, arms and legs occur. By the seventh month most of the vital reflexes necessary for extra-uterine existence are well advanced, so that the prematurely born child has a chance of survival. There is good reason to believe that the infant of six to nine months, whether within or without the womb, is already a habit-forming creature, able to learn through processes of conditioning. Prematurity of birth does not, however, hasten the general course of the infant's behaviour growth.



BY COURTESY OF YALE PSYCHO-CLINIC, YALE UNIVERSITY

GROWTH OF CHILD BEHAVIOUR FROM BIRTH TO FIRST BIRTHDAY

These pictures of a normal infant under systematic observation, were made in the photographic laboratory of The Yale Psycho-Clinic. They show characteristic behaviour patterns at advancing age levels as follows:

1. At *one week* of age the infant stares at large objects. Lies with head on side, extending arm on same side (tonic neck reflex; cf. 3 and 4)
2. At *6 weeks* of age, lifts head when held in ventral suspension
3. At *8 weeks* clasps a ring, without visual regard
4. At *12 weeks* follows with eyes a small moving ball
5. At *16 weeks* intently regards cube on table
6. At *20 weeks* makes crude approach on spoon
7. At *24 weeks* picks up cube on the table
8. At *28 weeks* bangs a cube on the table
9. At *32 weeks* plucks a tiny pellet
10. At *36 weeks* holds two cubes and attends to a third
11. At *40 weeks* explores the clapper of a bell
12. At *44 weeks* secures a ring by pulling a string
13. At *48 weeks* lifts a cup to secure a cube
14. At *52 weeks* makes a crude imitative scribble with crayon

Sensori-motor Development.—Sensitivity to light, sound, pressure and temperature, to change of position and internal bodily conditions is present to some degree before birth. The earliest sensory responses are on a spinal and sub-cortical level, whereas well-defined sense-perceptions, with appreciation of form, space and localization, depend upon the maturation of the whole sensory apparatus, particularly the cortex, and upon the organization of habits of response through conditioning. Hearing undergoes rapid organization in the first two months, but the acquisition of visual and oculo-motor control is a long process in which horizontally moving objects are followed before vertically moving objects. There is selective regard for the human face by the fourth week. A small quarter-inch pellet is regarded as early as 20 to 24 weeks. The early sensory life of the child is probably not a "big blooming, buzzing confusion"; but the stimuli are more or less distinctly sensed as arising out of a neutral or contrasting background (Gestalt).

Although there are individual variations, sensori-motor development tends to follow orderly sequences suggested by the approximate dates which are assigned to the following items: Closing in with two hands upon a dangling object (18 weeks); picking up an object on contact (20 weeks); reaching for object on sight (24 weeks); plucking pellet with pincer prehension (40 weeks); right or left handedness partially established (40 weeks); sitting alone (9 months); walking alone (15 months); running (2 years); scribbling imitatively (1 year); scribbling spontaneously (1½ years); copying a circle (3 years), a square (5 years), a diamond (7 years). The rate of tapping (with a stylus or pencil) steadily rises from about 100 per minute at 4 years to about 250 at 12 years.

Language.—Language constitutes perhaps the most complicated of all the mental achievements of childhood. The infant begins his post-natal career with a cry, which in the first few weeks becomes differentiated for hunger, cold, discomfort. At three months, pleasure is vocalized. At four months, laughter occurs. At five months eagerness is voiced; sound play, at first solitary, later imitative and socialized, becomes increasingly channelized. Interjections and syllables like "dada" and "mama" become well defined at nine months. Heedful responsiveness to words, and adjustment to simple verbal commands or signals, follow soon after. At one year the child may have a vocabulary of three words; at two years it is nearer 300; at six years it is nearly 3,000; at twelve years it may be reckoned (Stanford-Binet scale) at over 14,000. There are large individual differences which become enormous when retarded and precocious children are compared. About 60% of two-year old children use sentences from two to eight words in length. Verbs are relatively much more frequent in the young child than the adult. Conjunctions show a slow and steady increase from two to eight years, and subordinate clauses appear before the fourth year. Piaget has shown that during the first seven years the child's speech is highly ego-centric, even his conversation having a monologue aspect. At about eight years true communication of thought becomes more characteristic and infantile notions of causality give way to more conceptual types of judgment and reasoning. Childish lying due to immaturity of the language function also tends to disappear.

Intelligence.—In a psycho-genetic sense the growth of intelligence begins early. Even the new-born child is a habit-forming creature. Conjointly through experience and maturation of his abilities, he "learns" to adapt himself to his surroundings. He learns to act to cues, sights, sounds, and to relations between things. This adaptability is the essence of that which is later called intelligence. Even before his first birthday he shows insight and can use a string as a tool to pull an attached object toward him; at two years he distinguishes between *in* and *under;* at three years he builds from a model a bridge of three blocks; at five years he defines words in terms of use; at seven years he makes a verbal distinction between a stone and an egg; and at twelve years he can define abstract words such as *envy* and *pity*. His memory span, as measured by the number of digits he can recall, increases steadily during these years. He gradually acquires notions of similarity, analogy, truth, error, causation, but his intellectual interests are rooted in the concrete rather than the abstract. Much of his concealed thinking is more naïve and primitive than we suspect.

While the doctrine of psychological recapitulation in an extreme form is to be discredited, it has some applicability to the child's intellectual development. The child tends to follow primitive modes of thought in the early stages of his logic, and does not think merely like an undeveloped adult. Jaensch and others have demonstrated that many children have the gift of eidetic imagery, which is a capacity to reproduce vividly an object once seen and not as a transient pallid image. This natural and valuable child-like mental trait is in danger of disappearing under the influence of rationalistic culture.

Personality.—Mental growth results in a steady intensification of individuality. The new-born infant seems relatively inchoate, vegetative and unorganized; but the process of integration begins promptly and issues in a changing complex of attitudes, predispositions and habits, which constitutes his personality. The structure of this personality is the result of both intrinsic and extrinsic factors, the intrinsic ones being the organic cravings and propensities such as hunger, thirst, fear, rage and aggression, affection, imitative activity, playful, exploitive and experimental activity. Out of such general tendencies arise all sorts of emotional or instinctive seeking and avoiding responses, such as curiosity, modesty, self-display, jealousy, emulation and co-operation. Temperamental qualities, constitutional type, and endocrine characteristics, must be counted among the intrinsic factors. The actual patterns of behaviour, however, are decisively shaped by extrinsic conditioning factors through social impress, and by the action of the conditioned reflex. Psycho-analysis places stress on nutritional, sexual and presexual factors as moulding both the conscious and unconscious trends of conduct.

From the standpoint of personality, the development of the child's mind consists in the progressive attainment of emotional independence, or morale. This is a process of increasing detachment from the parental care upon which the infant is so completely dependent; hence the parent-child relationship is a key to the progress of the psychological maturity of the child. The child's mind is not a faded replica of the adult mind, but has unique characteristics which are inadequately understood. Schiller combined truth and imagination when he remarked that the adult would be a genius if he but lived up to the promise of childhood. Sincerity, directness, originality, naïve freedom from inhibition, vitality and happiness are characteristic of childhood at its best, and the mental health of the race depends upon an increasing projection of these qualities into maturity.

BIBLIOGRAPHY.—A. Binet, *The Development of Intelligence* (Paris, 1905); K. Buehler, *Die geistige Entwickelung des Kindes* (5th ed., Jena, 1929); A. Gesell, *The Mental Growth of the Pre-School Child* (1925), and *Infancy and Human Growth* (1928); G. S. Hall, *Adolescence* (1903); L. W. Stern, *Psychology of Early Childhood* (1924); L. Terman, *The Measurement of Intelligence* (1916); Edgar James Swift, *The Psychology of Childhood* (1930). (A. GES.)

CHILDREN, CARE OF: *see* INFANCY.

CHILDREN, DISEASES OF. The study of this subject, known also as Pediatrics, is comparatively modern. There was no recognition of the need for special instruction in it as part of the curriculum at the medical schools, until, in 1899, King's College Hospital (London) appointed a physician to treat children only and to teach the students this subject. Gradually the recognition of this need has spread to other medical schools, or been forced upon them by examining bodies.

Methods of Feeding.—Infant feeding has passed through various phases. In the 17th century, when the mother was unable to suckle, wet nursing was the recognized alternative. In the 18th century hand-feeding began to replace suckling and brought with it the ills of faulty feeding; in the latter half of the 19th century the importance of infant feeding as one of the largest factors in infant mortality and diseases began to be recognized.

An attempt to replace the haphazard methods of the time was made by the introduction of percentage feeding in America. This necessitated an exact knowledge of the percentage composition of milk, cream, etc. Directions for feeding were given as a prescrip-

tion ordering the percentage of proteid, fat, and sugar, and laboratories were established in which such foods could be prepared. This method involved fallacies of theory and practice, but it encouraged more accurate and intelligent understanding of infant feeding.

A new departure is the so-called calorie feeding. The energy-producing value of a food, calculated in units of heat which the food would produce on combustion (1 calorie=heat required to heat 1 kilo of water 1° C.), determines its adequacy for the infant. At certain ages a certain number of calories per lb. weight is found to be requisite, so that food requirements can be determined by mathematical calculations. The fallacies of this method are considerable, but it is occasionally useful.

Whilst the physicians and laboratory workers were investigating the subject from the scientific standpoint, a great step forward was made by the establishment of Consultations de Nourrissons (1892) in France, and a little later of Infant Consultation Centres or Infant Welfare Centres (1906) in Great Britain and in other parts of the world. Mothers take their healthy infants to these and are instructed as to their feeding and care.

Biochemical research has shown that, besides the gross chemical composition of foods, there are subtler constituents, viz., "accessory factors" or "vitamins," which are essential to health, and, indeed, to life. (*See* BIOCHEMISTRY.) Related to lack of these vitamins are two diseases, infantile scurvy and rickets, the former definitely due to lack of vitamin C, the latter to deficiency of some anti-rachitic factor of which little is known.

In connection with the latter, the value of ultra-violet rays has recently been recognized; whether from sunlight, arc lamp, or mercury vapour lamp, these rays improve the general health and vigour and are beneficial in certain diseases, particularly rickets, in which they effect a rapid cure of the bone affection. To a less degree they are useful in some forms of tuberculosis. Amongst diseases affecting nutrition in infancy, congenital hypertrophy of the pylorus was formerly one of the most fatal; but now has been so successfully treated by surgery that the majority recover.

The rise of bacteriology has revolutionized our views of many diseases of children, but some still await fuller knowledge. Infantile paralysis is one of these. Flexner and his co-workers in New York, by a series of experiments on monkeys, have shown that, as had already been suspected, this disease which wrecks the lives of so many children is due to some infection, and they have investigated the conditions and ways in which it can be communicated (*see* SPINAL MENINGITIS). The exact nature of the virus is uncertain, but experiments have shown that infection may enter by the naso-pharynx and may probably be spread by carriers. Isolated cases occur every summer and occasionally epidemics, as in England in 1911 and in America in 1910.

The specific fevers to which children are most liable, scarlet fever, measles, chicken-pox and mumps (*qq.v.*) are still a mystery as to their exciting cause. Whooping cough (*q.v.*), however, has been traced to a specific bacillus and a vaccine of this organism has been used extensively, but with doubtful benefit. The discovery of an antitoxin for diphtheria in 1893 led to a large reduction in the mortality from that disease: the deaths from laryngeal diphtheria fell within two years from 62% to 28%, and a few years later to 11.7%.

Tests for Diphtheria.—Various efforts have been made to immunize children against measles by serological methods and successes in this connection have been reported. The most notable advance touching specific fevers has been the Schick test for diphtheria (1913). Susceptibility to this disease can be detected by intracutaneous injection of a minute dose of the toxin of diphtheria; a slight redness or swelling at the site of infection within 24–48 hours indicates that the person showing it is susceptible. Such a means of distinguishing between children liable to infection and those who are not liable is clearly of great value when diphtheria occurs in a school or institution. As a sequel to this a new method has been introduced of conferring immunity by subcutaneous injections of a toxin-antitoxin. In this way a child found by the Schick test to be susceptible can be immunized for several months, whereas an ordinary antitoxin protects only for a few weeks. A similar test, the Dick test, has been used to detect susceptibility to scarlet fever by the intracutaneous injection of a very dilute toxin prepared from streptococci.

There has been a striking decrease in the mortality of the specific fevers of childhood during recent years. The annual mortality in England and Wales per million persons living was in 1883: scarlet fever 1,270, measles 962, whooping cough 1,086; in 1923, scarlet fever 83, measles 508, whooping cough 399.

The effects of congenital syphilis (*see* VENEREAL DISEASES), first studied in detail by Diday of Lyons in 1854, have been more fully realized since the introduction of the Wassermann test (1906), in which the examination of the blood indicates the presence or absence of this disease. It may be present when no characteristic symptoms occur, indeed without symptoms of any sort.

Applied indiscriminately to children attending hospitals, this test has shown a positive result in proportions varying from 0·59% in London to 10·4% in Glasgow, but for the general child population these figures are probably too high. Syphilis causes a large waste of potential lives by miscarriages and still-births, of which there were 40% in a series of 187 pregnancies in syphilitic families, whilst of 112 live-born children in these families 33% died in infancy or early childhood. Nor does this represent the full extent of its mischief, for mental deficiency, various forms of paralysis, impaired sight, deafness, and various deformities in the child are in some instances direct or indirect results of syphilitic parentage. Of late, a wider knowledge of the effects of syphilis and its prevention and treatment in adults has reduced the frequency and severity of the inherited disease in children. The latest treatment is by subcutaneous or intravenous injections of arsenical or bismuth preparations.

Tuberculosis.—Amongst the diseases which not only account for a considerable mortality in childhood, but also add to the number of the unfit when the child grows up, are tuberculosis and rheumatism (*see* TUBERCULOSIS). Of children dying in hospitals about one-third have tubercle, although in some of these it is not the cause of death. Tuberculous disease of bones or joints in children is responsible for much lifelong crippling, and tuberculosis of the lungs or other organs often means at a later age years of delicacy and unfitness for the battle of life. Tuberculosis takes its heaviest toll during the first five years of life, especially in the second year, to which belong 26% of the deaths from tuberculosis in children under 12 years of age. The danger of tuberculous cow's milk has become recognized. In 1913 9·3% of samples of London milk showed tubercle bacilli. The education of the public to the danger of unboiled milk is tending to safeguard children from this infection.

Rheumatism.—Rheumatism, unlike tuberculosis, hardly ever occurs under three years of age. It affects chiefly children from 5 to 12 years of age of the hospital class, and perhaps more amongst the poorer middle class than amongst the very poor. Of children from 6 to 12 years old admitted to the medical wards of a hospital, nearly 25% were suffering from some rheumatic affection and in an out-patient department of children 5 to 12 years old 13% were attending for rheumatic troubles. Rheumatism in children affects the joints much less than in adults. Often, especially in girls, it takes the form of chorea; often the only indication is vague pain mistaken for growing pains, or perhaps a stiff neck, but however slight such manifestations the rheumatism which they indicate is specially liable in children to attack the heart. Heart disease in childhood is mostly rheumatic; sometimes it is rapidly fatal, more often after some years of invalid existence the heart gradually fails and the child dies. The duration of life in these children with rheumatic heart disease depends chiefly on the possibility of prolonged rest and careful restriction of exertion, perhaps for two or three years. Complete recovery is not impossible in some cases, and in others life may be prolonged many years in usefulness and comfort.

BIBLIOGRAPHY.—L. Emmett Holt, *Diseases of Infancy and Childhood* (3rd ed., 1918) and *The Care and Feeding of Children* (3rd ed., 1918); Henry Ashby and G. Wright, *The Diseases of Children* (1922); Hugh T. Ashby, *Infant Mortality* (1922); J. H. Hess, *Premature and Congenitally Diseased Infants* (1923); G. F. Still, *Common Disorders and Diseases of Childhood* (1924); E. M. S. Chesser, *Health and*

Psychology of the Child (1925); R. Manning Clark, *Children's Diseases: Prevention and Cure* (1925); Emil Feer, *The Diagnosis of Children's Diseases*, trans. C. A. Scherer (1925); R. Hutchison, *Lectures on Diseases of Children* (1925). (G. F. S.)

CHILDREN—PROTECTIVE LAWS. English law has always in theory given to children the same remedies as to adults for ill-usage, whether by their parents or by others, and has never recognized the *patria potestas* of earlier Roman law. The only points in which infancy created a defect in civil status were that infants were subject to the restraints on complete freedom of action involved in their being in the legal custody of the father, and that it was and is lawful for parents, guardians, employers and teachers to inflict corporal punishment proportional in amount and severity to the nature of the fault committed and to the age and mental capacity of the child punished. But the court of chancery, in delegated exercise of the authority of the sovereign as *parens patriae*, always asserted the right to take from parents, and if necessary itself to assume the wardship of children where parental rights were abused or serious cruelty was inflicted, the power being vested in the High Court of Justice. Abuse of the power of correction was regarded as giving a cause of action or prosecution for assault; and if attended by fatal results rendered the parent liable to indictment for murder or manslaughter.

The conception of what constitutes cruelty to children undoubtedly changed considerably with the relaxation of the accepted standard of severity in domestic or scholastic discipline and with the growth of new ideas as to the duties of parents to children.

Starting from the earlier conception, which limited ill-treatment legally punishable to actual threats or blows, the common law came to recognize criminal liability in cases where persons, bound under duty or contract to supply necessaries to a child, unable by reason of its tender years to provide for itself, wilfully neglected to supply them, and thereby caused the death of the child or injury to its health, although no actual assault had been committed. Questions have from time to time arisen as to what could be regarded as necessary within this rule; and quite apart from legislation, popular opinion has influenced courts of justice in requiring more from parents and employers than used to be required. But parliament has also intervened to punish abandonment or exposure of infants of under two years, whereby their lives are endangered, or their health has been or is likely to be permanently injured (Offences against the Person Act, 1861, sec. 27), and the neglect or ill-treatment of apprentices or servants (same act, sec. 26, and Conspiracy and Protection of Property Act, 1875, sec. 6). By the Poor Law Amendment Act, 1868, parents were rendered *summarily* punishable who wilfully neglected to provide adequate food, clothing, medical aid or lodging for their children under 14 years of age in their custody.

The Acts of 1889, etc.—The chief progress in the direction of adequate protection for children prior to 1889 lay less in positive legal enactment on the subject than in the institution of an effective method of discovering and repressing cruelty punishable under the ordinary law. In the absence of any proper system of public prosecution, it is undeniable that numberless cases of neglect and ill-treatment went unpunished. The foundation of the National Society for the Prevention of Cruelty to Children by the late Benjamin Waugh met this need, and through its efforts a statute was passed in 1889 with the special object of preventing cruelty to children. This act was superseded in 1894 by a more stringent act, which was repealed by the Prevention of Cruelty to Children Act, 1904, in its turn superseded for the most part by the Children Act, 1908, which introduced many new provisions in the law relating to children and specifically dealt with the offence of "cruelty" to them. This offence can only be committed by a person over 16 in respect of a child under 16 of whom he has "custody," "charge" or "care." The act presumes that a child is in the custody of its parents, step-parents, or a person cohabiting with its parent, or of its guardians or persons liable by law to maintain it; that it is in the charge of a person to whom the parent has committed such charge (*e.g.*, schoolmaster), and that it is in the care of a person who has actual possession or control of it. Cruelty is defined as consisting in assault, ill-treatment, neglect, abandonment or exposure of the child in a manner likely to cause *unnecessary* suffering or injury to health, including injury to or loss of sight, hearing or limb, or any organ of the body, or any mental derangement; and the act or omission must be wilful, *i.e.*, deliberate and intentional, and not merely accidental or inadvertent. The offence may be punished either summarily or on indictment, and the offender may be sent to penal servitude if it is shown that he was directly or indirectly interested in any sum of money payable on the death of the child, *e.g.*, by having taken out a policy permitted under the Friendly Societies Acts. A parent or other person legally liable to maintain a child or young person will be deemed to have "neglected" him by failure to provide adequate food, clothing, medical aid or lodging, or if in the event of inability to provide such food, etc., by failure to take steps to procure the same under acts relating to the relief of the poor.

These statutes overlap the common law and the statutes already mentioned. Part of their efficacy lies in the provisions which facilitate the taking of evidence of young children, in permitting poor law authorities to prosecute at the expense of the rates, and in permitting a constable on arresting the offender to take the child away from the accused, and the court of trial on conviction to transfer the custody of the child from the offender to some fit and willing person, including any society or body corporate established for the reception of poor children or for the prevention of cruelty to children. The provisions of the acts as to procedure and custody extend not only to the offence of cruelty but also to all offences involving bodily injury to a child under 16, such as abandonment, assault, kidnapping and illegally engaging a child in a dangerous public performance.

Baby-farming.—The act of 1908 enacted more stringent provisions against baby-farming (*q.v.*). The Infant Life Protection Act of 1897 did not apply where only one child was taken, but now by the Act of 1908, where a person undertakes for reward the nursing and maintenance of one or more infants under the age of *seven* years apart from their parents or having no parents, he must give notice in writing to the local authority within 48 hours from the reception of the child. If an infant is already in the care of a person without reward and he undertakes to continue the nursing for reward, such undertaking is a reception of the child. The notice to the local authority must state the name, sex, date and place of birth of the infant, the name and address of the person receiving the infant and of the person from whom the infant was received. Notice must also be given of any change of address of the person having the care of the infant, or of the death of the infant, or of its removal to the care of some other person, whose name and address must also be given. It is the duty of local authorities to provide for the carrying out in their districts of that portion of the act which refers to nursing and maintenance of infants, to appoint infants' protection visitors, to fix the number of infants which any person may retain for nursing, to remove infants improperly kept, etc. Relatives or legal guardians of an infant who undertake its nursing and maintenance, hospitals, convalescent homes or institutions, established for the protection and care of infants, and conducted in good faith for religious and charitable purposes, as well as boarding schools at which efficient elementary education is given, are exempt from the provisions of the act.

The Acts of 1904 and 1908 deal with many other offences in relation to children and young persons. The Act of 1904 introduced restrictions on the employment of children which lie on the border land between cruelty and the regulation of child labour. It prohibits custodians of children from taking them, or letting them be, in the street or in public-houses to sing, play, perform or sell between 9 P.M. and 6 A.M. These provisions apply to boys under 14 and girls under 16. There are further prohibitions (1) on allowing children under 11 to sing, play, perform or be exhibited for profit, or offer anything for sale in public-houses or places of public amusement at any hour without a licence from a justice, which is granted only as to children over ten and under stringent conditions; (2) on allowing children under 16 to be

trained as acrobats, contortionists or circus performers, or for any dangerous performance; and the Children's Dangerous Performances Act, 1879, as amended in 1897, makes it an offence to employ a male young person under 16 and a female under 18 in a dangerous public performance.

The Act of 1908 renders liable to a fine not exceeding £25, or alternatively, or in addition thereto, imprisonment with or without hard labour for any term not exceeding three months, any custodian, etc., of any child or young person who allows him to be in any street, premises or place for the purpose of begging or receiving alms, or of inducing the giving of alms, whether or not there is a pretence of singing, playing, performing or offering anything for sale. An important departure in the Act of 1908 was the attempt to prevent the exposure of children to the risk of burning. Any custodian, etc., of a child under seven who allows that child to be in a room containing an open grate not sufficiently protected to guard against the risk of burning or scalding is liable on summary conviction to a fine not exceeding £10. Provision is made against allowing children between the ages of four and 16 to be in brothels; it is also made a misdemeanour if any custodian, etc., of a girl under 16 causes or encourages her seduction or prostitution, and any person having the custody of a young girl may be bound over to exercise proper care if it is shown to the satisfaction of a court of summary jurisdiction, on the complaint of any person, that she is exposed to such risk.

Tobacco and Intoxicants.—The Act of 1908, following in this particular legislation in many parts of the United States and in some of the British colonies, places a penalty on selling tobacco to any person apparently under the age of 16, whether for his own use or not. It empowers constables and park keepers to seize tobacco in the possession of any person apparently under 16 found smoking in any street or public place, as well as to search them; it also empowers a court of summary jurisdiction to prevent automatic machines for the sale of tobacco being used by young persons. The act also contains useful provisions empowering the clearing of a court whilst a child or young person is giving evidence in certain cases (*e.g.*, of decency or morality), and the forbidding children (other than infants in arms) being present in court during the trial of other persons; it places a penalty on pawnbrokers taking an article in pawn from children under 14; and on vagrants for preventing children above the age of five receiving education. It puts a penalty on giving intoxicating liquor to any child under the age of five, except upon the orders of a duly qualified medical practitioner, or in case of sickness, or other urgent cause; also upon any holder of the licence of any licensed premises who allows a child to be at any time in the bar of the licensed premises, or upon any person who causes or attempts to cause a child to be in the bar of licensed premises other than railway refreshment rooms or premises used for any purpose to which the holding of a licence is merely auxiliary, or where the child is there simply for the purpose of passing through to some other part of the premises. It makes provision for the safety of children at entertainments, and consolidates the law relating to reformatory and industrial schools, and to juvenile offenders. (*See* JUVENILE OFFENDERS.)

Very important provisions for the protection of children are contained in sec. 58 of the Act of 1908. This section provides that *any person* may bring before a juvenile court any child under 14 years of age who is found to be (*a*) begging in the street; (*b*) wandering and having no proper guardian; (*c*) destitute with parents, or surviving parent, in prison; (*d*) in the care of drunken or criminal parents; (*e*) the daughter of a father convicted of the carnal knowledge of any daughter under 16; (*f*) frequenting the company of a reported thief or prostitute; (*g*) living in a house frequented by prostitutes or living in circumstances likely to lead to the seduction or prostitution of the child. The duty is laid upon the police to bring such children before the court in all cases where it is in the interests of the child, unless the matter is in the hands of the education authority, or proceedings are being taken by some other person. It will be noted that the right of "any person" to invoke the aid of the juvenile court on behalf of such children is carefully preserved, but for some reason this right is, in practice, rarely, if ever, exercised. The court before which such a child is brought may commit him either (1) to an industrial school, or (2) to the care of a relative or other fit person.

The juvenile offenders committee appointed by the home secretary has now reported (1927, p. 128) with regard to this section that the age should be raised to 17 years, that the services of probation officers should be made available and that the two following sub-sections should be added: (i.) Children and young persons under 17 who have no parents or guardians, or parents or guardians who are unfit to take care of them, or who do not exercise proper guardianship, where the court is satisfied that the children or young persons are falling into bad associations, or are exposed to moral danger or are beyond control; (ii.) children or young persons under 17 in respect of whom specified offences (such as cruelty or sexual offences) have been committed, or who are living in homes where such offences have been committed in respect of other children or young persons, and the court is satisfied that they require special protection. If this recommendation becomes law, as is probable, the two new sub-sections will practically cover all the cases set out in the existing sub-sections.

In the Act of 1908 "child" is defined as a person under the age of 14 years, and "young person" as a person who is 14 years and upwards and under the age of 16 years. The act applies to Scotland and Ireland. Legislation much on the lines of the Acts of 1889–1908 has been passed in nearly all the British dominions.

See also articles CHILDREN'S COURTS, EDUCATION and LABOUR LAW. (W. F. C.; T. A. I.; W. C. HA.)

UNITED STATES

The tendency of American law has been to enlarge the rights of the child and the measure of protection afforded to him against ill-usage, exploitation and conditions affecting his health, morals and general well-being. While the laws of the various States and the judicial decisions interpreting them differ in details, certain general principles are now quite widely accepted.

The first duty of the parents of children is to provide them with support. This obligation rests principally upon the father but the mother is required to do so upon the death of the father. In recognition of the difficulty in which a widow finds herself in caring for her children and at the same time working to provide support, 39 States have passed so-called mothers' pension laws. Under these laws the mother, upon a proper showing of her own good character and the suitability of her home, may receive regular grants of money from public authority. She is thus enabled to remain in the home and care for her family. The father of step-children is not obligated to provide for them unless he voluntarily undertakes to do so. In the case of an illegitimate child, the mother is liable for its support, and she usually does not have the benefit of mothers' pensions. The father may be required to provide support if his paternity has been legally adjudged or if he voluntarily acknowledges it and assumes the duty of support. The precise extent of the duty of support is determined by the law of the particular jurisdiction. Generally it includes food, shelter, clothing, medical care and education. Compulsory education laws require the attendance of children at school and impose a penalty upon the parents for non-compliance. At the same time, child labour laws prohibit the employment of the child during the time when he is required to be in school or in dangerous occupations.

Generally speaking, the father has the control and custody of the child and he may determine where it shall live although the modern tendency is to recognize a larger right in the mother as to these matters. Either or both parents may be deprived of custody by conduct harmful to the child. In case of the father's death, the mother assumes full custody and control. An illegitimate child becomes legitimate upon the subsequent marriage of its parents. In a few States, legitimation can be effected through a judicial proceeding instituted for the purpose or through the process of legal adoption. A legitimated child assumes the same relation to the parent or parents as if born in lawful wedlock. Where a child becomes an orphan or where his parents prove to be wholly unfit to care for him properly, he may be committed in

a legal proceeding, usually through the juvenile court, to the guardianship of a suitable person, a public agency or a private philanthropic society. Guardians may be appointed either to conserve the property of the child or to provide care and maintenance, or both.

A guardian does not assume the full status of a parent. This relationship is established only through the process of legal adoption by which the child becomes the lawful child of his adoptive parents. The tendency of modern legislation is to safeguard adoption proceedings by requiring that the child shall remain in the prospective foster home for a trial period, usually six months, before the proceeding is completed. Georgia, Minnesota, New York, New Mexico, North Dakota, Ohio and Virginia have such laws. In addition, Minnesota, North Dakota, Oregon and Virginia require that some investigation of the foster home must be made by public authority and reports presented to the court having jurisdiction of the proceeding as to whether the foster parents are proper persons to adopt the child and their home a suitable one for the purpose.

Because of the abuses arising out of the casual transfer of children from parents to irresponsible people, several States have passed laws prohibiting any transfer of parental control except upon a court order; *i.e.*, through guardianship or adoption proceedings or upon order of a juvenile court. This is the law in Minnesota, North Dakota, Michigan, Alabama, Indiana, Nebraska and New Jersey. The law in many jurisdictions prohibits the bringing of children into one State from another for purposes of permanent care until after investigation and approval by the authorities of the State to which the child is brought.

In addition to the duty of support the parent must shield the child from evil surroundings and may not impose injury or cruelty upon him. The parent may use physical force to protect the child from danger and, under proper circumstances, to impose reasonable parental correction. The conduct of any adult which tends to deprave the morals of a child or endanger his health or well-being is punishable as a criminal offence.

The White House Conference on the Care of Dependent Children called by President Roosevelt in 1909 incorporated among its conclusions the following: "To engage in the work of caring for needy children is to assume a most serious responsibility, and should, therefore, be permitted only to those who are definitely organized for the purpose, who are of suitable character, and who possess, or have reasonable assurance of securing, the funds needed for their support. The only practicable way of securing this end is to require approval, by a State board of charities, or other body exercising similar powers, of the incorporation of all child caring agencies . . .; and by forbidding other than duly incorporated agencies to engage in the care of needy children."

Ten years later the International Conference of Child Welfare Experts called by the Federal Children's Bureau declared in favour of regular inspection and licensing by public authority of privately organized and supported child caring agencies.

These pronouncements are in recognition of the duty resting upon the State to provide proper care for dependent children or to insure that only adequately equipped private organizations undertake the responsibility. Moreover, it is now clear that mere approval by the State of articles of incorporation is not sufficient. There must be regular and continuous public supervision of the work of these societies in the light of changing standards and conditions. Generally speaking, recent legislation has provided for the annual licensing and regular inspection of three types of organizations—those placing children to board or for permanent care in foster homes; institutions for dependent children, and maternity hospitals, particularly those caring for the mothers of children born out of wedlock. It is the latter type of hospital which has frequently carried on a traffic in illegitimate babies often referred to as baby farming, by which is meant the disposal of such babies to any person willing to take them and to pay the amount asked. Alabama, California, Minnesota, Missouri, North Carolina, North Dakota and Virginia have comprehensive legislation on this subject. Connecticut, Georgia, Kansas, Nebraska, New York, Ohio, South Carolina, Utah and Wisconsin deal with the question in a variety of ways.

Child Welfare Bureaus.—The State is the ultimate guardian of all children who need what they cannot provide for themselves and what natural or legal guardians are not providing for them. To assist in the proper discharge of this obligation, laws have been enacted in several States providing for the establishment of State child welfare bureaus. The work of these bureaus varies widely and is not subject to ready classification. One of the primary objectives is to centralize and co-ordinate the child welfare work carried on by public authority. Among other activities the following are typical: securing enforcement of laws for the protection of children, child placing, special care for the feeble-minded and for children born out of wedlock, supervision of private institutions and child caring institutions, co-operation with juvenile courts and probation departments, assistance to local authorities in the administration of mothers' pensions and, finally, the promotion of good standards of child care by all organizations doing that work. Among some of the States having child welfare bureaus or departments are Alabama, California, Connecticut, Georgia, Illinois, Massachusetts, Minnesota, Missouri, New Jersey, New York, New Mexico, North Carolina, North Dakota, Oregon, Pennsylvania, Virginia, West Virginia, Wisconsin and others.

The growth of legislation for State departments has been paralleled by the creation of local county units of child welfare administration. These county boards of public or child welfare deal directly with the delinquent, dependent or neglected child in the city and surrounding rural country and usually work in close harmony with the State office. California, Minnesota, North Carolina, New Jersey and New York are the leading States which have developed this type of local organization.

Since 1911 protective legislation for children has been markedly accelerated by the work of State commissions for the study and revision of child welfare laws. This movement was no doubt stimulated in part by the British Children Act of 1908, sometimes referred to as the "Children's Magna Charta." While this Act was mainly a codification of existing law on the subject, in the process of compilation and revision distinct advance in protective measures was made. The White House Conference on the Care of Dependent Children recommended periodic review and revision of child welfare legislation. In 1911 the first State commission was appointed for this purpose. By Dec. 1923, 29 States and the District of Columbia had followed the precedent set by Ohio. In the meantime, the conferences on child welfare called by the U.S. Children's Bureau in 1919 again endorsed the principle of careful reconsideration of child welfare legislation at reasonable intervals to secure the proper co-ordination of existing law and new provisions where experience proved them to be necessary. In 1913 New Hampshire and Oregon appointed commissions; Missouri in 1915; Minnesota in 1916; Michigan and Montana in 1917; Delaware, Kansas and Wisconsin in 1918; Connecticut, Indiana, Nebraska, Oklahoma, South Dakota, South Carolina and Texas in 1919. In 1920 New York, Kentucky, Tennessee and the District of Columbia made similar provision; North Dakota, Utah and Virginia in 1921; Georgia and Maryland in 1922. In 1923 new commissions were created in Florida, Iowa and Pennsylvania. These commissions were created by legislative act or appointed by governors without specific legal authority. In all cases the governors named the members, except where *ex-officio* membership was specially provided for. The recommendations of the various commissions have been fairly widely adopted in several States. This is notably true in the State of Minnesota. Iowa, North Dakota and Pennsylvania may also be mentioned as among the States making progress in this field.

BIBLIOGRAPHY.—L. A. Atherley Jones and H. H. L. Ballot, *Law of Children and Young Persons* (1909); Minnesota Child Welfare Commission, *Report* (1917); "Laws Relating to Mothers' Pensions in the United States, Canada, Denmark and New Zealand," U.S. Dept. Labor, Children's Bur., bull. 63 (1919); E. Freund, "Illegitimacy Laws of the United States and Certain Foreign Countries," U.S. Dept. Labor, Children's Bur., bull. 42 (1919); "Minimum Standards for Child Welfare," U.S. Dept. Labor, Children's Bur., bull. 62 (1920); "Child Welfare," *Annals* of the Ame. Academy of Political and Social Science (Philadelphia, 1921); "County Organization for Child Care and Protection," U.S. Dept. Labor, Children's Bur., bull. 107 (1922);

"Public Welfare in the United States," *Annals* of Ame. Academy of Political and Social Science, vol. cv. (Philadelphia, 1923); "Recent Progress in Child Welfare Legislation," papers read at a conference held in Washington, D.C., May 1923 (Russell Sage Foundation); E. O. Lundberg, "State Commissions for the Study and Revision of Child-Welfare Laws," U.S. Dept. Labor, Children's Bur., bull. 131 (1924); H. H. Hart, *Child Welfare in the District of Columbia* (1924); E. F. Peck, "Adoption Laws in the United States," U.S. Dept. Labor, Children's Bur., bull. 148 (1925). Russell Sage Foundation, *Law and Public Welfare in the District of Columbia* (1925). (W. Ho.)

CHILDRENITE, a rare mineral species; a hydrous basic aluminium iron phosphate, orthorhombic in crystallization, found as small brilliant crystals of a yellowish-brown colour during the cutting of a canal near Tavistock in Devonshire in 1823.

CHILDREN'S AID SOCIETY, THE, an American charitable organization in New York city, was the first Children's Aid Society in America, and was founded in 1853 by Charles Loring Brace, "to improve the condition of poor and destitute children in the City of New York and in the State of New York." Mr. Brace's unique contribution to social work was his belief that the best place for a homeless child was in a private family home where he could grow up loved and protected like other children. Out of this philosophy has grown foster home activity.

In 1853 the placement of homeless children in private family homes in the country was begun by the society, and the provision of free noon lunches for poor school children was started. The same year the society established the first Boys' Club—the Brace Memorial Newsboys' House. In 1869 it opened the first school for Negro children in New York; in 1873 the society opened the first Children's Health Home—a forerunner of summer camps and convalescent homes. The year 1898 saw another pioneer venture by the society—a day school with bus transportation for crippled children.

In 1929 the society inaugurated the first of six Children's Centres for the development of neighbourhood health and the wise use of leisure time; in 1933 it established Housekeeper Service for families where mothers are ill.

In 1937 a Department of Personal Relationships was organized to aid juvenile adjustment.

In 1938 plans were effected for a three-year demonstration of practicality of boarding dependent Negro children in carefully selected foster homes.

CHILDREN'S BOOKS. Children's "books" in Europe, like other books, were in use before the invention of printing. Such works as *Gesta Romanorum,* the riddles and scholastic exercises of Aelfric and Alcuin, versions of Aesop's *Fables,* etc., were all used by elder children. They are, however, a piece of social history rather than of specialized literature. The early printed (and ms.) "books of courtesy"—meant to make a boy either a "litel clergeon, seven year of age," or a squire "curteys, lowly, and servisable"—are also social documents, and may be set apart with abecedaria, horn-books, battledores and pure school-books. They lived a changed life later in works like Francis Osborne's *Advice to a Son* (1656), Halifax "the Trimmer's" *Lady's Gift* (1688), and above all in Chesterfield's *Letters,* to which the Blue-stockings provided many antidotes. The later Puritans wrote fierce moral text-books for children as children, not as nascent knights, or monks, or men of fashion. But the greatest of all Puritans was one of the first to see that something less stark was needed. John Bunyan's *Book for Boys and Girls; or, Country Rhimes for Children* (1686; later renamed *Divine Emblems*), popular for more than a century, contained rough but kindly "natural history" verses and vigorous "morals."

The Fairy Tale.—Meanwhile, oral tradition was preserving vernacular folk-lore, destined to be the bed-rock of children's literature. The lore of "rewards and fairies," in the phrase of Bishop Richard Corbet (1582–1635), is plain in Chaucer and Shakespeare, as also in the interminable mediaeval romances like *Guy of Warwick.* There was no printed version, however, before the vilely-printed chapbooks which spread over England in the late 17th and early 18th centuries—the library of Steele's little godson (*Tatler,* No. 95). But the fairy-tale invaded England from Court—Louis XIV.'s—when Perrault's *Histoires ou Contes du Temps Passé* (1696 in French, probably 1729 in English; better known as *Mother Goose's Fairy Tales*), and the Comtesse D'Aulnoy's tales (1707) were translated.

But this was not enough to make a literature. Other developments were needed. Isaac Watts created one with his moral but technically excellent verses. But the real beginning lay in four volumes and in the personality of one man. A few well-known rhymes had appeared incongruously in severer treatises; but the nursery-rhyme was first thoroughly collected in *Tommy Thumb's Pretty Song Book* (1744), *The Top Book of All, Mother Goose's Melody,* and *Gammer Gurton's Garland* (all ascribed to 1760).

The man was John Newbery, who in 1744 published his first children's book, *The Little Pretty Pocket Book.* Before his death in 1767, this friend of Goldsmith had built up a business which itself lasted into the 20th century, and had founded a new branch of the book trade. There is no space here to enumerate even the chief of his "pretty gilt toys for girls and boys" (so called from their gay Dutch-paper bindings). In form (strongly bound, not ill-printed, before long quite tolerably illustrated) as well as in substance, they decided the nature of children's books for three or four generations, even though fashion in expression changed.

The Moral Tale.—Their contents were soon influenced by wider issues than the kindly bookseller probably foresaw. Philosophy and even politics intervened. Maria Edgeworth (1767–1849), the best of all story-tellers (as such) for children, and her friend, Thomas Day (*Sandford and Merton,* 1783–89) deliberately put into nursery tales the doctrines of Rousseau. Arnaud Berquin ("l'ami des enfans") translated Day into French, and was himself translated copiously, with other French writers. The active Quakers (like Priscilla Wakefield) wrote many moral tales. Mrs. Trimmer, whose *Robins* (1786; originally called *Fabulous Histories*) remains in print on its merits as a really good story, at once combated Jacobinism, on behalf of the Church, and desired fairy-tales to be suppressed as immoral. Mrs. Sherwood, at one period almost Calvinistic in her faith in damnation, also wished to depose Titania; but her *Fairchild Family* (1818, etc.) survives —a remarkable piece of English. Ann and Jane Taylor (1804, etc.) of a notable Nonconformist family, put the "cautionary tale" into nimble verses, of which "Twinkle, twinkle, little star" will never die; with them should be associated Elizabeth Turner (1807, etc.). The Lambs, despite the glamour of their name today, were, in a sense, of the same school, and did not, if one is honest, do much better. Blake is splendidly apart from all tendencies.

The Return of Fantasy.—Fantasy returned in 1806, when 40,000 copies of Roscoe's *Butterfly's Ball* and Mrs. Dorset's *Peacock at Home* were sold. The tide of reaction against "amusement with instruction" came to a head in 1824, when the *German Popular Stories* of the brothers Grimm began to appear in English, with Cruikshank's illustrations. Hans Andersen was translated in 1841, levity (even naughtiness) condoned by Catherine Sinclair in *Holiday House* (1839), and absurdity made sublime by Edward Lear's *Book of Nonsense* (1840).

This new freedom infected even the infant South Kensington, and "Felix Summerly" (Sir Henry Cole, an adviser of the Prince Consort) was fain to introduce the Seven Champions and other fabulous monsters into his chaste and well-produced *Home Treasury;* an irony similar to that which had made Mary Howitt (with her industrious brother, an able purveyor of matter-of-fact) the translator of Andersen. There followed what may be called the Parley epoch, in which a number of Peter Parleys—the chief an American, S. G. Goodrich—vied in amassing instruction in easy-going form. Their output, at its best, was common-sense reasonably expressed; at its worst, the merest unctuous Gradgrindery.

Facts are known to be stubborn, and they persist for girls and boys to-day in many admirable works of popular science, often tinged by humanity, as in nature study and tales of discovery and invention. But as the substance of true children's books they were killed for ever by the two *Alice* volumes (1865 or 1866, and 1872) of Lewis Carroll (C. L. Dodgson), with whom is for ever indissolubly associated John Tenniel. Those inspired tales passed at once not only into the affections of the whole English-

speaking world, but also into its arsenal of quotations. They made possible the success of the good modern fairy-tale (the poor one is a perpetual trap for inexperienced writers), like those of Kingsley, George Macdonald and Mrs. Molesworth; of such books as Mrs. Ewing's *Lob-lie-by-the-Fire;* of the better grotesques, like the *Golliwog* books of Miss Upton; even of the magical *Peter Pan,* and of such delicate modern art as A. A. Milne's and Kenneth Grahame's.

Nothing can be said here of the illustrators, so numerous and gifted, from Bewick onwards. Nor can methods of book production be treated here, beyond the bare mention of the movable heads in books of 1810 or so, of "cut-out" (odd-shaped) books, panoramas, "rag" books, and so on; few of them are really novel to-day. Neither has it been possible to pursue into detail a most important point—the sub-division of young readers into boys, girls (*i.e.,* adolescents, each for 40 years past provided with specialist writers like Henty and Charlotte Yonge), and "children" (which includes "babies"). Lastly, the nursery has "annexed" scores of grown-up books, from *The Pilgrim's Progress* onwards.

BIBLIOGRAPHY.—*The Cambridge History of English Literature,* vol. xi., bibl.; C. Welsh, *A Bookseller of the Last Century* (1885), a life of John Newbery and history of his firm; L. F. (Mrs. E. M.) Field, *The Child and his Book* (1891); A. W. Tuer, *History of the Horn-Book* (1896), *Pages and Pictures from Forgotten Children's Books* (1898), *Stories from Old Fashioned Children's Books* (1899); E. Godfrey, *English Children in the Olden Time* (1907); F. V. Barry, *A Century of Children's Books* (1925). (F. J. H. D.)

UNITED STATES

The development of children's books in the United States follows two distinct trends:—

(1) In colonial times, England supplied her American Colonies not only with her current books for children, but with the religious, ethical and didactic ideas that entered into the first juvenile books printed in her Colonies. Since that period, the leading English books for children have continued to form the nucleus of children's libraries in the United States. Changes in British literary taste have influenced the production of the best American "juveniles." The preceding English section of this article covers this ground for the United States as well.

(2) American life and environment, the influx of foreigners from all lands, the spread of the democratic idea, the emphasis on things material and active, are developing a composite indigenous literature for American children, modified by Anglo-Saxon standards of life, language and liberty. This admixture is still in the crucible, but its component parts may easily be separated. It is chiefly this evolving "American spirit" that is discussed here.

Colonial Period to 1800.—The Puritan conception of sin and preparedness for death found expression in John Cotton's *Spiritual Milk Drawn out of the Breasts of Both Testaments, chiefly for the Spiritual Nourishment of Boston Babes in either England* (1646). This little catechism is thought to have been the first book for children printed in British colonial America. The famous *New England Primer,* "The Little Bible of New England" (*c.* 1690), combining lay instruction with religion, was issued in many editions. From time to time it changed its text, softening its religious teachings and, in revolutionary days, expressing patriotic sentiments purely American. Here we have the beginnings of the American spirit in children's books. A glance backward, before the close of the 18th century, shows us an output of small story books grim and sombre in their Puritan emphasis. About the middle of the century, Newbery's gilt toy books (see *The Fairy Tale*) were imported, and even pirated, by American booksellers, lending a lighter touch to the reading of American children. Little chap-books, probably versions of *Cinderella, Tom Thumb,* and other fairy tales, gave delight. In 1751, Mrs. Benjamin Franklin was ordering from London for Sally Franklin, "One good Quarto Bibel," "2 Doz. Select Tales and Fables" and other books. In 1741, little George Washington was revelling in a "pretty picture book." In 1759, Washington was ordering from his London agent, for his step-children, "6 little books for children beginning to read and a fashionable dressed baby to cost 10 shillings," and, later, two small Bibles bound in turkey and two small prayer books. At the close of the 18th century there was a drawing away from the dismal narrative towards the tale with a stately moderated spirit of child happiness. But the new century was to bring oddly assorted groupings of American books for children, embodying changes in the American spirit.

1800–1900.—This was the American children's century. The Puritan argument that a child is a small-sized adult more prone to sin, possibly, than his parents, and that his mind should be stuffed with facts and his imagination suppressed, gradually lost its hold on education in the United States. With the beginning of the 19th century, the kindergarten movement and the impetus given child study rediscovered the play life of little children and the unfolding of their faculties, thus affecting the writing of children's books. The changes, however, were progressive. The 19th century was marked by three distinct attitudes toward child life—the religious, the didactic and the sympathetic.

The moral and religious tale of England (see *The Moral Tale*) crossing the Atlantic, developed into a class of pious books interpreting American religious experiences. These books became an aid in the wide-spread Sunday school movement, having their outlet through the Sunday school library. Again American children were subjected to the religious controversies of their elders, and fed on a diet of reading more or less emotional and stern. A legion of inferior Sunday school books were written by authors now forgotten. There were, however, high lights in this introspective gloom. Two leading writers of the Sunday school library period were Catharine Maria Sedgwick (1789–1867) and Susan Warner (1819–1885), author of *The Wide, Wide World* (1850). Mrs. S. J. Hale (1790–1879) is remembered for her popular American nursery rhyme, "Mary had a little lamb." Towards the end of the century, the U.S. public libraries began to organize children's departments for the free distribution of juvenile books. The Sunday school libraries, unable to compete with these, died out. The advent of the children's free libraries, supported like the public schools by taxation, created a demand for books without religious teachings, books that met the changing requirements of democratic life in the United States.

At the beginning of the 19th century the instructional book was in full force, but C. C. Moore's jolly Christmas ballad, "A Visit from St. Nicholas" (1823), was followed by many happy-hearted tales. Toward the close of the century an important influence was the kindergarten movement for "children's rights," with stress on ethical instruction. Leading kindergarten writers of story-books for children were A. E. Poulsson (*In the Child's World,* 1893), Elizabeth Harrison (*In Storyland,* 1899) and K. D. Wiggin (*Birds' Christmas Carol,* 1888). Mrs. Wiggin's *Polly Oliver's Problem* (1893) had a remarkable effect. It suggested the starting of library story hours at the Carnegie library of Pittsburgh (1899), a movement which has since spread over the United States, and which has resulted in the publication of many collections of stories appropriate for telling.

This whole period produced a group of American authors whose works stand side by side with the best English books for children. In the field of verse were Alice Cary (1820–71), Phoebe Cary (1824–71), Lucy Larcom (1826–93), Eugene Field (1850–95), Celia Thaxter (1836–94), John B. Tabb (1845–1909) and J. W. Riley (1849–1916). In the field of narrative among the leaders were Nathaniel Hawthorne, *Grandfather's Chair* (1841 and 1842), *The Wonder Book* (1852), *Tanglewood Tales* (1853); Mary Mapes Dodge, *Hans Brinker; or, The Silver Skates* (1865); T. B. Aldrich, *Story of a Bad Boy* (1870); Howard Pyle, *Story of Jack Ballister's Fortunes* (1895); Brander Matthews, *Tom Paulding* (1892); F. C. Baylor, *Juan and Juanita* (1897); John Bennett, *Master Skylark* (1897). There were besides such favourite names as Frank R. Stockton (1834–1902), J. T. Trowbridge (1827–1916) and, of course, Charles Edward Carryl, who modelled his *Davy and the Goblin* (1884) after *Alice's Adventures in Wonderland,* and Joel Chandler Harris (1848–1908), who collected the Uncle Remus tales of the American negro. *Little Women* (1868; second part, 1869) by Louisa M. Alcott (1832–88) is animated by a high type of the American spirit. Miss Alcott, in her numerous volumes, added a refreshing note of human nature to children's

books. She has had many imitators. Boys' books by W. T. Adams (known as Oliver Optic, 1822–97), Horatio Alger (1832–99) and Edward S. Ellis (1840–1916), have passed under the ban of juvenile book critics, in some cases rightly, in others questionably.

Children's magazines of the 19th century stimulated the writers of American juvenile fiction. The *Juvenile Miscellany* founded by Lydia Maria Child (1826) and *The Youth's Companion* (1827) were followed by *Our Young Folks* (*c.* 1865), *Wide Awake* (1875), *Harper's Young People* (1879), which later became *Harper's Round Table* (1895) and *St. Nicholas,* founded in 1873 by Mary Mapes Dodge.

Brain and Brawn.—Before quitting the 19th century, one must take into account the sturdiest of American books. Their themes were drawn from pioneer and frontier days, struggles for liberty, Indian and border warfare, adventures of scouts, trappers, whalers and explorers of the vast reaches of North America. The best of these tales are rough-hewn, honest, courageous, patriotic and often reverent. James Fenimore Cooper's *The Spy* (1821) and his "Leatherstocking Series," as well as Richard Henry Dana's *Two Years Before the Mast* (1840) have been appropriated by youth. *Green Mountain Boys* by D. P. Thompson (1840) is the "classic of Vermont." C. C. Coffin's *My Days and Nights on the Battlefield* (1864), is a fine sample of numerous Civil War narratives. Among the titles reminiscent of covered wagons and other dramatic American experiences are: T. M. Reid, *The Scalp Hunters* (1851); C. C. Coffin, *Boys of '76* (1879); Noah Brooks, *Boy Emigrants* (1876) and *Boy Settlers* (1891); E. Eggleston, *The Hoosier School-Boy* (1883); H. H. Jackson, *Nelly's Silver Mine* (1878). The 19th century books of brain and brawn have many followers in the 20th, some forceful and accurate, others false and sensational. The dime and nickel novels of the 19th century have passed out of the market, largely because of high cost of book production.

Their successors are equally "yellow" but more costly.

Didactic.—It is a far cry from *The New England Primer* (*c.* 1690) with its instruction for Protestant young America, to the modern American school reader which must satisfy Jew and gentile, Roman Catholic and Protestant, and also atheist, and which must offend no nationality that has contributed citizens to the United States. These are the demands of the modern American school book; in it the name of God is rarely mentioned, and the name of Jesus Christ is usually suppressed. The current school readers are ethically and pedagogically planned to reach the minds of mixed racial groups of children attending the public schools. The children's pleasure as well as material profit is considered in selecting the reading matter. The trend is away from the literary, like the literary "Eclectic Series" of readers of W. H. McGuffey (1800–73). A vast number of instructional books are issued yearly, more pedagogically correct than their predecessors, the horn-books (see *The Return of Fantasy*), Noah Webster's *Spelling Book* (1783), the informational books of S. G. Goodrich, known as the original Peter Parley (1793–1860), the *Lucy, Rollo, Jonas* and *Franconia* stories of Jacob Abbott (1803–79) and the biographies written by his brother John Abbott (1805–77). The 20th century instructional books for boys and girls cover every known subject of interest to modern youth. Some of them present their subjects as projects for the young folk to work out; many of them have a sugar coating of fiction; but they steadily increase in clearness, attractiveness and informative value.

1900 and the International Mind.—The first decades of 1900 in the United States may well be called the "Reign of Youth." At the opening of the century, educators recognized the child as an individual with rights, and leaned towards the substitution of moral suasion and ethical instruction for discipline. These impulses are entering more and more into modern educational systems which encourage boys and girls to elect their own studies and to work out their problems in the school laboratories. The reaction on American story books for youth is evident. The annual output is increased. The themes of stories stress personal liberty, independent action, self-support, the benefits of education, clean athletics and outdoor life, equal rights for boys and girls; also competition under leadership, the individual counting in the success of the group. The outstanding books of this class are well written, brisk and full of action. Some of them are noble-minded; others reflect the weaknesses of their authors. Most of them ignore things of the spirit. On the whole they are hearty and patriotic, although materialistic, and represent the best in American school life. They are offset by long series of books for both boys and girls, trashy, stereotyped or sensational, and under the ban of educators.

The American spirit is taking a vital turn, modifying juvenile fiction. Upon our cherished Anglo-Saxon foundations is being reared a literary edifice composed of universal racial ideas. The public school and public library are active factors in welding the whole. This creates an international sympathy that welcomes translations of the best world books for children. Some have depth, reverence, and domestic settings—wholesome ingredients. Excellent examples are Hans Aanrud's *Lisbeth Longfrock* (Norwegian); Laura Fitinghoff's *Children of the Moor* (Swedish); Eugénie Foa's (pen-name of Eugénie Rebecca Rodrigues-Gradis) *Little Robinson Crusoe of Paris,* and *Mystery of Castle Pierrefitte* (French); Hector Malot's *Nobody's Boy* (*Sans Famille*) French; Josephine Siebe's *Hay Village Children* (Thuringia, German); Johanna Spyri's *Cornelli, Heidi, Vinzi,* and many stories of child-life (Swiss); Zacharias Topelius's *Canute Whistlewinks* (Swedish-Finnish); Ninke van Hichtum's (pen-name of S. Troelstra-Bokma de Boer) *Afke's Ten* (Dutch); Dikken Zwilgmeyer's *Johnny Blossom,* and *What Happened to Inger Johanne* (Norwegian).

As said before, the American spirit in children's books is elemental and is still in the crucible. Its elements, rich and active, have been assembled from the best in the world. They promise astonishing results when once fused into a whole to produce a 20th century American juvenile literature of living worth.

BIBLIOGRAPHY.—*See* Prof. Algernon Tassin's chapter on "Books for Children," in *Cambridge History of American Literature,* vol. ii., (1918), which is brief and comprehensive and characterizes many American authors for children. *See* also A. M. Earle, *Child Life in Colonial Days* (1899); W. T. Field, *Guide to Literature for Children* (1928), with bibliographies of English and American children's books; P. L. Ford, *The New England Primer . . . with Many Facsimiles and Reproductions, and an Historical Introduction* (1899); R. V. Halsey, *Forgotten Books of the American Nursery, a History of the Developments of the American Story-Book* (1911); C. F. Heartman, *The New England Primer Printed in America Prior to 1830* (1915), a bibliographical check list embellished with cuts; Edna Johnson and C. E. Scott, *Anthology of Children's Literature* (1935), sample contributions, foreign and American, to American children's reading, bibliographies; S. J. Kunitz and Howard Haycraft, *Junior Book of Authors* (1934), short biographies with portraits of more than 250 foreign and American writers for children; A. S. W. Rosenbach, *Early American Children's Books* (1933), with historical introduction and annotated bibliographies; Elva S. Smith, *History of Children's Literature* (1937), syllabus including bibliographies covering foreign and American; M. J. Moses, *Children's Books and Reading* (1907), a history of the development of children's literature in England and America accompanied by bibliographies. The N. Y. Public Library has a fine collection of early American "juveniles." (F. J. O.)

CHILDREN'S COURTS or **JUVENILE COURTS,** a special system of tribunals for dealing with juvenile offenders, which has found its widest development in the United States. The earliest trace of such institutions is however contained in a Swiss ordinance of the year 1862. In 1869 Massachusetts adopted the same principle when a plan was introduced of hearing charges against children separately and apart from the ordinary business of the lesser tribunals. The system of "probation," by which children were handed over to the kindly care and guardianship of an appointed officer and thus escaped legal repression, was created about the same time in Boston (Mass.) and produced excellent results. The probation officer is present at the judge's side when he decides a case, and is given charge of the offender, whom he takes by the hand either at his parent's residence or at school, and continually supervises, having power if necessary to bring him again before the judge. The example of Massachusetts in due course influenced other countries, and especially the British colony of South Australia, where a State children's department was created at Adelaide in 1895, and three years later a juvenile court

was opened there for the trial of persons under 18 and was conducted with great success, though the system of probation officers was not introduced.

The movement when once fully appreciated went ahead very rapidly and most civilized countries throughout the world have now adopted it. France, Germany, Spain, Holland, Belgium, Austria, Hungary, Sweden and Switzerland have all established these courts. In Paris the splendid work of M. Henri Rollet secured the foundation of such a court in 1912, while the Berlin children's court, established in 1923, is a particularly well worked and efficient one. Italy, Czechoslovakia, Yugoslavia, Poland, Bulgaria and Esthonia are making arrangements not yet completed. Norway, Denmark and Finland deal with children's cases under a special code, while the Soviet Government of Russia entrusts the whole matter to the education authorities. In India, Madras secured a Children Act under which the powers conferred were to be exercised "only by a juvenile court." Bengal followed in 1922, and the Indian Government are now striving zealously to establish the principle throughout India. Australia, Canada, South Africa and New Zealand all have children's courts in good working order, and in Melbourne, Sydney, Cape Town and Johannesburg they are particularly flourishing. Japan introduced a very interesting system for dealing with offenders under the age of 18 in juvenile courts in the year 1922, Brazil in 1923 and the Argentine in 1924. Amsterdam has tried the new experiment of instituting a police service especially for children, many of its members being women. The republic of Colombia insists that all juvenile offenders shall be examined by a medical man who is present in court as an assessor.

In England the Home Office recommended London police magistrates to keep children's cases separate from those of adults; the same practice or something analogous obtained in many county boroughs, such as Bath, Birmingham, Bristol, Bolton, Bradford, Hull, Manchester, Walsall, Halifax and others, and the Children Act, 1908, definitely established children's courts. This act enacted that courts of summary jurisdiction when hearing charges, etc., against children or young persons should, unless the child or young person is charged jointly with an adult, sit in a different building or room from that in which the ordinary sittings of the court are held, or on different days or at different times. Furthermore, provision must be made for preventing persons apparently under the age of 16 years whilst being conveyed to or from court, or whilst waiting before or after their attendance in court, from associating with adults, unless such adults are charged jointly with them. The act prohibits any persons other than members and officers of the court, the parties to the case, their solicitors, counsel and other persons directly concerned in the case, from being present in a juvenile court, except by leave of the court. Bona-fide press representatives are also excepted. The main object of the whole system is to keep the child, the embryonic offender who has probably erred from ignorance or the pressure of circumstances or misfortune, altogether free from the taint or contagion that attaches to criminal proceedings. The moral atmosphere of a legal tribunal is injurious to the youthful mind, and children who appear before a bench, whether as accused or as witness, gain a contemptuous familiarity with legal processes.

The most beneficial action of the children's court comes from its association with the system of personal guardianship and close supervision exercised by the probation officers, official and voluntary. Where the intervention of the newly constituted tribunal can not only save the child from evil association when first arrested, but can rescue him without condemnation and committal to prison, its functions may be relied upon to diminish crime by cutting it off at the source. Much depends upon the quality and temperament of the presiding authority. Where a judge with special aptitude can be appointed, firm, sympathetic, tactful and able to gain the confidence of those brought before him, he may do great good by dealing with each individual and not merely with his offence, realizing that the court does not exist to condemn but to strengthen and give a fresh chance. Where the children's court is only a branch of the existing jurisdiction worked by the regular magistrate or judge fulfilling his ordinary functions and not specially chosen, the beneficial results are not so noticeable. The Juvenile Courts (Metropolis) Act, 1920, has given legislative authority to this principle by enacting that the home secretary in selecting as presidents of such courts certain metropolitan magistrates "shall have regard to their previous experience and their special qualifications for dealing with cases of juvenile offenders."

In view of the fact that about 50% of regular criminals begin a life of crime when under 21 years of age, the importance of the juvenile courts can hardly be exaggerated. Rightly, sympathetically and firmly dealt with whilst still young, the vast majority of these potential criminals would become good citizens of the State. Bad surroundings, evil companions, undesirable parents, mental and physical deficiencies and various psychological causes are responsible for most juvenile delinquency. The responsibility for discovering, removing or eliminating these causes rests with the children's courts, and too much care, time and effort cannot be expended in the carrying out of this work. The younger the offender, the greater is the need for efficient diagnosis of the underlying causes of his wrongdoing. That the Home Office is fully alive to this necessity is shown by the very careful report of the juvenile offenders committee published in 1927. Valuable as probation has proved itself to be in the adult courts, it is of even greater value in the children's courts. The legislature, recognizing this importance in all courts, has greatly strengthened the system by the passing of the Criminal Justice Act, 1925, the first ten sections of which deal exclusively with the question of probation. It enacts that "one or more probation officers shall be appointed for every probation area," but in country districts combined areas may be created. The secretary of State is empowered to make rules (which have now been promulgated and are in force) governing the appointment, qualifications and salaries of probation officers and the constitution, procedure, powers and duties of the probation committees. *See* also CHILDREN—PROTECTIVE LAWS; INFANT; JUVENILE OFFENDERS.

(W. C. HA.)

UNITED STATES

Legal and Historical Background.—The juvenile court as a distinct organization originated in America but takes its root in legal and philosophical assumptions current in the 19th century. Its immediate aim was to preserve children from the abuses of criminal procedure. Its principles involve a revolutionary change of attitude. The 17th and 18th centuries record great severities. A child of ten who confessed to killing his bed-fellow was punished with the death penalty, because "sparing of this boy simply on account of his tender years might be of dangerous consequences to the public by propagating a notion that children might commit such atrocious crimes with impunity." "In 1828 in New Jersey, a boy of 13 was hanged for murder committed when he was 12. A survey in Illinois revealed that in 1898 575 children between 10 and 16, were confined in the Chicago jail, and 1,983 boys were committed to city prison." Similar conditions existed in every part of the United States.

At first there was no thought of modifying court procedure. The idea was stressed that after conviction the confinement should be apart from adult criminals. Rise of children's reformatories made this possible in New York (1825), Pennsylvania (1828), and Massachusetts (1847). There was also some provision for separate hearings for children, and for probation in Massachusetts between 1870 and 1880, and in New York in 1892. In 1899 the first juvenile court was organized (Cook county, Chicago, Ill.). It brought under one jurisdiction children who violated laws and dependent children, provided identical procedure for both, established probation, decreed that adjudication be deemed not a conviction of crime, but the placing of the child in the relation of ward to the State. The care for the delinquent child was to "approximate as nearly as may be that which should have been given by the parents." Instead of warrant of arrest, examination by a police judge, bail, indictment, jury trial and sentence, there was substituted complaint, investigation by probation officer, petition, informal hearing and commitment. Fines, imprisonment and penal treatment were abolished. The movement spread with rapidity. By

1904 ten States had juvenile courts; after the first ten years, 20 States and the District of Columbia; by 1914, 30 States; and in 1928 only two States (Wyoming and Maine) were without juvenile courts.

This rapid expansion, without trained personnel, led to a period of critical inquiry. The State supreme courts, however, have upheld the constitutionality of the original statutes. Juvenile court ideals have not been applied throughout the rural districts and small towns. In 1918 the Children's Bureau, Washington, D.C., estimated that of 175,000 cases of children in the U.S. courts, approximately only 50,000 went before courts adapted to handle them.

The juvenile court principle is, first, that the child is not an ungrown adult, but a distinct being, physically, mentally, emotionally and socially; the child's response to life is different; secondly, that the State should not proceed against the child as prosecutor, but exercise the chancery power of *parens patriae* to protect the child.

Age-limits.—The legal meaning of the term "child" is defined by statute, which limits the age of criminal responsibility. Under the English common law, no child under seven was held responsible for crime. Belgium in recent years has raised this to 16, the period *sans discernment*. In the United States the tendency is to increase it to 18 and even 21 (excepting offences punishable by death or life-imprisonment). In approximately one-third of the States jurisdiction of the juvenile court extends to children under 16, in one-third to children under 17, and in the remaining third to children under 18 and above.

It is argued that the older child is entitled to trial by jury, and will not be injured by penal treatment. There is however scientific evidence that the child is not capable of complete integration, or maturation, until 21 or beyond, a belief crystallized in the practice of civilized countries to keep him under legal disabilities as regards contract, voting and marriage until age of majority is reached. In the opinion of many experts it is only a question of time until the juvenile court age-limit will be the same as the recognized age of majority.

Treatment.—The psychological importance of the first offence cannot be overstated. Police methods of apprehension and investigation should be eliminated. The child's court hearing in the better sort of American courts is informal. A well trained juvenile court judge does not proceed to disposal unaided. He seeks the wisdom of the clinic and the social worker. If the child has constructive possibilities he may safely be placed on probation.

Foster homes are used in some parts of America for the placement of delinquent children from unfit homes. Maintenance is supplied by public or private agencies. Correctional institutions are used for cases where an extended period of training is indicated, or where the child is under physical or mental handicaps. Some correctional institutions have supplied individual education, notably for girls, in Sauk Center, Minn., Sleighton Farms, Penn., Samarcand, N.C., Gainsville, Texas, and for boys, in New Jersey, California and elsewhere. In these training schools self-government and expert scientific guidance have met with success. Other social resources are clubs for boys and girls in industry, habit clinics, child guidance clinics, religious agencies, Big Brothers or Big Sisters, and Juvenile Protective agencies. These work most effectively under a co-ordinated philosophy of child care. To achieve this a conference is often held for social diagnosis.

Thus the old sentiments of revenge and deterrence give way to a concerted effort to understand, and to remove underlying causes. In this way sponsors of children's courts have become leaders in the scientific and humanitarian movement to prevent delinquency and to increase human happiness.

BIBLIOGRAPHY.—U.S. Children's Bureau publications, especially *Juvenile Court Standards;* Jane Addams, *Spirit of Youth and the City Streets* (1909); J. W. Mack, *The Juvenile Court* (1909); W. Healy, *The Individual Delinquent* (1917); Judge Baker Foundation, *Case Studies* (Boston, 1922–23); the Commonwealth Fund Program, *Pamphlets* (1923–24–25); B. B. Lindsey, *Twenty-five Years of the Juvenile and Family Court of Denver* (1925); C. Burt, *The Young Delinquent* (1925); E. J. Cooley, *Probation and Delinquency* (1927); H. H. Lou, *Juvenile Courts in the U.S.* (1927); H. C. Parsons, *Report* of Mass. State Probation Commission; *Report* of the Departmental Committee on the Treatment of Young Offenders, 1927; T. W. Trought, *Probation in Europe,* 1927. (M. V. W.)

CHILDREN'S DIET. At the end of the first year the infant has passed from an entirely, or almost entirely, liquid diet to one which includes solid food, and yet not to the same degree nor of the same sort as is given to older children. During the second year, and often during part of the third year, an important factor in determining diet is the progress of dentition; foods which require thorough mastication are clearly unsuitable before the molars are present. On the other hand, it is good that the child should be trained to masticate as early as possible, so that even before the molars are present, solids which crumble easily, *e.g.,* rusks, biscuits and stale bread are good. At the end of the first year the child should have reached a régime of three meals daily, with a drink of milk in the middle of the morning.

Up to the age of three years milk continues to be the most important item in the diet: 1½ pints, exclusive of puddings, should be taken daily. Eggs are also of great value, but must be introduced cautiously into the menu, as some children show an idiosyncracy to eggs, which produce in them various untoward symptoms. Milk and eggs are rich in the bone-forming lime salts; they are also rich in the growth-promoting and antirachitic vitamins. Another food which is of importance and is, fortunately, a favourite with most children, is potato, which, cooked though it is, supplies very richly the antiscorbutic vitamin; potatoes should be baked in their skins and given thoroughly mashed.

Bread.—At a year old, bread may also form part of the diet, whether as milksop, or bread with butter. For children from one to three years of age it is better to use white bread; older children may have brown occasionally; the amount of indigestible residue from brown bread acts as an intestinal irritant, and young children are specially susceptible to the irritation of undigested material in the bowel, very easily contracting therefrom a mild mucous catarrh of the bowel, which interferes with absorption. Children are almost always fond of biscuits, and these supply carbohydrate (starch and sugar) in a very easily assimilable form, especially if the biscuit is of a variety which crumbles easily and finely under pressure. Hard biscuits have been recommended as encouraging mastication; the finely crumbling biscuits have been thought harmful, as they cling about the teeth; a tooth-brush, however, can remove this objection.

Sugar.—Sugar is needed by children. The starch which is taken in bread, potatoes, and many other foods has to be converted into sugar in the body, and sugar, given as such, is a ready source of energy; childhood, with its ceaseless activity, needs a large supply of energy. On the other hand, excess of sugar results in unhealthy fermentative processes. Nature has included sugar in milk, so that very little should be added to foods made with milk. There is also natural sugar in ripe fruits, but cooked fruit, which is usually not fully ripe, should have sugar added to it. There is no objection to the addition of a little sugar to bread-and-milk, or to porridge, or sprinkled on bread-and-butter. Treacle also, and jam or honey are valuable. The eating of sweets between meals is bad: it tends to destroy the appetite for meals. The best time to give them, if at all, is just after a meal, and those made with plain sugar are less upsetting to the digestion than chocolate.

Fruit.—The juice of raw fruit is a pleasant addition to the diet, and is necessary if the child is not having potato; but for any child who is having an ordinary allowance of potato daily, fruit juice is unnecessary so far as vitamins are concerned. Fruit has, however, other values, in its fruit-sugar and salts, and, moreover, is sometimes useful for its laxative effect. The solid part of raw fruit is not suitable until the child begins to masticate well; fruit such as an apple requires very thorough mastication. Bananas are often given to children at 18 months, or even earlier, but even mashed they are not easy of digestion. Most children are fond of them, and if the digestion will stand it, a mashed banana may be allowed occasionally at 18 months. The real value of apples and pears and many other fruits lies in the mineral salts which are combined with citric, tartaric and matic acids and, being converted into alkaline salts in the body, furnish alkali to

the blood. Grapes are often given in the second year. They supply sugar and mineral salts and, like oranges, provide antiscorbutic vitamin. The skin and pips should be removed; even the substance of the grape itself sometimes causes trouble and can be seen almost unaltered in the stool.

Meat.—The age when meat may be given depends largely upon the stage reached in dentition; finely minced meat is often given to children at 15 months, but the finest mincing is not a substitute for chewing, and it is wiser to wait until all the teeth are present. Red gravy from lightly cooked meat, especially beef, will supply all that the child needs from the meat, and two or three tablespoonfuls of red gravy with potato will make a suitable first course for dinner. Steamed fish, such as sole or plaice, which breaks up into shreds with slight pressure, or chicken pounded into a cream, or brains mashed, may be given when the child has at least 12 teeth.

Soups or broths are often given in the second year as part of the midday meal. For occasional use this is not objectionable, but the nutritive value of any soup or beef-tea is extremely small; if potatoes, peas or barley are included, the value of the broth is chiefly the value of these. Some have advised that in the preparation of broths, broken up bones should be added, perhaps with a small amount of vinegar to help in dissolving out the lime-salts. These salts, however, are much better supplied in milk and eggs, and in general, broths or soups give very little nutrition in proportion to their bulk, which distends the stomach and often prevents the taking of more valuable food.

Vegetables.—Green vegetables are valuable chiefly as supplying mineral salts, especially of potash; they also tend to prevent constipation. Much of their value is lost by the ordinary method of boiling; steaming is preferable, as less of the salts are lost thereby. Spinach has the further value that it contains some iron, which may be of use in blood-making. Carrot is highly indigestible, and has no special virtue apart from being rich in sugar, and is best avoided. Turnips are much less indigestible if well mashed, but of very little nutritive value. Watercress and raw lettuce have very small value as food, and as purveyors of vitamin they are superfluous in any ordinary diet.

All the farinaceous milk puddings, junket and custard, are valuable at any age from a year onwards. For children of two years and more, light suet or bread-and-butter puddings are excellent.

From Three to Five Years.—Much of what has been already said applies equally to children of three to five years. From the completion of dentition to the age of five, the dietary may include, in addition, bacon—fried or cold boiled—bread fried in bacon fat, any fish except salmon and mackerel.

For breakfast, dry cereal preparations, already cooked, are now much in use; they require an amount of mastication which few children will give, and should not be allowed to replace the much more valuable egg, bacon or fish; porridge or bread-and-milk are much better than these dried cereals. Meat and chicken can be given without mincing or pounding: indeed, the child should learn to masticate them. There is no objection to cakes, if not too rich—sultanas are better than currants, and a plain madeira or a ginger cake is best. Milk is the best drink, and the total amount daily should be 1–1¼ pints, exclusive of any used in making puddings, etc. At dinner, water should be given, and the child should be allowed water between meals. Cocoa, ovaltine, or very weak China tea may also be allowed.

The diet of a child should be as varied as possible, and this for two reasons: First, that a proper balance of the essential constituents of food may be maintained, and secondly, to prevent monotony, which is bad both for appetite and digestion. A diet well-balanced in the proportions of the various constituents is essential to good health. (G. F. S.)

BIBLIOGRAPHY.—United States Children's Bureau, "Nutrition work for pre-school children," *Bureau Publication No. 138.* (1924); L. E. Hogan, *How to Feed Children* (11th ed., 1926); L. E. Holt, *Care and Feeding of Children* (8th ed., 1916), and *Food, Health and Growth* (1922); United States Department of Agriculture, "Food for Young Children," *Farmers' Bulletin No. 717* (1920); L. H. Peters, *Diet for Children* (1924); E. Pritchard, *The Physiological Feeding of Infants* (1919); F. H. Maccarthy, *The Healthy Child from Two to Seven* (1922); D. N. Paton, *Poverty, Nutrition and Growth: studies of child life in cities and rural districts of Scotland* (1926); L. H. Gillett, *Adapting Nutrition Work to a Community* (1924), "Diet for the School Child," *Iowa University Extension Bulletin No. 57* (1919), and "A survey of evidence regarding food allowances for healthy children," *New York Assoc. for Improving the Condition of the Poor, Pub. No. 115* (1917); H. R. Baldwin, *Nutrition and Health* (1924); B. W. Bourjaily, *The Mother's Cook Book* (1926); T. Clark, *Indices of Nutrition* (1923), a reprint from the U.S. Public Health Service Reports, Vol. 38, No. 23; K. McHale, *Comparative Psychology and Hygiene of the overweight Child* (Teachers College, Columbia University, Contributions to Education, No. 221, 1926); L. J. Roberts, *Nutrition Work with Children* (1927).

CHILDREN'S GAMES. The study of traditional games has in recent years become an important branch of folklore research, and has contributed not a little towards elucidating many unrecorded facts in early history. These games may be broadly divided into two kinds—dramatic games, and games of skill and chance. These differ materially in their object. Games of skill and chance are played for the purpose of winning property from a less fortunate player. The dramatic games consist of non-singing and singing games; they are divided between boys' games and girls' games. Boys' games are mostly of a contest character, girls' of a more domestic type. The boys' dramatic games have preserved some interesting beliefs and customs, but the tendency in these games, such as "prisoner's base," has been to drop the words and tune and to preserve only that part (action) which tends best for exercise and use in school playgrounds. The girls' singing-games have not developed on these lines, and have therefore not lost so much of their early characteristics. The singing games consist of words, tune and action. The words, in verse, express ideas contained in customs not now in vogue, and they may be traced back to events taking place between men and women and between people of different villages. The tunes are simple, and the same tune is frequently used for different games. The actions are illustrative of the ideas to be expressed. The players represent various objects—animals, villages and people. The singing game is therefore not a game in the usual sense of the word. There is no element of "gambling" or playing "to win" in it—no one is richer or poorer for it; it also requires a number of children to play together. It is really a "play," and has survived because it has handed down some instances of custom and belief which were deeply rooted and which made a strong appeal to the imagination of our ancestors. The singing games represent in dramatic form the survival of those ceremonial dances common to people in early stages of development. These dances celebrated events which served to bind the people together and to give them a common interest in matters affecting their welfare. They were dramatic in character, singing, dancing and action forming a part of them, and their performers were connected by ties of place or kindred. They are probably survivals of what we might call folk drama. In those times it was held imperative to perform religious ceremonies periodically; at sowing and harvesting to ensure good crops; in the care of cattle and on occasions of marriage, birth and death. These were matters affecting the welfare of the whole community. Events were celebrated with dance, song and feasting, and no event was too trivial to be unconnected with some belief which rendered ceremony necessary.

At first these ceremonial dances had deep religious feeling for their basis, but in process of time they became purely secular and were performed at certain seasons only, because it was the custom to do so. They then became recognized as beautiful or pleasing things in the life of the people, and so continued, altering somewhat in ideas but retaining their old dramatic forms. They were danced by old and young at festivals and holidays, these being held about the same time of year as that at which the previous religious ceremonies had been held.

Singing games are danced principally in one of two methods, "line" and "circle." These represent two of the early forms of dramatic action. The "line" form (two lines of players standing opposite each other having a space of ground between them, advancing and retiring in turn) represents two different and opposing parties engaged in a struggle or contest. This method is used in all cases where contest is involved. The "circle" form, on the other hand, where all players join hands, represents those occa-

sions when all the people of one place were engaged in celebrating events in which all were interested. Thus games celebrating sowing and harvest, and those associated with love and marriage, are played in this form. Both these methods allow of development. The circle varies from examples where all perform the same actions and say the same words to that where two or more players have principal parts, the others only singing or acting in dumb show, to examples where the singing has disappeared. The form or method of play and the actions constitute the oldest remaining parts of the game (the words being subject to alterations and loss through ignorance of their meaning), and it is to this form or method, the actions and the accompaniment of song and dance, that they owe their survival, appealing as they do to the strong dramatic instinct of children and of uncultured folk.

It will be convenient to give a few instances of the best-known singing games. In "line" form, a fighting game is "We are the Rovers." The words tell us of two opposing parties fighting for their land; both sides alternately deride one another and end by fighting until one side is victorious. Two other "line" games, "Nuts in May" and "Here come three dukes a-riding," are also games of contest, but not for territory. These show an early custom of obtaining wives. They represent marriage by capture, and are played in "line" form because of the element of contest contained in the custom. Another form, the "arch," is also used to indicate contest.

Circle games, on the contrary, show such customs as harvest and marriage, with love and courting, and a ceremony and sanction by assembled friends. "Oats and beans and barley" and "Sally Water" are typical of this form. The large majority of circle games deal with love or marriage and domestic life. The customs surviving in these games deal with tribal life and take us back to "foundation sacrifice," "well worship," "sacredness of fire," besides marriage and funeral customs.

BIBLIOGRAPHY.—W. W. Newell, *Games and Songs of American Children* (1884); A. B. Gomme, *Children's Singing Games* (1894), *Traditional Games of Great Britain*, 2 vol. (1894–98), and *Old English Singing Games* (1900); P. B. Green, *History of Nursery Rhymes* (1899); R. C. Maclagen, *The Games and Diversions of Argyllshire*, Folklore Soc. Publ. (1901); L. Eckenstein, *Comparative Studies in Nursery Rhymes* (1906, 2nd ed., 1911); Emmett Dunn Angell, *Play—A Book of Games* (1910) and *Real Games for Real Kids* (1923). *See* also C. J. Sharp, *A Book of British Song for Home and School* (1902), *English Folk Songs* (1921), and *English Folk-carols* (1911); C. J. Sharp and C. L. Marson, *Folk Songs from Somerset* (1904–19), and publications of the English Folk Dance Society. *See* further FOLK SONG. (A. B. GO.)

AMERICAN GAMES

Games played by American children fall into two classes, the formal and the informal game. The formal game is given to the children "ready-made," and they play it as someone else has planned it with certain definite form, rules, regulations or words and music. The traditional games discussed above fall into the class of formal games and are used to some extent in American schools and playgrounds, or wherever large groups of children are playing games under direction. The United States is cosmopolitan and the traditional games played are therefore not from any one country. Educators and physical training directors have selected the best of these games and we find in use games from England such as "London Bridge" as well as games from many other countries. These games, however, have lost their traditional significance and the American children play them merely for pleasure in the activity. While there are some formal games such as baseball which are typically American there are no traditional games which reflect the customs and history of the country as do the games of England, France and Germany.

This does not mean that the play life of American children is limited or that there is no play which reflects the national spirit. A study of the spontaneous play of American children has shown that in their unsupervised play they show less interest in formal, traditional games than they do in their own informally organized games. An informally organized game is one in which the organization is developed by the players themselves as the need for it arises. The rules are made by the children and changed to fit the situation. An illustration of a game of this type may clarify this definition: Several children are playing with a ball, throwing it to each other, running after it, bouncing it. A low wall near by suggests a game. One child says, "Now all stand on the wall and I'll throw the ball to you." As the game progresses the organization grows. One child suggests bouncing the ball, which they do for a time, but it does not seem to work. So they return to the original plan of throwing it. A child happens to miss the ball and there must be a decision as to what is to be done in this situation. The children decide that anyone who misses the ball must get off the wall.

There are endless possibilities in a game of this kind and the children will add to it and vary it according to their age, interests, experience and organizing ability. In this way they learn to direct themselves and others, to keep self-made rules and to meet and think through situations as they arise. Educators and those who have made a study of children's games realize that this development of a game is more valuable than always following the directions and organization of an adult or being bound by rules and regulations made by someone else in another situation. The games children play in America are being influenced by the careful studies that have been made of unsupervised play, and more and more in schools and playgrounds children are being given opportunity to play their own informal games.

Games, whether formal or informal, grow out of certain definite interests and may be classified accordingly:—

Games of Physical Activity.—An interest in games involving physical activity persists through life and there is a different form of game for each stage of development. Very little children make a game of climbing up steps and down again, jumping from a wall, running from one tree to another and so forth. Interest in this simple form of activity persists until the age of five or six years. A little later on this activity may be organized into a simple game of tag, or a race game with definite rules. As the children grow older and develop more skill the element of competition enters in, and with older children most of the games of physical activity involve competition and have quite a high degree of organization. They tend to use the more formal games that have been worked out by adults or other groups of children. We find them playing "prisoner's base," football, basketball and baseball. The older children, however, still show great ingenuity in making their own games and adaptations of games.

Some of the most popular of the traditional singing games are "Ring-around-a-rosy," "Looby Loo," "London Bridge," "Oats, Peas, Beans and Barley Grow," "Farmer in the Dell" and "Drop the Handkerchief."

Hiding and Finding Games.—Interest in this type of game also persists through life with a different form for each stage of development from the "peek-a-boo" interest of the baby to the adult interest in cross-word puzzles (an intellectual form of hiding and finding). The hiding and finding game of the very young child is purely a guessing game, "Which hand is it in?" "Button, button who has the button?" Later children begin to use their senses to help in the finding and we have games in which a child uses his eyes or ears to help him find a hidden object or child. There are many ways of working out this kind of game, "Hide the Thimble," "I Spy" and "Hide and Seek" are typical forms. Here again we find that while older children tend to use an established form they make their own adaptations. For example, the signals in the game "Run Sheep Run" (*Games for the Playground, Home, School and Gymnasium*, by J. H. Bancroft) varied according to locality and were determined by the environment and experience of the children. In a Minnesota town the signals were colours, in the city environment of New York the signals had become pickles, tomatoes and other articles strongly suggestive of a delicatessen store.

There is another way in which this hiding and finding interest manifests itself. This is in the playing of a more intellectual type of game such as "I am thinking of something red," "I am thinking of something that grows on a farm" and so forth. The children show great ingenuity in developing these games and in making them more and more difficult. Finally we find them evolv-

ing games which require a knowledge of history, as guessing a historical character by the initials of the character's name; or a knowledge of science, geography and other studies.

Dramatic Games.—Here again the interest persists through life. It begins when the little child plays he is a train or a bear, and later becomes an interest in charades or amateur theatricals. The varied American life particularly lends itself to reflection in dramatic play and in this play are mirrored all the country's local interests, customs, institutions and industries. This type of play is even portrayed in American literature. Louisa Alcott has recorded much typical dramatic play in her stories and other descriptions are found in books by Mary Wells, Eliza Orne White and others.

BIBLIOGRAPHY.—J. H. Bancroft, *Games for the Playground, Home, School and Gymnasium* (1909); A. C. Sies, *Spontaneous and Supervised Play in Childhood* (1922); M. Hofer, *Children's Singing Games* (1914). (A. BUR.; X.)

CHILDRESS, a city in the "panhandle" of Texas, U.S.A., near the Red river and the Oklahoma border; the county seat of Childress county. It is on federal highways 287 and 83; is served by the Fort Worth and Denver City, the Fort Worth and Denver Northern, the Fort Worth and Denver Southern Plains railways; and has an airport 2·6 mi. S.E. Pop. (1940) 6,464. Cattle, hogs, wheat, cotton and grain sorghum are raised in the vicinity. Natural gas, gypsum and gypsites are found. The city has cotton compresses, gins, cotton-seed oil mill, railway repair shops, and a packing plant. Settled 1888, it was incorporated in 1892.

CHILDS, GEORGE WILLIAM (1829–1894), American publisher, was born in Baltimore, Md., on May 12, 1829. In 1847 he established a book-shop in Philadelphia, and two years later organized the publishing house of Childs and Peterson. In 1864, with Anthony J. Drexel, he purchased the *Public Ledger*. He died at Philadelphia, Feb. 3, 1894. Childs was known for his public spirit and philanthropy. He erected memorial windows to William Cowper and George Herbert in Westminster Abbey (1877), and to Milton in St. Margaret's, Westminster (1888), a monument to Leigh Hunt at Kensal Green, to Shakespeare a memorial fountain at Stratford-on-Avon (1887) and monuments to Edgar Allan Poe and to Richard A. Proctor. He gave Woodland Cemetery to the Typographical Society of Philadelphia for a printers' burial-ground, and with Anthony J. Drexel founded in 1892 a home for union printers at Colorado Springs, Colorado.

His *Recollections* were published in Philadelphia in 1890.

CHILD STUDY ASSOCIATIONS are of two types, those whose programs are devoted to child study in general and those who have incorporated in their programs a department of special work. In the United States the associations either organize or encourage the organization of study groups, and undertake research, lectures, conferences, consultation service, training of leaders for study groups, service to schools and colleges and the publication of books and pamphlets.

In England, the British Child Study Association (founded 1894), the Childhood Society and the Parents' National Educational Union are the most outstanding associations. In the United States, The Child Study Association, National Congress of Parents and Teachers, American Association of University Women, American Home Economics Association, Progressive Education Association and the Parents' Publishing Association which publishes *Children, the Magazine for Parents,* are all doing significant work. The New Education Fellowship in several countries in Europe has a program similar to that of the Progressive Education Association.

CHILD WELFARE AND CHILD LABOUR. Systematic child welfare work, the object of which is to promote the mental, moral and physical well-being of children, is a comparatively modern development and it received little official recognition in any country before the middle of the 19th century. At first, the work was developed on local national lines. Later, under progressive influences, the work became of common interest to different countries and a subject of mutual co-operation. Finally, child welfare has been definitely accepted as a subject of international concern and interest.

INTERNATIONAL CHILD WELFARE

The interest in child welfare that exists in all countries has found international expression in international child welfare conferences, in the organization of international child welfare associations under private auspices, and in international child welfare organizations supported by governments.

International Child Welfare Congresses.—The first international child welfare congress held in Paris in 1883 was attended by Government delegates and private individuals from several countries of Europe and America, including the United States. The agenda included maternity homes, aid to children in their parents' homes, foster-home care, institutions, school attendance, and care of wayward and delinquent children. A second congress was held in Bordeaux in 1895, a third in London in 1902; other congresses in Western Europe followed in Brussels in 1913 and 1921; Vienna and Budapest in 1924; Geneva in 1925; and Paris in 1928, 1931 and 1933. Two congresses, limited to the Balkan countries, were held in 1936 and 1938 respectively.

These congresses, with their exchange of information and of ideas and resulting inspiration, have been credited with stimulating the development of child welfare. It is considered not merely accidental that such innovations as milk stations and health centres for children, prohibition of employment of women for specified periods before and after childbirth, and other reforms followed in various countries soon after the first two congresses.

In the countries of the Pan American Union, the problems peculiar to that part of the world have led to the holding of separate congresses. So far the following seven congresses have been held: Buenos Aires, Argentina, 1916; Montevideo, Uruguay, 1919; Rio de Janeiro, Brazil, 1922; Santiago, Chile, 1924; Havana, Cuba, 1927; Lima, Peru, 1930; and Mexico City, 1935. The eighth congress planned for Costa Rica for Oct. 1939 was indefinitely postponed because of the international situation.

Like the European child welfare congresses, the Pan American congresses are also believed to have produced concrete results in the child welfare field. For example, the establishment of a juvenile court in Buenos Aires in 1919 has been considered among the results of the First Pan American Child Congress held in that city in 1916. The American International Institute for the Protection of Childhood in Montevideo was organized after resolutions asking for such an agency had been passed at three congresses. The progress in other branches of child welfare in the Americas has also been attributed to the stimulation of these congresses.

International Child Welfare Associations.—With the gradual development of child welfare work international child welfare associations, usually consisting of official and private organizations and individuals from several countries, have come to be considered as important instruments of international action. A decision to form such an association was made at the International Congress for the Protection of Childhood in Brussels in 1913. Because of the war of 1914–18 action was not taken until 1921, when the International Association for the Protection of Childhood was founded in Brussels. The purpose of the association was to serve as an international link between individuals and organizations interested in child welfare, to facilitate the study of child welfare, to promote legislation, and to collect and publish laws, regulations, and other documents on child welfare. In the beginning 10 Governments and a number of private societies joined the association. Several Governments soon proposed transfer of the governmental activities of the association to the League of Nations. This was done after prolonged diplomatic discussion, and the association was reorganized as a strictly private organization retaining only private societies and individuals as members. In 1940 the association was governed by an international committee and was supported by its members' fees. It prepared reports on child welfare in various countries, to be presented at its annual meetings.

The distress among children in Europe after the World War (1914–18) presented a problem which was considered too large for the efforts of the individual countries. International co-operative action was considered imperative. To facilitate such co-operation the Save the Children International Union was founded in Geneva in 1920. The Union, which is a federation of private welfare societies in many countries, began with relief work but its activities were gradually expanded to include the promotion of general child welfare. The Union adopted in 1923 a declaration of the child's rights known as the Declaration of Geneva. In Sept. 1924 the Fifth Assembly of the League of Nations approved the declaration and asked the member States of the League to apply its principles to the protection of childhood.

The Union has made a number of studies of the effects of the World War on children; and it publishes a bimonthly bulletin on the work of its affiliates in the various countries.

Pan American Organizations Concerned With Child Welfare.—The International American Institute for the Protection of Childhood, established in Montevideo in 1927 with headquarters in Montevideo, Uruguay, serves as a centre of study, information and advice on all matters pertaining to the welfare of children in American countries. Membership is open to any country of the Pan American Union. The Institute is governed by an international council consisting in Oct. 1939 of 15 representatives of 11 countries, including the United States. The income of the Institute is derived mainly from the dues of the member countries. A quarterly bulletin is published. The Pan American Union, Washington, D.C., was organized in 1890 by the Governments of the United States and the 20 countries of Latin America, by which it is maintained, for the purposes of promoting peace, commerce and friendship among these countries. In its monthly bulletin, issued in the English, Spanish and Portuguese languages, the Union publishes material, among other subjects, on child welfare in American countries.

The Pan American Sanitary Bureau, Washington, D.C., organized in 1902 by the First Pan American Sanitary Conference, is interested in preventing the international spread of communicable diseases and in improving the health of the people of the 21 American republics. It serves as a centre of information on public health in the United States and the 20 countries of Latin America; it arranges international conferences on public health, including child health, and publishes a monthly bulletin in Spanish which contains information on child health and welfare in the United States and Latin America.

Child Welfare Under the League of Nations.—The Treaty of Versailles (1919) pointed out the perils involved in social "injustice, hardship, and privation to large numbers of people." In recognition of these dangers as they relate to adults and children, article 23 of the Covenant of the League requests the member States of the League to endeavour to secure and maintain fair and humane conditions of labour for adult and child workers, to take measures for the prevention and control of disease, and to entrust the League with general supervision over the execution of agreements on the traffic in women and children.

The responsibility for providing these services is vested in (1) the International Labour Organization, (2) the Health Organization, and (3) the Advisory Committee on Social Questions and the Social Questions Section of the League Secretariat.

The International Labour Organization consists of representatives of the member States of the League of Nations and certain others including the United States. It endeavours to promote fair and humane conditions of labour for men, women and children both in the member countries and in countries with which they have commercial relations. (See *International Child Labour* below.)

The Health Organization includes an advisory council, a health committee, and the Health Section of the League Secretariat. "The purpose of the Organization is to promote the protection of public health by international co-operation." Its work has included campaigns for the reduction of communicable and other diseases, studies of rural hygiene, sanitation and housing, and measures for the adoption of international standards for certain vitamins and medicaments.

The study of nutrition as basic to welfare, especially to child welfare, has been the concern of the Health Organization and the Mixed Committee for the Study of Problems of Nutrition appointed by the Council of the League. This committee published a comprehensive report in 1937.[1] National inquiries into the state of nutrition have been organized in different parts of the world; the formation of national nutrition committees has been stimulated; international meetings on nutrition have been arranged; and an ever-growing interest in nutrition has been awakened.[2]

The Advisory Committee on Traffic in Women and Children appointed in 1921 was entrusted "with the general supervision of the execution of agreements with regard to traffic in women and children."[3] This traffic had been the subject of conventions adopted by international conferences in 1904 and 1910.

In 1921 the League called a conference on traffic in women and children. Thirty-four countries were represented and an international convention for the suppression of traffic in women and children was adopted and submitted to the countries for ratification. This convention, which binds the signatory countries to work more effectively than heretofore for the protection of women and children against this traffic, was in effect in 1939[4] in 45 countries and many colonies, protectorates and mandated territories. The Advisory Committee on Traffic in Women and Children was replaced in 1925 by the Advisory Commission for the Welfare of Children and Young Persons, which was divided into two committees: the Committee on Traffic in Women and Children and the Child Welfare Committee. In 1936 these committees were combined to form the Advisory Committee on Social Questions of the League of Nations. As now constituted, its membership is limited to the representatives of the Governments of 25 States although the services of private organizations and individuals are used on special occasions and for special tasks. The Health Organization and the International Labour Office each has a liaison officer who serves as a member of the committee. The committee meets annually in Geneva.

Among the subjects studied by the Child Welfare Committee between its appointment in 1925 and its reorganization in 1936 were: the age of marriage and consent; legal status of illegitimate children; juvenile courts and their related services; motion pictures and child welfare; and measures taken in various countries for the protection of children and young persons from the consequences of economic depression. The purpose of these studies was to improve the conditions of child life. The information was obtained mostly through correspondence with the Governments.

The Committee on Social Questions has enlarged its scope to include certain other problems relating to family life and the technical aspects of child welfare. The committee, through the staff of the Social Questions Section of the League Secretariat, collects and publishes information on legislation and practical work in different countries, answers requests for information, and conducts international and national inquiries on social questions. It also is responsible for promoting co-operation between Governments and proposing international conventions and agreements. With the co-operation of Government representatives, the Social Questions Section of the League Secretariat published in 1938 a two-volume study of the practices and procedures relating to the placement of children in foster families in 26 countries.[5] Final reports of studies of the rehabilitation of adult prostitutes and measures to prevent prostitution, especially with regard to minors, and of the legal and social aspect of illegitimacy are in preparation (1940). The training of persons engaged in social work, principles adopted in the administration and organization of welfare work for children and problems involved in family desertion, are subjects of studies recently undertaken. Traffic in women and children and the suppression of obscene publications are among the continuing concerns of the committee.

BIBLIOGRAPHY.—*Congrès International de la Protection de l'Enfance* (1883); *Compte Rendu des Travaux,* Publié au nom de la Commission Internationale Permanente par M. Maurice Bonjean (Paris, 1884–86); *Congrès International de la Protection de l'Enfance* (3 vols.), (Paris, 1928); *Deuxième Congrès International de la Protection de l'Enfance* (3 vols.), (Brussels, 1921); *Bulletin International de la Protection de l'Enfance* (Brussels, 1921 to date); Union Internationale de Secours aux Enfants, Geneva, regular bulletin and other publications; *Boletín del Instituto Internacional Americano de Protección a la Infancia,* published quarterly at Montevideo, Uruguay; League of Nations: Publications by the Advisory Committee on Social Questions and by other committees.

Child Welfare in the United States.—The child welfare movement in the United States began with concern for homeless children and children neglected, abused or exploited, and gradually broadened to include concern over such problems as the loss of infant life, the inadequacy of educational opportunity, and the early employment of children to the detriment of their health and education. Private effort in behalf of such children led to public action in the form of institutions and services for the care of children and laws prescribing various types of protection for them. Since the beginning of the 20th century activities in behalf of children have been developed rapidly, especially in the promotion of maternal and child health, in the provision of various types of community service needed for children handicapped physically, mentally or socially, in the equalization of educational opportunity, and in the regulation of child labour and the elimination of early employment. Increasingly State and local governments have assumed definite responsibility for safeguarding child life.

In 1912 the Federal Government by Act of Congress created the Children's Bureau (transferred to the newly created United States Department of Labor in 1913) and directed it to "investigate and report . . . upon all matters pertaining to the welfare of children and child life among all classes of our people." Through its investigations in the fields of maternal and child health, of child dependency, neglect and delinquency, and of child labour and employment, the bureau makes available facts for the guidance of professional groups and administrative agencies in developing programs for the benefit of children. On the basis of these facts the Children's Bureau cooperates with other agencies in formulating standards for various phases of child care and in obtaining widespread understanding and acceptance of such standards. The bureau publishes technical reports, pamphlets for parents on child care and training, material in chart and exhibit form, and a monthly news bulletin, *The Child.*

From time to time the Children's Bureau has been given administrative responsibility, including the administration of the first Federal child-labour law in 1917–18 and of the act providing Federal aid for the promotion of maternal and infant hygiene, 1921–29. The Social

[1] *Nutrition.*—"Final Report of the Mixed Committee of the League of Nations on the Relation of Nutrition to Health, Agriculture and Economic Policy," League of Nations Publication No. A.13.1937.II.A. Geneva.

[2] "The Development of International Cooperation in Economic and Social Affairs." Report of the Special Committee (appointed in 1939 at the suggestion of the Secretary-General of the League by Stanley M. Bruce of Australia for the purpose of considering methods of expanding the League's social and economic activities). Special Supplement to the *Monthly Summary of the League of Nations,* Aug. 1939, p. 14.

[3] Article 23 (c), Covenant of the League of Nations. See p. 188, *Essential Facts About the League of Nations,* published by the Information Section of the League of Nations Secretariat, Geneva, 1935.

[4] League of Nations. C. Q. S. 44, Advisory Committee on Social Questions, third session, June 19, 1939, Progress Report of the Director of the Social Questions Section, p. 4.

[5] *The Placing of Children in Families.* League of Nations Advisory Committee on Social Questions. Publication No. C.260.M.155.1938.IV.

Security Act in 1935 gave to the Children's Bureau responsibility for administration of grants to the States for the following purposes: $3,800,000 annually for maternal and child-health services—increased to $5,820,000 in 1939; $2,850,000 annually for services for crippled children—increased to $3,870,000 in 1939; and $1,500,000 annually for child-welfare services, increased to $1,510,000 in 1939. Grants for these purposes are made to the 48 States, the District of Columbia, Alaska, Hawaii, and Puerto Rico which became eligible for such grants beginning Jan. 1, 1940. The Fair Labor Standards Act of 1938 made the Children's Bureau responsible for the administration of the child-labour provisions of the Act, which regulate the employment of minors in establishments producing goods for shipment in interstate commerce.

Other Federal agencies responsible for programs directly benefiting children and youth include the following: the Office of Education of the Federal Security Agency conducts a research program in the field of education and administers Federal aid to the States for vocational education and vocational rehabilitation; the Department of Justice administers the act regarding juvenile offenders against Federal laws; the Social Security Board in the Federal Security Agency administers under the Social Security Act grants to the States for aid to needy dependent children, and benefits for children under the old age and survivors' insurance program. Two programs for youth have arisen as a part of the unemployment relief program, namely the Civilian Conservation Corps, which employs youths from 18 to 24 inclusive in conservation work on public lands, and the National Youth Administration, which conducts student-aid and work-projects programs for unemployed youth. The U.S. Department of Agriculture, as a part of its extension service for agricultural and home economics education, conducts a club program for the benefit of rural boys and girls.

National conferences have been held under presidential auspices as follows: 1909 Conference on the Care of Dependent Children; 1919 Conference on Child Welfare Standards; 1930 White House Conference on Child Health and Protection. On April 26, 1939, the first session of a White House Conference on Children in a Democracy was held and the final session held Jan. 18–20, 1940. These conferences have pointed out types of care and protection needed for children in the United States and have led to public and private action for the benefit of children.

See also articles on special phases of child welfare.

BIBLIOGRAPHY.—Publications of the Children's Bureau, U.S. Department of Labor, 1913 to date; Grace Abbott, *The Child and the State,* vol. 1; *Apprenticeship and Child Labor,* vol. II; *The Dependent and Delinquent Child; The Child of Unmarried Parents* (1938); *Social Work Yearbook,* published biennially (latest edition 1939); Publications of the White House Conference on Child Health and Protection, 1930 (1931–36); Publications of the White House Conference on Children in a Democracy (1940–). (K. F. L.)

Child Development in the U. S.—Within recent years great interest in the scientific study of children has arisen in the United States. A number of institutes which co-operate with and co-ordinate the work of various departments such as anatomy, pediatrics, psychology, home economics, education, sociology, etc., have been established in universities. In some, similar work is carried forward by a co-ordinating committee.

The work in child development covers three main purposes: fundamental and practical research on the development of the child, training future workers, and the conduct of programs for educating parents in child care and training.

The leading institutes are: the Iowa child welfare research station at Iowa City, Ia., founded in 1917; the Institute of child welfare research at Teachers college, Columbia University, New York city, founded in 1924; the Institute of child welfare at the University of Minnesota, Minneapolis, Minn., founded in 1925, and the Institute of child welfare at the University of California, Berkeley, Calif., founded in 1927. Organizations doing similar work are: the Yale Psycho-Clinic, the Merrill-Palmer school of home-making at Detroit, Mich., the St. George's school for child study at the University of Toronto, and the Committee on Child Development at the University of Chicago. (X.)

INTERNATIONAL CHILD LABOUR

The movement for the legal regulation of child labour began at the close of the 18th century when, with the rapid development of large-scale manufacturing in Great Britain, the exploitation of very young children in industrial work attracted public notice.

The first child-labour law, adopted in England in 1802, was an attempt to control the evils incident to apprenticing pauper children to cotton-mill owners. This law was largely futile because of lack of administrative machinery; moreover, the equally bad conditions of employment of the increasing number of free children (not apprenticed as paupers) aroused agitation for further factory legislation. A law enacted in 1819 applied to all child employees in cotton mills and prescribed a minimum age of nine years, but it still failed to provide machinery for enforcement. The Factory Act of 1833, which raised these child-labour standards somewhat, was the first law instituting even a rudimentary system of factory inspection. Gradually these standards were raised and administrative machinery was developed in England, and other industrial countries began to restrict child labour along similar lines.

The importance of international action in this field was early realized, and the proposals for such action were made in the first International Labour Conference, which convened in Berlin in 1890 at the invitation of the German Government. Fourteen governments were officially represented at this conference, but no agreement as to standards was reached. Subsequently other conferences were held and the demand for international action increased. The International Association for Labour Legislation, a private organization, was established in 1900 with headquarters at Basle, Switzerland, and with branches in at least 16 countries. This association worked for nearly 18 years to educate all countries of the world, through its conferences and publications, as to the need for international labour legislation, including child-labour legislation. At the end of the war of 1914–18 this association joined other organizations in urging that formal provision be made in the treaty of peace for international safeguarding of labour and, as a result, the Treaty of Versailles of 1919 directed the signatory powers to establish a permanent agency for improving the condition of workers, including children and young persons. Such an agency, the International Labour Organization, was founded several months later, affiliated with the League of Nations.

The Organization consisted of three parts: The International Labour Conference, which met annually in Geneva for the discussion of labour problems and to which each member country sent representatives of the government, employers and workers; the Governing Body, which acted as an executive committee and prepared the agenda of the annual conference; and the International Labour Office, which studied labour laws and other labour problems throughout the world, collected information, published reports and other material on labour, and drafted in preliminary form conventions and recommendations for submission to the Conference.

After a preliminary draft of a convention was made, based upon studies and conferences, it was submitted to the annual international labour conference of the Organization. If approved, the convention was sent to each member country and the government of each country submitted the convention to the national legislative body, which might either ratify it or reject it. Ratification involved an obligation to enact a law for carrying out the provisions of the convention. This phase of the work of the International Labour Organization was much hindered by the war of 1939.

Among the many conventions submitted to member countries by the International Labour Organization a number have been concerned with children and young persons. A convention approved in 1919 called for a minimum age of 14 years for employment in industrial occupations, except in Japan, where the age limit called for was 12 years for children with an elementary-school certificate and in India, where the convention provided that children under 12 could not be employed in a number of specified industries. In 1937 this convention was revised, and the minimum age was raised to 15 years, except in Japan (14 years) and India (13 years for specified kinds of work). For nonindustrial occupations, exclusive of agriculture, a convention of 1932 prescribed a minimum age of 14 years for full-time employment, which was raised in 1937 to 15 years, with specified exceptions.

The minimum age for work at sea was fixed at 14 years by a convention of 1920, but was raised to 15 years in 1936, with specified exemptions. There are also conventions prohibiting or regulating the employment of children and young persons at night or in dangerous or unhealthful work, as well as conventions and recommendations on various other phases of child-labour legislation.

By the end of 1939 the following conventions on minimum age had been ratified: 14-year minimum age for industrial employment, 29 countries; 15-year minimum age for industrial employment, 1 country; 14-year minimum age for nonindustrial employment, 7 countries; 14-year minimum age for work at sea, 32 countries; and 15-year minimum age for work at sea, 5 countries. No country has ratified the convention raising the minimum age for employment in nonindustrial occupations to fifteen.

The significant progress which followed the establishment of the International Labour Organization is manifest not only in the large number of ratifications but also in the rapid succession of new laws, or amendments of existing laws, for the purpose of giving effect to the ratifications. However, not all advances in legislative protection can be attributed to these international conventions. By the end of 1939, a minimum age of 14 years for employment in industrial occupations was required by law in at least 15 countries in Europe: Belgium, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, the Irish Free State, Italy, Latvia, the Netherlands, Rumania, Sweden and Yugoslavia. In Switzerland and Norway the minimum age was 15 years, in the Soviet Union it was 16 years. In Great Britain two education acts passed in 1936, one for England and Wales and the other for Scotland, provided for raising the school-leaving age from 14 to 15 years, effective Sept. 1, 1939, which would have brought about a corresponding increase in the minimum age for employment. However, because of war conditions the effective date of these acts was postponed. In Latin America, where labour legislation has been of more recent growth than in European countries, great progress has been made. At the end of 1939 the minimum age

for admission to industrial employment was 15 years in two of the 20 countries, 14 years, with exemptions, in ten countries, and 12 years in at least three countries. In Canada, Australia, New Zealand and South Africa the minimum age in general is 14 years. In India the minimum age was raised from 9 to 12 years in 1922. Child-labour laws also have been adopted in many colonies, protectorates and mandated territories; the minimum ages vary from 10 to 12 years according to local conditions of industrial development, climate and other circumstances.

The minimum ages in most of the laws apply to selected industries, which usually include factories, workshops, mines, quarries, construction and transportation. In some countries the same limits are laid down for work in trade, in commerce, on vessels and in other kinds of employment.

Exemptions are permitted by many laws. Workshops in which only members of the same family are employed are usually outside the scope of this legislation. In France, for instance, where, according to the Labour Code, the minimum age is 14 years, children under 14 who have not yet completed the required school course may be employed for definite periods of time in farm work and maritime fishing; in Italy, where the minimum age is also 14 years, children under 12 can work under specified conditions in the making of motion pictures; in the Soviet Union, where the minimum age is 16 years, children 14 years of age may be admitted to industrial work in "exceptional cases;" in Switzerland, where the minimum age is 15 years, younger children may be employed under specified conditions. In Latin American laws poverty is often given as a cause for exemption, and a child below the minimum age is allowed by some of the laws to go to work if he has finished the prescribed school course.

It is generally recognized that higher ages of admission should be set for employment in occupations which are dangerous to the life, health, or morals of the employed persons. The convention of 1937 providing for raising from 14 to 15 years the minimum age of admission of children to industrial employment also required the ratifying countries to enact laws prescribing "a higher age or ages than 15 years for the admission of adolescents to dangerous occupations." This followed the practice of many countries which have prohibited or regulated the employment of young persons in dangerous or harmful occupations.

Prohibition of night work of young persons under 18 employed in industry was the subject of a convention approved in 1919. This prohibition, however, does not apply to boys over 16 employed in specified continuous industries. By the end of 1939 this convention had been ratified by 31 countries, and legislation, in some cases enacted before the ratifying of the convention, was in effect in at least 30 countries.

The laws regulating employment of children are enforced by factory inspectors who report to the national departments of labour. In order to facilitate inspection it is often provided that every employer shall keep a register of all young persons under 16 or under 18 years of age, showing their dates of birth.

There has been a tendency toward more effective safeguarding of agricultural child workers than has been the case in the past. A draft convention of the International Labour Organization adopted in 1921 prohibits the employment of children under 14 in agriculture except for work outside of school hours that does not interfere with school attendance. By the end of 1939 this convention had been ratified in 20 countries and laws for its application were in existence in at least 12 countries: Belgium, Bulgaria, Chile, the Dominican Republic, Estonia, Hungary, the Irish Free State, Italy, Luxembourg, Rumania, Sweden and Uruguay.

An increasing tendency is developing internationally not only to protect children from harmful employment but also to prepare them for their introduction to industrial life. It is being more and more clearly realized that it is not enough merely to prohibit the employment of children. It is necessary also to prepare the child constructively for the employment which he eventually will enter. Thus increasing attention is being devoted in many countries to vocational education, technical training, and vocational guidance, with a view to equipping the child as completely as possible for his future work.

Experience has indicated that shortage of labour due to the military service of large numbers of men may create a demand for young workers. In the war of 1914–18 many of the child-protective laws in the warring countries of Europe were suspended with the resulting employment of children below the minimum age and under conditions prohibited by law. On Sept. 1, 1939, the day of the outbreak of the war between England, France and Poland on one side and Germany on the other, the National Defence Council of Germany issued an order permitting the suspension by the Minister of Labour of all labour laws, including child-labour laws relating to minimum age, hours of work and night work. In France a decree of Sept. 1, 1939, permitted the employment of children for 10 hours a day or 60 hours a week, instead of 40 hours; these hours may be lengthened upon authorization from a labour inspector, and they may be lowered for special localities or special occupations or categories of workers by order of the Minister of Labour. In Belgium the suspension of specified provisions of the child-labour law was permitted by decree of Aug. 26, 1939, in case of reinforcement or mobilization of the army. In Great Britain, as has been noted, the effective date of the law raising the school-leaving age from 14 to 15, which would have come into operation Sept. 1, 1939, was postponed. In addition, a relaxation of labour laws was permitted, and, upon application to the factory inspectors, employers were allowed to employ children under 16 for 48 hours a week instead of 44, as prescribed by law. Early, however, in the war of 1939, public authorities in England, France and Germany began to call attention to the evil effects of such relaxation on health and efficiency and to the need for restricting exemptions.

Health and safety measures, social insurance, shorter hours, higher wages and other measures tending to improve the situation of the adult worker also promote the children's well-being and a better family life.

BIBLIOGRAPHY.—Clara D. Rackham, *Factory Law* (London, 1938); Boutelle E. Lowe, *The International Protection of Labour* (New York, 1935); *Bulletin des Internationalen Arbeitsamtes* (Basle, 1902–19); *Treaty of Peace between the Allied and Associated Powers and Germany*, published by His Majesty's Stationery Office, London (1919); various publications issued by the International Labour Office.

Texts of child-labour laws are in the *Bulletin of the International Labour Office* (Basle, 1906–19), and in the *Legislative Series* from 1919 to date (International Labour Office, Geneva). Information on the application of legislation is contained in the Factory Inspector's *Reports* and in official reports issued by government departments in the various countries. (B. Mc.)

Child Labour in the U. S.—The U. S. Census of 1930 reported 667,118 children 10 to 15 years of age, inclusive, engaged in gainful occupations in the United States. This number was approximately one-twentieth of the total number (14,300,576) of children of those ages in the entire country. The number of child workers 10 to 13 years of age, inclusive, was 235,328. It is generally recognized, however, that for a number of reasons these census figures understate the extent of child labour even in 1930, when the industrial depression had reduced employment opportunities for all workers. Many of those 10 to 15 years of age, inclusive, employed in agriculture were not included because of the month (April) in which the census was taken, and there is reason to believe that many more children of these ages were employed in street trades and in industrial home work than were reported by the census enumerators.

Of the child workers 10 to 15 years of age, inclusive, in 1930 469,497, or 70%, were reported to be engaged in agricultural pursuits. There were 68,266 children, or 10.2%, employed in manufacturing and mechanical industries. More than 16,000 children were engaged in some type of clerical occupation; about 50,000 were in trades; 46,145, the majority of them girls, were working at occupations classified as "domestic and personal service"; and 1,184 were employed in the extraction of minerals.

During and since the World War of 1914–18, the number of working children fluctuated greatly. By the latter part of 1915 the effect of foreign orders for war goods was beginning to make itself felt, and a rise in the number of children employed in manufacturing and other industries followed.

Available statistics show that the peak in the employment of children for the war years was reached in 1918. The shutting-down of war industries and the return of soldiers resulted in a temporary decline in 1919, and the census of 1920 showed a considerable decrease in the number of children reported at work as compared with 1910. Although the total child population 10 to 15 years of age, inclusive, increased 15.5%, the number of working children reported decreased almost half (46.7%). Between 1920 and 1930, when the child population 10 to 15 years of age increased 14.4%, the census showed a decrease of 37.1% in the total number of working children. In 1910, 18.4% of all the children of these ages were employed in gainful occupations; in 1920, 8.5% and 1930, 4.7%. Between 1920 and 1930 the decline was most striking in extraction of minerals (83.5%); and least in domestic and personal service (14.6%).

Since 1930, the figures available indicate a continuing decrease in the general employment of children, in spite of a rise in the child population, due in part to unemployment conditions and in part to restrictive legislation and an increasing tendency to lengthen the period of schooling for children. It is significant, however, that in spite of this net decrease, such employment, unless restricted by State or Federal prohibitive legislation, has a tendency to fluctuate with the fluctuations in business conditions. Also, there is a change in the types of work in which children under 16 years of age are employed from the manufacturing industries to the mercantile and service industries, which are less adequately regulated by law, in general, than factory work.

During the 19th century, State legislation alone was depended upon for the control of child labour. A realization of the need for a national minimum standard, below which no State might fall, became articulate in the beginning of the 20th century. Proposals in Congress for such legislation were first made in 1906 but they did not result in legislation until the first Federal child-labour law, based on the power of Congress over interstate commerce, was enacted in 1916, to go into effect a year later. This law was declared unconstitutional in 1918 by the Supreme Court of the United States as beyond the power of Congress. After a second Federal child labour law, based on the taxing power of Congress, was declared unconstitutional on the same ground in 1922, a constitutional amendment

empowering Congress to enact child labour legislation was proposed. This amendment had in 1940 been ratified by 28 States. Ratifications by 8 more States are needed to make it part of the Federal Constitution.

Two Federal laws applicable to general labour conditions have also had a decisive influence on child labour. The first was the National Industrial Recovery Act enacted in 1933, under which a 16-year minimum-age standard was included in more than 500 codes for industries and trades, *i.e.*, agreements as to labour standards effective without regard to State lines. Prohibitions against the employment of minors under 18 years of age in hazardous occupations were included in a large number of these codes. This type of regulation went out of existence under the decision of the Supreme Court in the Schechter case in 1935, but in 1938 the enactment of the Fair Labor Standards Act by Congress, which regulates wages and hours in interstate industries, again brought about a Federal standard for child labour. The act, which went into operation on Oct. 24, 1938 applies a basic 16-year minimum age for employment to industries producing goods for interstate commerce, and makes provision for the prohibition by determination and order of employment of minors under 18 years of age in occupations found to be especially hazardous or detrimental to their health or well-being. The minimum-wage and maximum-hours provisions of this Federal law apply to all workers regardless of age or sex. The law sets a basic work-week of 40 hours and a minimum hourly rate of 40 cents to be reached by gradual steps within a 7-year period.

In the child-labour legislation enacted by the various States there are many differences. Such laws usually require:

(1) That a child must reach a specified age and meet an educational and physical standard before he can be employed;

(2) That an official work permit be issued certifying that the child has reached the age legal for employment in which he is to engage and has satisfied any other requirements of the statute;

(3) That the age at which children may be employed in hazardous or unhealthful occupations must be higher than the age at which they may enter general employment;

(4) That hours of labour be restricted and employment at night prohibited.

Of these standards the minimum age was the first to be generally adopted. Every State except one has prohibited the employment in industry of children under 14 years of age. A significant tendency is toward the establishment of a 16-year minimum age. Thirteen States (Connecticut, Massachusetts, Montana, New Jersey, New York, Ohio, North Carolina, Pennsylvania, Rhode Island, South Carolina, Utah, West Virginia and Wisconsin) had in 1940 a basic 16-year minimum, whereas in 1930 only two States had established this basic minimum age. Four States (Michigan, Maine, California and Texas) have a basic 15-year minimum age.

The usual standard for hours of work for young persons is a maximum 8-hour day and 48-hour week, but a few States have advanced to a 40-hour week for workers under 16 or under 18 years of age. One State (Wisconsin) has established a 24-hour week for children under 16. In 1940, 46 State child-labour laws prohibited the employment at night of children at least up to 16 years of age in specified occupations or in all gainful employment. The hours varied; for example, New York prohibited the employment of children under 16 years after 5 P.M. or before 8 A.M., while the prohibited hours in California were between 10 P.M. and 6 A.M. In 44 States, including those of most importance industrially, the employment in certain unhealthful or hazardous processes was prohibited for children under 16 years, and sometimes under 18 years of age. (G. AB.; B. MC.)

CHILE (possibly from the Quichua *Tchili*, snow) is a South American, west coast republic, occupying the limited western slopes of the continent south of Peru. It is a narrow ribbon-like country, varying from 46 to 250 mi. wide, with a meridional length of 2,661 mi., and extending approximately between 17° 25′ S. and 55° 59′ S. It thus has a greater inhabited latitudinal range than any other country in the world. No thorough survey of the entire country has ever been made, but the area is estimated officially at 741,767 Km² (286,396 sq.mi.). The country is bounded on the north by Peru, on the east by Bolivia and Argentina, and on the south and west by the Pacific ocean. Topographically the country is divided into three fairly distinct belts: the Andean on the east, the coast range on the west, and the central or longitudinal valley in the middle. Climatically it is also divided into three zones: the desert region, north of about 30°, where rain rarely falls; the southern rainy belt, south of about 40°, with a precipitation of 100 in. or more, and in places more than twice that amount; and the central zone, between the two in latitude and with a much more favourable rainfall. The country may also be divided geographically into three divisions, roughly corresponding to the climatic zones: the northern mineralized region with its life centred about mining; the central, made up of the justly famed Vale of Chile, the agricultural centre with its allied industries; and the southern forested part, sparsely populated, with most of the land given over to the Indian.

Physical Features.—The northern coast of Chile conveys the impression of a great land barrier, with a remarkably even skyline, that rises almost vertically out of the sea to a height of 600 to 1,500 feet and rarely up to 6,000 feet. There is no true coastal plain and only at the more sheltered places or where a stream cuts through to the ocean is there sufficient level land for town sites. This coastal bluff materially lengthens the routes into the interior and thus seriously handicaps movement. South of Valparaiso the coastal escarpment is more broken and the elevations assume the characteristics of a mountain chain. From Chiloe south the region subsides leaving only the higher parts of the coastal range above the water as islands. The coast range therefore is not continuous but is an elevated plateau area, presenting a steep escarpment toward the west and gradual slopes to the eastward.

The great barrier ranges of the Andes, which make up fully a third of the country, may be divided roughly into two groups at about 30° south. The southern forms a rather narrow complex chain composed of two parallel ranges of fairly equal altitude and so close together as to permit little development of intermediate valleys and plateaus. In general the chain increases in width toward the north until it reaches a maximum of 100 mi. or more. It also increases in height from an altitude of 6,000 to 7,000 ft. at the southern end, until it culminates at about 32° 30′ S. in Aconcagua, which is over 23,000 ft. above sea level. This section of the Andes is a less serious barrier than others because the mountain belt is relatively narrow and the passes comparatively low. The highest part of the tunnel on the trans-continental railway from Valparaiso to Buenos Aires is 10,469 ft., and of the nearby Uspallata pass, 12,795 feet. Southward occur still lower passes until at about 40° 30′ S. the Nahuel Huapi is only 4,920 feet. From this point onward the passes are low enough to permit trade to alternate between Chilean and Argentine centres. This entire southern section offers little to man and consequently is very sparsely settled. The lack of water in the north makes the working of mines difficult, while the cold and excessive precipitation of the south, coupled with the general ruggedness of the section, renders much of the south unfavourable even to grazing. Yet from Aconcagua to the strait snow domes and glaciers give unexcelled dignity and beauty to the range.

North of 30° the Andes are divided into several chains of which the western forms the major eastern boundary of northern Chile. No important stream cuts this western range, which is higher than the others and has higher passes. Two railways cross it, the one from Arica at 13,956 ft. and the one from Antofagasta at 12,972 feet. The former utilizes 22 mi. of cog-rails in its entire length of 281 mi. The extreme ruggedness, the aridity, and the cold of this section limit crop raising and grazing, but it is highly mineralized, although handicapped by the lack of water.

Between the coast range and the Andes lies the so-called longitudinal valley. This is not a true valley but an irregular depression, in places 25 to 50 mi. wide and at times reaching an altitude of 3,000 to 4,000 feet. In some sections it is broken by isolated groups of mountains or by spurs from the main range, which divide the portion above 30° S. into a series of basins, locally known as pampas. The most northern of these is the Tamarugal extending north from the river Loa. This differs from the others in that the ground water in places lies within four or five feet of the surface. Although on the whole this pampa is very barren of vegetation there are remnants of what once must have been extensive thornwood areas. The desert of Tarapaca lies in the western part of the Tamarugal pampa and furnishes nearly half of Chile's nitrate. Practically all the rest of the nitrate is produced in the neighbouring province of Antofagasta although a very small amount comes from Atacama still farther south. In this province the desert pampas end with an irregular mass of low mountains which occupy the whole belt between the ranges, until approximately the latitude of Valparaiso. Here begins the Vale of Chile, one of the finest agricultural valleys in the world, which is continued south until approximately 40°. The longitudinal valley

then gives away to a series of lakes, and then to a complex series of beautiful islands sparsely inhabited by Indians. (W. H. Hs.)

Geology.—Along the coast of Chile lies a belt of rocks formed mainly of old granite and schist and overlying Cretaceous and Tertiary deposits; farther inland is the Western Cordillera of the Andes, which is composed chiefly of intrusive masses, volcanic rocks and folded Mesozoic beds. The deposit in the great longitudinal valley of Chile, which lies between these two zones, is formed of débris that is in places more than 300 ft. thick. In northern Chile the rocks of the coastal zone, which disappear northward beneath the Pacific, consist mainly of isolated masses that stand close to the shore or that project into the sea. South of Antofagasta these old rocks, which there begin to rise to higher levels, form a nearly continuous belt along the coast, extending southward to Cape Horn and occupying the greater part of the islands of southern Chile. They are greatly folded and are doubtless Palaeozoic. In northern Chile the Cretaceous and Tertiary beds of the coastal zone are of small extent, but in southern Chile the Mesozoic beds, which are at least in part Cretaceous, form a rather wide band. The Tertiary coastal beds include both marine and terrestrial deposits, and most of them appear to be of Miocene or Pliocene age. The whole of the northern part of Tierra del Fuego consists of plateaus formed of horizontal Tertiary beds. The northern part of the Chilean Andes, which is the Western Cordillera of Bolivia, consists almost entirely of Jurassic and Cretaceous sediments and Tertiary eruptive rocks. The Mesozoic beds are thrown into a series of parallel folds, which run in the direction of the mountain chain. Into these folded beds are intruded granitic and other igneous rocks of Tertiary age, and upon this foundation rise the cones of Tertiary and later volcanoes. Triassic rocks are found only at La Ternana, near Copiapó, where coal seams containing upper Triassic (Rhaetic) plants have been found, but the entire Mesozoic series appear to be represented at different places. The Mesozoic rocks are chiefly marine sandstone and limestone, but they include also tuff and conglomerate of porphyry and porphyrite. These porphyritic rocks, which form a characteristic element of the Southern Andes, are volcanic, and as they contain marine fossils they must have been laid down beneath the sea. They are not confined to any one geologic horizon but occur at different levels in the Jurassic beds and at some places in the Cretaceous. Here and there they may be traced laterally into the more normal marine deposits of the same age. A large part of the Andes is covered by the products of the great volcanoes that still form the highest summits. The volcanic rocks are liparite, dacite, hornblende andesite and pyroxene andesite. The recent lavas of the volcanoes in southern Chile are olivine-bearing hypersthene andesite and basalt.

(G. McL. Wo.)

Ports.—As outlets for her products Chile is unusually rich in ports, but singularly unfortunate in harbours. Nearly all of these are mere open roadsteads, requiring the transfer of goods by lighters. Moreover the heavy swells along the major part of the coast frequently cause the transfer of goods to be abandoned temporarily for hours, or even days. Of the 57 ports listed relatively few are very important in international trade, and due to the abrupt slope of the ocean bottom artificial protection is both costly and difficult. Many breakwaters have been constructed of recent years, however, particularly at Antofagasta and Valparaiso, but without securing thoroughly safe anchorage at those ports. Valparaiso, with its modern wharves and other harbour facilities, also illustrates the case of an older port which is favoured by the Government in its fight for continued supremacy. In colonial times it was selected as the outlet for central Chile because the traffic of that day could pass from the capital to the coast without encountering any considerable ford. Better natural harbours are to be found in the vicinity, both to the north and south of it and Valparaiso today is meeting serious competition from San Antonio, 50 m. below, which ships the large copper output from the Rancagua district and is gaining in general commerce. Valparaiso is also handicapped by the unwise selection of the route for the railroad leading to the interior. Antofagasta, which of late has surpassed Iquique as the chief port for the shipment of nitrates, now finds itself contending with Tocopilla to retain the exports and imports passing through it to and from the copper centre at Chuquicamata. Arica, the northernmost port, gains its economic importance as an outlet of the Bolivian plateau but formerly played a more conspicuous part as a diplomatic pawn. This port and its fellows in the north, like Valparaiso, are hampered by railway conditions. Talcahuano in the south is the chief naval station of the country as well as the commercial outlet of an extensive section. Near by, Coronel is one of the three ports serving the coal producing district as Cruz Grande, north of Valparaiso with its direct docking facilities, serves the iron mines of Tofó. Valdivia, through its port, Corral, and Constitución are able to make some commercial use of the rivers on which they are located. Punta Arenas on the Strait of Magellan gives Chile the distinction of having the most southerly port in the world.

(W. H. Hs.; I. J. C.)

Rivers.—Due to the general outline and topography of the country, the rivers are short and unimportant except for the life giving waters they may bring, and have little or no significance in directing the settlement or trade of the country. In the north they are few, and for a distance of approximately 600 m., the waters of only one, the Loa, reach the sea throughout the year. This stream, the longest in Chile (440 km.), has made possible certain settlements. The Copiapó, 300 km. long, marking approximately the southern limit of the northern desert, once discharged its waters into the sea, but rarely does so now, as the needs for irrigation are greater than the supply. The rivers to the south are better fed at their heads and flow through much less arid regions. Some of them become raging torrents at certain times of the year; a few have recently been harnessed for the production of electricity. The electrification of the road in the Chilean section of the Trans-Continental has already been completed together with the main line to the capital and other minor developments. With the increased demand for electric current has come also the storage of waters for irrigation.

Lakes.—The lakes of Chile have little significance in the life of the people. In the north occur occasional salt playas, which are dry the greater part of the year. In central Chile, south of the Biobío river, there is a series of very picturesque lakes in the provinces of Cautin and Llanquihue. The largest of these lakes are Ranco and Llanquihue, the former with an estimated area of 200 sq.m., the latter 300 square miles. Due to its natural beauty, the lake region has become the resort place for Chileans during the dry season and it also attracts a large tourist trade.

Climate.—Not many countries have the climatic extremes of Chile. The north is an absolute desert, but there is a gradual increase in precipitation through central Chile until it reaches a rainfall in south Chile not surpassed by any extra-tropical region. The strong permanent high pressure area formed over the Pacific at about 30° dominates the climatic conditions of northern Chile, accounting for its northward flowing winds and consequently for the great aridity of the region. South of this high pressure area are the prevailing westerlies or better, northwesterlies, which correspond to the southwesterlies of the northern hemisphere, but are much stronger. In this belt are the terrific winds that sweep the mountain passes between Chile and Argentina. This belt, migrating with the seasons, may occasionally make its influence felt as far north as the region of Coquimbo, where it produces winter rains. At Santiago, this migration is shown in a winter rainfall (3·4 in. in July, 0 in. in January, annual 14·4 in.). In certain years or series of years this migration does not take place or goes on beyond the normal and the result is either great droughts or heavy rains. South of the southern tip of Chile is a belt made up of numerous low pressure areas, with unusually high barometric gradients, which produce very strong winds averaging over 30 m. per hour, and reaching velocities three or even four times as high. These moving low pressure areas give a constant succession of storms for which the passage around the Horn has been renowned ever since its discovery, and farther northward give the lower part of Chile its westerly winds and immense rainfall.

North Chile is quite the driest region of which there is any record. During a 21-year period Iquique had an average rainfall

of 1·5 mm. (0·6 inches) and Arica for a 19-year period had less than one-half as much. These averages do not represent normal conditions but show that North Chile is not entirely rainless. On the Andean slopes of this region, periodic summer rains fall as low as 8,000 ft. with occasional heavy snows. These may produce stream floods, which spread mud and gravel over the valley and give rise to temporary salt lakes. Needless to say such rains are calamitous; nitrates are destroyed, the work of the *saliteras* paralyzed, and the homes of the people, because of the poor mud roofs, practically ruined. This absolute desert condition does not change until in the latitude (27°) of Caldera or Copiapó, where a mean rainfall of about 15 mm. prevails. The rainfall increases rapidly to the south, being 141 mm. (5·6 inches) at La Serena (30°); 500 mm. at Valparaiso (33°). The increase southward is still fairly regular reaching 2,707 mm. (107 inches) at Valdivia (39° 50′). From here south, the rainfall is more or less uniform except for local modifications with the striking maximum of 5,379 mm. (216 inches) for south Chile at Balúa Felix (53°).

The Chilean rains definitely come from the west. The western Andean slopes are wetter than the valley areas in all latitudes, and this is very noticeable even on the Andean slope of the northern desert region, where a rainfall map, however, shows all of Chile north of 31° with less than 10 inches. This dry area thrusts a finger down the central valley nearly as far south as Santiago. The 10 to 20 in. rainfall area, whose southern coastal limit is at Valparaiso, sends a strong arm down the valley nearly as far as Concepción, with a rain belt on either side of 20–40 in. and with a belt along the western slope of the Andes, overlooking the beautiful agricultural valley, of 40 to 80 inches. This belted arrangement is still more marked in the southern rainy section. The various islands and embayments show a rainfall of 80–200 in., the mountainous area directly to the east has a precipitation of over 200 in., while over in Argentina the rainfall gradually decreases again to less than 20 inches.

Irrigation is needed throughout the central valley, not only because of the low rainfall but more especially because the greater part occurs in the winter. This discrepancy becomes less marked from north to south. At La Serena over 98% of the rain comes in the six winter months and 82% in the three colder months. The percentages at Santiago for the same periods are respectively 90 and 73; for Concepción 83 and 61. Even at Magallanes 61% of the precipitation is during the six winter months. This seasonal distribution has given Chile an irrigated agriculture with an intensive rather than an extensive use of the land and with the climatic life of the Mediterranean.

In general, for its latitude, the temperature is low. The cold Humboldt Current, which strikes Chile at about 40° S., sends a branch northward along the entire coast, and keeps the temperatures down and very uniform. The average summer temperature, even at Arica, does not rise above 75° F. Similarly the mean at Iquique is only 66° F, and at Antofagasta 65° F, although southward the temperature is somewhat lower as at Valparaiso, where it is only 58° F. At the latter place, the mean monthly temperature varies from 63·5° F in summer to 52° F in winter, and the thermometer seldom rises to 85° or falls below 38°. Santiago at an altitude of 1,740 feet has recorded extremes of 96° F and 25° F, and on rare occasions snow falls in the city. At Valdivia in the southern end of the central valley, January is the warmest month with 61·5° F and July the coldest with 45° F. Due to the winter rainfall and the attendant cloudiness, the sensible winter temperature is much lower than the records indicate; and the general consensus of opinion is that, in spite of its excessive humidity, the climate of the inhabited parts of the country is conducive to health.

Vegetation.—Chile's isolation by desert and high mountain ranges has given it a number of distinct species of plants not found elsewhere. The indigenous flora of Chile, however, does not show the great variety that the wide range in latitude would seem to indicate. Although a goodly part of the country may be classified as lying well within the tropics, yet because of the arid wastes in the north, no part of the Chilean vegetation is to be considered tropical. The north is absolutely barren along the coast from the extreme north to the region of the Loa, but in the oases and along the stream courses there thrives the Algarroba tree (*Prosopis*) with its tiny yellow flowers in the spring and its nutritious seedpods later, also the Chañar (*Gourliea*) one of the leguminaceae. One of the more striking is the Tamarugos (*Prosopis tamarugo*) which gives its name to that stretch of desert. The western slopes of the northern Andes produce certain nutritious grasses besides the *tola* brush and *ichu* grass. Farther south the Cacti become common. In Coquimbo, from the sea to the Andes, the *quiscales* form an effective covering but in addition a variety of vegetable forms thrive and afford some pasturage. In this section also are to be found large numbers of bulbous plants with their showy colourful blooms.

To some degree Central Chile presents a transitional flora between the north and the south, but it also has a number of distinct species of its own. Among the most familiar of these are the Espino (*Acacia*) with its twisted limbs especially prized for the excellent charcoal made from its wood; the Colihuai (*Colliguaya*) with its milky sap; and the thorny Trevu (*Trevoa*) one of the rhamnaceae. Mixed clumps of these give a safe asylum from grazing livestock to a host of tender flowering plants. The evergreen largely predominates here, and the dense dark foliage of the *Peumo* (*Cryptocarya*) is commonly conspicuous together with the *Quillai* (*Quillaja*) another characteristic evergreen. The Coquito palm (*Jubaca*) was once very abundant but has been almost completely destroyed by collectors of its sweetened sap. One of the most striking trees is the *Piñon,* Chilean pine (*Araucaria araucana*), which often grows to a height of 100 ft., and is highly prized by the natives for its nuts, which are small but have a very attractive flavour.

When the Spaniards first visited Chile, the southern forests extended northward to the region of Santiago; from here on north was the semi-arid bush land. The good lands now have been cleared. The true forests of Chile may be said to be south of the Bio-Bio; rough estimates of the timbered areas vary from 40,000,000 to 50,000,000 acres. South of Valdivia is a vast forested region of which little information is available. Among the dominant types of commercial woods are the various species of conifers (*Podocarpus, Araucaria, Fitzroya, Libocedrus*); the laurels (*Billota, Cryptocarpa, Persea*); the magnolias (*Drimys*); and the beech-like group (*Nothofagus*) of many local kinds and names. Trees become smaller and more stunted to the south, until at the Straits of Magellan only shrubs prevail and the altitude of the tree line is below 2,000 feet.

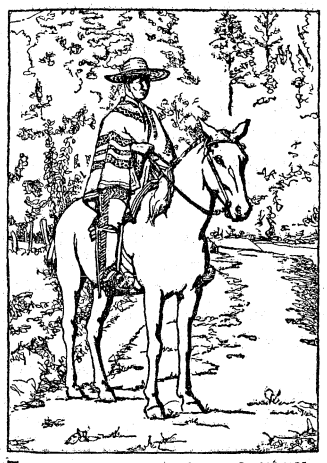
Fauna.—The animal life of Chile is limited to relatively few forms. Both the north arid region and the south humid region are unfavourable to the development of many species or numbers. The largest of the mammals, the *pangi* or puma (*Felis concolor*), extends its range down to the Straits of Magellan. Of the three species of wildcats the *guina* and the *colo* are the most common; of the foxes, the *chilla* (*C. azerae*) is small and considered stupid, the *culpeo* (*C. magellanicus*) is much the larger of the two; and of the other smaller forms the *coypu,* or nutria, sometimes called the South American beaver, and the chinchilla (*Chinchilla naniger*) are the most important because of their excellent furs. The last named with its much prized skins is fast disappearing. Of the ruminants, the Guanaco, one of the camels closely related to the llama, although a plains animal, is now found only in the mountainous areas. The deer are small and nearly extinct. The *huemul* (*C. chilensis*), appears on the Chilean escutcheon, and the *pudu,* a small animal with branching horns is found only in the south, especially on the island of Chiloé. The bird life is much more abundant. The hawks and owls seem especially numerous. Unusually rich is the southern part of the country in wading and swimming birds, especially geese, ducks, swans, cormorants, ibises, bitterns, rails, red-beaks, curlew, snipe, plover and moorhens. The smaller singing birds are found also in great numbers.

(W. H. Hs.)

Population.—Quite commonly Chile is spoken of as a "white man's country." This is true when compared with the plateau countries to the north, but the qualification is more a matter of class than of blood. There was abundant opportunity for mis-

cegenation during the colonial period as the fierce Araucanian remained unconquered for three centuries and the conflict with him called for an endless succession of Spanish soldiers, who in turn left in their wake a large number of half breed children. From such unions came the foundation of the Chilean race. The mixture occurred so long ago that its results are now expressed in racial unity and common characteristics and are quite unnoticed in the country itself.

The Chilean population is definitely divided into two classes, those who do, and those who do not possess material and cultural wealth. To some degree the distinction is the result of racial admixture but more definitely it arises from differences in inheritance, in opportunity and in outlook. Nominally independent and working for wages the *roto*, or agricultural labourer, lacks vision or initiative. The *patrón*, or landlord, who profits from his labours may, as landed proprietor, be a gentleman of culture, and of sufficient wealth to supply his own requirements and to educate his children abroad. He rarely seems to care how wretched his *inquilinos* (tenants) may be, although nearly always ready to help in times of special adversity.



THE HUASO (COWBOY), A FAMILIAR FIGURE IN THE AGRICULTURAL PROVINCES OF CENTRAL CHILE

In the south are the Araucanian Indians who proved such valiant and unconquerable foes during both the Inca and Spanish regimes. Their definite overthrow as an independent people came only in 1882 when seasoned troops from the battle fields of the north pushed through the *frontera* and put an end to their resistance. The Araucanian strain in Chilean blood is considerable although not so noticeable as the blood of other tribes for it has not resulted in deterioration. Pride in the Araucanian heritage is reflected even in the national anthem. About 80% of the Indians (98,703 in 1930) live in the provinces of Malleco and Cautin. Beyond lies Valdivia and Llanquihue. It is in this region that German colonists of the mid-century encountered extraordinary hardships. But they introduced much-needed handicrafts, iron and wood working, tanning, shoe making and the like, and soon drew large numbers of Chileans to their settlements. The Germanization of south Chile has not been a matter of sheer numbers, but is due to a far reaching cultural influence that if more widespread might prove a great blessing. In the extreme south one still encounters some remnants of the Fuegians, an indigenous people of extremely low culture.

In other parts of the country a plentiful sprinkling of English, Irish, and Scotch names denotes an infusion of northern European blood that is still going on. Recently arrived Spaniards, Italians, and Slavs bespeak a continued connection with southern Europe. Chile has never attracted a large immigration. Only 2,851 naturalization papers were granted from 1890 to 1926. Of those then nationalized, the Germans were first with 722, the Spaniards second with 382, and the Peruvians third with 365. The annual gain in immigration from 1921 to 1928 was slightly under 1 per cent. The number of foreign born reported in the 1930 census was 105,463 of whom 23,439 were Spaniards.

In the north the "Changos" may represent survivors of an earlier native stock. The nitrate plants have attracted some immigrants from Bolivia, who are not regarded, however, as particularly welcome or efficient labourers. Chile has been making an effort to bring back to its soil those expatriated citizens, estimated, but probably inaccurately, to number 120,000, who are largely located in southern Argentina. They are offered free lands and other inducements to settle on the Chilean side of the Andes. The annual birth rate is slightly under 40 per 1,000. The death rate for the decade 1920–30 was 27·6 per 1,000 with a slight increase in mortality since 1930 due to less favourable living conditions.

Provinces and Population*
(Census Figures of 1920, 1930 and 1940)

Provinces	Area in sq. mi. 1930	Population Census of 1920	Population Census of 1930	Area in sq. mi. 1940	Population Census of 1940
Aconcagua	5,798	422,160	463,544	3,940	118,049
Antofagasta	47,502	172,330	178,765	47,515	145,147
Arauco	..	..	..	2,222	66,107
Atacama	30,835	48,413	61,008	30,843	84,312
Bío Bío	6,155	164,362	180,688	4,343	127,312
Cautín	10,517	312,466	383,791	6,707	374,659
Chiloé	12,733	179,507	183,499	9,052	101,706
Colchagua	6,167	284,942	295,971	3,423	138,036
Concepción	4,422	291,071	329,495	2,201	308,241
Coquimbo	15,397	176,041	198,336	15,401	245,609
Curicó	..	..	..	2,215	81,185
Linares	..	..	..	3,791	134,968
Llanquihue	..	..	..	7,107	117,225
Malleco	..	..	..	5,512	154,174
Maúle	5,962	203,155	197,468	2,172	70,497
Ñuble	5,485	224,981	231,890	5,487	243,185
O'Higgins	..	..	..	2,746	200,297
Osorno	..	..	..	3,867	107,341
Santiago	6,557	718,211	967,603	6,559	1,261,717
Talca	5,935	200,665	218,227	3,722	157,141
Tarapacá	21,341	117,239	113,331	21,346	104,097
Valdivia	10,731	185,410	236,115	7,723	191,642
Valparaiso	..	..	..	1,860	425,065
Aysen (Terr.)	38,511	1,660	9,711	34,357	17,014
Magallanes (Terr.)	52,271	28,960	37,913	52,285	48,813
Total	286,322	3,731,573	4,287,445	286,396	5,023,539

*This table represents the distribution of territory established in 1928 and 1940. In 1928 the former province of Valparaiso was annexed as a department to Aconcagua and the former province of Llanquihue was made a department of Chiloé, while the territory included in the old provinces of O'Higgins, Curicó, Linares, Arauco, and Malleco was divided among the neighbouring provinces. At the same time the new territory of Aysen was created from the lower part of Llanquihue and upper Magallanes. The populations here given for 1930 are for the provincial boundaries then in force.

The surplus of births over deaths in 1921 was 23,598; for 1925, 47,438; for 1937, 43,736. For 1925 the illegitimate births were reported as 360 out of 1,000 born. The slow increase in population is a cause for concern to the authorities.

Government.—Technically Chile is a unitary republic with responsibility centred in the president, who is elected for six years and cannot succeed himself. After experimenting for more than 30 years with a pseudo-parliamentary government, Chile in 1925 reverted to the "presidential" type. The constitution adopted in that year provides for direct elections, for suffrage and citizenship without class distinction, for the separation of Church and State, and for an independent president.

The validity of a president's election is finally determined by a special tribunal made up of former presiding officers of the senate and chamber of deputies and members of the supreme and appellate courts.

The president selects the members of the supreme court from a list of five proposed by the court itself, designates members of the courts of appeals, of which there are eight, from lists submitted by the supreme court, and appoints judges of first instance from lists submitted by the court of appeals in the jurisdiction concerned. He cannot remove judges but he is empowered to transfer them, when necessary, within the jurisdictions to which they belong. Judges are removable by a two-thirds vote of the supreme court.

The president names the *intendentes* of the provinces, the governors of departments, and *alcaldes* in municipalities or communes of more than 10,000 inhabitants. He also has the power to remove these officials and indirectly controls their subordinates. The constitution provides for provincial elective assemblies, but so far no measures have been taken to carry out this provision or to give greater power in local affairs to the *intendentes* and governors. The taxpayers are empowered to name communal committees (*juntas de vecinos*), non-political in character, who advise in local administrative and economic matters. Since 1935, women

and foreigners residing for 5 years in the country may vote in municipal elections.

Congress consists of a senate and chamber of deputies. The former is composed of 45 members, five from each of the nine groups of provinces into which the republic is divided. Each senator holds office for eight years, and half the seats are renewable at the end of four years. The chamber of deputies numbers 132 members, one for each 30,000 inhabitants or major fraction. Electors are registered citizens over 21 years who are able to read and write. The ordinary session of congress lasts from May 21 to Sept. 18. It passes on the budget but the president may increase or decrease items within the limits therein prescribed, but congress may by a two-thirds vote pass a bill over his veto. Members of the cabinet are ineligible for seats in congress, but may speak in its sessions. They are subject to impeachment by congress and to removal from office for cause.

Credit and Finance.—Up to 1880 Chile maintained a modest, commendable financial record. For the next forty years more than half of its relatively large expenditures were derived from the export tax on nitrate and the recent decrease of income from that source has been little short of disastrous. Moreover, for several decades the Government was confronted with the problem of stabilizing its currency. The disturbances of 1924 and 1925 made further delay impossible. Acting upon advice of the Kemmerer commission (*see* below, *History*) the Government adopted legislation which established the paper peso at a gold valuation of 6*d.* (in place of the fanciful 18*d.*), established a *Banco Central de Chile* with the exclusive right to issue paper money and with the power to regulate general credit, and placed the general banking interests under the supervision of a Superintendent and central commission. This central bank received from the Government the conversion fund of 409 million pesos that it had been accumulating for 30 years and with the aid of this sum established its own credit, replaced a large portion of the outworn paper money, and met the difficulties caused by the business and political slump of 1926. The bank follows the Federal Reserve system of the United States and in its first few years of operation reduced by a third the discount rate for banks and for the public. Through its service as fiscal agent and public clearing house it kept fluctuations in exchange within a narrow range and showed a substantial profit.

The Government badly needed to better its own fiscal affairs. At the end of 1926 it faced a prospective deficit of 161,500,000 pesos. By cutting salaries and pensions, and reorganizing the system of internal revenues, in which extensive defalcations were discovered, and of the customs; by rigorously applying the tax laws and adhering to a fixed budget, the situation was greatly improved and with some recovery in general business and a foreign loan, the year 1927 ended with a slight balance. The income for 1928 was estimated at 959,119,617 pesos. With this improved record the government of General Ibáñez was able to make extensive loans abroad to be devoted to railroads and highways, port and irrigation projects, water supply for cities, and for public buildings. In addition, it authorized a farm loan fund and an institution of industrial credit. A revised income tax promised to take from the nitrate industry a part of its tax burden. Chile did not at first feel the effects of the world depression. By 1931, however, the Government was forced to take note of the loss in revenues, principally those derived from foreign loans and trade. Temporary credits through the Central Bank for a time enabled it to carry on, but in July General Ibáñez had to yield to financial and political pressure and resign. His immediate successors, Montero and Dávila, likewise failed to withstand the financial storm. The deficit at the accession of Alessandri, late in 1932, was 189,000,000 pesos. By that time the necessary curtailing of imports and the encouragement to domestic production had made the country more nearly self-sufficing. Under Gustavo Ross, as minister of the treasury, the new administration was able to balance the budget and to propose a plan for meeting in small measure the service on the foreign debt. This plan, though not acceptable to creditors in the United States, France, and Belgium, has been accepted in Great Britain and has resulted in a reduction of 311,000,000 pesos on the foreign debt. Since 1936 the budget has been balanced each year with a slight surplus. The estimate for 1939 of 1,667,000,000 pesos was slightly more than the revenues and expenditures of 1938. The public debt, Dec. 31, 1937, stood at 5,319,949,000 gold pesos. Public revenues increased each year since 1935, but not in keeping with expenditures, especially those for national defence. The treasury-general in the Ministry of Finance now controls all receipts and expenditures throughout the country. A new officer, the controller general, audits all accounts. A new department of the ministry maintains close relations with the producers of nitrate and with mining. This is in keeping with the new policy to encourage business by tariffs, by shifting the burden of taxation and by undertaking public works.

Education.—The present system received its initial impulse about the middle of the last century. To the efforts inaugurated by the notable publicists of that period were added the laws of 1879 and 1889. This combined legislation represented a commendable program for the better classes and the cities. Within recent years, however, there has developed an insistent demand for the education of the unlettered country population and for improvements in the existing system, especially in the direction of practical training. The State has accomplished something in the matter of technical and commercial training and during recent years the Catholic University at Santiago and the laical University of Concepción have substantially broadened higher instruction. Since 1920 the demands for reform have occasionally expressed themselves in extended student strikes, which likewise reflected the prevailing unrest. In response to this agitation, which was supported by a few substantial leaders and by an increasing number of educators who had been trained abroad, a commission was appointed in 1925 to draft a comprehensive program. This plan, somewhat simplified in the ministry, was issued by decree in May, 1927. It aimed to decentralize the administration of primary schools by placing more responsibility on the provinces, to separate the administration of secondary schools from that of the university, and to give the latter more freedom.

In 1920, out of a total population of 3,753,799, 50·3% were reported as able to read. This may be a liberal estimate, but it is about four times larger than in 1854. The total number of educational establishments in 1931 was 4,301 of which 3,227 were public and 717 private secondary schools. The total matriculation was 617,146, yet some 200,000 children of school age (seven to 16) were still without schools. At the same time there were 200 secondary schools of which 119 were private, and 135 vocational schools, mostly technical and commercial. At the top of the system was the University of Chile, virtually autonomous under its own budget, the Catholic university of Santiago, the University of Concepción, and the Santa María Technical institute, privately endowed, which had just opened its doors.

By 1937 the number of private and public primary schools had increased to 4,663 with a reported enrolment of 587,108 pupils. Some 12,000 primary teachers represented the training of ten normal schools with 770 teachers and 1,597 pupils. The enrolment in secondary schools was 44,199 pupils and 3,600 teachers; in twenty-four commercial schools 3,054 pupils; and in 153 special schools 31,655 pupils. The University of Chile reported 5,862 students of whom 503 were foreign, and the Catholic university 941 students. Educational budget for 1940, 266,301,000 pesos.

Under the law of 1927, responsibility for the educational system was to be divided between the Minister of Education and a special Superintendent of Education. The latter post, however, was soon abolished, and according to the law of Nov. 22, 1929, the Minister of Education controls the entire system. He is assisted by (1) one sub-secretary, (2) a director-general of primary instruction, (3) a director-general of secondary instruction, (4) a director-general of commercial instruction, (5) a director-general of libraries and museums. One notes in the system as a whole the great disparity in numbers between those enrolled in the first year of primary instruction (47·3 per 100) and those in the sixth year (2 per 100). Rural schools as a rule offer only three or four years of the usual six year primary course. In 1931 only about 30% of the secondary school population was

enrolled in 119 private schools, while 81 public secondary schools enrolled more than twice that number. A few women attend the Catholic university, while in the other two universities the number of men is about double that of the women. The law courses in all three attract the largest number of students. The university professors frequently supplement their incomes by giving instruction in secondary and technical schools. In 1931, illiteracy in the country at large had decreased to 25·2 per cent. Marked increases in all grades of instruction, public and private, characterize the past few years, except in normal and special schools. The magnificently equipped Instituto Santa Maria of Valparaiso, a private college of engineering, made possible by a legacy from the late Federico Santa Maria, was a hopeful sign of awakened interest in Chile's educational needs; so also the national library with 450,000 volumes, which reported a commendable list of general activities, in addition to the collections maintained for consultation. Valparaiso and Concepción also maintain small public libraries. The capital supports three museums and the other two cities one each. The *Club de Señoras* of Santiago stimulates a healthy activity among women of the upper class. There were reported in 1937, 981 periodicals of various types, of which 84 were of daily issue. Among these were an encouraging number devoted to professional and scientific interests and to social and labour propaganda.

Social Conditions.—Labour organizations before the 20th century were of the beneficiary type. The pioneer was the Typographical Union organized in 1853 and unions of this type, representing commercial and bank employees, numbered 240 in 1900; in 1925, 600 with 90,000 members. After 1900, the workmen began to group themselves more definitely for defence and in 1909 organized the "Labour Federation of Chile" with provincial, departmental and federal councils, which took definite part in strikes in the coal region and in the nitrate fields. Its program embraced mutual aid, propaganda against alcohol and in behalf of education and an eight hour law, for arbitration of disputes, and for amicable relations with the public authorities. At its annual meeting in 1917 measures were taken to include in its membership all classes of labourers without distinction of sex. The Federation in 1919 adopted a program that was frankly Communist. In 1921 it adhered to the Third International and reorganized on the basis of six industrial councils (foods, manufactures, transportation, construction, public service, mines). Much of its program was embodied in the social legislation of 1924–26. The I.W.W. (Industrial Workers of the World, *q.v.*) became especially strong among port labourers. Among other representative organizations of the period were the various unions of trainmen, a federation of printers, and a Catholic Federation of Labourers. These organizations are usually dubbed "yellow" by their more radical fellows, because of a tendency to co-operate with the Government, while those that simply emphasize beneficiary measures are dubbed "white." Since 1920 all types of these unions have abandoned the policy of abstention from politics. In 1926 the anti-capitalist groups formed the *Union Social Republicana de los Asalariados de Chile* (U.S.R.A.Ch.) with the purpose to work for the "spiritual, social, political, and economic emancipation" of the employed class and for the organization of "a new society, based on justice, co-operation, and solidarity." This organization displayed increasing activity in political affairs until curbed by measures of General Ibañez.

Up to 1924 employees were protected by general principles of law under the Code of 1857 and the commercial Code of 1867. Occasionally some organization was given definite juridical status. The I.W.W. lost this through resort to violence. About 1922 the Radical Party, representing the middle classes, began to favour legislation to legalize relations between capital and labour. The result was the law of Sept. 8, 1924, which created a series of general unions on a syndicalist base—the *Union de Empleados de Chile* (U.E.Ch.). The Confederación Nacional de Trabajadores de Chile, with its headquarters in Santiago, is the leading conservative organization of labourers today, with the Confederación General de Trabajo representing the syndicalists.

This followed the tendency toward collective action shown during the preceding 15 years in the capital and the chief industrial centres. Its social tendencies appear in the formation of a Credit Bank, of a Cooperative Association, and of a Mutual Building Association. Its program, since elaborated, is that labourers should work for their own emancipation, which means a living wage, an eight hour day, equal pay for men and women, and the nationalization of industry.

The primary and secondary teachers each have their separate professional organizations, and the former has occasionally shown a tendency to ally itself with elements opposed to the existing régime. The members of the medical profession, the engineers, and the architects have societies that occasionally assume a syndicalist attitude, although the Medical Society of Chile is strictly scientific and professional in its attitude. In 1921 the employers formed the *Asociación del Trabajo de Chile*, for which they immediately obtained government recognition. Their object is to co-ordinate and give solidarity to all measures "in questions which relate to labour or affect the natural evolution of industry, agriculture, and commerce." Both individuals and corporations may belong to this association.

Since 1900 there has been a growing interest in the labouring classes. A few leaders have directed their efforts to amelioration rather than prevention of specific evils, as is shown in "League against Alcoholism" and various agencies to care for destitute children. Of similar character were government measures against disease—measures which though largely unobserved date back to 1892. In 1906 the Government passed a law for working class housing, which marks the first intervention by the Government in a strictly social question. Later laws in favour of rest on Sunday (1907), the creation of the Office of Labour Statistics (1907), of laws for National Savings Banks (1912), for the care of abandoned infants (1912), for the regulation of conditions of labour including the labour of women and children, and providing for insurance against accidents (1912–16), on the railroads and in the nitrate establishments, and the law for obligatory primary education (1920), and for a fiscal pawnshop and for regulating maritime and other tasks, all point in the same direction. These culminated in the Decree Law of Sept. 8, 1924 which initiated a veritable era of social legislation. This regulated labour contracts, the day's work, salaries, hygienic conditions, conditions for women and children, security, arbitration, syndical organization, and methods of co-operation. A special ministry took over the administration of this code and with the supplemental legislation finally codified in the law of May 28, 1931, it became one of the important cabinet posts. Much of this legislation has provoked bitter criticism, as being ill-advised and not adapted to those for whom it was intended nor to prevailing conditions in business.

Conditions during the attempted socialistic régime of 1932 led to a great increase in the number of industrial and professional unions. The total number reported for the country in 1932 was 170 industrial unions with an average membership of 174, and 263 professional unions with an average membership of 102. This represents a doubling in numbers during this one year. The success of the Popular Front represents a determination to secure continuous work at a living wage for Chile's labouring population.

The Government also undertook an extensive program for sanitary betterment. The inroads of alcoholism, of tuberculosis, and of venereal diseases; the extremely high death rate among infants, the lack of and poor quality of water supply and of sewerage systems gave Chile a death rate of about 40 per 1,000 that was hardly surpassed anywhere. Dr. J. D. Long of the United States Health Service in 1925 revised and put in force a sanitary code that within three years put Chile far ahead of its neighbours. Among conspicuous features of his campaign was a widespread attempt to stamp out the pest of flies, to prevent commercialized prostitution, and to purify the water supply of the larger cities and give them better markets, a supply of pure milk, and improved drainage. With the assistance of a group of local helpers much was done to improve conditions, despite the ever present financial shortage. This betterment has shown itself in a reduced death rate for the decade 1920–30 of 27·6 per 1,000, and in a marked appreciation of the dangers that menace the coun-

try through inadequate sanitation. Since the year 1930 the State has assumed greater responsibility for charitable work as well as public health and sanitation but with due regard to the needs of various sections of the country. As in the case of labour legislation, however, much of this legislation has proved too advanced for the people.

Mining.—In few countries are the activities of the people so restricted to certain regions as in Chile. Of these divisions none has its characteristics more sharply defined than the northern desert area with its unusual mineral riches, especially nitrates, which came into the possession of Chile as a result of the "War of the Pacific" (1879–83).

The nitrate beds lie between 19° and 26° S. and are found on the upland or "pampa" lying behind the coastal range at altitudes varying from 4,000 to 9,000 ft., but practically all the *oficinas* or nitrate works are below 7,500 feet. The workable beds, with a concentration of from 12 to 40% sodium nitrate, are non-continuous and vary in thickness from about 8 in. to 14 feet. The ordinary workings are by the open pit method and use only the richest *caliche,* or ore, so that unit areas produce variable amounts.

Of *caliche* mined only 55 to 75% of the sodium nitrate is recovered. A new method—the so-called "Guggenheim process"—produced a more complete recovery of nitrate, together with a considerable reduction of costs. The latter is effected by mining both high and low grade ores on a large scale and by reducing the product at a lower temperature. Running tests have shown a 94% recovery in *caliche* of 10% grade. This gain in productivity, has been neutralized by the lessening market for the product.

The origin of these immense deposits is more or less conjectural. The theories roughly fall into two groups, the organic and the inorganic. The origin through organic means are (1) from sea weed, (2) from guano and (3) from fixation of atmospheric nitrogen by bacteria. However, none of these theories is taken very seriously at the present time. The inorganic origin has been attributed to (1) the electric fixation of atmospheric nitrogen, and (2) to the concentration of the nitrates coming directly from tuffs and lava flows. The latter postulates, probably the more scientific, present fewer difficulties. Of this group, two theories stand out most prominently. The one (J. T. Singewald, Jr., and B. L. Miller: "The Genesis of the Chilean Nitrate Deposits," *Econ. Geol.,* xii., 1917) "is that the nitrate deposits have resulted from the accumulation, by means of evaporation of the minute nitrate content of the underground waters of the region. In other words, they represent a sort of efflorescence of soluble salts out of the ground water." The other (W. L. Whitehead: "The Chilean Nitrate Deposits," *Econ. Geol.,* ix., 1920) and later suggestion is that the source of the salts is from the Mesozoic rocks of the region which in extent correspond remarkably with the nitrate fields. Ammonium salts were probably sufficiently common in the volcanic rocks of the region to account for the present deposits. The process of reconcentration, through oxidation with alkaline earth, has been going on since early Pliocene time. Under desert conditions the salts derived from sources on steep slopes and hill-tops were carried down by dews, fogs, or infrequent rains to be deposited during evaporation in the gravels below. Here in periods of high humidity, sodium nitrate, a deliquescent substance, was separated from the accompanying sodium chloride and sodium sulphate, to be precipitated during dry weather lower in the gravel.

The importance of these deposits to Chile can be gauged with little certainty. It has been estimated that between 1880 and 1910 Chile derived from the export tax on nitrate alone an average annual income of $10,000,000 gold and up to 1920 one of twice that amount. For many years this nitrate trade has constituted more than half the total value of her exports, and the tax thereon of $10.60 U.S. gold per ton collected by the Government has constituted not only the largest item of its revenue, but also for some years has exceeded all other revenues combined. The prosperity of the whole country and the financial condition of the national treasury were to a very large measure determined by the condition of the nitrate industry. The nitrate fields, which in ordinary times gave employment to over 40,000 workmen, offered one of the chief markets for Chilean produce. The effect of this easily acquired wealth, especially during the earlier years of the industry, is believed by many to have been actually harmful to Chile's sound development. The tendency to use this money for other than wealth producing investments has hindered the development of agriculture. Both capital and labour have naturally sought the more remunerative rewards of the nitrate regions. Since the World War, however, Chilean producers have been experiencing the reaction from the boom days of that period and have encountered keen competition from the manufacturers of synthetic nitrates. Some slight improvement in production after 1922 was followed by another decline. Chile, which had produced 64% of the world's nitrogen requirements in 1910, mined only 25% in 1926. The attempt to reduce stocks on hand led to further unemployment and loss of revenue. In the midst of this crisis the Guggenheim interests, long connected with Chile's copper mining, announced a cheaper process for reducing nitrates, and with the co-operation of the Government, took over most of the existing plants on a preferred stock basis. Still unable to compete with synthetic nitrates, the Government and producers united in 1930 to form Cosach (*Compania de Salitre de Chile*). In this new combine the Government, endeavoring to meet external competition, agreed to accept an equal share of profits in lieu of the former export tax. But the new combination was unable to form a cartel with foreign synthetic producers, and this failure led to the overthrow of the Ibáñez government and contributed to the downfall of Montero. Under Alessandri, Chile and synthetic producers in July 1934, formed a sales corporation and entered into a world cartel which permitted the country to market from 1,000,000 to 1,250,000 tons per year—an increase of 20%. In 1937–38 the exportation, including surplus, rose to 1,544,000 tons. More than half of this went to the United States. The output of iodine, a by-product, was 832,290 kgs., 60% of the world's production.

In addition to nitrate, Chile is also rich in low grade copper deposits. Some of the richer ores were worked by the Spaniards as early as 1601 and by the Indians long before. In the latter half of the 19th century, Chile was a leading copper centre of the world, in 1876 producing 38% of the total supply. With the development of the copper deposits in the United States, Chilean production fell off to only 4% of the world total in 1906. Its rise in more recent years has been rapid and in 1939 held second rank with abundant prospects that it will retain or better this position. About 90% of Chilean copper is produced by two large American companies, operating at three centres: one in the north at Chuquicamata, another near Rancagua at El Teniente, and the third at Potrerillos near Chañaral. The Chuquicamata is one of the large scale mining operations in the world, working a low two per cent grade ore at an expense of seven or eight cents per pound. The copper reserve, the largest known, is conservatively estimated at 134 billion pounds. The output in 1937 was 403,196 tons, a record due to the existing race in armaments. Although Chile's high grade iron reserves are estimated at over 900,000,000 tons, production of pig iron is almost nil due in large part to a lack of coking coal. Only one of the deposits, that at Cruz Grande, in the province of Coquimbo, is being exploited and shipped to the United States under the control of the Bethlehem Steel Corporation. The mining and loading on steamers of this ore, on an unusually large scale, is considered a model of efficiency. The production in 1937 was 1,529,270 metric tons. Because of high grade and cheapness in its handling, these ores enter into competition with the great deposits in the United States.

The coals of Chile are noted for their quantity rather than their quality. They occur on the coast south of Concepción and are of Tertiary age. They vary considerably in quantity, improving with depth. The product has been described as second class steamer coal, on the average 25% inferior to the Welsh product. There are four principal coal fields in the vicinity of the Biobío, of which the most important, Coronel and Lota, are worked under the sea by means of inclined drifts (*chiflones*) on the long wall system. In addition there is a small lignite deposit near Ma-

gallanes mined only for local use. Four-fifths of all the coal mined is used by the State railways and production in recent years, averaging 1,786,844 metric tons, has been adversely affected by the increasing use of petroleum.

Since 1931 the increased purchasing power of gold has led to the reopening of former gold washings and the consequent lessening of unemployment. Production in 1937 amounted to 315,560 ounces. At the same time the country produced 1,786,000oz. of silver.

There was also an appreciable yield of sulphur (25,000 tons), together with some borax, salt, and guano.

Agriculture.—The agriculture of Chile is confined almost wholly to the central valley. The available productive land is extremely limited, the amount devoted to cereals and other food crops being estimated at not more than four per cent of the total area of the country; orchards, vines, planted woodlands, grasses, and alfalfa (lucerne) occupy a somewhat smaller area; and the natural pasturage occupies a smaller area still. This 10 or 12% of the area, together with the 20 to 22% in natural forests and woodland, mostly in southern Chile, make up the productive land—about $\frac{1}{3}$ of the total area of the country. The leading crops with their average acreage for the three years ending in 1937, were, wheat 1,990,000ac.; barley 163,000ac.; oats 229,000ac.; haricots 205,000ac.; maize 111,000ac.; potatoes 124,000ac.—a considerable increase over the acreage of the previous decade. In view of the great decrease in trade, this gain in acreage and production has materially helped to make the country self-supporting. Chile is the seventh country of the world in wine production with 36,415 vineyards reporting a product of 93,620,000gal. and an export of 3,564,000gal., chiefly to Belgium and Germany.

The number of cattle reported for 1938 was 2,634,499, still insufficient to meet the demands of the population. For the year 1936, 5,749,069 sheep were reported from 33,956 ranches, largely in the south. The total number of draft animals was 621,452. Exports of wool, principally to Great Britain and Germany, were 12,059 metric tons.

By far the major part of the crop land is made possible only by irrigation, which was practised in limited areas of northern Chile, even during prehistoric times. The chief areas now under irrigation lie along the river terraces within the Cordillera, upon the piedmont to the west, or within the central valley. The available streams from the Loa to the Biobío are the chief sources of water.

Some of the irrigation projects are of long standing and on a large scale, and carry water in canals over 100 m., besides furnishing extensive electric power. Many of the undertakings are privately owned, others belong to associations, and in recent years some very large projects have been financed by the Government. The area served by the three largest canals aggregates 300,000 acres.

Although agriculture in the central valley lays the foundation for the social and political structure of the country and affords a large share of the products for local consumption, it has little influence on trade balances. Socially the bulk of the people are organized around the large feudal estates and suffer little change in condition whether crops are good or bad. The owner may be more or less affluent from year to year, but this adds little to his comforts or discomforts, and he always remains on the social and political register of the country. In the northern valleys maize is the chief food crop and besides there is a great variety of sub-tropical fruits. The best developed type of feudal estate may include some 250 ac. of irrigated fields and 2,000 ac. or more of hillside land, which offers excellent range for live stock during the rainy season. These *propriedades agricolas* are mixed farms producing a large variety of grains and fruits, and alfalfa, some horses and a larger number of cattle and sheep, but never many hogs. The growing of live stock on irrigated land, however, is not profitable. As a result Chile has less than half the cattle of Cuba and must depend upon Argentina for part of its meat supply. This source, owing to recent tariff changes, is being still further restricted. The relatively large number of sheep is accounted for by the big development in Magallanes where more than one-half of the sheep of the country are found. The central valley, so similar to that of California, favours the growing of fruits, but lacks a good market. A number of attempts have been made to develop one in the United States where recent shipments have met with reasonable success.

The chief gain of the Chilean farmer has come from his vineyards. The wine of the country is widely known throughout South America.

The grape acreage ranks next to wheat and is larger than that devoted to any other cereal, or to beans, or alfalfa. Whether this is the cause or not, Chile is considered as more afflicted by alcoholism than any other South American country.

Agriculture, like industry in general, has experienced its ups and downs since 1929. The year 1929 represented a high point in production; 1932 because of prevailing low prices, coupled with poor crops, the lowest point of recent decades. Since 1932 conditions have improved, and the country has moved toward self-sufficiency, although the Government maintains a close supervision over the exportation of food crops. The local meat supply is inadequate.

Although south Chile is the great forest section of the country, yet because of transportation problems relatively little of the output enters into its internal or external commerce. On the whole it has been found more economical to import timber products from the United States. Chilean forests were once very much more extensive than now but have been destroyed as an incumbrance, even in late years. Of the forested area, estimated at about 35,000,000 ac., at least two-thirds of it must be discounted because of the character of the woods or the type of country in which it is found. Only the province of Cautin can lay claim to first class forests.

Manufacturing.—Like other South American countries, Chile has not yet reached the industrial stage, although the Government has done much to stimulate local activity. Most of the manufacturing establishments are little more than workshops, for in the 3,196 factories listed in 1923, there were employed only 82,118 people—an average of 25 or 26 each. Favoured by a wider use of electric power and the efforts of the Government to diversify production, there was a great increase in domestic manufactures up to 1930. The census of that year reported 92,719 proprietors of industrial establishments with 296,201 employees—one-fourth of the active population of the country. The period, however, was one of brief prosperity. World-wide depression and political disturbances at home brought the country by 1932 to a very low productive plane. The re-establishment of stable government and the great reduction in foreign trade led to a new boom in industry. One notes, for instance, that in 1937 there were 145 textile factories with production valued at 389,498,463 gold pesos. Similar increases were noted in footwear, pottery, cement, and paper. By far the most numerous group of factories and the one employing the greatest number of workmen was engaged in the preparation of foods. About one-third of these factories, with nearly one-half the people employed, are in the province of Santiago. Great strides have been made in the preparation of leather and in the use of up-to-date machinery for the manufacture of shoes, so that Chile is largely supplied (1939) from the local output. The high tariffs of recent years have also done much to stimulate local production, especially of textiles. About 19% of the active population is engaged in manufacturing.

Commerce.—Although Chile ranks seventh in size among South American republics, it stands third in the value of its foreign commerce, being exceeded by Brazil and Argentina only. Its per capita trade, about 100 ps., is equal to that of Argentina and double that of Brazil, although only one-tenth the total of the latter. This is a striking result, for fully one-half of the population is made up of agricultural rotos, who are modest consumers.

By 1850 England, France, and Germany had largely crowded Spain out of Chilean trade, and Valparaiso had become the leading port of the west coast. Lines of communication were developed with California and Australia, and the trade of Chile became a vital factor in its development. Gradually copper and silver

became more important as exports. The nitrate deposits were opened up, but this trade was of slow growth until after the "War of the Pacific." In 1880 nitrate accounted for 30% of the Chilean exports, and in five years this increased to 60%. From then on up to the World War, the exportation of nitrate grew rapidly and made Chile rich. The years just preceding the war were banner years, due largely to the cumulative effect of mounting revenues, to which seemingly there was to be no end. This naturally encouraged a lavish expenditure of money.

The outbreak of the war and the blocking of the trade channels brought on a national crisis of unusual severity. Then as the war progressed unprecedented demands for nitrate and copper in the United States, together with the opening of the Panama canal (1914), brought to Chile a prosperity never before equalled. In three years the trade more than doubled and the export figure reached the high mark of $278,000,000. With the close of the war, the market collapsed and the exports fell to the pre-war figure. Then with the short post-war boom the export trade reached the new height of $284,000,000 for 1920. But hard times followed, the country passed through one financial crisis after another, the Government changed hands, and as a result between 1929 to 1932 foreign trade declined sharply to less than one-sixth of its average for the preceding decade. With the re-establishment of a stable government, the country slowly recovered, until in 1938 Chilean exports were three times as large as they had been six years before, while the imports had doubled in value.

The situation with respect to minerals is unique. Although agricultural activities are vitally important to the bulk of the population, the economic position of Chile in world markets depends upon its mineral resources, which account for the major part of its exports, and indirectly furnish the funds for most of the imports. The prosperity of the people, therefore, depends on an export trade, in which they take little part and over which they have little control.

The fluctuations of copper, the second largest item of export, have relatively little influence on the general prosperity of the country, as that commodity pays a local impost rather than a direct export tax. Practically all the export of iron, about 1,000,000 tons, comes from the Tofo mines, under the control of the Bethlehem-Chile Iron Mines Company. With a commercial balance in its favour since 1931 and an active and stable government, Chile has greatly increased its foreign trade. Nitrate and copper have the most prominent places among the exports; iron and steel manufactures, machinery, cotton fabrics, and petroleum among the imports. Even those countries that produce synthetic nitrates accept a quota of the Chilean product. Agricultural exports and imports fluctuate with Government regulations, price levels, and transandine connections, although the general tendency is toward closer trade relations with its immediate neighbours. The restrictions on foreign exchange have shifted a portion of the trade from the United States and Great Britain to Germany, France, and Italy, where quota arrangements are possible. The merchant marine of the country seems neglected, but new treaties with Cuba and other Caribbean countries present hopeful prospects. The fluctuations in nitrate exports in the early '30s hampered general trade, but this has been partly remedied by the formation of the Nitrate Sales Corporation.

After various minerals, mutton and wool rank first as exports. Their combined value in the total trade is exceeded only by nitrate and copper. Fully four-fifths of the sheep output comes from the hinterland of Magallanes and hence figures slightly in the trade of Central Chile. Of the other exports, wheat and flour fluctuate greatly from year to year, but average about 4% of the total export. The margin above the home demand comes only with a crop that is above normal. In certain years there is a slight exportation of barley, oats, peas, lentils, fruits, nuts and the like. The analysis of the trade clearly shows that a nation depending on minerals for 90% of its exports is one whose prosperity is not built on a firm foundation.

The import trade is largely made up of manufactured goods and may be grouped into three dominant classes: (1) iron and steel products, about 30%; (2) textiles, 25%; and (3) a host of miscellaneous products. In the import trade, nearly one-half (48% for 1922–24) of all products come from two countries, the United States and Great Britain, although recently Germany has been gaining at the expense of both. As with almost all South American countries, there is little interchange with neighbouring countries. One of the strong features of the trade has been its regular balance in favour of Chile, but on the whole the outlook is not particularly alluring. The remedy seems to lie in the establishing of a new class of small farm holdings under the control of enlightened *rotos*. With such a change in social order, there may arise a new industrial and commercial Chile.

Transport.—Railway construction started in the north under private auspices in 1850. The Government road from Valparaiso to Santiago was first opened in 1863 and thereafter gradually extended southward to Puerto Montt. Chile's narrow width called for a strategic longitudinal "system" and the barren character of the country to the northward seemed to place the burden of construction on the Government. In 1910 it definitely completed the building of a line in that direction and extended it from Arica to La Paz. In 1928, this road within Bolivia was turned over to that country.

In spite of this activity, by which 61%, or 3,772 m. out of a total of 6,209, are State owned, the major portion of the northern railways are operated under private ownership or lease, and serve the mineral interests of that region. The Chilean railways are Government owned primarily for strategic reasons.

Those roads that are under private control are on the whole efficiently administered. The State owned roads, which up to 1926 uniformly showed a deficit and thereby contributed to the financial crisis of that year, have been criticised for faulty location, poor equipment, and high operating costs. Political pressure will account for many of these defects, which President Ibáñez attempted to remedy by eliminating graft, favouritism and unnecessary employees, by the construction of new railways, and the electrification of the main lines under a program which called for an annual expenditure of 183,000,000 pesos. Despite his efforts and those of his successors, this program was only partially realized. The Transandine railway is a case in point. It was first adversely affected by a tariff on Argentine products and then was closed by a landslide in the winter of 1933. Freight traffic has been partially restored, but to become economically profitable, the road must be taken over by the two countries under a more favourable working agreement and must be electrified. In any case, it will be difficult to meet the competition of aeroplane passenger traffic.

Little was done for highways before the law of 1920, which embodies some of the best foreign stipulations. In 1923, 21,959 m. of public road were reported, of which some 3,030 m. were fit for automobiles.

The Ibáñez administration also undertook a wide program of road building. Between 1932–38 some 1,900 miles of additional highway were constructed and 6,000 miles improved. The number of miles open to traffic in 1936 was 26,695. Chile is on the route of the Pan-American airways and has direct aeroplane connection with Europe. Coastwise connection with the Strait of Magellan has been established with the construction of a canal through the Peninsula of Ofqui and also by aeroplane. In 1937 the country reported nearly 38,035 motor vehicles of which 12,000 were trucks and buses. The telegraph dates from 1851 and this enterprise, like the railroad and steamship service, owed its inception to William Wheelwright. For some time the telegraph was united with the postal service, then administered separately for about 40 years, and later amalgamated in 1920. It was disorganized during the revolt of 1891 and by the earthquakes of 1906 and since. In 1937, there were 283 telephone exchanges in the country with 49,162 subscribers. Telegraph lines amounted to 15,687 kms. There were nine wireless stations on the Chilean mainland and one on Juan Fernández, and three large broadcasting stations.

The sea constitutes Chile's best highway. Much, therefore, has been done since 1910 in constructing docks, erecting breakwaters, and in other ways making ports more serviceable, and in directing roads and railways thither. A new department of har-

bour works has been added to the Naval Ministry. Subsidies have been provided for national vessels using the Panama canal and the Strait of Magellan and other measures adopted to stimulate a commercial marine. Shipping reported for 1938 was 99 craft with a tonnage of 16,422. In 1936, 369 vessels cleared at Chilean ports while the coastal shipping amounted to 1,702,400 tons. The postoffices in 1936 numbered 1,038, and handled 92,130,893 pieces of mail.

Defence.—Compulsory military service prevails in Chile. Every able-bodied man over 20 years of age is due to receive 18 months' training. Following the months of active service they belong to the first reserve for 12 years and to the second reserve till the completion of their 45th year. The active army in 1936, numbering 1,400 officers and 16,000 men, was made up of three divisions of infantry of ten regiments each, and one of cavalry of six regiments; three mountain infantry battalions, four batteries of field artillery, three of heavy artillery, and three of mountain artillery; one engineering regiment and one battalion of railway troops. The first-line reserve numbered about 225,000 men and the second-class reserve about 200,000. The army has been trained and organized largely on the German system. The spirit of the vast majority of the recruits facilitates the task of able officers. Discipline is good, the uniforms neat, and weapons are of modern pattern and well kept. The cavalry, in particular, is conspicuous for its first class condition. The infantry are armed with a modified Mauser rifle, the cavalry with a carbine (of similar make) and lance, and the field artillery with Krupp guns. The air service, introduced in 1918 under British instruction, consisted in 1938 of three air groups, one bombing group, two seaplane groups, and a flying school equipped with 210 planes. Cadet, artillery, cavalry, engineering, and infantry schools are maintained by the State; in 1924 a school for non-commissioned officers was formed.

The Chilean Navy took its rise in 1817 with the capture of a Spanish frigate and brigantine at anchor in Arica bay. This initial success, due to a Scotchman, Captain William McKay, was brilliantly continued during the four years that Thomas Cochrane served Chile and cleared the west coast of Spanish vessels. These operations, loyally supported by the Supreme Director, Bernardo O'Higgins, made possible the success of San Martín in Peru, and left a definite British impress upon the navy of Chile. It was the "Cochrane" which won the naval battle of Angamos in 1879. The Chilean fleet consisted (1939) of one battleship, the "Almirante Latorre," a 28,000 ton craft constructed in 1913, one coast defence vessel, and one armoured cruiser of 8,500 tons, the "O'Higgins," and two protected cruisers each of about 4,500 tons. In keeping with the world strife for armaments, appropriations were made in 1937 for two cruisers of 8,000 tons. In addition, the navy has 8 large destroyers and 9 submarines together with training vessels and oil tankers—all built in England. The present Government, however, is inclined to welcome the loan from the United States, for purpose of inter-American defence, of additional cruisers and destroyers of older models. The officers of the Chilean Navy maintain a more aristocratic tradition than the other branches of service. This led the major part of them under their leading officer, Captain, later President, Jorge Montt, to support Congress in 1891 against President Balmaceda. In 1939 enlisted personnel numbered 8,000. Between 1924 and 1932 the army and navy and the air forces each in turn directed or supported revolutionary movements, but since that date the army has consistently adhered to the conservative government, and in 1938 prevented the repudiation of the recent president-elect. (I. J. C.)

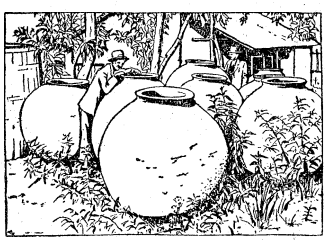
HISTORY

In the 15th century the Peruvian Indians invaded the country—even then known as Chile—and dominated it as far south as the Rapel river (34° 10′ S.). Their control may have furthered the later conquest by the Spaniards. The latter made their first attempt to occupy the region under Diego de Almagro, associate and subsequent rival of Pizarro. After Almagro's death the conqueror of Peru granted Chile to his favourite aide, Pedro de Valdivia. That invader founded Santiago (Feb. 12, 1541), and after establishing other fortified towns north and south of that centre and east of the Andes, lost his life in a general uprising of the Araucanian Indians, under their celebrated *toqui,* or war-chief, Caupolicán. The greater part of his settlements were destroyed, although La Serena and Concepción remained as the outposts of the future colony to the north and the south, while Cuyo held the same position east of the Andes.

The Colonial Period.—With this inauspicious beginning Chile entered upon its three centuries of colonial history. In such phases of its development as were affected by the administrative and commercial control of the homeland it differed in no wise from its neighbours. Its population took no part in political affairs, aside from membership in the town councils. It accepted ecclesiastical control in its scant educational facilities as well as in spiritual matters. It endured all the vagaries of Spain's trade restrictions, varied by the piratical and contraband practices of its enemies. Chile differed from other Spanish colonies in that its remote position forced upon the people a more thorough isolation, while continued conflicts with the Araucanians tended to harden the settlers, and the scarcity of precious metals turned them toward farming.

By the end of the 17th century this population numbered 100,000. A century later it approached a half million. This included 300,000 *mestizos* (mixed bloods), half as many *Criollos* ("Creoles," *i.e.,* natives of European descent), some 20,000 *Peninsulares* (recently arrived Spaniards, among whom Basque immigrants from northern Spain formed an energetic commercial element), and a smattering of negroes and recently emancipated Indians. This hardy population had progressed far towards racial unity but the *mayorazgos,* a system of transmitting estates by entail, gave enhanced importance to a few leading families. The people, set down in the midst of resources that were barely touched, were stimulated to activity by a bracing climate, but were pitifully handicapped by ignorance, isolation, and the lack of political experience.

Independence and Self-government.—None of the above conditions that hampered Chile in common with its fellow colonies provoked the movement for independence. Nor was this act due to the rise of the United States nor to the French Revolution. It was the intervention of Napoleon in Spain—an act that in 1808 threw each part of the Spanish monarchy on its own resources—that led Chile to take the first halting step toward self-government. This occurred on Sept. 18, 1810, when an open *cabildo* or general town meeting in Santiago accepted the resignation of the president-governor and in his stead elected a *junta* (board) of seven members.



JARS USED IN MAKING WINE

This act divided the people (not including, of course, the ignorant masses) into two general groups. The first, which was composed exclusively of Creoles was headed by the *cabildo,* or town council of Santiago. The *audiencia* headed the second, which largely represented peninsular interests. The former group wished to organize for local protection during the intervention and possibly for more complete self-government thereafter. The peninsulars followed reluctantly, for they preferred to keep intact the existing system which insured them special privileges.

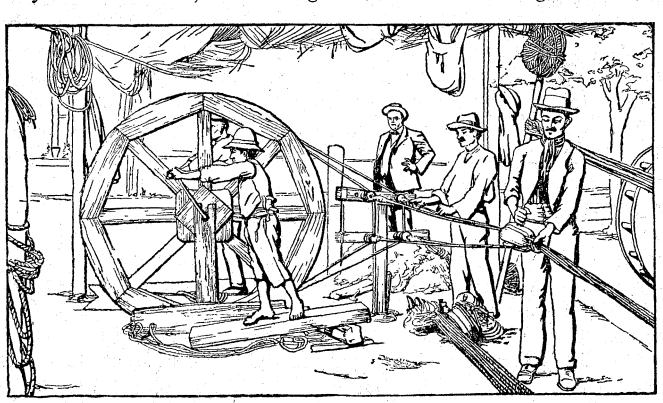
The creole leaders gained their immediate point—a recognized position in the new *junta,* took measures for the defence of the province, opened its ports to general trade, abolished the *audiencia,* when that body encouraged a reactionary uprising, and summoned a national congress. By this time Concepción, under the leadership of Juan Martínez de Rozas, broke away from the conservative leaders of the Santiago *cabildo.* This split enabled an ambitious popular leader, José Miguel Carrera, to dissolve congress, some two months after it finally organized, banish Rozas, and assume dictatorial powers, but this did not occur before congress had assumed administrative control of the colony, broken relations with Peru, abolished slavery, established a press, en-

couraged education and suggested further important steps towards self-government—all in the name of the captive king. Affairs in Chile now assumed the aspect of civil war between those of its people who favoured the former autocracy, as represented by the viceroy of Peru, and those who espoused self-government under a more liberal monarchy. Owing to divisions among the autonomists, who called themselves partisans of Carrera or of Bernardo O'Higgins, who had superseded him, the royalists gained the upper hand at Rancagua, Oct. 7, 1814, and brought to an end that first phase of the Chilean War for independence known as *la patria vieja* (the Old Country).

Two and a half years of repression under the restored government effectually cured the Chilean people of further loyalty to Spain. During this period José de San Martín patiently gathered an army at Mendoza and led it early in 1817 across the Andes. With this force, in which O'Higgins commanded a contingent, he defeated the royalists at Chacabuco, on Feb. 12, and made his associate supreme director of Chile. Their first task was to meet the inevitable counter attack under Osorio, the victor of 1814, who surprised and routed the patriot forces at Cancha Rayada. But with a reorganized force San Martín met and crushed the royalists at Maipú, April 5, 1818. This victory made good the declaration of independence which had been formally proclaimed on the first anniversary of Chacabuco.

During the next 15 years Chile passed through a period of political uncertainty that fortunately was less prolonged and less anarchic than her neighbours experienced. For five years O'Higgins maintained a fairly efficient personal rule, slightly modified by constitutional offerings of his own devising. After his abdication in 1823 there followed a more unsteady dictatorship under Ramón Freire, which was modified in 1826 by an ill advised attempt at federalism and two years later by the liberal but unworkable constitution of 1828. During this period the Spaniards were finally expelled from Chiloé and that island and the contiguous area incorporated with the country. Aided by a naval contingent under Lord Cochrane (earl of Dundonald) the Chileans united with other patriotic forces in freeing Peru and thus assuring their own security. Then followed recognition by Brazil, Mexico, the United States, and Great Britain. Through the last named country Chile was enabled to float its first external loan.

In domestic affairs the country was less fortunate. A few social reforms, initiated by O'Higgins and Freire, did little to remove the discontent engendered by years of warfare, to counteract the hostility of the Church, or to straighten out financial tangles. Politics



PRIMITIVE METHOD OF MAKING ROPE FROM HEMP FIBRE IN CHILE

was almost wholly personal and merely served to reveal political incapacity. Matters reached a crisis in 1829 with the outbreak of civil strife between Freire, who seemed the only hope of liberalism, and Joaquín Prieto, a successful military chief whom the reactionaries accepted. The conflict was decided at Lircay, April 17, 1830, with the utter defeat of the Liberal forces.

This victory made Prieto president of Chile, but his chief minister, Diego Portales, became its controlling spirit. This conservative leader, the Alexander Hamilton of Chile, aimed at something more substantial than mere military control. He wished to establish the credit of the country and assure its orderly progress. He proposed to continue in power those aristocratic elements that had softened the rigours of colonial control and had kept the struggle for independence clear of unproductive radicalism. With the aid of the *Pelucones* ("Bigwigs"), he centred administration in a President of almost dictatorial powers, whose acts were subject to limited revision by Congress. It was this combination of aristocratic supervision with autocratic administration that constituted the main feature of the Constitution of 1833.

The Autocratic Republic (1831–61).—The government under the new constitution soon faced a series of intrigues that in 1835 called Portales from retirement, and forced the re-election of Prieto. In furthering his efforts to preserve the constitution and to develop the resources of the country Portales now systemized the revenues, reorganized the treasury and refunded the public debt. But the benefits of this policy were measurably neutralized by his severity. Further dissatisfaction was aroused by a conflict with the Peru-Bolivian confederation, in the midst of which a regiment stationed near Valparaiso revolted and seized and assassinated the dictatorial minister, June 6, 1837. His death, regarded as a national calamity, served to fix his policy upon the country more firmly than ever. The war that he had brought about ended with the overthrow of the confederation at Yungay (Jan. 20, 1839). This victory assured the predominance of Chile on the west coast and made its successful general, Manuel Bulnes, the next president.

The first half of Bulnes's double term (1841–51) was an era of conciliation, of material progress, and of cultural awakening. The public debt was liquidated and the customs better regulated. Steamship lines were established, coal mines were opened, and the output of copper and silver was greatly increased. Colonies of Germans were located in the south and in 1849 the Strait of Magellan occupied. This last move provoked a series of boundary disputes with Argentina which were further complicated by similar controversies with Bolivia. Per contra Spain now recognized the independence of Chile, and Peru settled the debt—a legacy of the period of independence—that had helped provoke war between them.

Intellectual expression kept pace with material progress. The National Institute improved its course of instruction. In 1843 the University of Chile opened its doors under the direction of Andrés Bello, a naturalized Venezuelan who later codified the civil law of Chile and attempted to nationalize its language. The Argentine refugee, Domingo F. Sarmiento, headed the first Normal School (1842) and for several years served on the editorial staff of *El Mercurio*. Literary expression manifested itself especially in the press, where José Victorino Lastarria represented reviving liberalism, and Francisco Bilbao, more definitely the revolutionary philosophy of 1848. Growing demands for religious toleration led the State to legalize the marriage of dissenters and to exercise some control over clerical appointments.

After two decades of effective rule the Conservative Party found its supremacy threatened when in 1850 it brought Manuel Montt forward as the successor of Bulnes. But the administration ruthlessly suppressed opposition, which culminated in an unsuccessful revolt, and ushered in the decennium (1851–61) which closed the "autocratic republic." Montt was a fit executive for the period. A pedantic devotion to law and order motivated his policy but once assured of these essentials he devoted himself to developing his country's resources. He introduced the telegraph, began the construction of railways, started the hall of congress and various public buildings, and encouraged the founding of savings banks, the Mortgage Loan Bank, and other financial institutions. Agriculture was aided by the suppression of tithes and of the *mayorazgos*, by the subdivision of rural properties, and by modifying the *alcabalas*. He provided for better primary instruction, for more normal schools, and for public libraries. The discovery of gold in California created for a few years a better market for Chilean flour, but later led to a disastrous financial reaction.

Montt's insistence upon the authority of the State provoked a controversy over the appointment of the archbishop of Santiago and split his party. In a quarrel over the budget the malcontents

were joined by a new party—the Radical—and the combined opposition forced the president to reconstruct his cabinet. This incident was later interpreted as a step toward fixing its responsibility to Congress. When opposition in 1859 became open revolt, Montt with the aid of his efficient co-labourer, Antonio Varas, rigorously suppressed it. It was felt inadvisable, however, to force the election of the latter as his successor.

The Liberal Republic (1861–91).—Joaquín Pérez was a compromise president. He began his administration in a spirit of conciliation and supported by a fusion of Liberals and Conservatives carried it on for ten years without recourse to the "extraordinary faculties," which preceding presidents occasionally used. The opposition maintained by the "Montt-Varistas" (Nationalists) and by the Radicals, mollified by religious and civil concessions, finally secured a constitutional amendment against the re-election of the president. The Radicals also sponsored closer relations with their west coast neighbours, when in 1866 Chile was drawn into the war between Peru and Spain, of which the outstanding event was the wanton bombardment of Valparaiso by the Spanish fleet. The growth in public revenues, which were doubling each decade, permitted this administration to complete the railway between Valparaiso and the capital and to increase expenditures for such public services as the police, the postoffice, and highways. A new commercial code went into effect in 1867 and two years later was held the first National Exposition of Agriculture—both marks of a healthy expansion in production. Colonization was extended into the south at the expense of the Araucanians.

Federico Errázuriz Zañartu (1871–76) continued the record of Pérez for efficient public service. He pushed forward the construction of railways, improved the water front at Valparaiso and finished the edifices for congress, for the University, and for the Agricultural Exposition. At the same time his colleague, Benjamin Vicuña Mackenna transformed and beautified Santiago. The opening of new silver mines and the exploitation of guano deposits and of nitrate greatly stimulated business activity. But still more significant were the political changes of the period. Such issues as the secularization of cemeteries, civil marriage, the separation of Church and State brought the Conservatives forward as champions of ecclesiastical privilege, with the Radicals, aided by a press that was practically free, as their chief opponents. Fundamental changes in the penal code and in the organic Law of Tribunals subjected clerics to civil procedure, restricted the "extraordinary faculties" of the president, and rendered those holding judicial appointments ineligible for other political offices. Amendments to the constitution enlarged the powers of the chamber of deputies, provided for the election of its members by cumulative voting, and made the ministry more thoroughly subject to congress.

His successor, Aníbal Pinto (1876–81) suspended specie payments to meet the economic crisis caused by the exportation of gold and silver, and in 1881 finally settled the long-standing dispute with Argentina over the Strait of Magellan. The quarrel with Bolivia over the guano deposits at Atacama proved insoluble. An attempt had been made in 1866 to settle it by dividing the revenues of the disputed territory. The discovery of silver mines at Caracoles and of nitrate deposits near Antofagasta increased the tension and ultimately led to the War of the Pacific.

Hostilities began in 1879 with the occupation of Antofagasta by Chilean troops. Bolivia immediately declared war and appealed to Peru for aid under the terms of an alliance made in 1873. Chile rejected Peru's offer of mediation and declared war against both republics. The first stages of the conflict were marked by naval engagements at Iquique and at Angamos, Oct. 8, 1879. The latter victory gave Chile command of the sea. After brilliant campaigns the Chileans speedily occupied the province of Tarapacá and followed this with the capture of Arica. Here in Oct. 1880, the contestants met in conference under the auspices of the United States but failed to come to terms. Chile, determined to force a territorial indemnity, then transferred her arms to the vicinity of Lima and in Jan. 1881, after desperate fighting occupied the city. Then followed two years of desultory guerrilla warfare, after which the Peruvians brought together a government that in 1883 accepted the Treaty of Ancón. Under this pact Peru unconditionally ceded Tarapacá to Chile and gave that country control for ten years over Tacna and Arica. At the end of that period, according to the third article of the treaty, a plebiscite should determine whether the provinces were to continue under Chile or return to Peru, the country winning the plebiscite being then obligated to pay the other 10,000,000 pesos. In 1884 Chile and Bolivia agreed to a truce by which the latter yielded to Chile for an indefinite period the province of Antofagasta—its only outlet to the sea.

In the midst of hostilities Domingo Santa María succeeded to the presidency. While bringing the war to a close he also subdued the Araucanian Indians. These successes in the north and south increased the territory of the republic by a third. Within the five years of Santa María's administration (1881–86) the public revenues more than doubled and continued to increase. The government, therefore, was able to meet all existing obligations, to encourage immigration and aid agriculture and mining—in short, to do everything except redeem its paper money. The peso depreciated to about half its value; prices rose accordingly. Thus in a period of apparent national prosperity the masses of the people suffered greatly.

More significant than fiscal issues was the election of an archbishop in Santiago—an act which revived the fervid discussion of "theological reforms." The authorities secularized the cemeteries and recognized civil marriage by law, but failed to bring about the separation of Church and State. At the same time congress extended individual guarantees, assumed the power to override the president's veto by a two-thirds vote, curtailed the powers of local officials, and established manhood suffrage. Yet the president, as before, intervened in the following election and despite prolonged opposition, secured the choice of his designated successor, José Manuel Balmaceda (1886–91).

The new president was a reformer who showed a tendency to use autocratic methods. Yet at the outset he attempted to reconcile his enemies and even permitted them to name the archbishop. Substantial increases in the revenue, especially from the export tax on nitrates, enabled him to initiate a veritable "dissipation of progress," including commendable attention to educational affairs. The system of secondary and higher education had been revised under the law of 1879. Medical instruction was now improved and a pedagogical institute founded for the training of secondary teachers. In fiscal affairs a more just system of taxation was introduced, a tribunal of accounts created, and part of the public debt paid. But the Government made no attempt to abandon the system of paper money. It supplied the army and navy with better equipment and made efforts to encourage immigration.

These improvements were accompanied by complaints of wastefulness and of unnecessary increases in the civil service. At this period also occurred extensive strikes among the labourers, due in part to the depreciation of the currency and to the introduction of workmen from abroad. These conditions gave rise to a new party—the Democrats. The old parties were thoroughly disorganized and at outs with the executive, despite his conciliatory attitude. Cabinets were formed and dissolved mechanically. The president used his influence to elect new members to congress, only to have them join the opposition. The real issue at stake was the election of 1891, which Balmaceda, as usual, planned to dominate in favour of a friend. Congress attempted to checkmate the scheme by adjourning in 1890, without voting supplies. Balmaceda thereupon selected a group of advisers headed by his favoured candidate and announced that he would collect taxes for 1891 under the budget of the preceding year. This step was clearly illegal, but the president's worst offence was his open challenge to the aristocratic and clerical influences that had hitherto dominated the country.

His opponents, who comprised a majority of both houses of congress, did not hesitate to declare themselves in revolt. Led by the vice president of the senate and the president of the chamber of deputies and supported by the navy under Capt. Jorge Montt, they fled northward and established themselves at Iquique. Utiliz-

ing the revenues of the nitrate fields, they recruited an army from the labourers and prepared to fight the dictatorial president. He in turn declared Montt and his levies traitors and raised a force of 40,000 men to combat them. He filled up Congress with his supporters and directed an election in June, when his friend Claudio Vicuña was chosen to succeed him. He aroused further vindictive feeling by the execution in August of several youths belonging to leading families of the country.

Meanwhile his enemies in the north sought to purchase a supply of arms in the United States. Their vessel, the "Itata," evaded the American authorities, but after reaching Chile was forced to return without landing its cargo. The revolutionists finally obtained arms from Europe with which they met and defeated the Balmacedists at Concón and then utterly overwhelmed them at Placilla. Their victory was largely due to the scattering of the president's forces, to treachery in his ranks, and especially to the resentment inspired by his recent arbitrary course. Balmaceda abdicated on the evening of his defeat, took refuge in the Argentine legation and there, on the evening of Sept. 18, the last day of his administration, committed suicide. The contest had cost 10,000 lives and had added materially to the public debt, but it apparently decided that Congress and not the president should control the country.

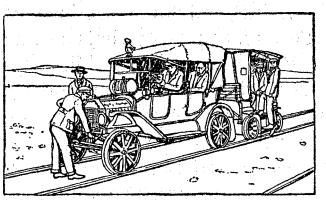
The Democratic Republic (1891–1924).—The triumphant Congressionalists speedily restored order and in November elected their leader, Admiral Jorge Montt as president. The new president proved a straight-forward, conciliatory official. He and his associates extended amnesty to the greater part of their opponents and assumed the debts contracted by both factions in the late contest. Then they proceeded to consolidate the pretentious parliamentary régime for which they had contended. The Municipal Law of 1892 by which the victors hoped to provide more definitely for local participation in affairs and to forestall further executive interference in elections, was accompanied by a new law of parliamentary incompatibility, which prevented any one drawing a salary from the State from holding a legislative office and definitely shifted the control of elections from the executive to Congress. Political campaigns were henceforth carried on by party groups, seven or more in number, whose leaders resided in the capital and directed the activities of their representatives in each of the communes into which the country was divided.

These party groups now became mere personal followings, which could determine action only through precarious combinations. In presidential elections, however, the parties generally formed themselves into two general groups—the Alliance and the Coalition—of which the former embraced the more liberal elements. Yet there was nothing fixed in these combinations. In 1896 the Coalition carried the election of Federico Errázuriz, son of the former president, by a very narrow majority; in 1901 the vote went the other way in favour of Germán Riesco and swung back again five years later.

At this election in 1906 certain groups that were disgusted with sterile political combinations united to form a "National Union." They proposed to bring about "administrative regeneration" in the government and fittingly chose as their candidate, Pedro Montt, son of the man whose earlier administration still suggested law and stability. Although Montt had been defeated in 1901 the "National Union" now put him into office by an overwhelming majority. But the new executive was unable to bring about the redemption of the currency and only after the greatest efforts was he authorized to start construction on the Longitudinal railway. On the completion of the Transandine railway in 1910 President Montt, accompanied by a brilliant entourage, journeyed to Buenos Aires, where the presidents of Argentina and Chile celebrated together the common struggle for independence. In the midst of preparations for the return celebration in Santiago, the president fell ill and in August died while on his way to Europe. Montt's successor also died in September, and Emiliano Figueroa, head of the cabinet, presided over the centennial festivities, and directed the election for president, which took place a few days later. After a prolonged contest within their party the Liberals placed in nomination Ramón Barros Luco, a veteran publicist, whom the Conservatives accepted and who was elected without opposition; but this result did not insure administrative stability nor repress the growing influence of money. Cabinet changes occurred as frequently as before. Bribery, despite severe laws against it, replaced executive intervention as the controlling factor in all elections, and made procedure therein a matter of purchase and of fraud.

In respect to international affairs the quarter century that followed the Civil War presents a more flattering record. The resentment aroused against the United States over the "Itata Affair" led to the still more irritating "Baltimore incident," which was finally settled by Chile's offer of compensation. The Alsop claim, growing out of the war with Bolivia, was finally arbitrated in 1911 by King George V. With the turn of the century there was a recurrence of border quarrels with Argentina, in two regions—the Puna de Atacama in the north and the Patagonian area in the south. The former was settled in 1899 by arbitration of the American minister in Buenos Aires, but without appeasing popular agitation in either country. In May, 1902, the two countries signed treaties which provided for the arbitration of disputes between them, for naval equality during five years and for limitation of armaments. The last two points made this treaty a pioneer. Moreover each country was to remain neutral with respect to affairs upon the other's coast. Some months later the British king, who had been asked to arbitrate the dispute in Patagonia, announced his award, which proved to be a virtual division of the contested area. Thus was ended a controversy that had lasted more than a half century (1847–1902). In commemoration of this settlement the two nations later joined in erecting on their common boundary above the tunnel of the Transandine railway the famous statue known as the "Christ of the Andes."

In 1904 Chile signed with Bolivia the pact of Santiago by which the former gained full sovereignty in the Atacama region. A secret article of the treaty assured Bolivia an outlet through Tacna-Arica. As a temporary substitute for this corridor Chile agreed to construct a railway from Arica to La Paz (which was completed in 1915) and in 1928 to turn over to Bolivia the portion in the latter's territory. Meanwhile Bolivian goods were given free entry and shipment in bond at Arica. These arrangements created a better sentiment between the two peoples. Chile and Peru, however, could not agree upon terms for holding the plebiscite under the Treaty of Ancón. All attempts to arbitrate the question failed. Chile began, after 1908, to interpret the disputed clause as a disguised cession and in 1913 the two countries agreed to postpone for 20 years any further attempts to carry out its provisions. Through Chile's understanding with Brazil and Argentina and through the participation of the three in the controversies between the United States and Mexico, the country gained marked prestige in Pan American affairs.



CHILEAN DESERT CONVEYANCE ON TRACKS

The irredeemable paper money affected adversely the volume of trade, and caused a moratorium during the war scare of 1898. Industry which was checked by the Civil War showed a favourable turn before the end of the century. This process was hastened by the protective policy of the Government and by its measures to encourage the colonization of the Magellan area and to develop its wool interests and gold washings. The financial crisis of 1907 gave a set-back to industry, already suffering from the great earthquake of 1906. These successive disasters, however, affected the country less than had at first been feared.

The rise in the cost of living led to demands for increased salaries and wages—demands that in the case of workmen were not granted without frequent resort to strikes. A series of these in 1905 terrorized Santiago and led to bloodshed. Serious disturbances also marked outbreaks at Iquique in 1907 and later in the coal fields of Lota. A few publicists now began to call attention to the misery and squalor that afflicted the Chilean masses and to the general lack of public sanitation. Agricultural labourers in

times of scarcity showed a tendency to migrate, especially to Argentina. Because of this continued public neglect the population of Chile failed to keep pace with its growth in wealth and productivity.

A better situation obtained in cultural activities. A freer press supplied both books and periodicals to wider circles of readers. Primary instruction, both public and private, received fresh impetus from new normal schools, while the Pedagogic Institute (founded in 1889) exerted a marked effect on secondary education. Progress was shown in the establishment of trade schools and in the betterment of professional instruction. A General Congress of Instruction, held in 1902, and a General Congress of Secondary Instruction held ten years later, greatly stimulated the production of didactic treatises and the development of a professional spirit. A reputable group of scientific writers and of historians, of litterateurs and of artists registered the intellectual and social advance of the country and with these cultured and zealous Church officials kept pace.

In the presidential election of 1915 Chile was hampered both by disturbances caused by the World War and by local political strife. In spite of the unanimity that marked the choice of Barros Luco in 1910 and of his general conciliatory policy, partisan spirit showed itself in the intervening elections and forced numerous cabinet changes. Accordingly the Alliance and the Coalition now put forward separate candidates and thus precipitated an exciting campaign in which neither received an actual majority. Congress, with whom final decision rested, chose Juan Luis Sanfuentes, the candidate of the Coalition, who succeeded in reorganizing public administration, in improving the army and navy, in extending railroads, encouraging the commercial marine, constructing port works and public buildings, and beginning the National Library. These improvements were effected despite the grave financial and industrial depression that rested upon the country during the early months of the war, and despite cabinet changes and the later renewal of difficulties with Peru.

Chile had already experienced some trouble in maintaining neutrality when Sanfuentes became president. The country was terribly affected by the loss of European markets. Prussian methods in the army and German scholars among her educators, not to mention a thrifty German population in southern Chile and extensive German business connections, inclined large sections of the people to favour the Central Powers. In 1915 the German cruiser "Dresden" was sunk by a British squadron while supposedly interned in Chilean waters. England apologized for the affront and owing to the clever management of Agustín Edwards, the Chilean minister in London, suffered no further trouble from the incident. Gradually as the war continued public opinion in Chile veered toward the Allies, but the Government maintained its neutrality and continued therein after the United States entered the struggle. Nor did the country fail to reap material rewards from the increase in its trade which in 1916 surpassed that of any previous year and two years later had still further doubled in amount.

The difficulties of the war period were surpassed by those that followed the Armistice. Anti-Peruvian riots at Iquique and Antofagasta in 1918 caused the withdrawal of consular agents from both countries. In the following year Bolivia and Peru, encouraged by the attitude of President Wilson, talked of carrying their grievances to Versailles or to Geneva. By 1920 Peru and Chile were on the verge of hostilities. A *coup d'état* in Bolivia, where Chile was supposed to be exercising too much influence, relieved the situation, and left affairs in train for a more definite *rapprochement* the following year. In the first assembly of the League of Nations Chile gained an important chairmanship and in 1922, its delegate, Agustín Edwards, presided over the assembly.

Post-war recovery was retarded by the slump in nitrate and the ensuing labour disturbances. In the midst of these difficulties occurred the memorable election of 1920. Arturo Alessandri, the candidate of the Liberal Alliance, had served with distinction in Congress and cabinet. He launched his candidacy in 1918 and based his platform on an extensive social program. This precipitate act, typical of the man, increased his prestige as a candidate. As representative of the middle classes and the labour groups, he covered the country in a veritable whirlwind campaign. At the election on June 25, 1920, it was announced that he had received 179 electoral votes to 175 for his opponent. Numerous charges of fraud, however, cast doubt upon the result. The canvass of the voters rested with congress, where each chamber favoured a different candidate. There was a demand for a special court of honour to determine the dispute. In the face of popular clamour, which culminated in a general strike, congress appointed the court and on the basis of its decision gave Alessandri 177 valid votes against 176. The settling of the election by this method, probably saved the country from a revolutionary outbreak.

In his message of June 1, 1921, President Alessandri outlined a program of political and social reform. He wished to improve the conditions of labour and the status of women; to decentralize administration, separate Church and State, change the parliamentary system, establish executive responsibility, and elect the president and vice president by popular vote. A split in the ranks of the Alliance (following a general election to the chamber of deputies) added to the strength of the Conservative groups. In despair at his failure to overcome political opposition and faced with adverse economic conditions Alessandri tendered his resignation Nov. 17, 1921, but was persuaded to continue in office. Some slight betterment in the nitrate industry eased labour conditions, while the adoption of a protocol for the arbitration of the Tacna-Arica dispute diverted attention from domestic difficulties. The Fifth Pan American Congress, which was held at Santiago in April and May, 1923, served momentarily to distract attention from pressing local problems; but fiscal and business affairs showed an alarming uncertainty that was further increased by continued manifestations of unrest among students and labourers. Parliamentary government in Chile seemed hopeless.

Reform and Readjustment.—At the beginning of 1924 affairs in Chile were in an alarming state of uncertainty. Unsuccessful attempts were made to modify by general party agreement the ineffective parliamentary system, to hold a fair election for members of congress, and to carry out the presidential program of reform. With the failure of these efforts, Alessandri determined at all cost to secure control of the reactionary senate. He personally took part in the campaign that preceded the March election and as a result of his intervention, coupled with an extensive but as it proved unnecessary use of military pressure, he carried both houses of congress and for the first time seemed in a position to control public policy.

Congress, however, failed to follow his urgings. The opponents of the administration plotted its overthrow. Unmindful of its increasing unpopularity congress, late in August, intensified the general unrest by proposing to pay its members. Thus it brought upon itself charges of gross selfishness as well as of general incapacity. Army officers attended the sessions of the senate in token of disapproval and in reply to a demand for their punishment forced, on Sept. 5, the installation of a military junta to direct affairs. The president at first agreed to accept its supervision in return for support of his program but soon resigned and left the country. The junta, presided over by General Luis Altamirano, dissolved congress with evident public approval, proposed some fiscal measures, and issued a few "decree-laws" in the way of reform. Then its members seemed to fall under reactionary influences. In Feb. 1925, a second *coup d'état,* directed by the younger army officers, dismissed Gen. Altamirano and his colleagues and recalled Alessandri. A young cavalry officer, Major Carlos Ibáñez, took a conspicuous part in this overturn.

The recalled president received a delirious ovation. He had come back on condition that he be permitted to carry out his program for political and social reform. His way was smoothed by an agreement between the Conservative and Radical parties for the separation of Church and State. The decision in the Tacna-Arica controversy, shortly handed down by President Coolidge, also promised to strengthen his cause. His first care was to prepare a new constitution. This task, after some consideration of a convention, was turned over to a general committee—hand

picked, indeed, but fairly representing all shades of public opinion. A smaller committee, of which Alessandri was chairman, actually prepared the document, which was then submitted to popular vote along with an alternative proposal for a modified "parliamentary" system. The new pact, based on what may be termed "presidential" principles was overwhelmingly successful, although some political groups abstained from voting.

The selection of the new executive caused further difficulty. An attempt to present a single candidate failed. Then Colonel Ibáñez, who had been promoted and was then serving as minister of war, announced his candidacy, thereby disrupting the cabinet and forcing the president's resignation. In alarm at the prospect of military domination most of the political factions came to a belated agreement upon Señor Emiliano Figueroa as a joint candidate. He triumphed at the polls although the leader put forward at the last moment by the more radical elements received a large vote in the capital and industrial centres. In Santiago a general strike followed the election but the acting president, Señor Barros Borgoño, handled the situation firmly, and in Dec. 1925, turned the administration over to president-elect Figueroa.

Each shifting authority of this tumultuous year furthered measures to rehabilitate finances. Unable to secure domestic agreement as to methods, the government finally invited Professor E. W. Kemmerer, of Princeton university, and a group of associates, to study the situation. A decree-law of Sept. 1925, finally embodied the results of their investigation. This act thoroughly revised the fiscal system and created a national bank for the triple purpose of administering the finances of the government, of reducing general rates of interest, and of regulating the other banks of the country. Other decree-laws provided for extensive social legislation, including the regulation of labour conditions and of public health. With the promise of greater stability under the new constitution, Chile seemed destined to experience an important social and industrial advance.

The new administration failed to meet expectations. For some months, indeed, President Figueroa held together a meritorious cabinet, but the legislative factions could not keep from tinkering with executive affairs The Tacna-Arica plebiscite did not materialize and this failure rested heavily on the administration. Many features of the social program were premature and still others proved unpopular. No serious friction occurred over the separation of Church and State, because under agreement, the Government was to continue its ecclesiastical subsidies for five years longer. The national revenues failed to respond to the strain resting upon them.

Changes in 1926 in the ministry of foreign affairs and in that of finance failed to restore public confidence. The one point of stability in the midst of general uncertainty was the ministry of war, still directed by Colonel Ibáñez. A general disruption in the cabinet, late in the year, made the colonel its head, without depriving him, however, of his military control. This new position enabled him to establish a veritable dictatorship, under which Conservatives, Communists, Radicals, Liberals and Democrats were alike proscribed. By such measures he dominated congress and essayed to reform the judiciary, even proceeding to arrest, and finally to banish, the presiding judge of the supreme court, who was President Figueroa's brother.

Before this extreme measure was carried out the president himself quitted office. The executive duties thereby devolved upon Colonel Ibáñez, who continued more openly but not less effectively his policy of administrative reform. In July 1927 an election was held which confirmed Ibáñez as President with virtually dictatorial powers. His administration rested upon a combination of military force and public largess. For a time, through borrowings abroad, he was able to bestow unexampled prosperity on the country. When in 1929 this source of income failed, the true test of his power occurred. In May 1930, came the first proposal to reduce the budget, but it was not accepted. A succession of ministers essayed the hopeless task of reducing expenditures, but when the foreign credit ceased and the efforts to float the nitrate industry likewise failed, the Ibáñez administration of military repression came to an end in July 1931.

Juan Estéban Montero, a liberal law professor, took over temporary rule and, despite his protest, was formally elected president. He inherited a huge deficit from the preceding administration, and faced such additional problems as unemployment, partial crop failure, and an abrupt drop in the revenues. When he proved unequal to the task for which he had been elected, a military revolution, fomented in the aviation school early in June 1932, placed Carlos Dávila in power. After a few days of kaleidoscopic political changes, he essayed a socialistic régime which in September came to an end through a second military revolution. Quarrels between military leaders led the president of the Supreme Court to assume temporary civilian rule. He in turn was followed by Arturo Alessandri, former president of radical tendencies, who now seemed the only hope of the Liberal-Conservative elements. Chosen as chief executive in October, he assumed office in December, with a promise to restore the badly shattered political and economic reputation of the country.

This promise he carried out with reasonable success during the next six years. He rigidly suppressed sporadic attempts at insurrection. Fiscal affairs were entrusted to Gustavo Ross as minister of finance. Within two years the latter had balanced the budget, reorganized Cosach by making it a general sales corporation, and was using the nitrate industry for international trade on a quota basis. By manipulating a portion of the proceeds from this industry, he arranged for token payments on the interest of the foreign debt and sought to redeem the bonds at a fraction of their face value. This arrangement was accepted by Great Britain, but rejected by American, French, and Belgian creditors. In his five years of incumbency, however, Ross did much to restore Chile to a pay-as-you-go basis.

The general economic situation gradually forced the country into a strongly nationalistic policy. Unable to accept adequate imports, the country turned to domestic production. The renewal of gold washings, further issues of paper money, better crops and better prices in time relieved unemployment. Foreign trade increased; public works, especially in the capital and larger cities, helped to meet economic needs. In the midst of continued depression elsewhere, Chile developed a more adequate system of social and economic procedure. The Government encouraged a system of sanitation and public health that easily gave it leadership in Latin America.

The year 1936 marked the 400th anniversary of Diego de Almagro's discovery of Chile. It likewise reopened an era of political strife. Alessandri had attempted to administer affairs with a cabinet representing all the more conservative elements. The Radical Party which had supported him in 1932 found itself divided into rightist and leftist factions. The leftist bloc in Congress attempted to force the ministers of interior and of defence to resign in Feb. 1936, but only succeeded in obstructing the president's legislative program and in precipitating a general strike of railroad employees. This enabled the president to crush the opposition by suspending Congress, declaring martial law and arresting some 600 members of the opposition. When normal procedure was resumed, the president found himself confronted by a Popular Front, from which he tried to detach the Radicals by an offer of three cabinet posts, but they refused unless other leftist parties were also given recognition. This refusal, coupled with frays between Socialist and Nazi groups, with demands for the resignation of the minister of finance, led Alessandri later in the year to ask for dictatorial powers on the pretext of suppressing Communism. This enabled him to gain the congressional election of 1937 by a small majority. The Republican militia, a volunteer force of 50,000 that had supported the Alessandri government for four years, was formally dissolved in July 1936, but reappeared in October as Acción Nacional, definitely pledged to oppose both Communism and Naziism. To meet the demands of radical elements, the Government suggested laws calling for a living wage to workmen, low cost dwelling projects, public works, and adult education. A surplus from 1935 and 1936 enabled the Government to make payments on the foreign debt. Resources mounted, but not so fast as public expenditures or the living cost.

The congressional election of 1937 was but the preliminary

skirmish to the presidential election of 1938. The Radicals, holding the key to the situation, attempted to hold seats in the rightist cabinet and at the same time adhere to the leftist program. Minister Ross resigned his cabinet post in order to force them out of the ministry and to prepare for his own campaign as the Conservative candidate. Alessandri perforce had to carry on with a cabinet wholly rightist, made up of Conservatives, Liberals, and Democrats. As a precautionary measure, the Government, on April 10, 1937, banned Nazi mass meetings or parades. Ex-President Ibáñez returned from exile and after some uncertain manoeuvres, became the candidate of the Nacisti group. The leftists at first were inclined to support Col. Marmaduke Grove, a socialistic leader in the tempestuous days of 1932, but after bringing the middle-class Radicals into the Popular Front, accepted Pedro Aguirre Cerda, a capitalist and educational leader of moderate social views, as their candidate.

The election of 1938 was marked by bitter discussion, accompanied by resort to violence. Ross was charged with using his position as president of the Nitrate Sales Corporation to close the plants and scatter the labourers so as to keep them from voting. A scene of disorder, marked by the wild pistol shot of a Nazi member, greeted President Alessandri when in May he delivered his last annual message before both houses of congress. The arrest and punishment of this member further alienated the leftist groups. A few weeks later, some young Nazis attempted to seize buildings near the presidential palace, but were quickly subdued with considerable loss of life. Their leader, Deputy J. González von Maree, was sentenced to 20 years imprisonment and perpetually barred from holding public office. Ibáñez, the Nacisti candidate, was also arrested, but released when he was found to be innocent. He withdrew his own candidacy and his supporters largely voted for Aguirre Cerda, thus insuring his election by a narrow majority.

The triumph of the Popular Front marked a notable step toward democracy in Chile. It was likewise a definite tribute to the personal character of Aguirre Cerda. Wealthy, according to Chilean standards, teacher and lawyer by profession, an experienced party leader and former cabinet minister, he represents the widespread but too often thwarted aspirations of Chile's workmen and middle classes. His opponents were at first unwilling to accept his election, but acquiesced when assured that the army would not support a revolt. The new president's declarations and his initial acts point toward continued encouragement to domestic industry, and toward social progress and peace with his American neighbours. Despite reports to the contrary, Naziism seems to have little to offer Chile, despite its population of German descent. In order to carry out the numerous reforms and to make the country self-supporting, much must be done through education and public welfare work to raise the purchasing power of the masses.

Aguirre Cerda had barely taken over the administration and declared his policy, when it was threatened with disruption by the earthquake of Jan. 24, 1939. This disaster, the worst in respect to loss of life and damage in Chilean history, especially affected the cities of Chillán and Concepción in the south, and for a time threatened the evacuation of the whole region. The figures given for the dead range from 8,000 to 15,000 with double that number injured, while a property damage from 30 to 50,000,000 dollars rendered some 80,000 people homeless and destitute. The disaster excited universal compassion, with help afforded by neighbouring countries, the United States, and Europe. After the initial measures of relief, the Government proposed to accompany it with a special loan of 2,000,000,000 pesos for the encouragement of industry, the exploitation of natural resources, and better means of transportation. This extensive socialistic program met with intense opposition from the rightist groups with each faction intensely criticizing its opponents. The Government was likewise to undertake measures of national defence and more definite control of Nazi and other foreign inspired organizations as part of its program of public betterment. Chile's relations with its immediate neighbours since 1929 have on the whole been friendly. New commercial treaties with Bolivia and Peru have helped to increase trade and investments with those nations. Its tariff policy has to some extent hampered trade with Argentina, but a recent treaty will settle her remaining minor boundary dispute with that nation. Since the settlement of the Tacna-Arica controversy with Peru, in large part through the good offices of the United States, Chile has maintained cordial relations with that power, despite suspension of payments on its external debt and some difficulties with respect to credits, and agitation against foreign capital. In general, Chile has co-operated in a general inter-American policy. Chile has participated in the various Pan-American gatherings, including the sessions of the International Conference of American Republics (Pan American Conference), and President Alessandri and his minister of foreign relations played a conspicuous part in settling the Chaco War. Like her Latin American neighbours, Chile has been subjected to propaganda from European Fascist powers with respect to its commerce, its cultural connections, and its political policy. But, on the whole, its people have assumed a commendable independent attitude.

The Chilean Government began to express its dissatisfaction with the League of Nations in 1936, and two years later definitely gave notice of its withdrawal from the League.

BIBLIOGRAPHY.—The most complete general work is that of Diego Barros Arana, *Historia general de Chile* (16 vols., Santiago, 1884–1902), which covers the period up to 1830 and is virtually continued in his *Un decenio de la historia de Chile, 1841–51*. A convenient summary is to be found in Luis Galdames' *Estudio de la Historia de Chile* (8th ed., Santiago, 1937), (Eng. trans. in 1940 by I. J. Cox, Chapel Hill, N.C.). A. U. Hancock's *History of Chile* is an available English text; but H. C. Evans, Jr., in *Chile and its Relations with the United States* (Durham, N.C., 1927), summarizes clearly the major phases of the country's development during the colonial period, as does I. J. Cox in *Argentina, Brazil and Chile Since Independence*, (Washington, 1935) pp. 279–414.

M. L. Amunátegui contributes for the colonial period the *Descubrimiento y conquista de Chile* (Santiago, 1885) and *Los Precursores de la independencia de Chile* (1870) and numerous other studies. Agustín Edwards' *Peoples of Old*, (London, 1929) deals in popular fashion with the Indians. The standard work on the Indians is Ricardo E. Latcham, *La prehistoria Chilena*, (Santiago, 1928). Abbe Eyzaguirre's *Histoire du Chile* (Lille, 1855) deals with the Church during this period while Horacio Lara's *Cronica de la Araucania* is devoted to the Indians. Crescente Errázuriz, *Historia de Chile* (Santiago, 1911–12) treats of the conquest by Valdivia and the period immediately following. R. B. Cunningham Graham's *Pedro de Valdivia, Conqueror of Chile*, (London, 1926) is a scholarly narrative of the conquest. The monumental editorial works of José Toribio Medina, *Colección de documentos ineditos para la historia de Chile* (Santiago, 1888–1902), his *Cosas de la colonia* (Santiago, 1889), and his *Colección de historiadores i de documentos relativos a la independencia de Chile* (Santiago, 1900–14) form a veritable mine for research on the colonial and revolutionary periods. His *Historia de la Literatura Colonial de Chile*, i-iii (Santiago, 1878), reviews the cultural history of the period. His *Biblioteca hispano-americana, 1493–1810* (Santiago, 1898–1907) is a detailed bibliography in seven volumes. Alejandro Fuenzalida Grandón's *La Evolucion Social de Chile* is an important contribution to colonial social life, as is his *Lastarria i su Tiempo, (1817–1888)*, (Santiago, 1911), to that of the 19th century. Ramón Briseño, *Memoria historico-critica del derecho publico chileno* (Santiago, 1849) is still the standard work on the early constitutions of Chile.

A. Chisholm, *The Independence of Chile*, reviews the struggle against Spain. John J. Mehegan, *O'Higgins of Chile*, (London, 1913), popularizes the life of that hero. A. Edwards' *Bosquejo historico de los partidos politicos chilenos* (Santiago, 1936) and his *La fronda aristocratica* (Santiago, 1928) review the struggle and subsequent national events. His *El Gobierno de Don Manuel Montt, 1851–1861*, (Santiago, 1932), gives the best treatment of that administration. L. Galdames presents a detailed study of certain phases of the period in *La evolución constitucional de Chile*, vol. i. (Santiago, 1926), and José Guillermo Guerra's *Constitucion de 1925* (Santiago, 1929) affords the best commentary on the present Constitution. The *Historia general de la republica de Chile* (Santiago, 1866–82) by B. Vicuña Mackenna and collaborators still has an important place for the revolutionary period. The same author's *Vida de O'Higgins* (Santiago, 1882) and his *Don Diego Portales* (Valparaiso, 1863) are useful supplemental works. Thomas Cochrane, Earl of Dundonald, *Narrative of Services, etc.* (London, 1859) treats of events during the War of Independence from the viewpoint of the outsider.

R. Sotomayor Valdés, *Historia de Chile, 1831–71* (Santiago, 1875) covers less than a decade of the period indicated. P. P. Figueroa, *Historia de la revolucion constituyente, 1857–59* (Santiago, 1895); F. Fonck, *Chile in der Gegenwart* (Berlin, 1870); Sir T. Holdich, *Countries of the King's Award* (London, 1904); I. Errázuriz, *Historia de la administración Errázuriz* (Santiago, 188?); Joaquim Nabuco,

Balmaceda (Santiago, 1914); Barros Arana, *La Guerra del Pacifico* (Santiago, 188?), F. Velasco, *Memorias sobre la revolucion de 1891* (Santiago, 1926), C. Walker Martínez, *La Administracion de Santa María* (Santiago, 1888-89), are works devoted to individuals and men of importance in the national period. W. J. Dennis in *Tacna and Arica* (New Haven, 1931), summarizes the nitrate war of 1879. Ricardo Salas Edwards, *Balmaceda y el parlamentarismo en Chile* (Santiago, 1925) is the latest review of that epoch. A. Roldán, *El desarrollo constitucional de Chile* (Santiago, 1925) is the best text for the legal background. Alberto Cabero, *Chile y los Chilenos* (Santiago, 1926), combines social, political, industrial features of Chilean life. A. Coester in *Literary History of Spanish America* (2nd ed., New York, 1928) has an interesting chapter on Chile. G. F. Scott Elliot, *Chile* (London, 1907) and L. E. Elliot, (New York, 1922) and Fred H. Carlson, *Geography of Latin-America,* (New York, 1936), ch. v. are suggestive descriptive works. Occasional articles in *Revista Chilena de historia y geografia* (Santiago, 1911–) and in *Chile* (New York, 1926–31) have historical notes or treat of recent topics. There are numerous monographs relating to Alessandri and Ibáñez, but as yet no definitive biography of either. The publications of the United States Department of Commerce and of the British Department of Overseas Trade are helpful for matters of trade and industry, and also *The South American Handbook* (London, annual). Carlos Keller R., *Sinopsis Geográfico-Estadistica de la Republica de Chile,* (Santiago, 1933) presents a summary of all public activities. Convenient reviews of current events are given in the *Bulletin of the Pan-American Union* (Washington, monthly).

(W. H. Hs.; I. J. C.)

CHILEAN CIVIL WAR (1891). The Chilean civil war grew out of political dissensions between the president of Chile, J. M. Balmaceda, and his congress (*see* CHILE: *History*), and began in Jan. 1891. On the 6th, at Valparaiso, the political leaders of the Congressional Party went on board the ironclad "Blanco Encalada," and Capt. Jorge Montt of that vessel hoisted a broad pennant as commodore of the Congressional fleet. Preparations had long been made for the naval *pronunciamento,* and in the end but few vessels of the Chilean navy adhered to the cause of the "dictator" Balmaceda. But amongst these were two new and fast torpedo gunboats, "Almirante Condell" and "Almirante Lynch," and in European dockyards (incomplete) lay the most powerful vessel of the navy, the "Arturo Prat" and two fast cruisers. If these were secured by the Balmacedists the naval supremacy of the congress would be seriously challenged. The rank and file of the army remained faithful to the executive, and thus in the early part of the war the "Gobernistas," speaking broadly, possessed an army without a fleet, the congress a fleet without an army. Balmaceda hoped to create a navy; the congress took steps to recruit an army by taking its sympathizers on board the fleet. The first shot was fired, on Jan. 16, by the "Blanco" at the Valparaiso batteries, and landing parties from the warships engaged small parties of Government troops at various places during January and February. The dictator's principal forces were stationed in and about Iquique, Coquimbo, Valparaiso, Santiago and Concepción. The troops at Iquique and Coquimbo were necessarily isolated from the rest and from each other, and military operations began, as in the campaign of 1879 in this quarter, with a naval descent upon Pisagua followed by an advance inland to Dolores. The Congressional forces failed at first to make good their footing (Jan. 16–23), but, though defeated in two or three actions, they brought off many recruits and a quantity of munitions of war. On the 26th they retook Pisagua, and on Feb. 15, the Balmacedist commander, Eulogio Robles, who offered battle in the expectation of receiving reinforcements from Tacna, was completely defeated on the old battle-field of San Francisco. Robles fell back along the railway, called up troops from Iquique, and beat the invaders at Haura on the 17th, but Iquique in the meanwhile fell to the Congressional fleet on the 16th. The Pisagua line of operations was at once abandoned, and the military forces of the congress were moved by sea to Iquique, whence, under the command of Col. Estanislao Del Canto, they started inland. The battle of Pozo Almonte, fought on March 7, was desperately contested, but Del Canto was superior in number, and Robles was himself killed and his army dispersed. After this the other Balmacedist troops in the north gave up the struggle. Some were driven into Peru, others into Bolivia, and one column made a laborious retreat from Calama to Santiago, in the course of which it twice crossed the main chain of the Andes.

The Congressional *Junta de Gobierno* now established in Iquique prosecuted the war vigorously, and by the end of April the whole country, from the Peruvian border to the outposts of the Balmacedists at Coquimbo and La Serena, was in the hands of the "rebels." The *Junta* now began the formation of a properly organized army for the next campaign, which, it was believed universally on both sides, would be directed against Coquimbo. But in a few months the arrival of the new ships from Europe would reopen the struggle for command of the sea. The Congressional Party could no longer aim at a methodical conquest of successive provinces, but was compelled to attempt to crush the dictator at a blow. Where this blow was to fall was not decided up to the last moment, but the instrument which was to deliver it was prepared with all the care possible under the circumstances. Del Canto was made commander-in-chief, and an ex-Prussian officer, Emil Körner, chief of staff. Balmaceda could only wait upon events, but he prepared his forces as best he was able, and his *torpederas* constantly harried the Congressional navy. By the end of July Del Canto and Körner had done their work as well as time permitted, and early in August the troops prepared to embark, not for Coquimbo, but for Valparaiso itself.

The expedition by sea was admirably managed, and Quinteros, north of Valparaiso and not many miles out of range of its batteries was occupied on Aug. 20, 1891. Balmaceda was surprised, but acted promptly. The first battle was fought on the Aconcagua at Concón on the 21st. The eager infantry of the Congressional army forced the passage of the river and stormed the heights held by the Gobernistas. The killed and wounded of the Balmacedists numbered 1,600, and nearly all the prisoners, about 1,500 men, enrolled themselves in the rebel army, which thus more than made good its loss of 1,000 killed and wounded. The victors pressed on towards Valparaiso, but were soon brought up by the strong fortified position of the Balmacedist Gen. Barbosa at Viña del Mar, whither Balmaceda hurried up all available troops from Valparaiso and Santiago, and even from Concepción. Del Canto and Körner now resolved on a daring step. Supplies of all kinds were brought up from Quinteros to the front, and on Aug. 24, the army abandoned its line of communications and marched inland. The flank march was conducted with great skill, little opposition was encountered, and the rebels finally appeared to the south-east of Valparaiso. Here, on the 28th, took place the decisive battle of La Placilla. The splendid fighting qualities of the Congressional troops and the superior generalship of their leaders prevailed in the end over every obstacle. The Government army was practically annihilated. Valparaiso was occupied the same evening and Santiago soon afterwards. There was no further fighting, for so great was the effect of the battles of Concón and La Placilla that even the Coquimbo troops surrendered without firing a shot.

BIBLIOGRAPHY.—Lieut. Sears and Ensign Wells, U.S.N., *The Chilean Revolution of 1891* (Office of Naval Intelligence, Washington, 1893); *The Capture of Valparaiso, 1891* (Intelligence Department, War Office, London, 1892); H. Kunz, *Taktische Beispiele aus den Kriegen der neuesten Zeit; der Bürgerkrieg in Chile* (1901); *Revista Militar de Chile* (Feb.–March 1892); Sir W. Laird Clowes, *Four Modern Naval Campaigns* (1902); M. H. Hervey, *Dark Days in Chile; an Account of the Revolution of 1891* (1892); F. Velasco, *La Revolución de 1891* (1914); and C. Mondiola Gana, *Páginas de la Guerra Civil de 1891* (1915).

CHILE-PERUVIAN WAR (1879–82). The proximate cause of this war was the seizure, by the authorities of Bolivia, of the effects of the Chilean Nitrate Company at Antofagasta, then part of the Bolivian Province of Atacama. The first act of hostility was the despatch of 500 soldiers to protect Chilean interests at Antofagasta. This force, under Col. Sotomayor, landed and marched inland; the only resistance encountered was at Calama on the river Loa, where a handful of newly raised militia was routed (March 23, 1879). About the same time Chilean warships occupied Cobija and Tocopilla, and Sotomayor, after his victory at Calama, marched to the latter port. Bolivia had declared war on March 1, but Peru not till April 5: this delay gave the Chileans time to occupy every port on the Bolivian coast. Thus the Chilean admiral was able to proceed at once to the blockade of the southern ports of Peru, and in particular Iquique,

where there took place the first naval action of the war. On April 21, the Chilean sloop "Esmeralda" and the gunboat "Covadonga"—both small and weak ships—engaged the Peruvian heavy ironclads "Huascar" and "Independencia." After a hot fight the "Huascar" sank the "Esmeralda," but Carlos Condell in the "Covadonga" manoeuvred the "Independencia" aground and shelled her into a complete wreck. The Chileans now gave up the blockade and concentrated all their efforts on the destruction of the "Huascar," while the allies organized a field army in the neighbourhood of Tacna and a large Chilean force assembled at Antofagasta.

On Oct. 8, 1879, the "Huascar" was brought to action off Angamos by the "Blanco Encalada," and the "Almirante Cochrane." Although hopelessly outmatched the "Huascar" made a brave fight. When she finally surrendered she had but one gun left in action, her fourth commander and three-quarters of her crew were killed and wounded, and the steering-gear had been shot away. The Peruvian navy had now ceased to exist. The Chileans resumed the blockade, and more active operations were soon undertaken. The whole force of the allies was about 20,000 men, scattered along the seaboard of Peru. The Chileans on the other hand had a striking force of 16,000 men in the neighbourhood of Antofagasta, and of this nearly half was embarked for Pisagua on Oct. 26. The expeditionary force landed, in the face of considerable opposition, on Nov. 2, and captured Pisagua. From Pisagua the Peruvians and Bolivians fell back along the railway to their reinforcements, and when some 10,000 men had been collected they moved forward to attack the Chilean position of San Francisco near Dolores station (Nov. 19). In the end the Chileans were victorious, but their only material gain was the possession of Iquique and the retreat of the allies, who fell back inland towards Tarapacá. The tardy pursuit of the Chileans ended in the battle of Tarapacá on the 27th, in which more men were killed than were wounded, the Chileans suffering a complete defeat. For some inexplicable reason the allies made no use of their victory, continued to retreat and left the Chileans in complete possession of the Tarapacá region. With this the campaign of 1879 ended. Chile had taken possession of the Bolivian seaboard and of the Peruvian province of Tarapacá, and had destroyed the hostile navy.

The objective of the Chileans in the second campaign was the Province of Tacna and the field force of the allies at Tacna and Arica. The invasion was again carried out by sea, and 12,000 Chileans were landed at Pacocha (Ylo), far to the north of Arica. Careful preparations were made for a desert march, and on March 12, 1880, the advanced corps started inland for Moquegua, which was occupied on the 20th. Near Moquegua the Peruvians, some 2,000 strong, took up an unusually strong position in the defile of Cuesta de los Angeles. But the great numerical superiority of the assailants enabled them to turn the flanks and press the front of the Peruvian position, and after a severe struggle the defence collapsed (March 22). In April the army began its advance southward from Moquegua to Tacna. Arica was also watched, and the blockade was extended north of Lima. The land campaign had in the meanwhile culminated in the battle of Tacna (May 26), in which the Chileans attacked at first in several disconnected bodies, and suffered severely until all their forces came on the field. Then a combined advance carried all before it. The allies engaged under Gen. Narciso Campero, the new president of Bolivia, lost nearly 3,000 men, and the Chileans, commanded by Manuel Baquedano, lost 2,000 out of 8,500 on the field. The defeated army was completely dissolved, and it only remained for the Chileans to march on Arica from the land side. The navy co-operated with its long-range guns, on June 7 a general assault was made, and before nightfall the whole of the defences were in the hands of the Chileans. Their second campaign had given them entire possession of another strip of Peru (from Pisagua to Ylo), and they had shown themselves greatly superior, both in courage and leadership, to their opponents.

The Chilean army was reorganized during the summer, and prepared for its next operation, this time against Lima itself. Gen. Baquedano was in command. The leading troops disembarked at Pisco on Nov. 18, 1880, and the whole army was ready to move against the defences of Lima six weeks later. These defences consisted of two distinct positions, Chorrillos and Miraflores, the latter being about 4,000 yd. outside Lima. The first line of defence was attacked by Baquedano on Jan. 13, 1881. The defenders had 22,000 men in the lines, the Chileans engaged about 24,000. The battle of Chorrillos ended in the complete defeat of the Peruvians, less than a quarter of whose army rallied behind the Miraflores defences. Two days later took place the battle of Miraflores. Here the defences were very strong and the action began with a daring counter-attack by some Peruvians. Neither party had intended to fight a battle, for negotiations were in progress, but the action quickly became general. Its result was, as before, the complete dissolution of the defending army. Lima, incapable of defence, was occupied by the invaders on the 17th, and on the 18th Callao surrendered. The resistance of the Peruvians was so far broken that Chile left only a small army of occupation to deal with the remnants of their army. The last engagement took place at Caxacamara in Sept. 1882, when the Peruvians won an unimportant success.

BIBLIOGRAPHY.—T. B. M. Mason, *The War on the Pacific Coast, 1879–1881* (U.S. Office of Naval Intelligence, 1883); Capt. Châteauminois (trans.), *Mémoire du Ministre de la Guerre du Chili sur la guerre Chilo-Peruviénne* (1882); Barros Arana, *Hist. de la guerre du Pacifique* (1884); Sir W. Laird Clowes, *Four Modern Naval Campaigns* (1902); R. Markham, *The War between Peru and Chile* (1883); Pascual Ahumada y Moreno, *Guerra del Pacífico, Recopilación Completa de Todos los Documentos Oficiales, Correspondencia, etc.* (1884–89); I. Santa María, *Guerra del Pacífico* (1919); C. V. C. Varigny, *La Guerra del Pacífico* (1922); Gonzalo Bulnes, *Chile and Peru; the Causes of the War of 1879* (1920).

CHILI or **CHILES,** the pods of several kinds of peppers, notably the capsicum, used as a condiment. In Mexico a dish of meat and beans, called *chili con carne,* is highly flavoured with chili; this is a popular dish also in the United States.

In tropical countries chiles are used in many ways to flavour native cooking.

CHILIA, a town of Bessarabia, Rumania, in the Department of Ismail, and on the Chilia branch of the Danube. Pop. (1930), 17,049. Anciently known as Chilia, Chele or Lycostomium, it was a place of banishment for Byzantine political dignitaries in the 12th–13th centuries, a Genoese trading settlement 1381–1403, then Walachian, Moldavian and Hungarian, and taken by Turkey in 1484. It was taken by Russia in 1812. Ceded with Bessarabia to the U.S.S.R. in June 1940, it was regained by Rumania during the Axis attack on Russia in 1941.

CHILIASM, the belief that Christ will return to reign for a thousand years (from Gr. χιλιασμός, χίλιοι, a thousand), the doctrine of the Millennium (*q.v.*).

CHILLÁN, a city and the capital of the province of Ñuble, in the southern part of central Chile, 246 mi. by rail south-south-west of Santiago and about 56 mi. direct (108 by rail) north-east of Concepción. Pop. (1940) 39,909. Chillán is one of the most active commercial cities of central Chile, and is surrounded by a rich agricultural and grazing country. Chillán was founded by Ruíz de Gamboa in 1594. Its present site was chosen in 1836. The original site, known as Chillán Viejo, was the birthplace of the liberator, Bernardo O'Higgins. Chillán, severely damaged by an earthquake in 1939, is being rebuilt (1943). The hot sulphur springs of Chillán, which were discovered in 1795, are about 45 mi. east-southeast. They issue from the flanks of the Volcán Viejo, about 7,000 ft. above sea level. The highest temperature of the water issuing from these springs is a little over 135°. The principal volcanoes of the Chillán group are the Nevado (9,528 ft.) and the Viejo. After a two-century repose, Nevado de Chillán erupted in 1861 and again in 1864.

CHILL HARDENING, the process of hardening the surface of a metal by rapidly cooling it while it is molten or at a very high temperature. Usually the chilling is done by plunging the object in a bath of water or oil. In the case of railway and other wagon and car wheels, a "chill mould" is used, consisting of a sand mould with the outer part (which forms the rim) made of cast iron. When the wheel is cast, the rim cools very rapidly because the iron part of the mould absorbs and conducts away the

heat from it, and the consequent chilling hardens the rim. Chill hardening is sometimes combined with case hardening. (*See* FOUNDING; CASE HARDENING; IRON AND STEEL.)

CHILLIANWALLA, a village of British India in the Punjab, situated on the left bank of the river Jhelum, about 85 mi. N.W. of Lahore. It is memorable as the scene of a battle on Jan. 13, 1849, between a British force commanded by Lord Gough and the Sikh army under Sher Singh. The loss of the Sikhs was estimated at 4,000, while that of the British in killed and wounded amounted to 2,800, of whom nearly 1,000 were Europeans and 89 were British and 43 native officers. An obelisk erected at Chillianwalla by the British government preserves the names of those who fell. (*See* SIKH WARS.)

CHILLICOTHE, a city of northern Missouri, U.S.A., on the Grand river, 80 mi. N.E. of Kansas City; the county seat of Livingston county. It is on federal highways 36 and 65 and 23 other roads, and is served by the Burlington, the Chicago, Milwaukee, St. Paul and Pacific, and the Wabash railways. Pop. (1940) 8,012. Coal and limestone abound in the vicinity, and much livestock is raised. The city has various manufacturing industries, and is one of the principal assembling points for dairy products in the state. The state industrial school for girls is there.

Chillicothe was settled about 1830. The town was laid out in 1837 on land granted by the federal government, and the city was incorporated in 1855. A famous tavern of the '50s, kept by "Uncle Johnny" Graves, is now a beautiful private residence. A tablet on the county courthouse commemorates the death, in 1868, of Nelson Kneass, composer of the music for "Ben Bolt," who drifted there with a travelling theatrical troupe.

CHILLICOTHE, a city of Ohio, U.S.A., on the Scioto river, 50 mi. S. of Columbus; the county seat of Ross county. It is on federal highways 23 and 50, and is served by the Baltimore and Ohio and the Norfolk and Western railways. Pop. (1940) 20,129 (92.4% native white). It is the trade centre of a rich agricultural region and coal and iron are mined nearby. The city has railway construction and repair shops, paper mills and a shoe manufacturing industry, with a factory product in 1940 valued at $25,000,000. There are ancient mounds in a state park 4 mi. north. Chillicothe was founded in 1796. On the Camp Sherman site of 1914–18 is a veterans' hospital and a federal reformatory. Chillicothe was the capital of the Northwest territory in 1800–03, and the capital of Ohio in 1803–10 and 1812–16.

CHILLINGWORTH, WILLIAM (1602–1644), English divine and controversialist, was born at Oxford in Oct. 1602. In June 1618 he became a scholar of Trinity college, Oxford, and was made a fellow of his college in June 1628. He was persuaded by a Jesuit propagandist to embrace Catholicism and went to study at the Jesuit college at Douai. But his godfather, Laud, then bishop of London, recommended him to make an impartial enquiry into the claims of the two churches. After a short stay he left Douai in 1631 and returned to Oxford. On grounds of Scripture and reason he at length declared for Protestantism but declined a preferment offered to him in 1635. His principal work, *The Religion of Protestants a Safe Way to Salvation; or, An Answer to a Book entitled "Mercy and Truth"* etc., published in 1637. The main argument of the *Religion of Protestants* is a vindication of the sole authority of the Bible in spiritual matters and of the free right of the individual conscience to interpret it.

CHILLIWACK, an incorporated city of British Columbia, Canada, on Fraser river, 70 mi. E. of Vancouver. Pop. (1941) 3,675. It is the terminus of the British Columbia electric railway from Vancouver, is served also by the Canadian National railways, and is connected by ferry with Harrison Mills on the Canadian Pacific line. Sawmilling and timber manufactures, canning, mineral water and dairy-produce works are of growing importance. The fertile district east and west of the city, incorporated as the municipality of Chilliwack (pop. in 1941 7,787) is devoted chiefly to dairy farming and small fruit growing, and has been extended by the drainage of Sumas lake (30,000 acres).

CHILOÉ, a province of southern Chile, and also the name of a large island off the Chilean coast forming part of the province. The province (area 9,052 sq.mi., pop. [1940] 101,706) is composed of numerous islands and a section of the mainland which border on the gulfs of Ancud and Corcovado. The mainland portion of the province is extremely rugged and is virtually uninhabited, such colonies, towns and Indian settlements as there are being principally on the island of Chiloé. The island, which is some 90 mi. long by 35 mi. wide, lies within the temperate rainforest belt of South Chile, where frosts are rare, summers are cool, and rainfall is abundant throughout the year. Both the coast range of western Chiloé and the rolling plains of the east are heavily forested with large evergreens (mostly broad-leaved) such as *alerce, roble, ciprés,* cinnamon trees and filberts. For four centuries these dense forests, which are too wet to be burned, have provided an effective barrier to the majority of white settlers who have tried to clear the land for cultivation and pasturage. Logging operations have never been developed on an extensive commercial scale, and most of the timber that is cut is consumed locally. Ancud, the capital of the province (pop. of the town 4,327 in 1940), is situated at the N. end of the island on the sheltered bay of San Carlos. Castro, the oldest and only other sizable town in the province (pop. of the town 4,786 in 1940), is on the eastern shore of the island, 55 mi. S.E. of Ancud by rail.

CHILON, of Sparta, son of Damagetus, one of the Seven Sages of Greece, flourished about the beginning of the 6th century B.C. In 560 (or 556) he acted as ephor, an office which he is even said to have founded. According to Chilon, the great virtue of man was prudence, or well-grounded judgment as to future events.

A collection of the sayings attributed to him will be found in F. W. Mullach, *Fragmenta Philosophorum Graecorum,* i; *see* Herodotus, i, 69; Diogenes Laertius i, 68; Pausanias iii, 16, x, 24.

CHILPERIC, the name of two Frankish kings.

CHILPERIC I. (d. 584) was one of the sons of Clotaire I. Immediately after the death of his father in 561 he endeavoured to take possession of the whole kingdom, seized the treasure amassed in the royal town of Berny and entered Paris. His brothers, however, compelled him to divide the kingdom with them, and Soissons, together with Amiens, Arras, Cambrai, Thérouanne, Tournai, and Boulogne, fell to Chilperic's share, but on the death of Charibert in 567 his estates were augmented. When his brother Sigebert married Brunhilda, Chilperic also wished to make a brilliant marriage. He had already repudiated his first wife, Audovera, and had taken as his concubine a serving woman called Fredegond. He accordingly dismissed Fredegond, and married Brunhilda's sister, Galswintha. But he soon tired of his new partner, and one morning Galswintha was found strangled in her bed. A few days afterwards Chilperic married Fredegond. This murder was the cause of long and bloody wars, interspersed with truces, between Chilperic and Sigebert. In 575 Sigebert was assassinated by Fredegond at the very moment when he had Chilperic at his mercy. Chilperic retrieved his position, took from Austrasia Tours and Poitiers and some places in Aquitaine, and fostered discord in the kingdom of the east during the minority of Chilperic II. One day, however, while returning from the chase to the town of Chelles, Chilperic was stabbed to death.

Chilperic may be regarded as the type of Merovingian sovereigns. He was exceedingly anxious to extend the royal authority. He levied numerous imposts, and his fiscal measures provoked a great sedition at Limoges in 579. He wished to bring about the subjection of the church, and to this end sold bishoprics to the highest bidder, annulled the wills made in favour of the bishoprics and abbeys, and sought to impose upon his subjects a rationalistic conception of the Trinity. He pretended to some literary culture, and was the author of some halting verse. He even added letters to the Latin alphabet, and wished to have the mss. rewritten with the new characters. The wresting of Tours from Austrasia and the seizure of ecclesiastical property provoked the bitter hatred of Gregory of Tours, by whom Chilperic was stigmatized as the Nero and the Herod of his time. *See* Sérésia, *L'Église et l'État sous les rois francs au VIe siècle* (1888).

CHILPERIC II (d. 720) was the son of Childeric II. He became king of Neustria in 715, on which occasion he changed his name from Daniel to Chilperic. At first he was a tool in the hands of Ragenfrid, the mayor of the palace. Charles Martel, however,

overthrew Ragenfrid, accepted Chilperic as king of Neustria, and, on the death of Clotaire IV set him over the whole kingdom. The young king died soon afterwards. (C. Pe.)

CHILTERN HILLS or **THE CHILTERNS,** a range of chalk hills in England, extending from southwest to northeast through part of Oxfordshire, Buckinghamshire and Bedfordshire. They form a well marked escarpment, facing northwestwards, with a long southeastern slope, and run from the Thames in the neighbourhood of Goring to the headwaters of its tributary the Lea between Dunstable and Hitchin, the crest line between these points being about 55 miles. But these hills are part of a larger chalk system, continuing the line of the White Horse hills from Berkshire, and themselves continued eastward by the East Anglian ridge, a series which represents the edge of the chalk rising from beneath the Eocene deposits of the London basin. The greatest elevation of the Chilterns is found in the centre from Watlington to Tring, where heights from 800 to 850 ft. are frequent. Westward towards the Thames gap the elevation falls away but little, but eastward the East Anglian ridge does not often exceed 500 ft. There are several passes through the Chilterns, followed by main roads and railways converging on London. The hills were formerly covered with beech, and there is still a local supply of this wood for the manufacture of chairs and other articles in the neighbourhood of Wycombe.

CHILTERN HUNDREDS. An old principle of English parliamentary law declared that a member of the house of commons, once duly chosen, could not *resign* his seat. This rule was a relic of the days when the local gentry had to be compelled to serve in parliament. The only method, therefore, of avoiding the rule came to be by accepting an office of profit from the crown, a statute of 1707 enacting that every member accepting an office of profit from the crown should thereby vacate his seat, but should be capable of re-election, unless the office in question had been created since 1705, or had been otherwise declared to disqualify for a seat in parliament. Before this time the only course open to a member desiring to resign was to petition the house for its leave, but except in cases of incurable ill-health, the house always refused it. Among the posts of profit held by members of the house of commons in the first half of the 18th century are to be found the names of several crown stewardships, which apparently were not regarded as places of profit under the crown within the meaning of the act of 1707, for no seats were vacated by appointment to them. The first instance of the acceptance of such a stewardship vacating a seat was in 1740, when the house decided that Sir W. W. Wynn, on inheriting from his father, in virtue of a royal grant, the stewardship of the lordship and manor of Bromfield and Yale, and *ipso facto* vacated his seat. On the passing of the Place act of 1742, the idea of utilizing the appointment to certain crown stewardships (possibly suggested by Sir W. W. Wynn's case) as a pretext for enabling a member to resign his seat was carried into practice. These nominal stewardships were eight in number, but only two survived to be used in this way in contemporary practice—those of the Chilterns and Northstead; and when a member wishes to vacate his seat, he is accordingly spoken of as taking the Chiltern Hundreds. The Chiltern Hundreds formed a bailiwick of the ordinary type. They are situated on the Chiltern hills, Buckinghamshire. The appointment of steward was first used for parliamentary purposes in 1750, the appointment being made by the chancellor of the exchequer (and at his discretion to grant or not), and the warrant bestowing on the holder "all wages, fees, allowances and other privileges and pre-eminences." Up to the 19th century there was a nominal salary of 20s. attached to the post. It was laid down in 1846 by the chancellor of the exchequer that the Chilterns could not be granted to more than one person in the same day, but this rule has not been strictly adhered to, for on four occasions subsequent to 1850 the Chilterns were granted twice on the same day. The Chilterns might be granted to members whether they had taken the oath or not, or during a recess, though in this case a new writ could not be issued until the house met again. Each new warrant expressly revoked the grant to the last holder, the new steward retaining it in his turn until another should be appointed.

See parliamentary paper—*Report from the Select Committee on House of Commons* (*Vacating of Seats*) (1894).

CHILWA (incorrectly Shirwa), 15° 15′ S., 35° 40′ E.; a shallow lake of brackish water in the Nyasaland Protectorate abutting on Mozambique. Its area varies with the rainfall, but never exceeds 100 sq.mi. Formerly, at a period of higher level, it appears to have drained northward to the Lujenda branch of the Rovuma. There are four islands, one rising 500 ft. above the water level. The lake was discovered by Livingstone in 1859.

CHIMAERA. A term applied botanically to certain types of plants formerly regarded as "graft hybrids." The term graft hybrid suggests a plant produced by the fusion of vegetative cells derived respectively from two plants grafted together. That hybrid plants do in fact originate in such a way is, however, regarded by most botanists as problematical. It is true that plants composite in nature and having some of the characteristics of the two plants employed may result from an operation of grafting, but these are usually interpreted as arising in an entirely different way without the fusion of cells that would justify the appellation of hybrid. The term graft hybrid has been replaced in general by "plant chimaera" or simply "chimaera," since, like the mythological monster so-called, plant chimaeras are composite in nature and origin.

Many of these plants have been long known in gardens, being grown as curiosities rather than for their decorative value. The earliest to be described in scientific literature was the Bizzaria orange which appeared in a garden in Florence in 1644, arising as an adventitious bud from the region where a scion of sour orange (*Citrus aurantium*) had been grafted on a stock of citron (*Citrus medica*). Others are the so-called *Crataego-mespilus* forms, arising in a similar way following the grafting of medlar (*Mespilus germanica*) on hawthorn (*Crataegus monogyna*); the *Pyro-cydonias* from the grafting of pear (*Pyrus communis*) on quince (*Cydonia vulgaris*); and, best known of all, *Cytisus adami* (or *Laburnum adami*) from the grafting of the small purple-flowered broom (*Cytisus purpureus*) on the common laburnum (*Laburnum vulgare*). In all these instances the history of origin is the same; the plants at present in existence have been derived by vegetative propagation from an adventitious shoot that arose at the junction of scion and stock.

While all the examples mentioned above originated as the result of a horticultural operation, their production was unintentional. Knowledge of the subject passed into a new phase with Hans Winkler's experiments in 1907 deliberately designed to produce graft hybrids. In these experiments black nightshade (*Solanum nigrum*) was grafted on tomato (*Solanum lycopersicum*). After the graft had taken, a transverse cut was made through it at the junction of the stems. From the exposed surface numerous buds developed which grew into new shoots, all of which were shoots either of nightshade or of tomato except one; this, arising at the junction of the two tissues, had the characters of nightshade on one side and tomato on the other. Winkler called this shoot a *chimaera,* since it was partly of one species and partly of another. In the following two years large-scale experiments were carried out resulting in the production of many thousands of shoots from decapitated grafts. Most of these were either pure nightshade or pure tomato, some were chimaeras of the kind already described, but in addition there were a few shoots showing characters intermediate between scion and stock. These differed among themselves as to the extent to which they resembled scion or stock and Winkler gave them special names, believing them to be true graft hybrids.

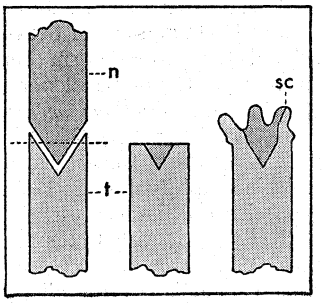


Fig. 1.—Stages in the production of a chimaeral branch; Winkler's method. Dotted line indicates position of cut. n, nightshade; t, tomato; sc, sectorial chimaera

In 1909 Erwin Baur published observations on variegated plants, in particular the garden geranium (*Pelargonium zonale*).

In such plants branches sometimes occur in which one side is green and the other colourless, corresponding structurally to the tomato-nightshade branch to which Winkler first applied the term chimaera. In the present instance the distribution of the two kinds of tissue constituting the branch is dramatically obvious owing to the difference in colour. Such a branch, called by Baur a

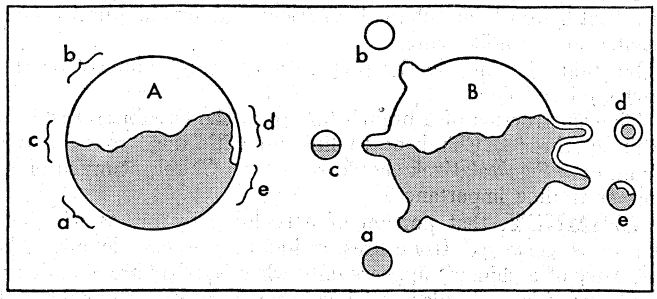


Fig. 2.—A. Diagram of a cross section of the stem of a sectorial chimaera consisting of green and colourless tissue; the line of junction between the two tissues is often very irregular
B. Illustrating how there may arise from such a stem pure green (a), pure white (b), sectorial (c), periclinal (d), or mericlinal (e), branches, depending on the position of lateral bud formation

sectorial chimaera, when cut through transversely usually presents an appearance as shown at A in fig. 2. The nature of any lateral shoot arising from it depends on the place of origin; shoots arising at b and d will be pure green and pure white respectively, while one arising at c will possess a sectorial structure like the parent branch. If a shoot arises as at d where, as often occurs, a superficial strip of one component overlaps the other, a *periclinal chimaera* will result—an arrangement in which a "core" of green tissue is invested by a "skin" of colourless tissue, one, two, or more cell layers thick, depending on the thickness of the overlap; or vice versa. If the bud arises at the extreme edge of the overlap, the superficial "skin" may occupy only part of the surface of the shoot, a condition described as mericlinal. Thus, a branch having a sectorial structure gives rise during growth, not only to occasional sectorial branches like itself, but to branches that are pure for either component, periclinal, or mericlinal. In contrast to this instability, a branch that has once acquired a periclinal pattern shows very great stability of structure during growth, producing lateral branches that are all periclinal chimaeras like the parent branch.

Baur's experience with these chimaeras of *Pelargonium* composed of green and colourless tissue led him to suggest that Winkler's so-called graft hybrids between nightshade and tomato were in reality periclinal chimaeras, and he provided cogent evidence that two of the plants to which Winkler had given special names were built up of a core of tomato with a skin of nightshade one and two cell layers thick respectively, and two of the others of a core of nightshade with skins of tomato one and two cell layers thick. After some hesitation Winkler fully concurred with Baur's interpretation. (A fifth form obtained by Winkler unfortunately died before it could be fully investigated.)

Attention was then turned to *Cytisus adami* and the other long-known "graft hybrids." The general consensus of opinion in 1944 was that these also are periclinal chimaeras: *Cytisus adami,* for example, consisting of a core of laburnum invested with a one-layered skin of *Cytisus purpureus,* the *Crataego-mespili* having a core of hawthorn covered with skins of medlar differing in thickness in the different forms, and so on.

Owing to the fact that in flowering plants the reproductive cells arise from the layer second from the surface at the growing point, seedlings from periclinal chimaeras are all pure core if the skin is but one cell layer thick, and all pure skin tissue if the skin consists of more than one layer; they are never periclinal chimaeras like the parent plant. Also, while stem branches or stem cuttings reproduce the periclinal condition, root cuttings yield invariably plants of core tissue only owing to the endogenous manner in which lateral roots are formed.

Apart from being an occasional product of grafting, chimaeras also arise in nature, most frequently, no doubt, as the result of a sudden mutation in some cell or cells of a growing region. The new kind of tissue may be conspicuously different from the old as when it is colourless instead of being green, but far more commonly the difference is evident only on special investigation as when the number of chromosomes is altered. Thus, chimaeras are of far greater frequency than the readily recognizable examples met with might suggest. In contrast to the graft-hybrid interpretation which predicates a blending of the two components, the chimaera hypothesis regards the components as maintaining their identity, but arranged in a definite pattern at the growing point; the manner in which vegetative growth occurs in flowering plants is responsible for the way this pattern is transferred from the growing point to the mature tissues. The whole behaviour of these plants in reproduction and vegetative growth, as well as the nature and arrangement of their mature tissues accords well with the supposition that they are chimaeras. The alternative graft-hybrid hypothesis cannot be said to be theoretically impossible, but it may be regarded as improbable in view of what is known of plant behaviour and as lacking positive support from indubitable evidence. Nevertheless it still has its supporters, few though they may be, as exemplified by Trofim Lysenko and his followers, representing one Russian school of thought.

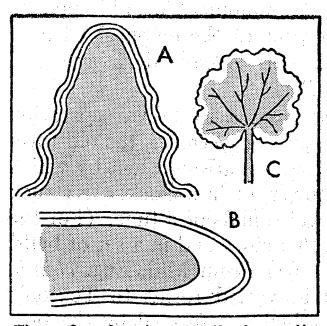


Fig. 3.—A. Longitudinal section through the growing point of a periclinal chimaera in which the cells of the central core possess potentially green plastids while in the two outer cell layers the plastids lack the capacity to become green
B. Transverse section near the edge of a leaf derived from such a growing point. Owing to the whole of the marginal tissue, apart from the epidermis, being derived from the second layer of the growing point, the leaf has a white margin
C. Superficial appearance of a leaf from such a periclinal chimaera. The central part of the leaf, as well as the stem, appears green since the green core tissue shows through the two enveloping layers of colourless cells

While in no sense conclusive, it is at least significant that variegated foliage as described above for *Pelargonium zonale* is commonly met with in flowering plants of all kinds, but never occurs in groups such as the ferns with a single-celled growing point. This is what would be expected if such variegation is correctly interpreted as a consequence of the possession of a growing point having a chimaeral structure, for which a multicellular growing point is a necessity.

BIBLIOGRAPHY.—R. J. Chittenden's article "Vegetative Segregation," *Bibliographia Genetica* (1927); and F. E. Weiss's review in *Biological Reviews* (1930) give detailed accounts in English of many aspects of chimaeras; Krenke's volume, translated from Russian into German under the title *Wundkompensation, Transplantation und Chimaeren bei Pflanzen* (1933) gives a later and more general discussion of the subject. All three are provided with full bibliographies. *Plant Chimaeras and Graft Hybrids,* by W. Neilson-Jones (1934) will be found to provide a general treatment of all aspects of the subject up to that date within a relatively small compass. Later experimental work, which is not extensive, must be sought in scientific journals.

(W. N.-J.)

CHIMAERA. In Greek mythology a chimaera was a fire-breathing female monster resembling a lion in the fore part, a goat in the middle, and a dragon behind (*Iliad,* vi, 179). She devastated Caria and Lycia until finally she was slain by Bellerophon (*q.v.*). In art the Chimaera is usually represented as a lion, with a goat's head in the middle of the back, as in the bronze Chimaera of Arezzo (5th century). The word is now used generally to denote a fantastic idea or fiction of the imagination.

Chimaera, or *chimère,* in architecture, is a term loosely used for any grotesque, fantastic or imaginary beast used in decoration.

CHIMAY, a town in the extreme southeast of the province of Hainaut, Belgium, dating from the 7th century. Pop. (1939) 3,250. Owing to its proximity to the French frontier it has undergone many sieges, the last of which was in 1640, when Turenne reduced it to ruins. The town is chiefly famous for the castle and park that bear its name. Originally a stronghold of the Cröy family, it has passed through the D'Arenbergs to its present owners, the princes of Caraman-Chimay. The castle, which in

1640 possessed seven towers, has now only one, which is in ruins; a château was built in the Tudor style in the 18th century. This domain carried with it the right to one of the twelve peerages of Hainaut. The church contains a fine monument of Phillippe de Cröy, chamberlain and comrade in arms of the emperor Charles V. Jean Froissart, the chronicler, is said to have died here, and has a statue in the square.

CHIME. (1) Probably derived from a mistaken separation into two words, *chimbe bell,* of *chymbal* or *chymbel,* the old form of "cymbal," Lat. *cymbalum.* A mechanical arrangement by which a set of bells in a church or other tower, or in a clock, are struck so as to produce a sequence of musical sounds or a tune. (For the mechanism of such an arrangement in a clock and in a set of bells, *see* the articles CLOCKS and BELL.) (2) From Mid. Eng. *chimb,* a word meaning "edge," common in varied forms to Teutonic languages, *cf.* Ger. *Kimme,* the bevelled rim formed by the projecting staves at the ends of a cask.

CHIME-BELLS, a mediaeval instrument consisting of a set of small bells of varying pitch which were arranged in a frame and struck with a hammer after the manner of a glockenspiel. They ranged in number from four or five up to as many as 14 or 15. The chime-bells were known also under the Latin name of *cymbalum.*

CHIMERE, in modern English use the name of a garment worn as part of the ceremonial dress of Anglican bishops. It is a long sleeveless gown of silk or satin, open down the front, gathered in at the back between the shoulders, and with slits for the arms. It is worn over the rochet (*q.v.*), and its colour is either black or scarlet (convocation robes). The origin of the chimere has been the subject of much debate; but it is practically proved to be derived from the mediaeval tabard, an upper garment worn in civil life by all classes of people both in England and abroad. It has therefore a common origin with certain academic robes (*see* ROBES: *Academic Costume*). The word "chimere," which first appears in England in the 14th century, is of uncertain origin. It occurs in different forms in various languages (Lat. *chimera,* Fr. *simarre,* Ital. *zimarra*) and may possibly be derived from the Greek χείμερος, "wintry". This derivation is made plausible by the original character of the chimere; for the word properly applies to the sleeveless tabard which tended to supersede, from the 15th century onwards, the inconvenient *cappa clausa* (a long closed cloak with a slit in front for the arms) as the out-of-doors upper garment of bishops. The chimere was, moreover, a cold weather garment. In summer its place was taken by the tippet. In the Anglican form for the consecration of bishops the newly consecrated prelate, hitherto vested in rochet, is directed to put on "the rest of the episcopal habit," *i.e.* the chimere. The robe has thus become in the Church of England symbolical of the episcopal office, and is in effect a liturgical vestment. The civil quality of the garment still survives; the full dress of an Anglican prelate at civil functions of importance (*e.g.* in parliament, or at court) is still rochet and chimere. The continental equivalent of the chimere is the *zimarra* or *simarre,* which is defined by foreign ecclesiologists as a kind of *soutane* (cassock), from which it is distinguished by having a small cape and short, open arms (*manches-fausses*) reaching to the middle of the upper arm and decorated with buttons. In France and Germany it is fitted more or less to the figure; in Italy it is wider and falls down straight in front. Like the *soutane,* the *zimarra* is not proper to any particular rank of clergy, but for bishops and prelates it is ornamented with red buttons and bindings. It is worn by university professors. A black *zimarra* lined with white, and sometimes ornamented with a white binding and gold tassels, is worn by the pope.

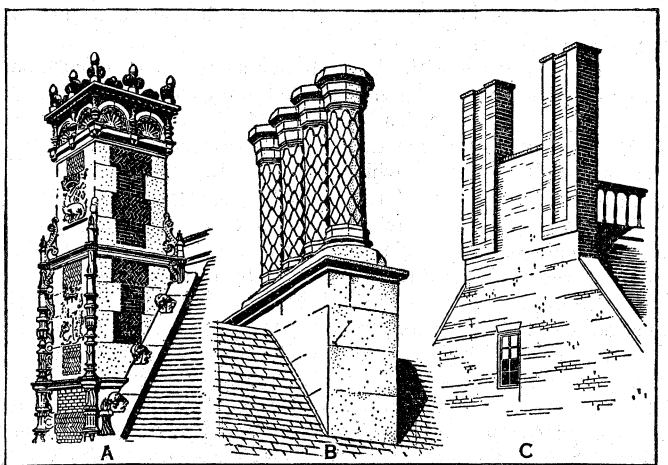
BIBLIOGRAPHY.—*See* the *Report* of the sub-committee of Convocation on the ornaments of the church and its ministers, p. 31 (London, 1908); the Rev. N. F. Robinson, "The black chimere of Anglican Prelates: a plea for its retention and proper use," in *Transactions of the St. Paul's Ecclesiological Soc.* vol. iv. pp. 181–220 (London, 1898); Herbert Druitt, *Costume on Brasses* (London. 1906); G. Moroni, *Dizionario dell' erudizione storico-ecclesiastica* (Venice, 1861), vol. 103, *s.v.* "Zimarra"; X. Barbier de Montault, *Traité pratique de la construction, etc., des églises,* ii. 538 (Paris, 1878).

CHIMKENT, a town in the Syr Daria province of the Kazak (Kirghiz) A.S.S.R. of the R.S.F.S.R., Lat. 42° 20′ N., Long. 69° 40′ E. Pop. (1939) 74,185, mostly Sarts. It lies in a fertile valley between the Alexander range and the Ala-tau, and is the centre of a grain, fruit growing and cattle rearing district, watered by streams from the Ala-tau. Above the town are the ruins of its citadel, stormed by the Russians in 1864. Its clear, dry air makes it a health resort for tubercular patients taking the kumiss (fermented mare's milk) cure.

Its industries include the preparation of santonin, cotton, tobacco, oil and flour.

The construction of a branch line from the Orenburg-Tashkent Railway through Chimkent to link up with the Trans-Siberian Railway at Semipalatinak should restore to Chimkent much of its former trading importance.

CHIMNEY, that portion of a building by means of which smoke is conveyed from fires inside to the outside air. The necessity of a chimney appears only when braziers are abandoned in favour of large fireplaces. Thus in northern Europe in the 12th century the primitive hole in the roof yielded to a hollow flue leading from a fireplace by the wall to the outside; but a specific architectural form of flue was not developed until the 15th century. The 13th and 14th century type was a simple, round, vertical conduit of stone, with a conical cap and openings at the sides under the cone. A remarkable example occurs in the monastic kitchen of the Abbey of Fontevrault, France, dating from the end of the 12th century. In the early 15th century the re-duplication of fireplaces led to the grouping of several flues inside a vertical, and generally rectangular, mass of masonry, which was carried well above the roof, and occasionally decorated. In France, in the latter half of the century, this decoration was of great richness, consisting of late Gothic pinnacles and niches, and in the châteaux of the Francis I. period, chimneys vied with dormers in their lavish detail. Heraldic ornaments, pilasters and entablatures abound. In England, decorative effect was obtained by grouping the flue tops as independent features, usually in brick, above a stone base; each flue was then treated as a separate shaft with base and cap, polygonal or twisted; *e.g.,* Compton Wynyates and Hampton Court palace. In the early Renaissance, the flues were sometimes treated like little classic columns, as at Burleigh House. With the development of classicism, the chimney became simple



A. FRENCH RENAISSANCE CHIMNEY (FRANCIS I. PERIOD), CHÂTEAU OF BLOIS; B. ENGLISH TUDOR, FROM COVENTRY; C. AMERICAN COLONIAL, WARRIER HOUSE, PORTSMOUTH, N.H. (EARLY 18TH CENTURY)

again, a mere rectangular mass of masonry. In colonial work in America, the chimney is either a large square mass in the centre of the roof or else developed as an important feature of the end gable walls. In the Italian Renaissance the chimney is merely utilitarian and, whenever possible, is hidden. (T. F. H.)

CHIMNEY AND FIREPLACE CONSTRUCTION

Correct chimney construction is absolutely essential to economical home heating. The ideal and most efficient chimney is vertical, with round flue and smooth interior surfaces (fig. 1). All chim-

neys should be built with "fire-clay" flue linings (not "flue-tile," "terra-cotta" or "clay" flue lining). Faulty chimney construction practically always shows its shortcomings by its effect upon some other feature of the plant. A lighted paper thrust in the bottom and sucked up and consumed with a roar is often erroneously taken to indicate a good draught. Chimney draught can be known definitely only by measurement with the proper instrument, a

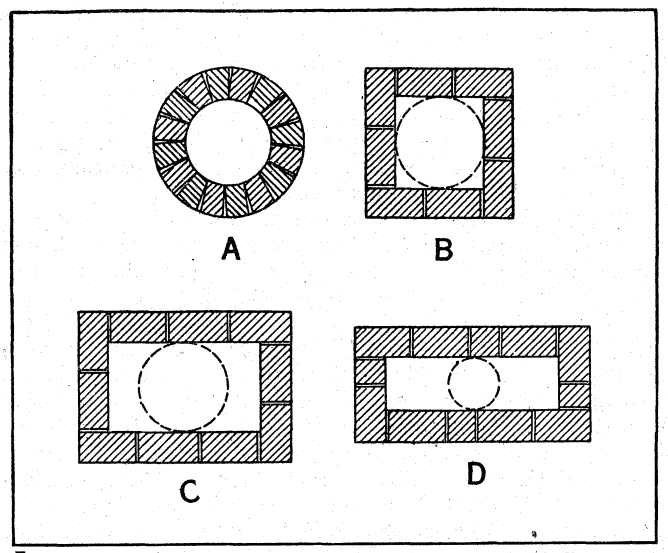


FIG. 1.—EXAMPLES OF CHIMNEY CONSTRUCTION. A. ROUND FLUE; B. SQUARE FLUE; C. OBLONG FLUE; ELONGATED OBLONG FLUE. TYPE A IS THE BEST, TYPE B, SECOND BEST, TYPE C, NEXT PREFERABLE, TYPE D, POOR CONSTRUCTION

draught gage. Chimney height and temperature inside and outside the chimney determine intensity of draught in a correctly built chimney.

Factors that contribute to faulty chimneys are: (1) Insufficient height to assure proper draught and avoid interfering air currents (fig. 2); the top of a chimney should extend at least 3ft. above flat roofs and at least 2ft. above the ridge of peaked roofs; extensions, if used, should be fitted with air-tight joints; (2) omission of flue-lining to ensure continued tightness, so that heat and weathering cause mortar gradually to disintegrate and result in a leaky chimney (fig. 2); (3) offsets and bends are likely to reduce the chimney free area and present difficulties in construction that militate against tightness and inside smoothness; loose bricks and mortar may fall and lodge in such a way as to cause objectionable restricted areas and provide lodgement for dangerous soot accumulations (fig. 2); (4) careless and improper installation of the smoke pipe into the chimney (fig. 3); (5) openings into a chimney for other than the smoke pipe of the boiler; such should never be permitted, they are apt to check and interfere with the draught; (6) lack of a tightly-fitting cover for the clean-out door; (7) failure to support the chimney properly; it should never be based on timber construction and when resting upon the ground sufficient masonry foundation should be provided to prevent settling; (8) improper laying of brick; it should never be laid on edge, should be properly bonded and sufficient mortar used between the bricks to fill all voids. Size and height of chimneys depend upon the total heat demands of the structure to be served, the type and number of boilers and the fuel to be used. Reputable manufacturers specify draught requirements for their respective equipment and state the required flue areas, sizes and heights of chimneys; these should be observed. Irrespective of fuel used, the minimum effective area[1] inside the flue lining for any installation should be not less than 70 sq.in. and the short cross-sectional dimension should be never less than six-tenths of the greater dimension. The minimum chimney height above the grate should be 35ft. if erratic draughts are to be avoided.

A chimney that is not tight will fail to draw properly. Force

[1]Effective area of a flue, broadly speaking, is the theoretical cross-sectional area occupied by the column of smoke and gases rising with spiral motion up the flue.

or direction of wind, the amount of moisture in the air or the quality of the fuel may aggravate the trouble. A smoke test will prove leaks and every flue should be tested before a boiler is connected thereto, by building a paper, straw, wood or tar-paper fire at the base of the flue. When the smoke is passing in dense volume

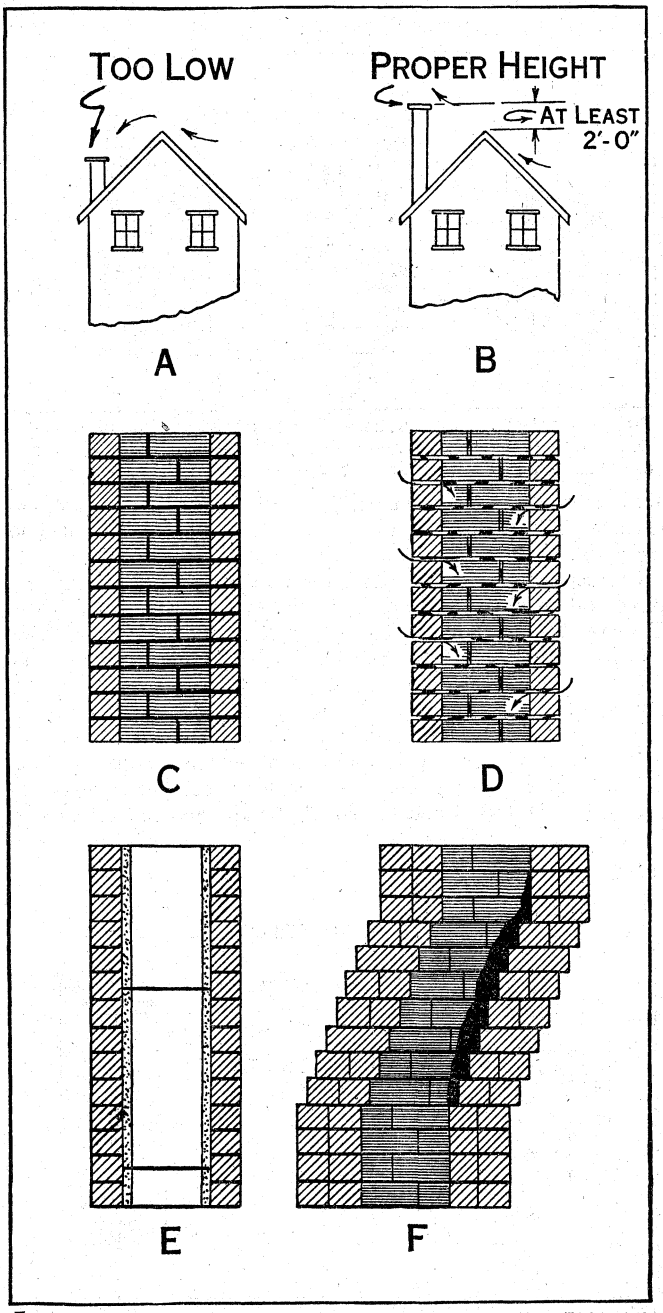


FIG. 2.—EXAMPLES OF CHIMNEY CONSTRUCTION. A. TOP TOO LOW, EDDY CURRENTS CAUSE DOWN DRAFT; B. TOP CARRIED PROPER HEIGHT; C. UNLINED FLUE BEFORE USE; D. UNLINED FLUE, LEAKS CAUSED BY HOT GASES AND WEATHERING; E. LINED FLUE, A PREVENTION AGAINST LEAKS; F. OFFSETS TO BE AVOIDED

if the stack be tightly blocked by laying a wet blanket over it, the leakage will be immediately evident by the appearance of smoke at the opening, or from an adjoining flue indicating leakage between the flue joints.

If a leakage is not obviously evident, further inspection by means of a mirror held at the proper angle at the base of a straight flue should be made for minor obstructions such as broken tile, mortar accumulations, birds' nests, partly burned paper, soot or tarry deposits; or removal may be accomplished by passing up and down the flue a weighted bag of hay or straw attached to the end of two ropes.

Fireplaces.—A satisfactory open fireplace requires: (1) a flue of proper area, (2) fireplace throat correctly proportioned and located, (3) a correctly built smoke shelf and chamber, (4) sufficient chimney height, (5) a shape for radiating maximum heat into the room. The area of a lined flue should equal one-tenth or more of that of the fireplace opening. For unlined flues, the proportion should be increased due to greater friction. For lined flue,

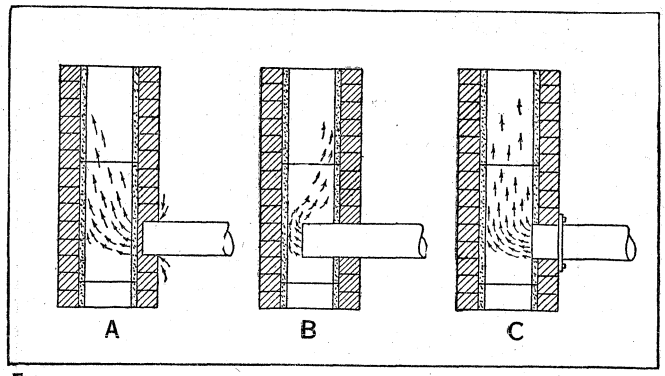


FIG. 3.—EXAMPLES OF SMOKE-PIPE CONNECTIONS. A. INCORRECT, LEAKY JOINT; B. INCORRECT, PIPE PROJECTS TOO FAR INTO CHIMNEY; C. CORRECT, PIPE MEETS EDGE OF FLUE AND JOINT PROPERLY SEALED

allow 13 sq.in. of clear flue area to each square foot of fireplace opening. The cross-sectional area should be the same throughout the entire length of the chimney.

Correct throat construction is essential, to avoid a smoky fireplace and to provide for proper velocity of the outgoing gases. The area of the throat should be not less than that of the flue, its length always equal to the width of the fireplace opening (fig. 4); the sides of the fireplace should be vertical until the throat is passed (fig. 4); and above the throat, the sides should be drawn in until the desired flue area is obtained; the throat should be not more than 4 or 5in. in width and set 8in. above the lintel of the opening (fig. 4). The use of a throat damper is advisable; if omitted, the throat opening should be 4in. and the smoke shelf

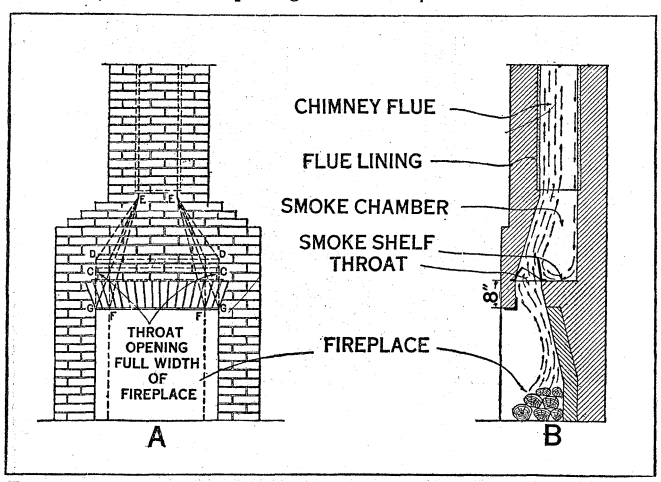


FIG. 4.—FAULTY AND CORRECT FIREPLACE CONSTRUCTION. A. TOP OF THROAT DAMPER IS AT DD, SMOKE SHELF AT CC. SIDE WALL SHOULD NOT BE DRAWN IN UNTIL THE HEIGHT DD IS PASSED. IF DRAWN IN AS INDICATED BY EF AND EG, THE WIDTH OF THROAT BECOMES LESS THAN THE WIDTH OF THE OPENING AND CAUSES THE AIR CURRENTS TO PILE UP RESULTING IN A SMOKY FIREPLACE. B, CORRECT FIREPLACE CONSTRUCTION

always included. A smoke shelf and chamber are absolutely essential. The shelf is formed by setting back the brick work at the top of the throat to the line of the flue wall, making the shelf equal in length to that of the throat. No shelf should be less than 4in. and may vary from this to 12in. or more, depending on depth of fireplace; the level of the shelf should be 8in. above the fireplace opening (fig. 4). The smoke chamber acts as a reservoir to hold accumulated smoke temporarily when a gust of wind across the chimney top momentarily dampers the chimney, as well as to lessen the down draft and prevent smoke being forced into the room. All smoke chamber walls should be smooth inside. The back of a fireplace should pitch forward from a point a little less than half-way from the hearth to the top of the opening and the sides should be beveled, as straight back and sides do not radiate heat as well.

The use of a throat damper affords means for regulating a fire. The type with lid hinged at rear, rather than in the centre, directs better the outgoing smoke into the flue. Full opening is required for fast-burning pine; slow-burning hardwood logs require only 1 or 2in. openings. Fireplace openings should be kept low, 30in. minimum and 42in. maximum height. The higher the opening, the greater the possibility of a smoky fireplace; the width of opening should be slightly greater than the height; a minimum depth of 18in. is advisable although 12in., in small fireplaces, will provide a good draft with properly constructed throat.

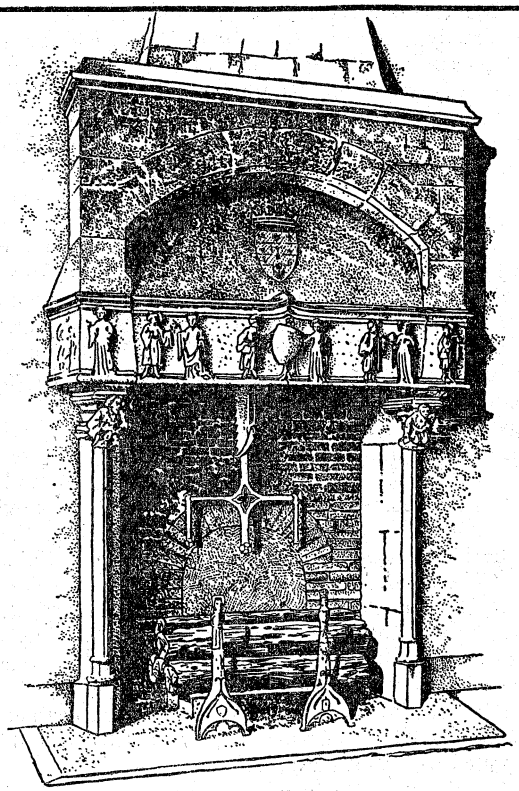
Efficiency of fireplace heating can be improved materially by the use of a fireplace heater which heats all incoming air before it enters the room. These devices consist of an intake air manifold, into which air from the outside is drawn and delivered into heat pipes lining the rear wall of the fireplace, from which it passes into a heated air manifold and is then delivered into the room directly above the fireplace openings at temperatures varying from 135° to 195° F. Tests have shown that the use of a proper fireplace heater is the means of increasing measurably the effectiveness of fireplace heating, through, (1) raising the room temperature $3\frac{1}{4}$ times as quickly as can be done with the bare fireplace, (2) maintaining a far more even temperature throughout the entire room, (3) avoiding cold air leakage through window and door cracks and (4) by producing a greater heating effect with less fuel than when no heater is used. (A. M. D.)

See J. J. Norman, *Design of a Brick Chimney* (1913); J. G Mingle, *Draft and Capacity of Chimneys* (1925); A. Custodis, *Radical Brick Chimneys* (1924).

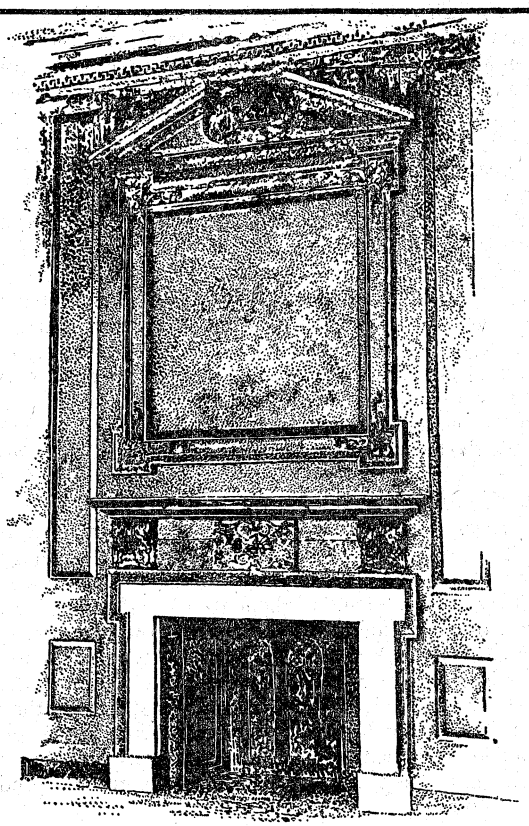
CHIMNEY-PIECE, in architecture, originally a hood, projecting from the wall over a grate, built to catch the smoke and lead it up to the chimney flue; later, any decorative development of the same type or for the same purpose; a mantel or mantelpiece. Like the chimney (*q.v.*), the chimney-piece is essentially a northern mediaeval development. Its earliest form, a simple hood, sometimes with shafts below, at the wall, is shown in the king's house at Southampton and at Rochester castle, England (12th century). Later, the spaces under the ends of the hood were made solid, so that the fireplace became a rectangular opening, and in some cases the fireplace was recessed into the wall. Late mediaeval fireplaces are of great size and richness, *e.g.* the triple fireplace in the great hall of the Palais des Comtes at Poitiers, and the earlier fireplaces in the château of Blois.

During the Renaissance fireplace openings were decorated with columns, pilasters and entablatures, and occasionally the front of the wall or hood above the overmantel was enriched. North Italian palaces are full of examples of great delicacy. In France the fireplaces at Blois and Chambord are famous. In England, the same formula appears in naïve and complex types, with the usual Elizabethan and Jacobean *mélange* of misunderstood classic and Flemish motives—strap work, gaines, etc. In France, after a brief classicism under Henry II. and Henry IV., the chimney-piece became a centre of fantastic design. Although the opening was usually small, the decoration was rich, and commonly characterized by the use of a great mirror as an overmantel. The detail assumed the classic extravagance of the Louis XIV. style, the swelling curves and bulbous shells of the Louis XV. and the distinguished restraint of the Louis XVI. styles, but almost always retained the same general proportions and the mirror. German design largely followed that of France; chimney-pieces are less numerous there, however, owing to the use of porcelain stoves.

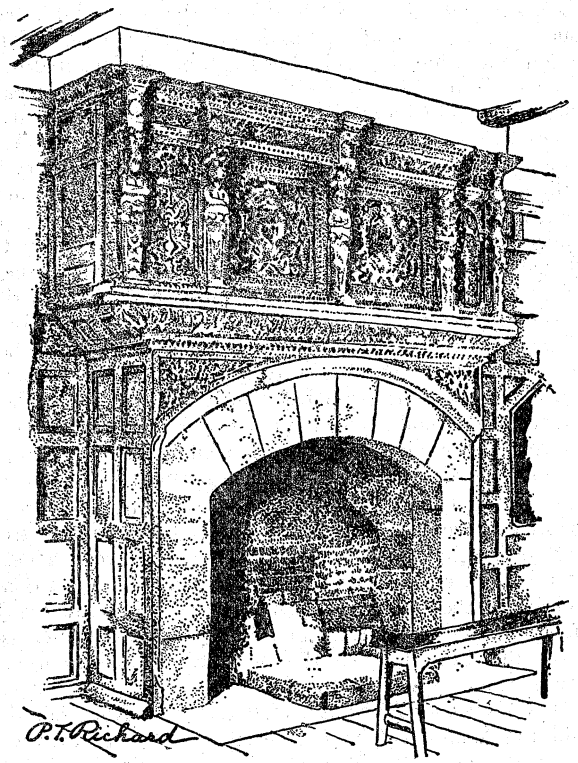
In England the Renaissance chimney-piece was at first treated, with simple architraves, frieze and cornice, in such a way as to serve as mantel shelf, occasionally with rich panelling above, and much breaking or keying of the mouldings. Later, consoles, caryatides and columns were used, although occasionally a simple moulding of sweeping profile replaced the architrave, and the shelf was omitted. In the last half of the 18th century the char-



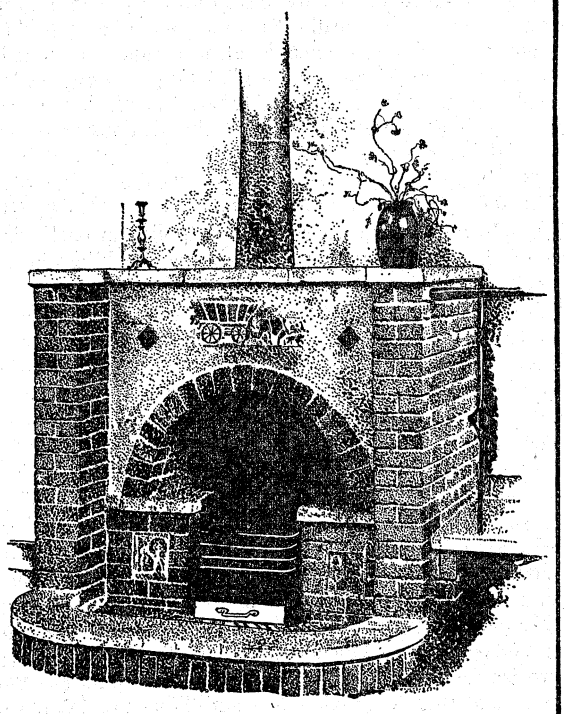
FRENCH GOTHIC 15TH CENTURY
(IN CLUNY MUSEUM, PARIS)



AMERICAN COLONIAL 1762
POWELL HOUSE, PHILADELPHIA



ENGLISH JACOBEAN, 17TH CENTURY
STOKESAY CASTLE, ENGLAND



MODERN ENGLISH
(STUDIO OF F. R. WALKER)

MODERN ENGLISH CHIMNEY PIECE BY COURTESY OF "THE AMERICAN ARCHITECT"

CHIMNEY-PIECES FROM THE 15TH TO THE 20TH CENTURIES

The early fireplaces of the Gothic period were enormous in order to permit the burning of large logs, but the manner in which they smoked led to a continued decrease in size, which reached a climax in modern English chimney-pieces designed for burning coal. The projection of the chimney breast has always been realized as a decorative opportunity and was developed in nearly all the Renaissance styles

acteristic English chimney-pieces, in the style of Robert Adam, owed much to Louis XVI influence. In American colonial work, there is an almost exact following of English precedent, and occasional examples can be traced to definite plates in English architectural books.

CHIMPANZEE, the popular name of one of the African anthropoid apes (*Pan troglodytes*), characterized by being smaller than the gorilla (*q.v.*). It has very large, outstanding ears and its abundant hair is black in colour. Frequently the area around the mouth is white. Males are only slightly larger than females; they weigh about 120 lb. and standing erect may be about $4\frac{1}{2}$ ft. in height. The chimpanzee is found from French Guinea to western Uganda and Belgian Congo. A pygmy species (*Pan paniscus*) occurs on the south side of the Congo river, but the various forms farther north, although they show great variation, are probably only races of the common species. The nomenclature of the chimpanzee is greatly complicated, partly owing to confusion with the orang-utan by early writers. *Anthropopithecus, Troglodytes* and *Simia* are frequently used as generic names, although the last has been ruled invalid for any animal.

Chimpanzees are forest animals living in small family groups—an adult male, one or several females, infants and several partly grown young. It takes 9 to 12 years for them to reach maturity. The territory of such a band is about 10 miles square. These apes spend most of their time in the trees, where they construct crude sleeping platforms high above the ground. On the ground chimpanzees walk on all fours, using the knuckles of the hands. The skin shows friction ridges and is horny, like that of the palm. They occasionally stand upright, but rarely walk in this position unless trained. Chimpanzees have a sense of rhythm, shown by a kind of dance, and they drum on trees or the ground, producing a primitive music.

Their food includes many fruits, shoots of certain plants, occasionally varied by insects and birds' eggs. They raid cultivated fields of cane, pineapple, cacao or bananas.

The popular interest in this ape lies in its resemblance to man. Physiologically and anatomically it is more like man than like the tailed monkeys. Its intelligence is also manlike, as has been amply shown by experiments and studies by psychologists Wolfgang Koehler, Robert M. Yerkes and others. The lack of capacity for speech seems absolutely to preclude the attainment of a culture or social inheritance. (*See* PRIMATES.)

See R. M. Yerkes, *Almost Human* (1935); *The Great Apes* (1929); W. Koehler, *The Mentality of Apes* (1925). (J. E. HL.)

CHIN, a Burmese term for a hill-man applied in particular to branches of the Kuki (*q.v.*) race, inhabiting the hills along the west bank of the Chindwin river south of Manipur.

CHINA, a vast country of eastern Asia containing over 400,000,000 inhabitants, is the scene of the oldest contemporary civilization and the world's largest cultural unit. Its official name is Chung-Hua Min-Kuo, *i.e.,* Republic of China.

See CHINESE ARCHITECTURE, CHINESE LITERATURE, etc.

The dominion of China in the widest acceptance of the term, includes Manchuria, Mongolia, Sinkiang and Tibet, occupying an area estimated at 4,277,060 sq.mi., which is about one-third larger than that of continental United States. It is bounded by Korea, Siberia, Russian Turkistan, Afghanistan, India, Burma, Indo-China and the Pacific ocean. The area of its component parts is as follows: China Proper (excluding Manchuria) 1,532,420 sq.mi., Manchuria 363,700 sq.mi., Mongolia 1,367,600 sq.mi., Sinkiang 550,340 sq.mi., Tibet 463,000 sq.mi.

The precise relationship of her dominions to China has varied from age to age and Outer Mongolia and Tibet are (1944) only technically subject to China while Manchuria and the greater part of Inner Mongolia are momentarily controlled by the Japanese.

(*a*) **China Proper** (the essential China) contains 18 provinces, which are overwhelmingly Chinese in population and culture. Here dwell the vast majority of the Chinese. The appellation China Proper, as used throughout this article, has reference solely to these provinces. It should be stated, however, that the Chinese now apply this term to a far larger area, since, in the years following the revolution of 1911, which resulted in the fall of the Manchu dynasty and the establishment of the republic, China directly incorporated many of its dependencies in order to knit its outlying districts more closely with the central government. As a result of this administrative consolidation, China consists officially of 28 provinces, which include the 18 mentioned above, the 7 provinces of Manchuria and Inner Mongolia and Sikang, Chinghai and Sinkiang in the west.

(*b*) **Manchuria.**—In 1932 the Manchurian provinces of Liaoning, Kirin and Heilungkiang, together with the former Inner Mongolian province of Jehol, were erected through the instigation of the Japanese into the so-called state of Manchoukuo. Although it has *de facto* relations with the soviet union, Manchoukuo has not been officially recognized by China or the world at large.

(*c*) **Mongolia.**—The term Mongolia as used to denote either a political or a cultural entity, is now misleading. There is a vital distinction between Outer and Inner Mongolia. *Outer Mongolia,* essentially Mongol in race and character, has asserted its independence and is autonomous. Its orientation is to the Union of Soviet Socialist Republics and the Trans-Siberian railway; but China has not relinquished its claims and the Sino-Soviet treaty of 1924 and its reaffirmation in 1936 recognized that "Outer Mongolia is an integral part of the Republic of China and respects China's sovereignty therein." Its precise international status must be regarded as still uncertain. On the other hand, *Inner Mongolia,* until this process was interrupted by the Japanese advance, has become increasingly Chinese in population and character and the area comprised within it, together with portions of the adjacent provinces of Hopei and Shansi, has been divided into the four provinces of Ningsia, Suiyuan, Chahar and Jehol and incorporated with China Proper.

(*d*) **Sinkiang,** or the New Dominion, on the extreme western frontier, consists of Chinese or Eastern Turkistan, Kulja and Kashgaria, *i.e.,* virtually the area between Outer Mongolia on the north and Tibet and Kashmir on the south and is technically but only partly in fact, a province of China. It is mainly inhabited by non-Chinese peoples but has been administered by Chinese officials. In the past 25 years Russian influence has been steadily increasing and Chinese control is more or less nominal.

(*e*) **Tibet.**—No more than Mongolia can Tibet be considered as a single political or administrative unit. The country has been split up and the term in a political sense is now applicable primarily to the southwestern portion of the country which is under the Lhasa government and whose relationship to China is analogous to that of Outer Mongolia. The Anglo-Chinese treaty of 1906 recognized China's suzerainty and Great Britain and Russia in 1907 agreed to negotiate with Tibet only through China. But the Lhasa government is virtually independent. On the other hand, China has actively asserted her interests in those peripheral portions of Tibet which can menace either China Proper or the vital corridor leading by way of Kansu to Sinkiang. To protect these interests along the Tibetan border two provinces under direct Chinese rule have been formed:

1. *Sikang* (the Szechwan marches and Yunnan marches), was created by uniting eastern Tibet with the mountainous western part of Szechwan. This acts as a buffer between Tibet Proper, and western central China. In consequence of the westward migration of the Chinese government occasioned by the Japanese invasion, Chinese activity in this region greatly increased after 1937 and Chungking in the province of Szechwan was made the wartime capital of the republic.

2. *Chinghai* or *Koko-nor,* embracing the Koko-nor depression and the Nanshan (the northeastern ramparts of the Tibetan plateau) protects the Kansu-Tarim corridor and presses back the Chinese frontier into Tibet.

Physiographically speaking, China Proper consists of three great river systems, the northern part of the country being drained by the Hwang-ho, the central part by the Yangtze Kiang and the south by the Si Kiang. All three rise in the high plateau regions of the west and flow irregularly to the east. The Manchurian plain is a continuation of the monsoon-watered lowlands which extend beyond the eastern terminus of the Great Wall which marked the boundary of the original Chinese culture area.

The four provinces of Inner Mongolia contain the relatively fertile southern and eastern margins of the Desert of Gobi, open to colonization from China and Manchuria. Distant Sinkiang is largely made up of the great depression lying between the lofty Kuen-lun mountains (the northern buttress of the Tibetan plateau) and the Tien-shan range. Where these great chains converge in the mountain-knot of Kasgaria and the Pamirs, occur the famous passes which, through all history, have connected China with the west by routes which follow both the northern and southern margins of the Tarim depression to Kashgar and Yarkand. The Tien-shan and the grassland of the Jungarian gate lying between them and the Altai range to the northeast, are also included within Sinkiang province, which derives its chief significance as the only practical land communication between China and the west and northwest. The oasis-studded margins of the Tarim depression and the rich grasslands of Jungaria also give Sinkiang agricultural importance.

Thus the outlying "dependencies" still more or less vaguely attached to China are in varying degrees related geographically to the main scene of Chinese civilization and are vital factors in her future.

I. THE COUNTRY

The immense terrain indicated in the preceding section is exceedingly diverse. Even within China Proper there is great variety of structure, climate and vegetation.

THE GROUND PLAN

It is to middle and southeastern China that the description of China as a land of river-valleys is most applicable. There the Yangtze Kiang and Si Kiang occupy well-defined valleys, each of which is the focus of the population and of the activity of the basin and still serves as the principal artery of commerce within it. In contrast the Hwang-ho (called "China's sorrow" because of its repeated and devastating floods), the great river of the north, has no such well-defined valley. In its upper course it hurries through deep gorges and in its lower course wanders over the wide open plain in a channel liable to shift bodily for hundreds of miles. Thus the Hwang-ho is not the clearly defined arterial line of north China as the Yangtze is of middle China, and, in the absence of any such unifying influence, the natural division of the north is into the great plains of its eastern and the loess-covered plateaus of its western sections. The initial distinction to be made is between the plains and loess-covered uplands which make up north China and the mountain and valley country of middle and south China. Between these two sections interpose, in the west, the high ranges of the Tsinlingshan, an eastern extension of the Kuen-lun and the sharpest climatic and vegetational divide in the whole of China Proper. Eastward the Tsinling ranges sink into the Fu-niu-shan and then the Hwai-yang-shan.

The uplands of northwest China form a broad belt from Jehol to Kansu keeping north of the Tsinling divide. Loess, it is true, extends down from the uplands into the north China plain, but it here lies too low to affect the topography in the same distinctive way as in the uplands, the loess-lands proper. These take the form of a girdle around Mongolia, a high rolling tableland, in places swept clean of any rock detritus, but in others piled high with sand-dunes and a principal source of the wind-borne loess of northwest China. The loess mantle, leaving only the ridges exposed, yet with a thickness of rarely more than 200 ft., weathers because of a strongly developed vertical cleavage into a topography of cliff-edges and steep-sided terraces. The same vertical cleavage is responsible for the porosity of the loess which, while accentuating the dryness of the plateau surface, gives rise to a relative abundance of water in the numerous basins within it. The loess is, however, no more than a mantle cast over a ground surface which remains independent of it.

The northern part of the belt consists of a parallel series of high, broad ridges separated by equally broad loess-filled troughs, the whole running from northeast to southwest across the routes between the north China plain and the Mongolian plateau. The route between Peking (Peiping) and Kalgan, the gateway into Mongolia, utilizes, however, the transverse valley of the Hun-ho and the easy Nankou pass. Southwards the ridges gradually sink beneath the plateau of south Shansi whose southeastern part constitutes a coalfield of the size of Wales. Let down beneath the general surface of this plateau is a chain of exceedingly fertile loess basins stretching from Tai-yuan in the north by way of the Fen-ho to the Wei-ho valley in Shensi. Leading from the plain into west China, this chain of basins was followed by the Imperial Courier road from Peking to the western province of Szechwan and from the establishment of Peking as capital until the advent of the railway, it was this rather than the Hwang-ho which formed the main artery of commerce in the southern loess-lands. The loess belt as a whole constitutes one of the most distinctive regions in all China.

The North China Plain.—The second major division of north China is the great plain which in the north communicates by a narrow lowland corridor with the plains of Manchuria and in the southeast merges imperceptibly with the delta of the Yangtze. Rising partly out of the plain and partly out of the Yellow sea, on which the plain is steadily encroaching, are the broken uplands of Shantung. The Hwang-ho has passed at certain periods to the south and at others to the north of them. The drainage of the plain is, however, to a large extent independent of the Hwang-ho, the streams of the northern portion finding their outlet by the Hai-ho at Tientsin and of the southern by the Hwai-ho, much of whose basin was for long a vast swamp. Shifting of channels has spread river sand and gravel, and the plain is not so continuously fertile as the deltaic alluvium of the Lower Yangtze.

The Shantung uplands are divided into two masses by a broad lowland now followed by the Shantung railway from Kiaochow bay. The eastern peninsular half faces the very similar peninsula of Liaotung. Both lie athwart the seaward approaches to the plains of Hopei and of Manchuria and their well-articulated coasts offer the best harbours in north China.

Thus in north China the loess and the plain give considerable uniformity of surface conditions and have always been in close relationship. In south and middle China mountain ridge and valley succeed each other apparently without end. The only large tableland is that of Yunnan in the southwest. The largest plains are simply expanded valley-basins and nowhere approach the bulk of the north China plain. Again, there is nothing to parallel the superficial uniformity bestowed on northwest China by the loess mantle. If the keynote of the surface of north China be uniformity, that of middle and south China is variety.

South China Highlands.—To the rugged country south of the Yangtze the term South China Highlands is often applied. In the east, high ranges overlook the broken country of the coastal provinces (Chekiang, Fu-kien and Kwangtung). In the west and southwest the characteristic form is that of massive and lofty plateaus. The intermediate country of south-central China is in the nature of a saddle between the eastern scarps and the western tableland, and across it the main routes from the Yangtze valley pass to that of the Si Kiang. The approach from the Yangtze is by way of the Siang and Kan valleys leading up to the Che-ling and Mei-ling passes respectively, the routes from both of which converge to pass down the Pei-kiang valley to the delta of the Si Kiang.

The central Asian background of middle and south China is not the Mongolian plateau but the high mountain ranges of the Tibetan highlands and the "march lands" of Szechwan. These ranges trend from north to south and confine the drainage in parallel longitudinal channels. Of the great rivers which flow southward from Tibet, only the Yangtze escapes to the east through a complex series of gorges. After this torrential descent from the Tibetan highlands, the Yangtze flows through the Red basin of southeastern Szechwan, the first of a chain of basins characterizing its later course. But, unlike those further downstream, the upland Red basin is so cut up by hilly country that the only

plain of any extent is that of Chêngtu at the foot of the high ranges of the Szechwan marches. This basin, almost completely ringed around by high mountain country, is a region apart, communicating with the rest of China mainly by way of the difficult route of the Yangtze gorges cut through the mountain rim. Below the gorges the Yangtze begins its true valley course. In this valley course the Yangtze first flows through the lowland alluvium-covered basin of Hupeh, on which converge the important river valleys of the Han from the northwest, the Yangtze from the west, the Yuen and Siang from the southwest and south. The latter empty into the Tungting lake which in turn debouches into the Yangtze. The routes from the north to south China, crystallized in the Peiping-Hankow-Canton railway, here cross the west-to-east arterial route of the Yangtze valley. This is pre-eminently the central basin of China. Below it the Yangtze, though passing through several small basins as that of Wuhu and skirting the margin of the larger Poyang basin of Kiangsi, does not itself flow through a basin of comparable size until its delta begins at Nanking. The delta is in the nature of an incompletely filled basin (the Chusan archipelago marks part of its eastern rim), but it is advancing seawards at the rate of one mile in every 60 years. As the Yangtze has at this stage deposited all its coarser detritus, the delta consists much more uniformly of fertile silt than the central basin farther upstream.

South China.—The characteristics of the Si Kiang in south China are quite different from those of the Yangtze. It has a normal valley course, without basins, through the south China highlands until it finally broadens out to form its delta. Its upper valley is entrenched in the southeasterly prolongations of the Yunnan–Kweichow plateau, but its lower cuts through the scarped country of southeast China. The routes linking the Si Kiang with the rest of China, whether by land over the saddle between the southeastern ranges and the southwestern plateau, or by sea, all lead from Canton, the unmistakable focus of south China. The orientation of Canton, separated from the central Yangtze basin by the whole breadth of the south China highlands and looking out over the sea towards the Indies, strongly contrasts with that of the north, encompassed by steppes and deserts. (*See* CANTON.)

The maritime provinces of southeast China, between the Canton and Yangtze deltas, form a very distinct region dominated by the southwest–northeast ridges which culminate westwards in the high axial range of the Ta-sha-ling on the Fu-kien–Kiangsi border, the watershed between the Yangtze drainage and the basins of several relatively small coastal streams.

This highly diversified region communicates with the rest of China more naturally by sea than by the difficult interior mountain passes and is a little world apart. (*See* FU-KIEN.)

The deeply dissected plateau of southwest China stands apart from the scheme of river-basins here outlined and, as an immense watershed, forms another distinct entity. In Kweichow the plateau is lowest and most dissected by winding river courses, but it rises towards the west, and in eastern Yunnan the rolling surface of the tableland is broken only by deeply trenched valleys and sunken lake basins. Farther west the trenches become deeper and the tableland between them narrower until, in western Yunnan, the plateau disappears and there is left a succession of high, narrow north-south ranges and very deep river troughs, belonging to the system of parallel chains and troughs of west Indo-China. The approaches to the southwest plateau from the heart of China are tortuous enough, but these north–south ranges and troughs of west Yunnan make it almost inaccessible from the west. Hence its orientation is towards China with which it has been gradually incorporated, but it was the latest part of the country to be colonized.

Mineral Resources.—In minerals China is handicapped in its efforts at industrialization. It has extensive deposits of coal, widely distributed, but especially in the north. However, it is deficient in iron and petroleum. Iron is found in many of its provinces but in insufficient quantities or unsuitable forms to constitute the basis of a large industry. Petroleum is very limited. Oil shales occur, especially in Manchuria, but a practicable inexpensive method of utilizing them has yet to be devised. Later surveys may alter these findings, but probably not materially.

Coal measures of workable bulk occur at two geological horizons —the Permocarboniferous and the Rhaetic-Lias; the coals of the latter are commonly more friable and of generally poorer quality than those of the Permocarboniferous. There is an important difference, too, in their distribution. The Permocarboniferous occur mainly in north, the Rhaetic-Lias mainly in south China. In both north and south China the larger fields lie towards the west, so that the smaller fields near the sea have considerable commercial significance.

The Permocarboniferous plateau of southeast Shansi forms by far the greatest Chinese coal field; continued, in more broken form, on either side in the troughs of southwest Shansi and in the faulted blocks at the foot of the Tai-hang-shan. Coastal position gives significance to the small fields of Fushun in south Manchuria, Kaiping in Hopei, and, though less important, Poshan and Ihsien in Shantung. In south China the most accessible and most valuable fields lie in the Siang valley along the corridor route from the central basin to the Canton delta. These are of Permian and, at Pinghsiang, of Rhaetic age. In the west the Rhaetic coal measures cover immense areas in the plateau of Kweichow and west Kwangsi and underlie most of the Red basin of Szechwan. Their coals are, however, very friable, especially those of Szechwan. Many synclinal troughs of southeast China contain Permocarboniferous coal measures which owe their significance to their proximity to the coast.

In the distribution of metallic ores there are again real differences between north and south. In north China and in the lower Yangtze valley iron is almost the only metallic ore of importance, but in south China there is a great variety of ores including tin, copper, lead, zinc, antimony, tungsten, manganese and mercury, as well as iron. Of the iron ores four main types occur. Interbedded with both Permocarboniferous and Rhaetic-Lias coal measures are nodules and lenses of carbonate ores. The Archaean ores in the Liaotung massif of south Manchuria are similar in nature to those of the Lake Superior ranges, though of lower grade. Scattered over north China, but especially abundant along the line of the Lower Yangtze, just outside the Sinian mole, there have been developed numerous magnetite-haematite iron ore bodies wherever granodiorite is intrusive into limestone. Although limited, they are important in the iron industry of the far east owing to accessibility from the Yangtze. About equal in bulk to these contact deposits along the Yangtze are the oolitic haematites bedded in the pre-Cambrian of the "grill of Peking." Copper is fairly widely found and has been mined in the present century chiefly in Yunnan, Szechwan, Kansu, Sinkiang and Manchuria. In antimony and tungsten China has an important place in the world's mineral resources. Most of the larger deposits of other ores are concentrated into two areas: the first around the Nan-ling mountains on the border of Hunan with Kwangsi and Kwangtung and in upper Hunan; the second in eastern Yunnan and adjoining parts of Szechwan and Kweichow. The Nan-ling is the centre of a number of tin fields as yet largely unworked. Northwards the tin is replaced by the lead-zinc ores of Shui-kou-shan in the upper Siang valley, which in turn give way to the antimony of central Hunan. In Yunnan the tin also lies in the south, near Mengtz, and the lead-zinc farther north in northeast Yunnan with Tungchwan as the centre. Even more important, however, in this region, is copper. Yunnan indeed with its tin, lead-zinc and copper is the most important mineral region in China for ores other than iron.

CLIMATE

China has a "continental" climate—extreme heat in summer and extreme cold in winter. Its winds are predominantly offshore in winter, and onshore in summer, forming winter and summer monsoons. The northerly outflowing winds of winter give its dry season, the southerly inflowing winds of summer its season of rains. Unlike India, hemmed in by the Himalayas, China is open to central Asia by way of Mongolia from which strong and very cold winds sweep down in winter. So, too, in summer, China, unlike India, is not the single objective of the air circulation of a

whole ocean and its monsoon consequently yields a less heavy and less concentrated rainfall spread much more equally over the interior. China, moreover, is a warm temperate rather than a tropical land, only its extreme southern fringes lying to the south of Cancer.

The winter monsoon sweeps over China from the northwest, but southwards it becomes first northerly in the Yangtze delta and then, combining with winds blowing off the sea, northeasterly along the south China coast. North China experiences the northwesterly and the south China coast the northeasterly regime during the whole winter monsoon (September to March). The intermediate Yangtze delta is affected by the land winds only from October to February; in September and again in March the prevailing winds are northeasterly from off the China seas. Between the winter and the summer monsoon comes a transitional period of calms (April and May) with light southerly breezes. The southeast monsoon, never as strong as the northwest monsoon of winter, blows from June until August and, sweeping in from the sea, gives China the bulk of its rainfall and also a striking uniformity of temperature, in strong contrast to the great regional variation in winter. Only locally, as in the Formosa channel, does the wind drift become southwest.

Exposed to the full blast of the northwesterlies from central Asia, north China experiences exceptionally severe winters, the coldest in the world for its latitude. On latitude 40° N., Peiping has an average January temperature of 23.5° F., St. Louis, Mo., of 31.0° F. and Naples of 46.8° F. The whole of China north of the Hwai river has at least one month whose mean temperature is below freezing point. The Yangtze valley is warmer, with temperatures in the depth of winter more like those of Britain, although the winter itself is much shorter. Yet the expanses of the Tungting and Poyang lakes in the Yangtze valley, in flood after the summer rains, are at times frozen over. South China has definitely warm winters, those of Hong Kong being as warm as an English midsummer, although snow has been known in Canton. The winter, even in north China, is comparatively short, and spring is nowhere long delayed. Summer uniformity is such that the midsummer temperature of Peiping approaches to within 3° F. of that of Hong Kong (July 81.7°). The high temperatures are, however, much less prolonged in the north. It is agriculturally important that south China has temperatures of over 60° F. practically throughout the year, the Yangtze for six to seven months, and north China for five months. The Yangtze valley has a temperate climate, with neither the extremes of north China nor the uniformly high temperatures of the south, and this feature is most pronounced in the sheltered Red basin of Szechwan which, although far in the interior, has milder winters and cooler summers than the valley below the Gorges. (*See* SZECHWAN.) Southeast China, ridged more or less at right angles to the monsoonal current, receives as a whole (the Fu-kien coast excepted) a higher annual rainfall—about 60 in.—than the plateaus of southwest China and the basin of Szechwan far in the interior, with about 40 inches. The average rainfall for the basins of the lower Yangtze is slightly higher. The summer rainfall of southern China seems to be evenly distributed, save for exceptional precipitation on the southern coastal strip. High relief in southwest China counterbalances its interior situation, and so promotes this relative uniformity. North China, on the other hand, has a comparatively low relief and is a greater distance from the source of moisture. Hence while the Yangtze delta has about 45 in., the plain to the north of the Hwai river receives from 20 to 30 and the loess plateau of northwest China less than 20; the rains die away altogether as the Gobi desert is approached.

Taking China as a whole, the rainfall is heaviest in the season of the southeast monsoon and least at the height of the northwest monsoon in midwinter. Peiping, as typical of north China, receives 75% of its precipitation during the summer months. But only 41% of the total fall of Shanghai occurs in that season. The Yangtze valley in winter receives occasional cyclones which draw in air from the south and from the sea on their southern flanks. These southerly winds temporarily replace the winter monsoon and bring rain. On the hilly coastlands of Chekiang and Fu-kien further precipitation occurs from condensation of moisture brought by the northeast monsoon. Thus the Yangtze valley and the coastal provinces of the southeast have a more evenly distributed rainfall than any other part of China.

VEGETATION

It is very difficult to reconstruct the primitive vegetation, for the face of nature has been greatly changed by long and intensive cultivation, and woods particularly have been destroyed. From the evidence of what remains, the natural vegetation of by far the greater part of China must have been woodland of peculiar richness and variety. The climate favours profusion of growth and the complex topography, especially of the south China highlands, where temperate and subtropical forms "dovetail" into each other, induces great variety of species. China has some 9,000 flowering plants, about half endemic, mainly in the valleys of the southwest. The Chinese flora, in fact, represents the overlap of the Indo-Malayan, the Palaearctic of the north European and Siberian plains and the Himalayan. The flora so compounded escaped any extensive impoverishment during the Ice age. In both North America and China plant forms could migrate southwards more freely before the ice sheets than in Europe, where they were crushed between the Scandinavian and Alpine ice and destroyed. The genera *Magnolia, Liriodendron, Menispermum* and *Nyssa* survive in both China and North America, though represented by different species, but they have been exterminated altogether in Europe.

The marked climatic rhythm of north China, which induces luxuriance of growth in summer but eliminates all but the hardier plants in winter, produces the supreme expression of the cool temperate, broad-leaved deciduous forest. The dominant trees, however, are not oaks and beeches, but more southern forms as the paulownia, catalpa and broussonetia, the paper tree. But in north China the woodland covering must always have been scantier and less continuous than in any other region: in the loess-lands only the better-watered ranges can have been forested and the north China plain probably consisted as much of heath and marsh as of forest. In the Yangtze valley the milder and rainier winter imposes no such check on plant life and broad-leaved evergreens replace deciduous trees. But deciduous and coniferous woods, though of a southern type, persist on the higher ranges and subtropical trees like camphorwood, the tea tree and the bamboo creep up the river valleys. The bamboo, which serves an enormous number of purposes, is, unlike any other, a cultivated tree, grown in groves throughout China south of the Tsinling. The variety of plant life, typical of China as a whole, reaches its highest development in the Yangtze valley and the south. Certain tropical forms, *e.g.*, the tall palm and banana, are typical only of the lowlands of Kwangtung and Hainan, while others do not penetrate beyond the northern waterparting of the Si Kiang. The tropical forest of the valleys gives way on the lofty plateau of southwest China to grasses and shrubs, including many rhododendrons and trees and herbs of common European genera.

Even in the south China highlands, deforestation, though not so complete as in north China, has restricted the forests to the less accessible mountain slopes, long the refuge of non-Chinese tribes; the more extensive are along the eastern edges of the Kweichow plateau and the axial ranges of the Fu-kien–Kiangsi border. They are made up of both deciduous (oak and chestnut) and coniferous trees (*Cunninghamia* fir and subtropical pines). These woods supply timber to south China and the Yangtze valley, while north China is dependent on the forests of the east Manchurian highlands. Throughout China there is urgent need for reafforestation.

It must be noted, moreover, that many cultivated plants have been brought into China from the outside in historic times. Among these are cotton, tobacco, maize, the sweet potato and the peanut.

ANIMAL LIFE

Profusion of vegetation and variety of relief have fostered the development of a fauna of great diversity and have permitted

the survival of animals elsewhere extinct. The diversity of the animal life is greatest in the ranges and valleys of remote western China, and there mainly occur the forms peculiar to the country. Among these are the panda or cat-bear of the Tibetan border, the takin or goat-antelope of the Tsinling country, numerous species of pheasants and laughing thrushes, the little Yangtze alligator (the only surviving alligator of the old world), the giant salamander of central and south China, and several members of the carp family for which China seems to have been one of the chief centres of dispersal. The faunistic provinces are much less clearly defined than the botanical. While in north China the steppe animals have central Asian and the forest animals Siberian affinities, and into south China Indian and Malayan forms have penetrated, in the Yangtze valley a Palaearctic fauna persists on the mountain ranges, but the valleys between harbour the tropical oriental fauna. Although Palaearctic, the animal life of these ranges is Himalayan in its affinities, whereas that of north China is Mongolian and Siberian. The Tsinling make a sharp divide between the forms inhabiting cool temperate and warm temperate latitudes in fauna as well as in flora. Owing to this overlap, increased by interpenetration of ranges and valleys, the Yangtze valley has a varied fauna as well as a rich vegetation.

Summary.—From the data discussed under the previous headings it is possible to summarize the essential characteristics of each of the great natural divisions into which China falls from the standpoint of physical geography. Such a synthetic view is extremely helpful to the understanding of the human and economic conditions discussed in later sections. Manchuria and Inner Mongolia, which lie beyond the Great Wall, the historic frontier of China Proper, are excluded from this summary.

I. North China.—A very distinctive major division. *Natural limits:* On the northwest and north the belt of scarps separating the northern apex of the plain from the rolling but relatively level Mongolian plateau. The outermost scarps, followed by the Great Wall, constitute a marked boundary. On the southwest and south the Tsinlingshan continued by the Funiu-shan and Hwai-yang-shan, forming the most decisive climatic, vegetational and economic divide in China. To the southeast no clear delimitation exists but historically the Hwai marshes were a great barrier.

Provinces included within this natural division: Hopei, Shantung, Shansi, most of Shensi and Honan, northern Anhwei, northern Kiang-su.

Essential characteristics: Light and mainly fertile soils, chiefly loess and alluvium. Cold, severe and dry winters with strong winds, often bringing dust storms from the northwest. Summers hot with a somewhat short rainy season; rainfall normally sufficient for agriculture but liable to fail. Rivers of little use for navigation (hence transport mainly by mule- or horse-drawn vehicles on sandy roads) and peculiarly liable to flood. Agriculture largely suspended in winter and precarious because of drought and flood. Famines common. Natural vegetation and cultivated products mainly temperate. Essentially treeless.

Orientation of region: Open historically to the mass movements of nomadic hordes from both Mongolia and Manchuria.

Chief subregions within the major division: loess plateau and associated basins, alluvial plain, Shantung highlands.

II. The Basin of the Lower Yangtze.—*Natural Limits:* On the north the Tsinlingshan and its easterly continuations; on the south the Nan-ling, the divide between the Yangtze and the Si Kiang, and on the southeast the series of ranges known collectively as the Tayu-shan, the divide between the Yangtze and the independent coast streams. On the west the Yangtze gorges above Ichang.

Provinces included within this natural division: Hupeh and adjacent portions of south Shensi and southwest Honan, southern Anhwei, southern Kiang-su with the northern fringe of Chekiang, Kiangsi and Hunan.

Essential characteristics: Rich alluvial basins and valleys, separated by broken, hilly country, still in part forested. Winters mild to cool, with some cyclonic rains. Summers hot and wet. Meeting ground of temperate and subtropical species, pines, chestnuts, maples on the one hand, and some palms, camphor-woods, etc., on the other. Basis for a very wide range of cultivated products, northern cereals in winter, rice, cotton and tea in summer. Agricultural activity continuous throughout the year. A magnificent system of natural waterways.

Orientation of region: The heart of China and the region most in touch with all other parts of the country.

Subregions within the major division: Numerous, the two most important being the Yangtze delta and the Central (Hupeh) basin.

III. The Red Basin of Szechwan.—*Natural Limits:* Clearly defined on all sides by lofty mountain chains. (Tapa-shan on north and northeast, Szechwanese Alps on northwest, west and southwest) or high plateau edge (Kweichow plateau on south) and steep scarps (southeast Szechwan).

Provinces included within this natural division: The whole of Szechwan save its high mountainous margins.

Essential characteristics: A large upland basin of red sandstone, dissected by river action into uplands and broad valleys whose sides lend themselves to extensive terracing. Climatic conditions similar to those of the lower Yangtze, but with marked tendency to fog and cloudiness and very equable temperature regime. Rainfall assured. Famines due to drought or flood are rare. Vegetation shows admixture of Himalayan forms. Range and character of cultivated products similar to those of lower Yangtze.

Orientation of region: Isolated and self-contained. Slight and difficult contact with the rest of China by the Yangtze gorges. The chief supply base for eastern Tibet.

IV. Southeast China.—*Natural limits:* The southern watershed of the Yangtze, as defined above, on the north; the high edge of the Kweichow plateau on the west, and the south China sea on the south and southeast.

Provinces included within this natural division: The maritime provinces of Chekiang (except northern fringe), Fu-kien and Kwangtung, together with lower Kwangsi.

Essential characteristics: A core of very ancient rocks, crumpled into prominent ridges trending southwest-northwest; a sea of mountains, valleys and small basins. A long, faulted coastline, highly articulated, with many independent rivers, generally unnavigable except in their lower courses. Topography fosters existence of many separate economic nuclei and great variety of dialects. Rainfall high, and dry season short. Climate subtropical to tropical in the basins and lower valleys, permitting of two or more rice crops, but winters in the highlands relatively cool.

Orientation of region: Essentially maritime; close connections with Indo-China and Malaya; communications with rest of China on landward side very difficult.

Subregions: Numerous, including Canton delta and lower Si Kiang valley, Swatow, Amoy and Foochow valley basins.

V. Southwest China.—*Natural limits:* On the north the Red basin, on northwest and west the lofty north-south ranges continuing the Szechwanese Alps through western Yunnan. On the northeast the basin of the lower Yangtze; on the southeast the upper basin of the Si Kiang. The natural limits to south and southwest are beyond the political frontier of China, thus including within this natural region much of the Shan plateau of upper Burma and the Laos country of northern Siam.

Provinces included within this natural division: Kweichow, central and southern Yunnan and western borders of Kwangsi.

Essential characteristics: A high tableland of sedimentary rocks, trenched by deeply incised valleys with torrential streams. Great climatic contrast between temperate character of high plateau and subtropical to tropical conditions of valleys with jungle vegetation. Very distinctive plant species.

Orientation of region: Very isolated and unlike the Red basin not in itself a focus. Essentially a borderland, difficult of access from any direction. Easiest maritime connection with Gulf of Tonkin (French Indo-China), but on landward side the best approaches, although very tortuous, are from lower Yangtze and Szechwan.

II. THE PEOPLE AND THEIR CIVILIZATION

China at the present time is passing through the most momentous transformation in her history, affecting every aspect of life: economic, cultural and political. The essential features of her traditional civilization were developed and established 3,000 to 4,000 years ago in the basins of the Hwang-ho and the Yangtze. The great isolation of this area of characterization—separated from the west by arid High Asia and from India by the lofty mountain chains and valley jungles of Indo-China—accentuated and stereotyped social conceptions already strongly marked. It has been said of China that "no other nation with which the world is acquainted has preserved its type so unaltered . . . has developed a civilization so completely independent of any extraneous influences . . . has elaborated its own ideals in such absolute segregation from alien thought." This generalization underestimates the debt of Chinese civilization to external sources, but in substance it is true, and enables us to appreciate the strength of the initial resistance to change when at long last this ancient culture was brought into active contact with the entirely different civilizations of Europe. Throughout the 19th century the European conception of the Chinese was of a people immobile, uniform, unchanging and virtually unchangeable. But the impact of Europe on China is relatively very recent. During the 19th century it affected little more than the fringes of the country, and its external political framework. Now its influences have begun to penetrate to the very foundations of Chinese civilization, and are bringing about changes in the social and economic fabric, and in the traditional philosophy and ethical outlook of the people of greater significance than the more dramatic changes in the political sphere. The ultimate effects on the structure of Chinese society of the alterations in its material environment and on the Chinese mind and character by the flood of new ideas, at once disintegrating and liberating, are beyond prophecy, but no generalizations can be valid which do not allow for the great vitality and adaptability of the racial stock. In the consideration of the various aspects of Chinese life it seems better to stress those elements inherited from the past which count for most in the present and the future, and to indicate the character of the new forces than to attempt an adequate description of the traditional civilization.

Population.—It has been said with some force that estimates of the total population of China have "assumed the importance of an indoor sport, unencumbered by any definitely established rules." The highest reasonable estimate of recent years, the Post Office census of 1926, returned a total of over 485,000,000 for China Proper (including Manchuria). Allowing 11,000,000 for Mongolia, Tibet and Sinkiang we have a round total of 496,000,000. At the other end of the scale the census of the Board of the Interior in 1910, the year before the fall of the Manchus, put the figure for China Proper with Manchuria as low as between 323,000,000 and 343,000,000. The total population of China may reasonably be put at about 400,000,000, but authorities differ vigorously as to whether it is under or over this figure. A number believe it to have increased in the past few decades. Particularly important is the extraordinarily uneven distribution and almost unparalleled density in certain large areas. The great bulk of the population of China is contained in the following regions:

(*a*) The central portion of the northern plain around the convergence of the provinces of Hopei, Shantung and Honan and a section of the valley of the tributary Wei river.

(*b*) The triangular tract of the Yangtze delta with its apex at Nanking.

(*c*) A relatively narrow coastal belt extending southwards from the Yangtze mouth through Chekiang, Fu-kien and Kwangtung to the Si-Kiang or Canton delta, where it widens considerably.

(*d*) The Central (Hupeh) basin with the triple city of Hankow–Hanyang–Wuchang as its node and extending up the radial valleys converging on it (Han, Siang, Kan, etc.).

(*e*) The Red basin of Szechwan, isolated far in the west beyond the Yangtze gorges.

The northern belt of maximum population is essentially one of peasant farmers, depending upon the land; large cities are rare and industries relatively few. In the Yangtze delta, the coastal zone, and the Canton delta agriculture greatly predominates, but in addition there are industries old and new and active river or maritime commerce. The merchant classes form a bigger element and great cities are numerous. That these great regions as a whole, but particularly the northern (Shantung), are supersaturated with human beings relative to the present means of subsistence there can be no question. It is attested by the appalling frequency of famines in the north (about one in every five or six years) and to a less extent in the Lower Yangtze, and by a very low standard of comfort which allows of no margin.

Outside these limited regions, population is dense only in isolated valleys or small basins. In the provinces of the loess plateau (Shensi and Shansi) the density is moderate and the population fairly evenly distributed. The same may be said of the south China plateau as a whole. In both, well-peopled valleys contrast with sparsely-occupied highlands. The southwestern provinces (Kweichow, Yunnan and Kwangsi), Kansu, the new provinces which have been formed out of Inner Mongolia in the northwest and the three Manchurian provinces in the northeast have all at present distinctly low densities, and, although in different degrees and affected by different factors, present limited opportunities for future colonization.

The Chinese have been throughout their history a colonizing race, but the mobility of movement from congested and overpeopled regions to sparsely-occupied areas has been constantly held in check by the great reluctance, for reasons connected with their social philosophy (*see* below) to leave their ancestral homes. This is least true of southeast China. There has long been an increasing stream from Fu-kien and Kwangtung with their densely-peopled coasts to the rich peninsulas and islands to the south, where they have helped to develop the far eastern tropics. In British Malaya they form more than a third of the total population. In the Philippines, in Java, and many other parts of the East Indies, in Thailand (Siam), in French Indo-China, and in Burma their vigour, frugality and tenacity make them a prosperous and progressive element. These same qualities often constitute a menace to the economic prospects of the less energetic native peoples. These important and thriving Chinese communities, although generally, as in Malaya, contented citizens of an alien power, retain close contact with their ancestral provinces. The latter receive large remittances from them and are influenced by them in many ways.

The peoples of the congested districts of the north in Shantung, Hopei and Honan have until recently been somewhat less adventurous. The rich grasslands of Manchuria beyond the Great Wall only became available for agricultural settlement under the Manchu dynasty, and economic development was very slow until after the Russo-Japanese War of 1904–05. With the rapid development of railways, new cultures and industries, Manchuria became a very attractive field. North China on the other hand was devastated by famines and the ravages of civil war. The almost intolerable conditions of life in many districts so weakened old prejudices that a tremendous mass movement set in. It was no longer a mainly seasonal migration of males, but a wholesale exodus of entire families. The increase of population in Manchuria in the four years 1923–27 is estimated at 2,000,000 and the exodus from north China during the summer of 1928 at 40,000 a week. The density of population in Manchuria according to the Post Office estimate of 1923 was only 61 per sq.mi., and large areas of fertile land were still available, particularly in the north. After 1931 the Japanese control of Manchuria temporarily brought to a halt the movement from south of the Great Wall. However, whatever the political status of Manchuria may be, its population will presumably continue to be overwhelmingly Chinese. To this field of colonization in the north must be added the adjacent districts of Inner Mongolia on the Chinese side of the Gobi desert, with very considerable pastoral possibilities which the Peiping–Kalgan–Suiyuan railway has made accessible. However, this is a marginal region in which the small and fluctuating rainfall makes settlement and livelihood precarious. In spite of climatic limitations, northern China has thus had a "land of promise" along her

whole northern border, but except for some sections of Manchuria this has about reached the saturation point. The tendency to over-population, which is the root cause of the grinding mass poverty of so many districts and which underlies so many of China's problems, is due essentially to social causes, and a modification in the traditional social philosophy of the people is alone capable of removing it.

Chinese Society.—In preceding paragraphs the diversity of China has been emphasized. But more significant than the diversity is the cultural unity which has held Chinese civilization intact for more than four millennia. M. Hovelaque has expressed it in a very striking passage which, if somewhat exaggerated and, as descriptive of the modern position, somewhat misleading, rivets attention on the most salient feature of the historic China. "Everywhere," he says, "under the blazing skies of the far south as in the icy north, one feels the same weight of abstract and all-powerful influence which, stronger than any differences of climate, race, circumstance or destiny, inexorably mould mankind, imposing everywhere an identical civilization, an absolute moral unity in the diversity of a country which is in itself a continent. All China is thus present in every corner of its vast expanse and at every moment of its history: the mysterious force, which through thousands of years, has fashioned these myriads and immobilized them in their immutable habits is the supreme reality of this land: and this force is a social one" (Émile Hovelaque, *China,* translated by Mrs. Laurence Binyon). The basis of this fundamental unity is the family system which has dominated Chinese society and permeated almost every aspect of economic and political life. The sanctity of the family has found expression in what the western world would regard as an excessive reverence for ancestors. It is the cornerstone of the Confucian teaching, accepted by 70 generations of Chinese, a teaching which gives first place to the virtue of filial piety and discourages children from going far away from their aging parents. It is the *raison d'etre* of much of the ceremonial prescribed by the "etiquette" to which Confucius and all his interpreters attached immense importance. Associated with the family have been the elaborate and expensive rites connected with marriage and death, the maintenance of ancestral halls, the family reunions at fixed seasons, the erection of memorial arches to virtuous widows who refused to remarry and countless other symbolic acts. In comparison with the family, the individual has counted for little. To it he has owed implicit loyalty. Marriage, for example, has been a contract between two families arranged without reference to the individuals concerned, usually when they were both young children and often without their having seen each other. The family in its extended form as a clan has served the function of insurance and benevolent societies in Europe and the provision of clan funds for education has enabled many a promising boy to qualify for public office. The association of families in a community provided a system of local government enabling village and district life to maintain an effective organization even during periods of political anarchy. The group of elders, selected from the wisest and most experienced heads of families, has combined many of the duties of an English parish council, board of guardians and bench of justices of the peace, and has dealt with the higher state officials. Their meeting place, the village temple, has been the centre of social life. So, too, the offices connected with the affairs of the village have been held in succession by the principal family heads. Thus the basis of the system of government has been patriarchal. The old China was in a sense a social democracy of myriad families whose relations were determined by an elaborate social code requiring obedience to an emperor who was himself regarded as at once the supreme patriarch and the "Son of Heaven," with power equalled only by his responsibility. If by his actions he incurred the wrath of the Spiritual Father on the immense family which he represented, he had plainly "exhausted the Mandate of Heaven" and revolt against him was justified. The bureaucracy through which he worked was immensely complex, and intended to counter-weight local and provincial interests, but the same patriarchal conception was seen in the functions of the head of the *hsien,* the one state official with whom the masses in the countryside and smaller towns came into close contact. Popularly known as the "father and mother" official, the *hsien* magistrate, who survived all the recent changes, has been entrusted with a great variety of duties, and under the old regime essentially represented to the people the paternal function of the emperor. In the city of Peking the Temple of Confucius, with a large hall preserving the ancestral tablet of the sage enshrined in an alcove, adjoined the Hall of Classics, where the emperor came on state occasions and whose courtyard contained 300 stone steles on which the complete texts of the "nine classics" were inscribed. The juxtaposition of two of the most famous buildings in the country symbolized the intimate relationship between the massive social fabric based upon the family and the traditional scholarship of China. This scholarship of high antiquity and unique continuity furnished alike the sanction of the social system, its support and its cultural background. Ethical teaching about social obligations, summarized in the five relationships (sovereign and subject, parent and child, husband and wife, elder brother and younger brother, friend and friend) lay at the heart of a moral code already hallowed by antiquity when Confucius gave it coherence. It was largely through schools provided by the family or clan for its own members that the rudiments of its teaching were given to the rising generation. By a graded system of public examinations, proficiency in this learning in its more advanced aspects was tested as the qualification for public office on the principle that only those were fit to be entrusted with affairs of state who understood the foundations on which society rested. Thus the scholars were the governing class and formed the only aristocracy recognized in China after the abolition of the so-called feudal system in the 3rd century before Christ. They enjoyed immense prestige and ranked first in the four recognized groups (scholars, farmers, artisans, traders). They could not transmit their offices to their children, but in practice retired officials had exceptional means for giving them the necessary education, so that many families had at once wealth, usually invested in country estates, and literary traditions, and constituted the *literati* or gentry, the notables of the countryside and small towns. Yet they were never a caste apart, and their ranks were open to any peasant's or craftsman's son who could qualify. The recognition of an aristocracy of learning, the recruitment of the civil service by competitive public examinations (from the time of the Han dynasty) and the absence of caste distinctions were three outstanding features of the old Chinese civilization complementary to the patriarchal system and adapting it to a complex state organization.

To the family system China undoubtedly owes the remarkable social stability which has enabled her to survive the many shocks which the political fabric has received and to outlive many far more highly organized communities. Many of the most attractive aspects and some of the most fundamental virtues of the Chinese character are bound up with it. Yet the cult of the family is the primary cause of the intense pressure of population in the land. In the long, formative period of Chinese history, when cultivation in the midst of undrained swamps and forest jungles called for the maximum of co-operative effort, there was a strong economic justification for the propagation of large family groups to which ancestor worship, and later the Confucian teaching, gave a sanction and force of religious intensity. But this sanction has long outlived that phase of economic development and now tends to a dangerous multiplication of the population. The social premium on male progeny (to insure the perpetuation of the family line) has led to early marriage, concubinage, and a high birth rate and the first result of this chronic tendency to over-population, in a country so largely composed of peasant proprietors and where no law of primogeniture exists, is naturally the excessive subdivision of land. The abnormally low standard of living and the absence of any economic reserve explain the existence of a "submerged tenth" of desperate men, ready to adopt brigandage. Hence the contrast between the singularly peaceful and law-abiding character of the Chinese as a whole and the frequent disorder and terrorism in country districts when authority is relaxed. Hence, too, the ease with which armies can be raised in

a country essentially unwarlike and the extreme difficulty of disbanding them once they have come into existence. Excessive emphasis on the family is also a potent cause of China's political weakness, since family-interests have been constantly preferred to those of the state. Nepotism, in fact, has been described as a religious duty in China, an obligation to use public office for the benefit of the family group as the supreme object of loyalty. Many individuals have attained to a larger vision but usually there has been a marked contrast between the admirable honesty and trustworthiness of the Chinese in their individual and trade relations and the corruption which has tended to characterize their public life and to ruin large-scale undertakings lying outside the traditional group organizations. The state, as such, has until recently meant very little to the vast majority of the Chinese people. China has been a civilization rather than a national entity in the European sense. The loose association of family and other groups permeated by this civilization are only now becoming conscious of a larger unity as the result of the poignant experiences of the last two generations.

Many influences are at work in modern China to reduce the importance of the family and to disintegrate the traditional structure of Chinese society. One of these is modern industry. The most important effects of industrialization are at present localized in the cities of the Yangtze and Canton deltas, the central basin, at nodal points along the main railways, at several of the seaports and in the regions in west China to which factories were moved to escape the Japanese. In these centres there is now a large and increasing class of industrial workers of a type quite new to China. They are losing touch with the corporate life of the countryside and are increasingly detached from the traditional social heritage. A large proportion of them are women, and the entrance of women into large-scale factory industry implies at once their growing economic independence and the break-down of the clan system. Nor is that all. Industry and commerce in China were formerly almost entirely controlled by the guild system. The guilds are group organizations of various types but like the family organization all make the well-being of the individual dependent on his obedience to the code governing the interests of his craft or trade or, in the case of provincial and city guilds, of his locality. In the main they have been essentially democratic and have emphasized not the separate interests of employers and employed but the solidarity of the trade. Loyalty to them, as for example in the matter of submitting books for inspection by guild officials, has been as conspicuous as loyalty to the family. Large-scale industries of western type employing the new class of artisans are for the most part outside the guild system, and the workers, often living under conditions similar to those of the factory towns of England in the early days of the Industrial Revolution, are open to the appeal of new influences such as the western trade union movement and communism. That the old capacity for combination is capable of taking new forms is shown by the many examples in recent years of relatively successful strikes and boycotts.

Of the new cultural forces which have tended to disrupt the traditional family and other phases of the hereditary culture the most outstanding have been the modern educational system, the student movement and the penetration of new ideas from Europe, America and modernized Japan. The sudden abolition of the old classical system of examinations in the last years of the Manchu dynasty marked a dramatic break more fundamental in effect than the abolition of the imperial office six years later. In spite of many difficulties, a system of schools has gradually emerged in which, while western subjects and methods predominate, traditional language and literature still find a place. The most revolutionary of the social influences of the new education have been (1) the granting of educational facilities to women and the introduction of coeducation in primary schools. In conjunction with the economic forces already noticed this is producing a remarkable change in the status of women and the relations between the sexes. Many young people now arrange their own marriages without consultation with their elders. (2) Western science, at present very imperfectly organized in China, but implying a mental discipline of a kind quite foreign to the old literary training. (3) The ideal of mass education. In respect for learning no country has excelled China, but in the past it has always been associated with a relatively small group of scholars. A long time must elapse before there is a sufficiently large number of adequately staffed primary schools; but there are few more promising features in modern China than the almost passionate enthusiasm with which the students and teachers of secondary schools and colleges have organized the popular educational movement, devoting evenings and parts of vacations to the conduct of free schools, for poor children and adults. The mass education movement, inaugurated by a returned student from the United States, greatly aided the progress toward literacy and the popular vernacular (*Pai-hua*) of the Mandarin dialect has been made the accepted medium for new literature, in place of the old classical and "dead" language. The change, virtually accomplished, is comparable in character and importance to the adoption of the vernacular as the medium of literary expression in place of Latin in Chaucer's England and Dante's Italy. Further, out of the vast number of Chinese characters, 1,000 (or even 600) of the most essential have been selected for use in the people's schools—hence often called "foundation character schools"—and are exclusively used in the writing of appropriate popular books. The alternative method of a phonetic alphabet, in which extensive experiments have been made, seems likely to be discarded. A standard form of the Mandarin vernacular (*Kuo-yü*) is being taught in the schools throughout the country, a procedure which is tending towards uniformity in the spoken tongue and towards national linguistic unity.

These important linguistic reforms, especially the development of the new national language (*Pai-hua*) have been to a large extent the outcome of the remarkable movement known as "the new tide" or Chinese renaissance. This movement, associated with the new "intelligentsia" in the chief centres of thought, such as the National university at Peiping, owes its origin to returned Chinese graduates of foreign universities (especially Paris and certain American universities), and in particular, on its literary side, to Dr. Hu Shih, often called "the father of the Chinese renaissance." It gives evidence of an intellectual ferment similar in many ways to that which characterized the revival of learning in Europe. On its literary and linguistic side it was essentially constructive while critical in many other respects. Especially notable was its vigorous and unsparing attack on the inferior status of women, child betrothals and costly expenditure on funeral rites. On its more speculative side it was concerned with what its exponents described as a "revaluation" of Chinese thought and philosophy in the light of western science and knowledge. In the sphere of religion it was for the most part sceptical and rationalistic and, in conjunction with the political agitation of recent years, helped to give birth to a widespread but transient anti-Christian movement in the ranks of "Young China." At the same time the movement in many of its aspects included some of the most distinguished of the leaders of Chinese Christianity.

For years political agitation absorbed a large proportion of student time and energy. Students have been intensely nationalistic and for a time in the 1920s and 1930s many were attracted by communism. In the 1940s communism still won many in the regions which the communist armies controlled. In areas in which the Kuomintang was dominant, in the early 1940s, communism among students was, however, frowned upon. Moreover, under the stress of the westward migration due to flight from the Japanese, and the exigencies of an extreme inflation, students in "Free China" were too much engrossed by the problems of maintaining a bare existence to be as concerned as formerly with political questions. In Japanese-controlled areas all such student activity was effectively prevented.

The disintegrating effects of the new influences inevitably invaded the religious sphere, but in many respects the break with the past was less complete and revolutionary than in some other aspects of life. Even here, however, there has been some change and traditional religion and religious observances have been

greatly weakened. Of the three historic religions of China (*see* under *History*), Taoism in its later phases has been little more than a congeries of superstitions which must gradually lose their vitality. The same may be said of the cruder side of popular Buddhism, especially in its northern form (Lamaism), but in its more philosophical aspects Buddhism has a definite adaptability and is by no means a negligible factor. Confucianism, although it has a religious aspect, denotes a social code and an attitude towards life, rather than a religion. Although obviously weakened by the changed conditions it retains great vitality; it forms the mental background and in part orientates the lives of many educated Chinese who hold no definite religious beliefs. The average attitude of the majority of educated Chinese may probably be described as an agnosticism, coloured and softened by Confucian and Buddhist tendencies. The influence of Christianity is considerably greater than the relatively very small number of its adherents would indicate and the Christian community has already played a part in the public life of China out of all proportion to its numbers. Nor is the influence of the missionary schools, colleges and hospitals to be measured by the sum total of professed converts.

Thus in modern China "the old order," stable for four millennia, "changeth, yielding place to new." Yet many-sided as is the revolution through which the country is passing, prolonged as must be the social turmoil and difficult the new integration, there are many elements in the heritage of the past still vital and making for stability.

ETHNOLOGY

The earliest remains of man found in China are what is known as the Peking man (*Sinanthropus pekinensis*). Remains of Peking man have been found in a cave north of Peking. These hominids probably lived in early Pleistocene times. They had crude stone, bone and horn implements and knew the use of fire. They bore some slight resemblance to the Chinese of today in that region. There are also traces of Palaeolithic man underneath the loess. Neolithic man left more extensive and widely scattered indications of his presence.

It is probable that the ancestors of the present Chinese came from many different centres and at many different times. Some presumably came from the west by way of the Tarim basin. Others were from the north and still others from the south.



A CHINESE WEDDING, WITH THE BRIDE WEARING A SEMI-OCCIDENTAL DRESS

The true home of the Chinese, whatever their original centre or centres, seems to be the basin of the lower Hwang-ho; but they have dominated, racially and culturally, both the original 18 provinces, and Manchuria, Korea, and to some degree Japan.

There is in China a mixture of many stocks; not only have the Chinese invaded aboriginal territory and absorbed the inhabitants, but China itself has been continuously invaded especially from the north. The skin colour is generally light yellow, the hair is usually dark and straight. The Mongolian eyefold is conspicuous. The stature is medium and the head-form ranges from long to round; the nose is of medium width. Here and there are fair, light-eyed, wavy-haired groups, evidence of the alien stocks which have penetrated into this area.

Social Organization.—The basis of Chinese social organization is a closely knit and highly organized family. The house father is directly responsible for all who live under his roof, including his wife and unmarried children, his married sons and their wives and children, his servants and probably other dependents. He is personally responsible for the economic and moral welfare of this miscellaneous group, which includes on an average between five and ten persons, and is liable legally for their misdemeanours. This system spreads upwards. The official was held to be the "father and mother" of his people, and the emperor was himself directly the head of a patriarchal family, the Chinese nation, for whose welfare and the success of the crops he was directly responsible to heaven. Much of the cohesion of China is due to this amazing social system, though it tends to exalt the family at the expense of the state. Owing to the necessities of ancestor worship, the raising of male progeny is the sacred duty of every Chinese, a fact which may account for the early marriage and the large number of children. Concubinage is permissible, but it is naturally a luxury of the wealthy rather than a general practice among the poor. Marriages are arranged by the parents of the prospective couple, but secondary marriages are usually "love matches." Where no sons are born the practice of adoption is used, both among rich and poor. By the rule of exogamy, marriages were forbidden between persons bearing the same family name.



BY COURTESY OF THE BOARD OF FOREIGN MISSIONS

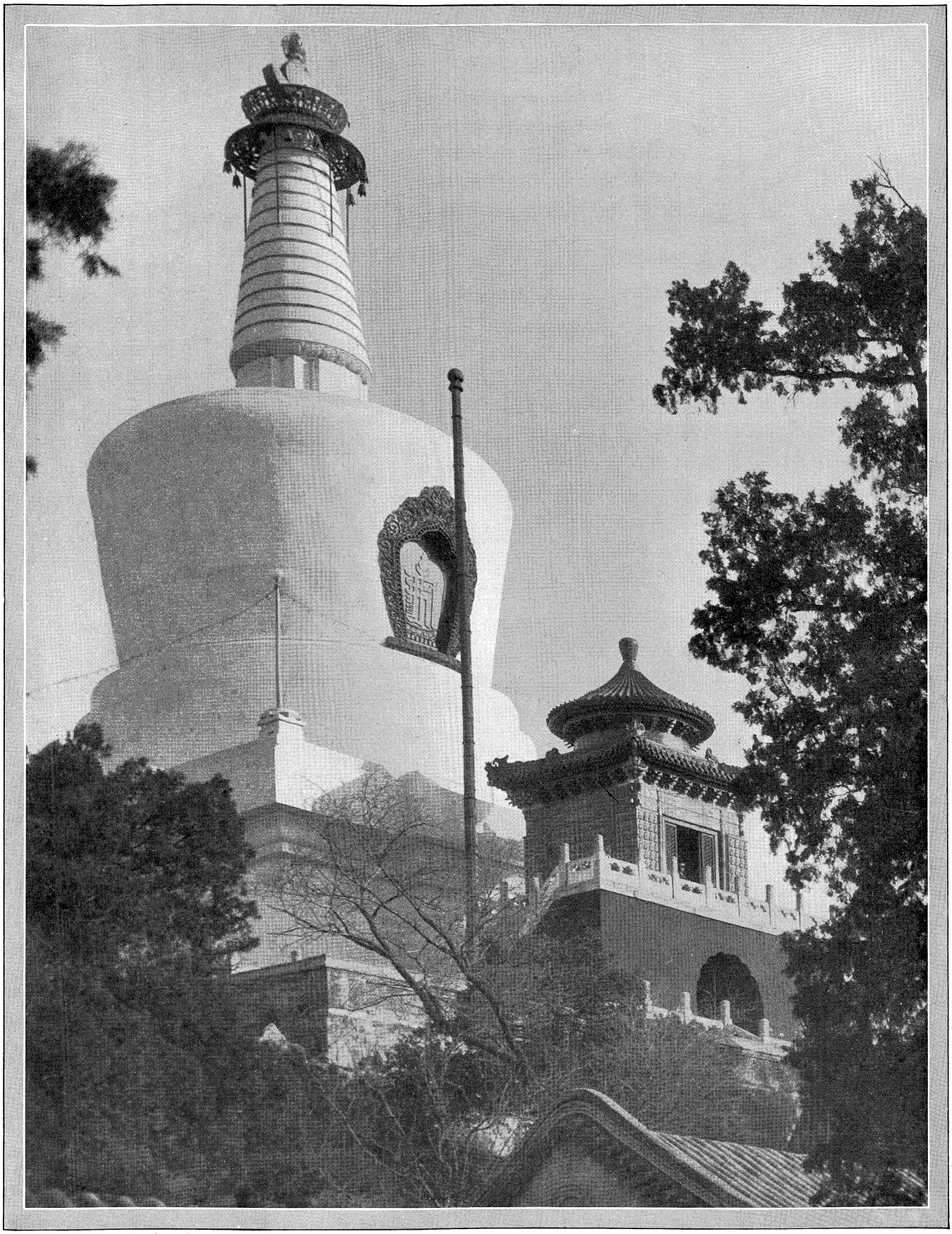
A MANDARIN IN OFFICIAL ROBES

With the exception of a few families, notably the descendants of Confucius, China long had no aristocracy. Position depended entirely on success in the great examinations for literary degrees, from the successful candidates of which officials were chosen. Side by side with the official class there has long been a merchant class enjoying the advantages of wealth. The levelling effects of dependents have probably contributed much to these democratic conditions. The higher a man pushed himself up the more numerous became his household, and it was a necessity under the old Chinese system that a magistrate should never hold office in his own province, otherwise his duties to his family would have outweighed his official duties.

Religion.—The three religions of China with the largest following are Confucianism, Taoism (*qq.v.*) and Buddhism (*see* BUDDHA AND BUDDHISM). The special feature of local religion is ancestor worship, though Taoism incorporates much that belongs to primitive religions. In China the dead form an important part of every household. A third son is always a third son, even if his elder brothers are dead. The head of the house, living or dead, is always the head of the house. To his tomb his descendants come, and they have mortgaged much of their scanty acres in erecting grave mounds which must never be ploughed till the family is forgotten. Against such a calamity every precaution is taken by adopting children when sons fail.

In addition to the worship of ancestors, which overshadows even the food quest in China, geomancy and other forms of magic play an important part. It is necessary for every enterprise, old or new, that it should possess the necessary *fêng shui*—literally "wind and water"—roughly "luck." Considerable opposition was once raised to the building of railways and other foreign inventions because a certain cutting might disturb the spirits and so spoil the luck of a city. Fortunately, spirits particularly like a valley girt about with hills, and to this we owe the preservation of such lovely pieces of scenery as the tombs of the Ming emperors near Nankow.

The Chinese are much addicted to the *sortes* and will cast lots before undertaking any enterprise, throwing down two pieces of



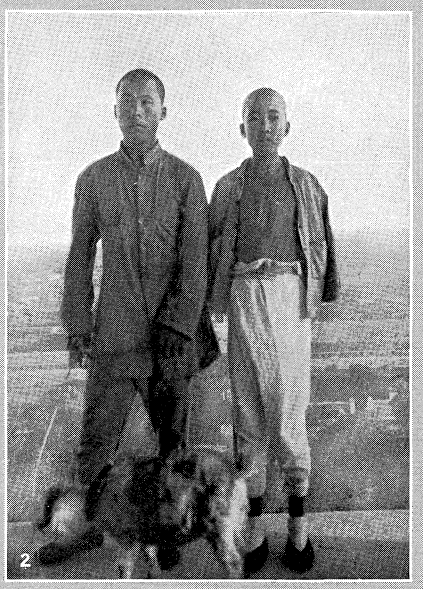
PHOTOGRAPH, HERBERT PHOTOS, INC.

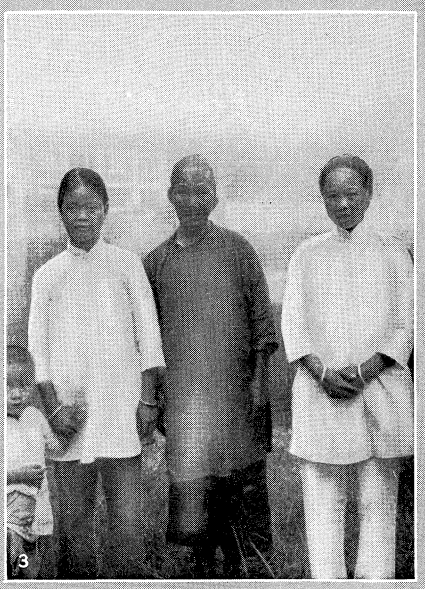
GREAT WHITE DAGOBA, PEKING

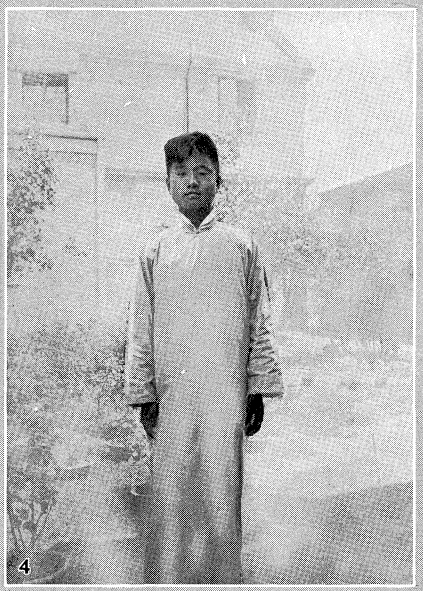
The great White Dagoba at Peking, China, built in 1652. Its shape is that of a Buddhist reliquary. Base, body, spire, crown and gilded ball are symbols of the five elements earth, water, fire, air and ether

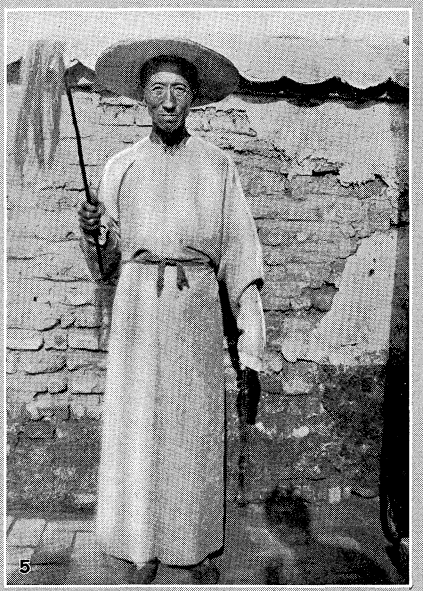
CHINA

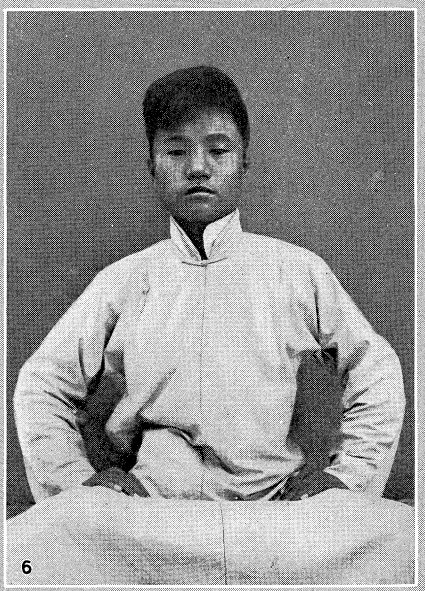


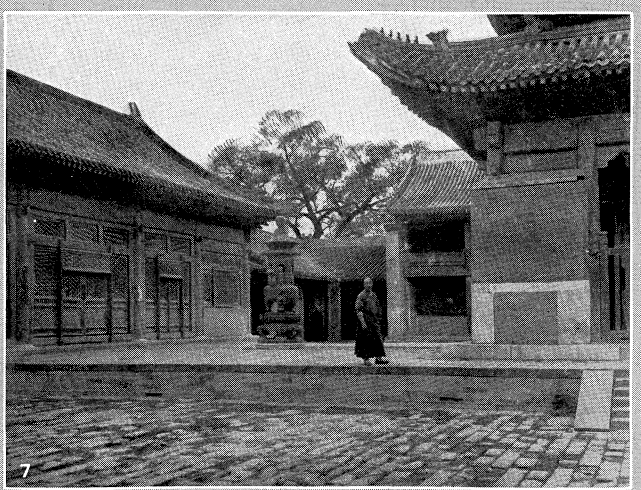














(5) FROM L. H. DUDLEY BUXTON'S "EASTERN ROAD" BY PERMISSION OF KEGAN PAUL, TRENCH, TRUBNER AND COMPANY, LTD.

NATIVE TYPES IN CHINA

1. A Manchu type
2. Chinese soldiers off duty
3. Three women; characteristic types of southern China
4. Boy of the middle class
5. A mixed type common on the northern and western borders
6. Young Pekingese of the middle class
7. Court of Pekingese temple; man of mixed border type
8. Peasants from the northern provinces of China

bamboo root till they turn up in a favourable manner.

Animism in its many forms has also been prominent in China. There are, too, many deities, some of them from the earliest times, which are not identified exclusively with Taoism, Buddhism or Confucianism.

Islam has several million adherents. They are scattered over all the provinces but are most numerous in the southwest and northwest.

Christians have multiplied, especially in the 20th century. Under the impact of the modern west there has been some disintegration among the older religions.

Aboriginal Tribes.—Chinese men of letters have classified the aborigines of China in a four-fold artificial manner, calling them by names which are more or less the equivalent of the Greek *barbaros*. It is probably more correct, however, to divide them into three groups, the Miao, the Lolo, and the Chung Chia. Their distribution is approximately as follows: there are Black Miao and Chung Chia in Hunan. The Chung Chia extend across the border into Burma, where they are known as T'ai (*see* SHAN). The Black Miao live north of these peoples. The two classes of Flowered Miao live in west-central Kweichow, and northeastern Yunnan. Originally their distribution was probably much wider. Physically all these peoples seem to represent an intermediate type between the long-headed people of the near and middle east and the Nesiot of southeastern Asia. They are all mixed to a greater or lesser degree with Pareoeans. Culturally they are mostly agriculturalists, but everywhere they have been much affected by the surrounding Chinese.

BIBLIOGRAPHY.—L. H. D. Buxton, *The Peoples of Asia* (1925).

ARCHAEOLOGY

The study of prehistory in China is particularly difficult owing very largely to the geographical structure of the country. Three areas may be enumerated, the great prairie region, which includes much of Mongolia and part of western Manchuria, northern China, including the great plain and the lowlands of Manchuria, and thirdly, southern China. This latter region, which is in the main extremely mountainous, has at present been little studied archaeologically, and its prehistory is almost unknown.

Thus there are many gaps in our knowledge, but none the less great credit is due to those explorers who have contributed the knowledge which we already possess. In the northern region the country is sparsely inhabited mostly by wandering nomad tribes. Distances are great and, except on the borders of China proper, few discoveries can be made without the aid of elaborate expeditions such as that of the American Museum of Natural History, which discovered the dinosaur's eggs in Gobi, and has already found abundant traces of Neolithic man in surface deposits. The southern part of this region and nearly all northern China is covered with fine wind-deposited loess. The discoveries of Pères Licent and Teilhard make it probable that the remains of early man are hidden beneath this yellow covering, which is so thick in some places that exploration is impossible except where the loess has been cut through by the action of water in river valleys, and the older strata have thus been exposed. Such canyons in the loess have proved in a few cases to be most fruitful. In the plain itself, however, these deep river valleys are non-existent for the streams run at a level which is actually higher than the plain. All along the fringe of the plain there are found the natural conditions necessary for the formation of deep valleys. The mountains of northern China also possess caves, which have been productive of finds of early and more recent man.

Sites.—The Palaeolithic sites so far discovered fall into three groups, all of them in the north. The first site is situated in the southwest corner of the Ordos bend of the Hwang-ho (Yellow river), and is called from a central spot Shuitungkou. The ancient floor of the principal site is about 18 in. thick, and between 3 and 6 ft. above the conglomerate at the base of the loess. The inhabited site is about 60 ft. long. No human bones have been found but the ground was literally strewn with implements and there were a very large number of animal bones, undoubtedly kitchen refuse. The bones belonged principally to the wild ass and possibly a horse, the woolly rhinoceros (*Rhinoceros tichorhinus*), *Bos primigenius*, gazelle, hyena and a type of ostrich (*Struthiolithus*) whose egg shells are abundant in the loess. The implements, most of which are worked on one face only, are usually of considerable size. They show little refinement of technique and are mostly rather crudely made. Their abundance and form can be explained by the nature of the material at hand. There are plentiful supplies of flinty stone, of a rather coarse grain, which does not allow careful or exact workmanship. This crude character and the large size of the implements found, are of considerable importance in making comparisons with other sites. The implements are difficult to place typologically. The majority suggest an Aurignacian industry, others are more reminiscent of the Magdalenian. The comparison between the finds made at the type site and on other hearths in the neighbourhood, at different levels, suggests that the area was inhabited by Palaeolithic man for the greater part of the time during which the loess was in the process of formation.

The second series of sites in the Ordos country is different from Shuitungkou. Finds have been made along the course of the Sara-osso-gol. This river, which is a tributary of the Hwang-ho, flows from the loess-covered mountains of the province of Shensi and traverses the southeastern angle of the Ordos country. It has cut a ravine which is sometimes over 200 ft. deep. The sides of this ravine show clearly the succession of strata which have filled up the basin which formerly existed in this region at the beginning of quaternary times. Man lived on an old floor and since Palaeolithic times there has been the following succession of strata. First, dunes accumulated over the old floor, then a lake, then new dunes, then there was a new lake, until finally the level of the modern steppe was reached. Neolithic finds have been made in the black soil at the top. In the levels associated with the presence of man the fauna is extremely rich, but implements are small and infrequent. The fauna in many ways resembles that from Shuitungkou. The woolly rhinoceros is very abundant, remains of elephant were found, probably *Elephas nomadicus*, not the mammoth (*Elephas primigenius*). The wild ass and *Bos primigenius* also occur, while gazelles abound. Numerous antlers of deer were found, apparently used as some form of weapon or tool. A very large camel also appeared. The big and small animals found in this deposit are in great contrast. The small mammals are without exception the same as those found today in the same regions. Among the big animals many types are represented which have either become totally extinct or are no longer found in the same area. These large animals show remarkable affinities with the fauna of Europe in Middle Quaternary times, and appear to have had a wide extension over northern and central Asia at the time of the formation of the loess. The implements are extremely small and present unusual forms. The largest implement is under 3 in. long. This implement presents a close parallel to some of the scrapers from Shuitungkou. Similarly some of the smaller implements from that place suggest the Sara-osso-gol specimens. It seems probable that we are not dealing with different cultures. The Sara-osso-gol neighbourhood is singularly deficient in any form of pebbles and it is probably due to this geological condition and not a difference in culture that the explorers of the site were only able to collect a mere handful of implements, whereas on the other site their finds ran into many pounds weight. The Sara-osso-gol culture appears to have had a wide extension in space. At present no implements have been found in the strata above the Palaeolithic. There is therefore a complete absence of any form of transitional period between the Palaeolithic age and the surface Neoliths.

The Palaeolithic industry has also been studied in the loess of northern China. Owing to the rapid erosion to which this soil is subjected this has been possible, and two principal sites have been examined, Kingyan in Kansu and Yufêngtou in Shensi. All these sites probably belong to the same period, that is, the base of the loess.

The distribution of the finds so far made is restricted to the

southern part of the Ordos country, the north of eastern Kansu, and the north of Shensi. Nothing Palaeolithic has been discovered either in eastern Gobi or beyond the northwestern border of the Ordos country, possibly due to the fact that the correct strata have been eroded, but it is curious that animal bones have been found in deposited strata. Discoveries have been made in northern Manchuria. In the more southerly regions no thorough search has as yet been made in those places where the base of the loess is exposed.

The chronology is as yet uncertain. Comparison of the fauna and of the types of the implements suggests that probably this early culture was approximately contemporary with the Mousterian and the earlier part of the Aurignacian period. The importance of the finds depends on several factors. First, they show that the Palaeolithic industries spread across the Eurasiatic continent, and some of the implements show analogies with implements found by Buxton in the north Arabian desert. Secondly, the finds at the base of the loess suggest that man was inhabiting China at a period before the deposition of that great yellow covering which is today the most characteristic feature of the country. The finds also help to throw light on the date of the loess.

The remarkable character of this culture is its apparently abrupt ending. The old floors are clearly defined. There are other strata superimposed upon them, but no traces of human handiwork, between the Palaeolithic and the Neolithic, have so far been discovered *in situ*. Up to the present the Mesolithic, *i.e.*, the age between the Palaeolithic and the Neolithic, is entirely absent with the exception of certain finds in Gobi. Nelson, a member of the staff of the Third Asiatic expedition of the American Museum of Natural History claims to have discovered certain implements on the surface of the desert which are Azilian in form, but as they are unrelated to any definite stratigraphy it is not possible at present to express any definite views on them.

Neolithic Remains.—The remains of the Neolithic period are widely scattered over the whole of China and Mongolia. Surface finds have been made in many provinces. In the extreme south, in the province of Kwangsi, which lies to the west of Canton, stone axes are said to be very commonly found. Associated with them is the folk tale, so widely spread over the world, attributing their origin to thunderbolts, and indeed in one region they are said to be particularly abundant near the temple of the Thunder God. A similar story, associated with finds of numerous Neolithic axes, also comes from Yunnan, the most southwesterly province of China. Grooved stones for polishing axes have also been reported from Kwangsi. Few reports have been made of finds from the central provinces of China, but specimens, undoubtedly Neolithic, exist in private and public collections in Shanghai.

Far the richest finds have been made in the north. The Gobi region and much of northeastern China and Manchuria have proved to be extremely rich in Neolithic remains. Surface finds are extremely abundant over most of the region. In some cases, especially in regard to arrowheads of stone, there may well be some doubt as to their age, as the Chinese were well aware of the use of these implements, which may have continued to serve barbarous tribes until well within the historic period. In certain parts of Mongolia, however, implements have been found *in situ*, not as surface finds, and can therefore be definitely dated.

The Neolithic implements nearly always occur in a bed of black sands, from 3–12 ft. deep superimposed on the Quaternary sands, which in Mongolia replace the Chinese loess. The Neolithic here appears to succeed the Palaeolithic without any transitional period and is very widely spread. One of the most remarkable sites so far explored is at Linsi (approximately 116° E. 44° N.). Here most of the implements are extremely rude, not unlike those of Palaeolithic date, but some fine and very delicately worked implements were also discovered. A few grindstones were found but no green polished celts. The pottery is very rude and was not made on a wheel. No painted pottery has been found on these Neolithic sites. Among the finds at Linsi certain flattened pear-shaped implements were found, and a similar instrument was obtained by Andersson at Kalgan. These stone implements are very important. Not dissimilar implements occur in other parts of Asia, but the closest parallel is in North America. There can be little doubt that they were rude ploughshares and it is possible that they form another link between northeastern Asia and North America. In any case there is every reason to believe that this Neolithic culture was extremely widely spread in the far east.

Some of the finds suggest that climatic changes have taken place since the Neolithic age. If the implements are, as suggested above, really ploughshares, some at least come from regions which today are devoted to pastoral nomadism, and the presence of agricultural implements suggests that in Neolithic times the climate was somewhat different. Further, quite a large number of Neolithic implements have been found in regions which today are extremely poor steppe. They may be the remains of a merely temporary occupation, but the evidence is suggestive of a considerable change in climate.

Chalcolithic Remains.—These finds, Palaeolithic and Neolithic, represent but the beginnings of discovery. The most revolutionary discoveries in prehistoric China are those made by Dr. Andersson of a culture which, though it may be termed Neolithic, because on most sites there is an entire absence of metal, more properly belongs to the transitional period between stone and bronze which is termed by archaeologists "Chalcolithic."

Dr. Andersson's finds cover a wide area, extending from the extreme east to the extreme west of China. The most easterly site is a cave at Sha Kuo T'un, in the province of Fengtien, of which Mukden is the capital, in Manchuria. To the west a site has been discovered at Paotê in Shansi, at Fuku in Shensi, and abundant remains of a Chalcolithic culture have been found in Kansu, the province which lies in the extreme northwest of China. Thus sites have been found all along the northern border. In Honan four sites have been explored, Yang Shao Tsun and Pu Chao Chai in the district of Mien Chih, and Ching Wang Chai and Chih Kou Chai in the district of Ho Yin.

The site at Yang Shao Tsun in Honan occupied a very big area, being over 600 yd. long and about 500 yd. broad. The deposits which are nearly 10 ft. thick are slightly covered by arable soil. The stratum on which the remains rest has been in places excavated into large pits, often as much as 6 ft. deep and of the same width. The deposits consist mainly of a mixture of soil and ashes, and apart from a few graves contain merely the débris of an inhabited site. The fauna of the site has not yet been published in detail, but apart from the porcupine it does not appear to include any interesting wild animal. As in modern China the domestic pig appears to have been abundant.

The finds in Fengtien province in Manchuria were made in a small cave close to the railway between Tientsin and Mukden, about half way between those two towns. The cave was only about 20 ft. long and 10 ft. broad. It contained, however, over 6 ft. of deposits, which consisted of a filling of clay alternating with three bands of charcoal which were extremely rich in ancient remains. In a layer, about halfway up, of broken and calcined human bones, Black recognized the remains of about 45 individuals. Apart from differences in the implements due to the available raw material, there is no reason to doubt that the Honan and the Fengtien sites belong to the same culture.

In Kansu, Andersson explored various parts, especially in the west of the province round the city of Lanchow. He found numerous sites, both inhabited and burying places. On the basis of the pottery, he grouped the sites into different subperiods of which the three lowest correspond to the sites from other parts of China, whereas the upper ones appear to belong to the copper or early bronze age. The pottery from Kansu is both abundant and of very fine workmanship, whereas the implements are both poor in workmanship and relatively infrequent. The best pottery has been found in the graves. Most of the bodies were found extended, the head being turned towards the north, but in two graves the skeletons had been placed on the left side in a contracted position. A large number of the bones were covered with red ochre.

At present no exact information appears to have been published on the associated fauna, but the domestic pig appears, as in the other sites, to have been extremely abundant.

Except for the sites in Kansu, no metal has as yet been found on any of these sites. Either the people were unacquainted with the use of metal, or alternately, and less likely, metal objects have so far escaped the eyes of the excavators. The artifacts may be divided into three classes, stone objects, bone objects and pottery.

Stone Implements.—The implements made of stone show a considerable variety. First there are rough implements made of chert or chalcedony. Many of these implements are very rude in form. Secondly there are a large number of stone celts and other axes and chisels. Some of the celts are very flat in section, recalling in many ways some celts from America, but this resemblance is possibly due rather to the material out of which they are made than to any real relation. The arrowheads which have been found present certain features of interest. Torii in reports on early sites in Manchuria thought that he was able to distinguish between two types of arrowheads, which he called Manchu and Mongol respectively. The Manchu type is made of slate or some similar material and is polished. The Mongol type, on the other hand, is of chalcedony and is flaked. The two types both occur in the Chalcolithic deposits, the flaked arrowheads occur in Manchuria, while the so-called Manchu type is found on the ancient sites in Honan on which only one flaked implement was found, an extremely important obsidian knife. Andersson regards the difference between the two types as probably due not to any ethnological differences but to the different varieties of material which could be obtained. In any case the arrowheads are of little value for archaeological purposes because as late as the T'ang dynasty which ruled China from A.D. 618–906 there are records that arrowheads of chalcedony were given by some of the tribes of Manchuria to the emperor of China.

Rings of stone and of mussel shell were also found. Their meaning is somewhat obscure. They may have had a magico-religious purpose. Parallels to such stone rings can be found in various parts of the world, but at present they have not been sufficiently studied to throw any light on this intricate problem. Bone needles and awls have been found by Andersson in some abundance. One he believes to be almost identical with a specimen from the Danish kitchen-middens. The resemblance was probably due rather to the limitations imposed by the material than to any actual cultural connection.

Pottery.—The pottery forms the most important element in the finds from the scientific point of view, is of great beauty and from the technique employed shows clearly that the makers must have been the inventors of, or the heirs to, a comparatively advanced civilization. Some of the pots are rather crude and undecorated, and may be paralleled by Torii's finds in Manchuria. This crude pottery may be local ware, possibly surviving from the true Neolithic period and widely spread over the far east. Such survivals of old wares for domestic purposes are by no means uncommon, just as other tools, or the use of stone for implements, may survive long after the culture with which they were originally associated has been superseded by a more advanced civilization.

The most characteristic pottery, however, from the Chinese sites consists of a very fine ware decorated with painted designs. In some cases the surface of the pot has been treated with a fine washing of clay, technically known as a slip, before the paint has been applied; in other cases the paint has been put directly on to the finished surface of the pot. The colour of the paint is usually either red or black and red. An examination of the fabric of the pots has shown that they are the product of a relatively advanced industry. They are made of a loess clay, the most readily obtainable material in northern China, which is not available south of the Yangtze Kiang; so that future finds south of this river, even if of the same culture, are likely to differ in technical details. The clay has been very well washed and freed from plant remains and other impurities, and probably worked into a paste. To this mixture some quartzite or other flinty material was added to give strength to the pot and to prevent its collapse during the process of manufacture. Some of the wares are of different colours. These differences are due to the amount of iron oxide and to various degrees of burning. It is probable that the addition of iron was made in order to affect the colouring, and possibly also the potters were able to control the firing, but on the whole these differences, striking as they are, must be considered largely as the result of semi-accidental factors. The classification by colours is therefore not an essential feature. The nature of the ornament is quite otherwise.

Ornamentation.—Two main types of ornaments may be distinguished. In the Kansu ware there are various more or less realistic paintings of animal forms. The sherds and pots from the easterly and southerly sites, on the other hand, are conventional or geometric. These ornaments consist of spiral bands and lines, of triangles, often fantastically exaggerated, of circles, sometimes single, sometimes concentric, and of disks, *i.e.*, circles whose interior has been filled in to form a solid. A kind of lattice pattern is extremely common, and is used either as a band all round the pot or as the filling of a triangle. This lattice ornament and the spirals are the most characteristic. In the Kansu finds an interrupted and a continuous Meander pattern is also found.

Most pottery was made on the wheel and the firing was carried out with considerable skill. The forms can seldom be reconstructed owing to the fragmentary condition in which they were found, but at least three classes appear to be represented. The painted pottery includes, first, bowls, which are either hemispherical or flat and basin-like. Secondly, there is a group of tall pear-shaped pots. These have a comparatively narrow base and gradually increase in size for about two-thirds of their height, after which they again decrease in diameter, but are provided usually with a projecting rim. The unpainted ware includes a series of tripod jars of considerable interest. A vessel which probably had a narrow neck like so many water pots used in the east today was also found, but the exact shape of this vessel is uncertain as it was much broken. Pots with pointed bottoms have also been found.

Tripod vessels are not uncommon in southeastern Europe and occur as early as the first city of Troy. The pear-shaped vessels show an undoubted analogy with similar pots, sometimes painted, sometimes plain, which have been found in the Danube–Dnieper region, although there are certain differences in the form of the rim. On the other hand the small bowls show affinities with others found at Anau and Susa, in the earliest strata on those two sites (Anau I and Susa I). The pots with pointed bottoms have a wide distribution, and parallels could be cited from Troy, Egypt and even India, and therefore provide little evidence for the solution of the real connection of the culture. A further parallel with Troy is, however, found in a pot with a perforated bottom, a type of pot also found in Persia and Egypt. At present, parallels with other regions of the far east are lacking, but some of the objects from Manchuria, described by Torii as pottery handles, may turn out to be the legs of tripod pots.

The decoration on the pottery throws further light on the problem. At a date which probably coincides with the 3rd millennium B.C. (though there are divergent opinions on this question) the use of painted pottery was widely spread over southeastern Europe and western Asia. The technique is similar, but certain differences in design have led some writers to question the association of all the Chinese finds with those of the west. There can be no doubt on general grounds that all the pottery belongs to the same family and that it has a very wide distribution in Eurasia, at the period covering the transition from the stone to the copper and bronze ages. Although the distance is very great there are no marked geographical boundaries except deserts in the region which stretches from the Aral-Caspian basin to the Pacific ocean. There have been trade routes across this region from time immemorial and there is reason to believe that in former times the deserts did not constitute the barriers which they do at present owing to different climatic conditions.

In the extreme west, painted pottery has been found on various sites in southeastern Europe, namely at Tripolye (in southwest

Russia), at Petreny (in Bessarabia), at Schipenitz (in Bukovina), and on various other sites in Transylvania, Galicia and Moldavia. The painted pottery penetrates as far south as Thessaly and had a wide distribution over the whole of the area mentioned. Both in form and in the types of decoration the Chinese ware is very suggestive of this Danube–Dnieper culture. The pottery of Asia Minor on the whole is less reminiscent of the Chinese ware, but elsewhere in western Asia close parallels can be found.

Main Parallels.—Two areas are important, a northern and a southern. In the north, Pumpelly conducted excavations at Anau near Ashkhabad in Turkistan in 1904. He found four different cultures called respectively Anau I, II, III, IV. The last culture was of iron age date. In the earliest period copper was relatively rare, but pottery was abundant, and the pots were hand made, painted, often polished and decorated with geometrical designs. In Anau II copper is abundant, but most of the ware is monochrome. It is therefore mostly with Anau I that parallels with the Chinese pottery must be found. There are certain agreements; lattice work designs are common to both and in the straight-line patterns there appears to be a close parallelism. At Anau, however, curves are very rare and circles do not occur. There is therefore a disagreement in what appears to be one of the most marked characteristics of the eastern Chinese ware. Pots which resemble the Anau I have been found near Nachitzevan in Transcaucasia, a site which can be dated at probably about 2500 B.C., and the artifacts in which represented a highly developed copper age.

In the southern area parallels can be found with the Chinese pottery in Mesopotamia, Persia and Baluchistan. The Persian sites include Susa, the capital of ancient Elam, and the mounds of Pusht-i-Kuh, about 100 mi. west of Susa, the most important site being Tepe Mussain. The earliest pottery from Susa may be divided into two classes, of which the first and most ancient shows certain resemblances with the eastern Chinese pottery, but it should be noted that copper implements are found in all strata at Susa. A closer parallel is found, however, at Tepe Mussain, which in date probably coincides with the transition from Susa I to Susa II. In the pottery from this site all the motives are found which occur in the eastern Chinese pottery, except the meander, which is limited to the finds from Kansu.

The finds of painted pottery from Mesopotamia, notably at Kish and Jemdet-Nazr by Langdon, in the north and by Campbell, Thomson and Woolley in the south provide the necessary link between Anau and the Persian sites.

The pottery from Baluchistan, published by Noetling, resembles very closely the Honan pottery, and indeed is closer to it than any other of the western material except possibly some of the Mesopotamian wares.

Links Between East and West.—These parallels, however, striking as they are, are by no means conclusive. At present the links between China and the west have not been fully established. There is a unity between the Persian and the Caucasus region, but between this area and China there is a long gap. Some suggest that the Honan finds should be considered as an early purely stone age culture and that China is the original home of copper-working, which spread thence westwards. This seems unlikely. Secondly, others think—and Arne seems inclined on the whole to support this hypothesis—that there have been two great waves of immigration. The first was so early that either it did not bring copper with it or it became so quickly isolated from the west that the metal did not come through by means of trade. Arne also suggests that the presence of copper objects in the graves at Sining and Chênfan in Kansu may mean that this culture is somewhat younger. Frankfurt, on the other hand, believes that the painted pottery with a spiral design is a local growth, but suggests an analogy between the Persian ware and some of the finds from Kansu. He states that "some sherds recently found in China might suggest that the knowledge of copper-working perhaps also spread to the east from the Persian Caucasian region." He admits "significant indications" but considers the material too scanty for a definite pronouncement. The different views then appear to be: the origin of copper-working in China, a series of immigrations from the west, and the possibility of copper-working spreading from the west, but a local growth for the Chinese painted pottery.

First, the mass of evidence is against the suggestion that copper-working took its origin in China and it seems more probable that it began in the near east, although the exact location is unknown at present. Secondly, the evidence of graves makes it unlikely that the spread of painted pottery was due to any large migration (*see* CHINA: *Ethnology*), as those skeletons which have been examined belong to a type which is not very different from the modern Chinese, whereas the users of painted pottery in the near east belong to an entirely different racial type. In whatever way the use of painted pottery spread, whether by trade or by the introduction of a superior culture by conquest or other method, the people who introduced it were able only to spread the culture but not to alter the physical type of the far east. Thirdly, a definite distinction must be made between the prehistoric pottery from Kansu and from the rest of China, as hitherto discovered; they can hardly be in the same line of evolution. It seems unlikely that there should be two independent sources of invention of such characteristic pottery and it seems reasonable to suggest that both represent successive waves of migrations of culture from elsewhere. The more eastern pottery has characters of its own in addition to those features which it shares with the near east. It may, therefore, represent a local development, due possibly to isolation, of a technique originally acquired from outside. Such an hypothesis might serve to explain the absence of metal objects in the sites examined.

Chronology.—The dating assigned to these finds in China necessarily depends to a large extent on the view taken as to its origin. First we have two separate strata: some of the Kansu finds, which may well prove, as has been suggested by Andersson, to be later, and the finds from other parts of China which appear to be earlier. If we accept their association with the painted pottery from the near east the dating in China will depend to a large extent on the chronology accepted for the near east. Gordon Childe suggests that in Elam and Egypt vases were being painted as early as 5000 B.C., while in Thessaly and in the Ukraine it is unnecessary to go back much beyond 3000 B.C. In Mesopotamia, on the whole, the consensus of opinion suggests the middle of the 4th millennium B.C. Some authorities incline to a very much earlier date. Gordon Childe on this basis considers that the earliest Chinese finds are really undatable. Arne believes that they belong to the first half of the 3rd millennium B.C., "perhaps very near 3000 B.C." He bases this dating on the assumption that the Chinese discoveries are more or less synchronous with Susa I. We have, however, no warranty that this assumption is justified. Indeed, the special character of the Chinese pottery suggests that it had time to develop on its own lines. The gulf between the Palaeolithic and the Neolithic has not yet been bridged, nor has it been possible to fill in the gap between the true earlier Neolithic and the painted pottery culture. The earliest date of this latter must therefore at present be considered entirely undefined, if we base our chronology on earlier cultures, and on this basis Arne's suggestion of 3000 B.C. is perhaps as probable as any.

The evidence so far discussed provides abundant evidence of relations between prehistoric China and the west but throws no light on relations between that country and the far east. Recent work by the Geological Survey of Indo-China has revealed the existence of a well developed Neolithic culture in that area, which extends to the south, probably over most of southeastern Asia, but whose northerly extension, as far as it is known at present, appears to lie on the borderland of China. This Indo-Chinese prehistoric culture appears to be entirely separate from any Chinese culture so far known and to constitute an entirely separate archaeological province. That there should have been no form of culture contact is unlikely, but at present it is quite impossible to suggest any definite analogies between this culture and the cultures which have been discussed above. Possibly the geographical conditions and the dense vegetation of tropical southeastern Asia provided an insuperable barrier, possibly the apparent lack of connection is due entirely to our lack of suitable explored sites.

To the north, however, we have more exact information. Japan

has always been in touch with China and there is every reason to believe that the painted pottery culture of China was not without its influence on Japan. Most of the Japanese Neolithic pottery depends for its ornament either on incised patterns or on relief. It is also characterized at least in one stage by the presence of figurines of quite a different type from anything so far found in China. The development of this early Japanese ware can be traced throughout the stone age in Japan and appears to represent a culture which is entirely independent of China, although it shows certain resemblances to some of the early ware from Manchuria and Korea. Painted pottery, however, does occur, although rarely. It seems not unlikely that such specimens represent either imported wares or possibly a local imitation of Chinese ware. It is probable therefore that there was a certain amount of relation between Japan and China in Chalcolithic times. On the other hand fairly extensive excavations have been made in Japan so that it is probable that if the painted ware culture ever existed in Japan it would have been discovered. But there are indications that there was a close connection between Neolithic Japan, at a certain stage, and part of the mainland opposite. Northeastern China may, therefore, possibly represent a different cultural province from the rest of northern China, but here again we must wait for further excavations before any definite light can be thrown on the question. There are indications that at least part of this region remained in the Neolithic stage of culture when China itself, or at least the plain of China, had developed a high civilization.

Relations Between Chalcolithic Culture and Chinese Civilization.—Andersson, to whom the discovery of this chapter in Chinese prehistory is due, suggests that many features of Chinese civilization are directly descended from the Chalcolithic culture. First, he has suggested that the Li character is directly descended from a pictographic representation of a tripod pot. Arne, however, seems inclined to think that although the development is striking the tripod pot may have been introduced into China from the west. Secondly, the knife at present used by knife-sharpeners in Peiping is alleged to be directly descended from a knife found in the Neolithic sites. A type of knife, akin to this form, is used today to reap kaoliang (a type of millet). Thirdly, the adze used today in Peiping appears to be descended from the stone celt by way of the bronze celt. The question of the origin of wheat in China is too controversial and not sufficiently supported by evidence to be included here, but it is at least suggestive that its earliest recorded use is in conjunction with painted pottery in the near east, so that wheat-growing may be part of the same culture complex of which painted pottery is such a conspicuous element.

We thus have evidence of a Palaeolithic phase, represented by implements and hearths of the middle and upper Palaeolithic periods. This is followed by a widely spread Neolithic. Presumably at a later date, from analogies elsewhere, there was in China a widely spread culture associated especially with painted pottery, a period which can probably be divided into two parts. But little in this culture can be considered to be definitely Chinese. Certain elements of it seem to have survived in the Chinese culture of the historic period, and as far as we know at present the possessors of this culture did not differ essentially in their physique from the inhabitants of modern north China. Side by side with this culture there seems to have persisted in the northeastern part of the Chinese dominions a type of Neolithic culture, which probably persisted among barbarous tribes well into the historic period.

In recent years still further finds have shed additional light on Chinese pre-history. Presumably these are only a beginning. Later discoveries will undoubtedly alter the picture as we now have it, for Chinese archaeology is only in its infancy. What has thus far been revealed seems to indicate either a varied stone age culture or more than one culture. It may be that both are true. There was, for instance, a black pottery which was often thin and lustrous and which so far has been found from Shantung in the north to Hangchow in the south. The peoples who used it lived in settlements which were often walled and in circular, partly subterranean dwellings. They farmed, hunted, fished and had as domestic animals horses, sheep, cattle, pigs and dogs. They made implements from the shells of fresh-water molluscs. Their dead were buried face downward in pits. Archaeology, too, has served to make vivid the life under the Shang, the second of the traditional dynasties. It is probable that several of these cultures existed simultaneously. The stone age presumably overlapped the bronze age.

BIBLIOGRAPHY.—J. G. Andersson, "An Early Chinese Culture," *Bull. Geological Survey of China,* No. 5 (1923); *ibid.,* "The Cave Deposit at Sha-Kuo-T'un," *Palaeontologica Sinica,* Series D., vol. i. (1923); *ibid.,* "Preliminary Report of Archaeological Research in Kansu," *Mem. Geol. Survey of China,* Series A. (1925); T. J. Arne, "Painted Stone Age Pottery from the Province of Honan," *Palaeontologica Sinica,* Series D., fasc. 2 (1925); Davidson Black, "The Human Skeletal Remains from the Sha-Kuo-T'un Cave Deposit in Comparison With Those from Yang Shao Tsun," *Palaeontologica Sinica,* Series D., fasc. 3 (1925, bibl.); E. Licent and Teilhard de Chardin, *L'Anthropologie,* xxxv., pp. 63, 201; V. Gordon Childe, *The Aryans* (1926; bibl.); H. Frankfurt, "Sumerians, Semites and the Origin of Copper Working," *The Antiquaries Journal,* viii. (1928); F. Weidenreich, *The Skull of Sinanthropus Pekinensis* (1943). (L. H. D. B.; K. S. L.)

AESTHETIC DEVELOPMENT

In northern China, mainly in the basin of the Hwang-ho or Yellow river, there slowly emerged in late prehistoric times a focus of civilization destined eventually to make its influence felt in all the neighbouring regions, both continental and insular.

Chinese Bronze Age.—It is only with the acquisition of bronze that a distinctly Chinese civilization first appears. So far no trace has been found of evolution out of an earlier copper period like that which took place in the occident. On the contrary, the bronze objects found in China are all essentially late forms, identical in principle with types which in other lands appear only toward the close of the bronze age. This great advance in civilization seems to have occurred under the Shang dynasty, which terminated about the end of the second millennium, B.C. Bronzes in the casting of which superb technique was employed were produced in this period. It is, however, with the succeeding Chou period that the Chinese bronze age is especially linked. Although barbarous in many respects, it was distinguished for colour and richness and the lavish use not only of bronze but also of gold, ivory, jade, featherwork and ornamental textiles. The high artistic quality of this civilization is best exemplified in the great bronze ceremonial vessels used in connection with the ancestor worship of the nobility. These, for grandeur of form, dignity and ornamentation, and mastery of technique, have never been surpassed, and command the admiration of students and art-lovers the world over.

The Ch'in Dynasty.—Of the artistic achievements of this powerful but short-lived dynasty we know but little. A nearly contemporary work states that large bronze statues were then cast, and certain types of vessels of that material have been ascribed to the period, but with hardly sufficient reason.

The Han Dynasty.—This period of over 400 years is a most important one, in art as in other respects. Then first appeared numerous hitherto unknown culture elements of fundamental importance to the Chinese civilization of later times.

Of its architecture the records have much to say, but nothing has survived save certain foundation mounds and city and boundary walls of rammed earth. Sculpture in stone now first made its appearance in quantity, in the form of low reliefs and figures of men and animals set up about tombs. Painting underwent a great development, its materials, instruments and technique becoming fundamentally what they have since remained. Of its achievements, only certain archaic delineations of human figures on funerary tiles are known; but it would seem mainly to have depicted scenes of battle, the hunt, and court and domestic life, with but little attempt at landscape. Only in the 2nd century A.D., toward the close of the dynasty, did the names of individual artists begin to be recorded.

The pottery of this period also shared in the great aesthetic evolution then taking place. The great Han mortuary vessels, sometimes embellished by bronze forms or encircled by bands of vigorous naturalistic scenes in relief, are well known to collectors.

Clay figures of men, women, animals, houses and utensils, found buried in tombs, throw much light on the life of the time. The decorative arts, like those of the jeweller and the lapidary, also underwent a rich and striking development; in connection with the latter it may be noted that seals, usually cut in jade or some other hard stone, long known in western lands, now first appeared in China.

The Period of Disunion.—The downfall of the Han dynasty, in the 3rd century, led to a condition of disunion and civil war, which lasted for nearly 400 years. Yet, in spite of this, great progress was made in the arts. Paintings on silk, still chiefly of human figures but displaying attempts toward landscape, are known to us through copies by later artists. Pottery was further improved and diversified in form, ornamentation and technique.

THE EFFECT OF BUDDHISM

The New Religious Factor.—It was, however, in religious rather than secular art that the period achieved its greatest aesthetic triumphs. This was due to the introduction of Buddhism from India. The effect of this upon China and her neighbours throughout all subsequent history has been incalculable. The famous early Buddhist sculpture of Gandhara, in northwestern India, reached its maximum development about the 2nd century, but in its pure form spread only as far as eastern Turkistan. The art which now developed in northern China under the Toba Tatar or North Wei dynasty (A.D. 386–636) was no direct outgrowth of this. It must have flowered locally under the stimulus of the new religious faith, although naturally finding inspiration for certain of its elements in Indian, Iranian or even Hellenistic ideas which reached China by the great Central Asiatic caravan-routes. It is best exemplified by the remarkable series of sculptured grottoes of Yün-kang in northern Shansi and Lungmên in Honan, in regions where the North Wei power successively centred. Its best work is characterized by slimness of figure, rhythmic grace of curve and that passionless, spiritual calm and benevolence which are the essence of Buddhism.

Shortly afterwards, mainly under the local Liang dynasty (502–557), the new influence also reached China by the sea-route through the Straits of Malacca. This latter movement, originating chiefly in southern India, brought with it an art little affected by that of Gandhara, but reflecting rather that of the great Maurya dynasty of the 3rd century B.C. Among the elements which it introduced were the fluted column and great and vigorously executed winged lions; examples of both these still survive, much mutilated, in the vicinity of Nanking, the capital of the Liang dominions.

A native religion, Taoism, borrowed from Buddhism not merely its temples, festivals and whole paraphernalia of worship, but also its art, notably its sculpture. Its works, however, were much cruder.

The T'ang Dynasty.—Under the powerful and wealthy T'ang dynasty Buddhist sculpture attained its highest pitch; naturalism replaced conventionality, and heads, instead of reflecting an impersonal and purely spiritual ideal, became individual portraits. Painting also underwent a noteworthy development. To this period belongs Wu Tao-tzŭ, greatest of all Chinese painters, whose style has exerted enormous influence upon all later times, not only in China, but also in Japan. Two schools appeared, a northern and a southern, and landscape was now seriously developed. Almost all the authentic existing T'ang dynasty paintings are religious in character; but fortunately a few secular examples survive, while others are known through copies by artists of later periods.

In pottery also the T'ang period reached a higher stage than hitherto. Glazes were increased in range of colour and texture. The forms themselves are predominantly native, although in some cases they reflect western influences, especially that of Sassanid Persia.

T'ang grave figures are well known for their artistic merits as well as their great archaeological interest. Bronze, long since displaced by iron for the manufacture of weapons and tools, was in great favour in the arts, notably for the casting of Buddhist statues and statuettes, often richly gilt. Ivory from southern China and Indo-China and jade from Turkistan were carved into a variety of ornamental shapes. Although probably already known in principle, engraving on wood now makes its first definite appearance.

The Sung Dynasty.—During the Sung period the influence of Buddhism greatly declined, being replaced by Confucianism, and probably as a result of this, sculpture became decadent. Painting, on the other hand, reached heights never attained before. Landscape underwent its greatest development, the effort being not to depict a scene exactly, but to reveal its inward spirit and arouse a corresponding emotion. Taoism, through its love of solitude and contemplation, provided Sung painting with many of its most romantic concepts. Thus there arose in China an appreciation of the beauties of nature. Authentic pictures of this period, while more numerous than those of the T'ang, are nevertheless very rare. During this extremely artistic epoch, pottery and porcelain also underwent a great development, losing, it is true, something of the strength and vigour of the best T'ang examples, but acquiring nevertheless a characteristic tastefulness in form and delicacy of finish. Especially noteworthy were monochromes—celadons and whites.

THE CONFUCIAN REVIVAL

The Ming Period.—The Ming period (1368–1644) is especially noteworthy for its great achievements in architecture, even today hardly appreciated at their real worth. Nearly all the city and frontier walls, paved roads, bridges, palaces, temples and pagodas still existing in China were constructed by the great Ming builders. Next to its architecture, probably the most important work of the Ming period was that accomplished in pottery. Here too inspiration was sought from the earlier epochs, especially that of the T'ang. But original work was done, and Ming celadons, polychromes and blue-and-white ware are well known. It was during the latter half of the dynasty that porcelain was first regularly exported to Europe, although numerous examples had reached Mediterranean lands far earlier through Arab traders. The sculpture of this time is dull and uninspired, as shown by its best known examples, the colossal figures of men and animals lining the famous avenue to the Ming tombs just north of Peiping. Painting not infrequently displays much excellence, but lacks the interest aroused by original creative art. Emphasis was placed chiefly upon landscapes and nature studies, and to the Ming artists who industriously copied earlier works we owe by far the greater part of our knowledge of the secular paintings of the T'ang and Sung times.

In the realm of textiles, embroideries, brocades and damasks of high character were produced, and for the first time, perhaps as a consequence of the contacts opened up with the near east under the Mongols, Chinese rugs and carpets assume a place of importance. In the minor arts also, development attained a high level. Ming cloisonné is characterized by a boldness of design and depth of colour never excelled. Much work of a high technical order was done in the carving of jades and other semi-precious stones and ivory, in dignity and beauty often far superior to later examples. In general, the art of this time, perhaps largely owing to the revival of Confucianism with its worship of antiquity, falls far below that of the earlier and truly great periods. These were spontaneous and creative and had a genuine message; while that of the Mings was consciously imitative and sought its mission in trying to bring back to life a long dead past.

The Ch'ing Dynasty.—The Manchu dynasty, known as that of the Ch'ing, produced several rulers of first-rate ability; but their genius displayed itself to better advantage in statecraft and war than in the development of the arts. In architecture they did but little in comparison with their predecessors the Mings, perhaps because the latter had left so little to be done. In sculpture, China under their rule displayed little originality, development being mainly in the direction of grotesque perversion of taste and excess of ornamentation. In painting almost no original work of consequence was done, although the copying of earlier works was continued. It was in the field of porcelain that the most noteworthy aesthetic achievements of the Manchu period have occurred. A marked development took place in fineness of texture

and elaboration of form and decoration. The greatest work was done in the two decades from 1662 to 1683. During the 18th century the tendency toward elaboration of form and decoration became more and more marked, and some of the pieces of the Ch'ien-lung period have never been excelled in these respects. The weaving of textiles and rugs, the execution of objects of personal adornment and household decoration, as well as carving of every sort, also display this elaborating tendency. With it went a steady deterioration in taste for which no intricacy of design could compensate.

Whether the present turmoil in China will lead to another period of artistic greatness remains to be seen.

Other Regions.—Chinese culture spread to Korea and Japan (*qq.v.*), but these were not the only regions into which it was carried. During the early centuries of the Christian era it spread over southern China and gradually made that region definitively Chinese. Indo-China and Tibet, although strongly affected, escaped such complete absorption, partly because of the presence in those countries of strong Indian cultural counter-currents. During the T'ang period, and again under the dynasty of the Mings, the influence of China penetrated far and wide through the Indian archipelago; Borneo and the Philippines underwent Chinese contacts of which traces still remain, and even distant Ceylon for a time was tributary of the Ming emperors.

BIBLIOGRAPHY.—W. G. Gulland, *Chinese Porcelain* (1898); W. C. Monkhouse, *A History and Description of Chinese Porcelain* (1901); E. Dillon, *Porcelain* (1904); S. W. Bushell, *Chinese Art* (1904–06, new ed. 1921); R. L. Binyon, *Painting in the Far East* (1908, 3rd ed., 1923); S. W. Bushell, *Description of Chinese Pottery and Porcelain* (1910); B. Laufer, *Chinese Grave-Sculptures of the Han Period* (Leipzig, 1911); E. F. Fenollosa, *Epochs of Chinese and Japanese Art* (1912); B. Laufer, *Jade. A Study in Chinese Archaeology and Religion* (Field Museum Publications, Anthropological Series, vol. 10, 1913); M. Anesaki, *Buddhist Art* (1916); *Ars Asiatica* (ed. v. Golonbew, 1914); A. Waley, *An Introduction to the Study of Chinese Painting* (1923); *The Chinese Journal* (Shanghai, 1923); R. L. Hobson and A. L. Hetherington, *The Art of the Chinese Potter from the Han Dynasty to the End of the Ming* (1923), and *The Later Ceramic Wares of China* (1925); A. J. Koop, *Early Chinese Bronzes* (1924, *see* also Bushell, *loc. cit.*); A. L. B. Ashton, *An Introduction to the Study of Chinese Sculpture* (1924); O. Sirén, *Chinese Sculpture from the 5th to the 14th Century* (1925); *The Burlington Magazine Monographs* (1925); *Artibus Asiae* (Dresden, 1925); T. J. Arne, *Painted Stone Age Pottery from the Province of Honan, China* (Geol. Survey of China, Peking, 1925); E. F. Strange, *Chinese Lacquer* (1926); C. Hentze, *Chinese Tomb Figures* (1928). *See* also CHINESE ARCHITECTURE; CHINESE PAINTING; CHINESE SCULPTURE; BRONZE AND BRASS ORNAMENTAL WORK: *Chinese Bronze*. *See* further JAPANESE PAINTING AND PRINTS; KOREA: *Aesthetic Development*. (C. W. B.; K. S. L.)

HISTORY

Introduction. The Influence of Physical Environment.—Throughout its course the history of China has been profoundly affected by physical environment. In the first place, what is known as China Proper is singularly fitted for a large and civilized population. Fertile valleys, the loess soil, great alluvial plains, a fairly large supply of minerals, a favourable climate and a rainfall which is usually adequate, combine to make the region a natural seat for powerful and highly cultured peoples. In the second place, the mountains and rivers within China Proper offer no insuperable obstacles to the union of the region under one rule. This is especially true of the part of China embracing the Yangtze valley east of the Gorges and the valleys of the Yellow, the Huai and the North rivers. China is fairly easily welded into an empire. On the other hand, these internal barriers, especially those in the west and southwest, are sufficiently marked to stimulate a strong provincial feeling and dialectical differences. Not infrequently—often for centuries—they have permitted political division. In the third place, the great plateaus, deserts and mountains by which China Proper is surrounded have been sources of periodic invasions. The sturdy dwellers in these relatively inhospitable wastes naturally looked with covetous eyes upon the fertile and wealthy plains to the south and east. The necessity of defense against them was constant with every government of China. Hence the Great Wall. Hence, too, the attempt to control them by the conquest of their homes—Tibet, Sinkiang, Mongolia and Manchuria. Hence, too, the periodic infusion of new blood and the highly mixed character of the present Chinese race. In the fourth place, these land barriers, together with the ocean, until the last hundred years or so prevented many intimate contacts with other seats of culture—India, Persia, Mesopotamia, the Mediterranean and Europe. Some contributions have come from without, notably Buddhism, but on the whole Chinese civilization has been indigenous. This may partly account for the intense pride and conservatism of the Chinese. The breaking of these barriers by the west is responsible for the stupendous revolution of the last few years. In the fifth place, the Chinese have not been a seafaring people. The lack of suitable harbours in the north, the absence of near-by large nations with whom profitable commerce could be maintained, and especially the great expanse of desirable land in China itself—enough to engross the energies of the Chinese—discouraged maritime enterprise. Not yet have the Chinese occupied all the soil within their natural boundaries, and only within the past 200 years have they begun to migrate in numbers across the seas. By their geographic environment, then, the Chinese were encouraged to become a numerous, highly civilized, fairly well unified though mixed race, isolated and self-contained.

Origins.—The origins of the Chinese people and civilization are still undetermined. Many conjectures, some of them very engaging, have been advanced. The hypothesis of an Egyptian source no longer finds support. Within the last generation, however, we have had scholars who have maintained that the first Chinese came from the Tigris-Euphrates valley, bringing with them Sumerian culture. Others have held that the Chinese and the earliest civilized inhabitants of Mesopotamia originated in central Asia, the ancestors of the Chinese moving east in successive waves into the valley of the Hwang-ho, and the Sumerians west and south. Others, basing their arguments chiefly upon the analysis of primitive Chinese written characters, have urged that the first Chinese culture came from the south and southeast. Still others are inclined to insist that primitive Chinese culture was indigenous.

The sources of information at present available do not enable us to determine with certainty which, if any, of these conjectures will finally prove to be true. Our oldest Chinese historical literature, that in the *Shu Ching* (*Canon of History*)—parts of it the so-called "ancient text," a late forgery—and the earliest extant collection of ancient songs and poems, the *Shih Ching* (*Canon of Odes*), cannot be depended upon for information earlier than the second millennium B.C., and much of that is by no means uncontested. The earliest documents in even these books show a civilization which is already far removed from primitive conditions and contain no certain proof of either a native or a foreign origin for the Chinese. Archaeology has only begun to help us. Researches in central Asia have disclosed extremely ancient seats of culture east of the Caspian and have suggested the possibility of migrations from what is now Sinkiang and Mongolia and possibly from farther west, and also the possibility of very early transmission of some art forms from western Asia and southeastern Europe. Recently members of the Geological Survey and others have brought to light remains of a Neolithic culture in Honan and elsewhere with vessels and implements resembling those in use by the Chinese in historic times. Whether these Neolithic peoples were the ancestors of the Chinese and the founders of Chinese culture is at present undetermined. Palaeolithic remains have also been discovered, but their full significance is not yet known. The excavations of Anyang in Honan have told much of the second traditional dynasty, the Shang, but give evidence of nothing but a native origin for the rich bronze culture and its highly sophisticated writing. All that we can say with certainty is that we first catch clear glimpses of what we can with assurance call Chinese culture, in present Honan, Shantung and Shensi, that it was then already old, and that it and the people who possessed it were probably the result of several strains from different parts of Asia. Much and perhaps all of Chinese culture may have developed in China itself.

Mythical and Legendary Period.—The Chinese, like other peoples, have accounts which attempt to trace their history to its

beginnings. Chinese myths speak of gods and demi-gods in what is now Kansu and Shensi, of a first man P'an Ku, who was endowed with supernatural powers and was the first ruler of the world, and of several series of emperors who were followed by Sui Jên, the "Fire Producer," who learned how to kindle fire by watching a bird produce sparks by pecking at a tree.

The Chinese believe that they are on more nearly certain ground when they come to Fu Hsi. They regard him as having introduced matrimony, substituting the patriarchate for the matriarchate, as the inventor of the *pa kua,* or trigrams, much used in divination, as having taught his people hunting, fishing and the care of flocks, as the originator of musical instruments, as having substituted a kind of hieroglyphs for a system of knot-writing previously used, and as having arranged a calendar. Fu Hsi is supposed to have been followed by Shên Nung, to whom is ascribed the introduction of agricultural implements and the tilling of the fields, and the discovery of the medicinal properties of plants. Shên Nung in turn was succeeded by Huang Ti, or the Yellow Emperor, who is held to have extended the boundaries of the empire, to have regulated the calendar, to have been the first builder of houses and cities, to have organized a board of historiographers and to have improved commerce. His consort is said to have invented the manufacture of silk. Various dates are assigned to these last three rulers, but most chronologies agree in placing them somewhere in the third millennium B.C. Whether these emperors ever existed is uncertain. At best they are but legendary figures.

Huang Ti is supposed to have been followed by four other rulers, and these in turn by the famous rulers, Yao, Shun and Yü. These three are the first monarchs mentioned in the *Shu Ching* and were regarded by Confucius as models. Dates and details are still extremely uncertain, for most of those usually given are of late origin. Even the historicity of the three is to be viewed with decided doubt. Yü is held to have dealt successfully with the problem of draining away the waters of a great flood and to have founded the first dynasty, the Hsia.

Hsia and Shang.—The Hsia dynasty (to which are ascribed the doubtful dates of 2205–1765 B.C. and whose very existence is questioned) is said to have come to a close with the reign of an intolerable tyrant, Chieh Kuei, and to have been overthrown by T'ang, who in turn founded another dynasty, the Shang or Yin. The Shang dynasty is said to have lasted from 1765 to 1122 B.C., but again the dates are debatable. The existence of the Shang, however, has been amply demonstrated by recent archaeology. What have been some of the most brilliant and startling of recent archaeological discoveries have revealed the Shang to have had bronze utensils of unusual beauty and skill of construction and writing out of which came the present Chinese system. There was an elaborate system of divination by heating bones and tortoise shells and interpreting the cracks which came with cooling. There were chariots and horses and domesticated cattle, pigs, sheep, dogs and chickens. There were buildings of some size. The cowry, a shell, was used for money. Stone was sculptured. The family was important and was reinforced by ancestor worship. Various spirits and deities were revered. The Shang dynasty, like its predecessor, is said to have been brought to its end by the misdeeds of its last ruler, Chou Hsin.

The Chou Dynasty.—Condign punishment was inflicted on Chou Hsin by the rulers of the principality of Chou. Chou was on the western frontier, a buffer against the constant pressure of invaders who would seize the fertile plains. It may itself have been founded by a fresh wave of immigrants from the northwest closely related to those controlled by the Shang. One of the rulers of Chou, Wên Wang, who had, so the records claim, devoted himself to governing well his little state, protested against the cruelties of Chou Hsin and was incarcerated for his pains. While in prison he is said to have produced the *I Ching,* or *Canon of Changes,* a volume based upon the trigrams, and later viewed with great veneration and incorporated into the Confucian Canon. The book is, however, undoubtedly of much later origin. Wên Wang's son, Wu Wang, eventually obtained his father's release and then, after his father's death, with the aid of a coalition of princes, overthrew Chou Hsin and established himself as the first monarch of the Chou dynasty. Wu Wang was greatly aided by his distinguished brother, Chou Kung, or the Duke of Chou, whose regency during the minority of the second emperor of the dynasty is held by orthodox historians to have been ideal. The Chou dynasty lasted until 249 B.C. and so had a longer life than any other which has held the throne of China.

The nearly nine centuries of the Chou dynasty witnessed many important developments. First of all, the area of the realm was greatly extended. Expansion carried the Chinese and their culture to the sea on the east, to the Yangtze river on the south, and to the eastern borders of Szechwan. The "barbarians" in these regions appear to have adopted Chinese culture and to have been assimilated by the conquerors. This expansion was for the most part not due to any leadership provided by the imperial house. After the death of its founders, the dynasty produced few monarchs of outstanding ability. One, Mu Wang, is reported to have been a great traveller and to have extended his journeys to the mysterious "Royal Lady of the West" (Hsi Wang Mu). Most of the emperors, however, were distinctly mediocre and some are remembered chiefly for their folly. The spread of Chinese power was due chiefly to the energies of adventurers and to heads of subordinate principalities.

In the second place, the realm, as it expanded and as the quality of the Chou declined, tended to break up into semi-independent states. These made war on one another, concluded peace and developed the rudiments of international law, with scant attention to the authority of the imperial house. The power of the central administration more and more fell into abeyance, until, finally, the result was a condition which in many respects resembled European feudalism.

In the third place, the Chou dynasty is memorable for a marked development in culture. Agriculture was highly developed through irrigation and the regular division of lands, some of the metals were in use, literature had come into existence, including poetry, history and state archives, schools were to be found, and industry and commerce had sprung up. As in the Shang, there were bronze implements and utensils, although not so skilfully cast as under the earlier dynasty. Religion was highly developed, with divination, the worship of ancestors and of spirits of hills, rivers, stars and other natural objects, and adoration of a Supreme Being variously called Shang Ti and T'ien. Much emphasis was placed on ceremonies and ritual, both in religion and in official intercourse, and a keen sense of ethical values had developed, reinforced by the belief that the Supreme Being was on the side of righteousness and hated iniquity. Then, as now, the family was the dominant social unit. Our knowledge of the period is not sufficiently complete to enable us to trace all the growth in culture which occurred, nor do we know how much this was due to influences from peoples outside the expanding frontier.

Some developments, however, we do know, chief among them the expansion of thought and the rise of schools of philosophy. Most of the thinkers seem to have been associated with the government. Certainly the problem which chiefly engaged their attention was the welfare of society. Cosmogony did not greatly concern them. To their minds, however, the disorder which attended the breakdown of the central government and the division of the country into warring states dominated by autocratic rulers was of great moment, and they sought to build a new order which would bring happiness to all. More is said elsewhere of the teachings of the Chou philosophers. It is sufficient to state here that Confucius (550 or 551–478 B.C.) sought to save society by a return to the way of the ancients. This he believed to involve an emphasis upon ethics—especially upon moral education—and upon ceremonies. By the leadership and example of the educated, and by the careful regulation of society by the ceremonies which had come down from the past he would bring in a golden age. In his train and approving his solution came others, chief among them Mencius (372–289 B.C.), who stressed the essential goodness of human nature and the right of subjects to revolt against a persistently unjust ruler. Another school, Taoism, had as its foundation classic the *Tao Tê Ching* and attributed this to

one Lao Tzŭ, who is said to have been an older contemporary of Confucius. The authorship and the dates of Lao Tzŭ are highly doubtful. The solution for the woes of mankind offered by the *Tao Tê Ching* was conformity to the way of the universe. The way of the universe was believed to be the absence of all man-made restraints and freedom from elaborate regulations and from what passed for civilization. This solution was, obviously, quite different from that advocated by Confucius, and members of the two schools engaged in frequent controversy. Belonging to the school of the *Tao Tê Ching*—Taoism—were many other thinkers, notably Chuang Tzŭ. In Chuang Tzŭ are accounts of men with miraculous powers. Mo Ti, who lived between the times of Confucius and Mencius and who was the precursor of two schools which for several centuries were to have great vogue but were eventually to disappear, taught that institutions should be submitted to the pragmatic test—were they of benefit to society? He was deeply religious, believed that T'ien (Heaven) loved men, and that all men should love one another. It was his doctrine of universal love as the basis of ethics which brought against him the vigour of Mencius' dialectic. Yang Chu, a contemporary of Mencius, declined to trouble himself about society, maintained that death ended all, and held that each man should live for himself and for his own pleasure. Hsün Tzŭ, born in 340, denied immortality and the existence of spirits, and held that man, although bad by nature, could be improved by regulations and ceremonies. The Legalists, as their name indicates, wished autocratic rule through the enforcement of law rather than the Confucian influence of moral example. These and others show how diverse and vigorous was the thought of the age. Never again was Chinese philosophy to be so creative and as untrammelled by the past. Systems then begun were to persist until our own day.

The Ch'in Dynasty.—The philosophers, for all their theories, were unable to prevent the progressive disintegration of the realm. Under the last Chou emperors internal strife so increased that the final 250 years of the dynasty are dubbed Chan Kuo, "the Contending States." Individualism was the order of the day. In the general anarchy the Chou dynasty at last disappeared. The end of the Chou and the union into one empire of the large territory over which the Chinese people and culture had now spread were achieved by the rulers of the state of Ch'in. Ch'in, on the northwestern frontier, like the state of Chou before Wu Wang, had been a buffer against the barbarians. Its princes at last conquered their rivals and took the emblems of imperial power from the weaklings of the Chou line. The last of the Chous was deposed in 249 B.C. The welding of the new domains of the Ch'in into a unified state was the work of the Ch'in ruler who ascended the throne in 246 B.C., and who styled himself Shih Huang Ti, the "First Emperor." Assisted and perhaps inspired and directed by his minister, Li Ssŭ, and utilizing the principles of the Legalists, Ch'in Shih Huang Ti abolished the political system of the Chou with its many petty states and hereditary princes, and divided the country into 36 provinces, over each of which he set officials appointed by and directly responsible to himself. As an emblem and centre of his power he built a capital near the present Hsianfu. He introduced a uniform system of laws, weights and measures, thus aiding both unity and commerce. He extended the boundaries of the empire, carrying his arms into what is Fu-kien, Kwangtung and Kwangsi, and against the barbarians—the Hsiung Nu—on the northern and western frontiers. To defend his borders on the side from which they were most frequently attacked, he constructed the Great Wall. This had probably already existed in part, but he completed and strengthened it. Later orthodox scholars held his name in reproach for one of the signal acts of his reign, the "Burning of the Books." What motives lay behind this deed we do not know: he probably believed that the scholars who were advocating political philosophies contrary to the Legalist school on which he was building his regime were enemies of the new order he was trying to establish. Whatever his motives, he had the existing literature collected and burned, exempting only copies he preserved in the imperial library and books dealing with divination, pharmacy, medicine, agriculture and arboriculture. He commanded scholars to desist from discussing the past. The old order did not expire without a struggle. Ch'in Shih Huang Ti died in 210 B.C. and almost as soon as his strong hand was removed the structure he had erected collapsed. Insurrection broke out, the feeble "Second Emperor" was murdered (207 B.C.), and military chieftains set to fighting for the throne.

The Han Dynasty.—Out of the renewed civil strife one of the contestants, Liu Pang, shortly emerged victorious and founded the Han dynasty (202 B.C.—Liu Pang counted his reign as having begun in 206 B.C.). The effort of Ch'in Shih Huang Ti had not been in vain. The "feudalism" of the last years of the Chou had been so badly shattered that Liu Pang found it possible quickly to unite the country. At the beginning the Han attempted to rule the empire by a system which was a combination of that instituted by the Ch'in and of "feudalism." Members of the emperor's family were placed over the main divisions of the realm. This compromise carried with it the seeds of the old pernicious particularism, however, and after about a century the principle of hereditary local power was curtailed, and the practice was adopted of governing through a civil service recruited on the basis of worth. Worth was to be discovered in part by means of examinations. Confucianism in a modified form rather than Legalism became orthodox. Greatly enlarged by later dynasties, the practice of recruiting officials by means of examinations was to be a means of holding the country together. It was one of the most successful political devices ever invented.

With the consolidation of China went foreign conquests. The major ones date from the long and brilliant reign of Wu Ti (140–86 B.C.). The Han arms were directed chiefly against the barbarians on the northwest, especially the Hsiung Nu. Alliances against this common foe were made with Central Asiatic peoples. To effect the alliances Chang Ch'ien was sent to the west and went as far as Bactria. The power of the Hsiung Nu was broken and the Han rule was extended into what is now Sinkiang. In the dry air of the far northwest remains of fortresses and walls built by the Han to guard the frontier have survived to our own day. The Han also carried their arms south of the Yangtze as far as Tonkin, and to the northeast into Korea.

With unity, increased prosperity and conquests came foreign trade. The caravan routes to the west had been made safe by the defeat of the Hsiung Nu, and products from central Asia and even from the outposts of the Hellenistic world reached China, and Chinese goods were sent in exchange.

Literature and art revived. The first emperor of the Han declined to remove the prohibition of Ch'in Shih Huang Ti against the ancient books. The ban was lifted by his successor, however; documents which had escaped the holocaust were brought out from their hiding places, and scholars devoted themselves to restoring the texts and writing commentaries on them. The Han could not boast of as much original philosophical thought as could the Chou: it may be that the emphasis placed by the state upon the study of the classics of the Confucian school discouraged originality. Taoism was espoused by many in high position, but it degenerated more and more into magic and the search for the elixir of life and for means of transmuting the baser metals into gold. Historiography was greatly developed, however, the outstanding work being the monumental *Historical Records* (*Shih Chi*) of Ssu-ma Ch'ien. Poetry, too, revived. In art the Han period showed some new forms, several of them possibly influenced by contacts with central Asia and the west.

The Han rule suffered a temporary interruption when, in the 1st century of the Christian era, Wang Mang, one of the most interesting social and economic innovators in Chinese history, set aside an infant emperor (A.D. 8), and for a few years ruled as the "New Emperor." Princes of the Han, however, defeated and killed him, and in A.D. 23 restored the dynasty. The capital was now moved from Ch'ang-an in the later Shensi to Lo-yang in the later Honan. The dynasty after this interruption is known as the Later or—because of the change of capital—Eastern Han as distinguished from the Earlier or Western Han. The Later Han renewed the conquests in the west and under Gen. Pan Ch'ao the Chinese became masters of parts of central Asia. A Chinese em-

bassy reached the Persian gulf. Partly because of the control by the Han of the caravan routes to central Asia and partly because of the possession of Tonkin and the south, commerce was maintained with the Roman Orient—known to the Chinese as Ta Ts'in—both by land and by sea. Chinese silks were carried to the Mediterranean world, and products from central Asia and the Hellenistic world were brought to China.

Through these contacts with the west came Buddhism. The story which attributes its introduction to a dream of the Emperor Ming Ti is a pious fabrication of a later age, but that it entered China under the Han is certain. The Later Han continued the patronage of letters, and especially of the Confucian school, which had been accorded by the Earlier Han. Literature flourished and was furthered by the invention of paper (*c.* A.D. 105).

The annals of the Han dynasty, like those both of its predecessors and successors, are punctuated by rebellions and intrigues. As the imperial line became weak, these succeeded in bringing it to an end, and a period of disunion followed which was to last for nearly four centuries. So thoroughly had the Han emperors welded China together, however, that cultural unity and the vision of a single empire were never lost, and to this day the Chinese call themselves the "Sons of Han." Under the Ch'in and the Han China had for the first time become a great state.

Three-and-a-Half Centuries of Disunion (the "Three Kingdoms").—The Later Han technically came to an end in the year 220. It was succeeded by three states—the "Three Kingdoms"—Wei in the north, ruled by the successors of Ts'ao Ts'ao, minister and betrayer of the last of the Han, Wu in the central and lower part of the Yangtze valley, with its capital at Nanking, and Shu, in Szechwan, whose monarchs, of the house of Han, claimed title to the entire empire and which, for its Han connection, is known as the Minor or Shu Han. The period was one of almost constant war and is famed for the exploits of its chief figures, popularized for later ages by the stage and the historical novel, *San Kuo Chih Yen I*. Liu Pei, first prince of the Minor Han, was aided by Chang Fei and Kuan Yü, the latter of whom was later deified as the God of War, Kuan Ti. He was also assisted by Chu-ko Liang, who was noted as a strategist and as the inventor of war machines. The fortunes of war varied, but not one of the three kingdoms was able long to conquer the other two. For a brief time the Minor Han was in the ascendant, but the folly of its second ruler soon brought it to an end and its territories were annexed by Wei. Wei fell under the control of the Ssu-ma family and in A.D. 265 Ssu-ma Yen deposed his sovereign and proclaimed a new dynasty, the Western Chin (A.D. 265–317). For a brief time nearly all of China was under the rule of this house, but the union was short-lived.

To domestic dissension was being added foreign invasion. Peoples from the north and west—Mongols, Hsiung Nu and Turks—took advantage of the internal weakness of the fertile lands to the east and south, and seized much of the territory north of the Yangtze. Many ephemeral states and dynasties followed, the invaders striving to establish themselves in the north, and the Chinese, from the south, endeavouring to beat them back. The period is accordingly known as the epoch of the northern and southern dynasties. The most prominent among many dynasties of the period were the Eastern Chin (A.D. 317–420), with its capital at Nanking, the Sung (A.D. 420–479, called Liu Sung to distinguish it from the later and more famous Sung dynasty), also with its capital at Nanking, the Northern or Yüan Wei (A.D. 386–636) of the Toba Tatars, with its capital at the present Tatung in Shansi, and at its end dividing into the western and the eastern Wei, followed by the northern Ch'i and the northern Chou. In the south ruled the Ch'en.

The period was one of transition in civilization. Many of the invaders adopted Chinese culture, but they could not but modify it. Buddhism now achieved popularity, perhaps in part because with the breakdown of central authority the Confucian school could not offer the resistance that it could under the Han. Many of the monarchs espoused the foreign cult, missionaries came in numbers, and Chinese, the best known of whom was Fa Hsien, went on pilgrimages to the sacred sites in India and returned with Buddhist scriptures. By the time that the empire was once more united, Buddhism had become an integral part of its life and was having profound effects upon other religions, popular thought, literature and art. The Buddhist sculptures of the period are noteworthy. During the last years of disunion and during the first century or two of the union which followed, Buddhism was more prosperous than it was ever again to be in China. The many new sects which arose within it testified to its vigour.

The Sui and the T'ang.—After the long period of division, union was once more achieved, first under the Sui dynasty (A.D. 589–618) and then under the T'ang (A.D. 618–907). Under the second emperor of the T'ang, T'ai Tsung (A.D. 627–650), China became more powerful than she had been since the Han and was for a time the strongest and largest empire on earth. Under the T'ang Chinese arms were carried again into Korea, into Turkistan, across the Pamirs to northwest India and into Tibet. To China, and especially to the T'ang court at Ch'ang-an, the later Hsianfu, journeyed peoples of many lands and faiths. Muslims, Nestorians, and followers of Manichaeism came, and Persians sought aid against the Muslim Arab wave of invasion. The Nestorians had missionaries and churches in China, and, apparently, a fairly extensive literature. Japanese carried home ideas which were to continue the revolution in the life of their nation that contact with China immediately before the T'ang had begun. Chinese Buddhist pilgrims, too, continued to visit India.

Under the T'ang the bureaucracy and its accompanying civil service examinations were further developed and the latter were capped by the foundation of the Han Lin academy, in later years charged with the compilation of histories, the drafting of decrees and other literary labours.

Under the T'ang, prosperity, brought by the arts of peace, flourished. Painting reached new heights and China's most famous poets wrote. Among the latter the most distinguished were the realistic Tu Fu and the Bohemian and attractive Li Po. From the T'ang dynasty dates the earliest known printing, and paper money made its appearance.

Of the many rulers of the T'ang little need be said here. Besides T'ai Tsung the best remembered was probably Hsüan Tsung (Ming Huang) (reigned A.D. 712–756). Under him lived the greatest poets and painters. In him the dynasty reached its apex and toward the close of his reign a disastrous rebellion broke out which marked the beginning of the dynasty's decline. After him invasions and rebellions decimated the population, and in A.D. 907 the dynasty was brought to an end.

The Five Dynasties (A.D. 907–960).—Following the T'ang various aspirants for imperial honours fought for the throne, and in quick succession there followed five ephemeral dynasties, known as the Later Liang, the Later T'ang, the Later Chin, the Later Han and the Later Chou. Their assumption of famous names did not prevent the early demise of each, and in 960 the last gave way to the Sung dynasty.

The Sung Dynasty (A.D. 960–1279).—The Sung dynasty, founded by Chao Kuang-yin, began auspiciously. Most of the country was reduced to submission, the capital was placed at Kaifeng, near the site of the glories of some earlier dynasties, and a further step toward centralizing power in the hands of the emperor was taken in creating a national board of punishments, to which, rather than to the provincial authorities, as formerly, the final decree in capital offenses was entrusted. Before long evil days came. An attempt to conquer the K'itan, a people of Mongol tongue who ruled the Liaotung peninsula, proved unsuccessful, and the K'itan occupied portions of the empire adjoining their domains and were prevented from further depredations only by the payment of tribute. On the northwest another kingdom, that of Hsi Hsia, threatened the frontiers and fought both the Sung and the K'itan. The Sung called to their assistance the Chin ("Golden") Tatars, but these, after expelling the K'itan, made themselves masters of the territory north of the Yangtze and the Sung were constrained to move their capital to Hangchow. In the wake of the Chin came the Mongols. The great Mongol general, Temuchin, or Jenghiz Khan, invaded China early in the 13th century. By 1223 he had possession of most of the country north of the Yellow river, hav-

ing defeated the Chin. Before his death (1227) Jenghiz had made further inroads on the Chin and had defeated the Hsi Hsia. Jenghiz' successor, Ogodai, formed an alliance with the Sung and the two made an end of the Chin. The allies then fell out and the Mongols under Ogodai, Mangu and Khublai pressed south, until, after the last of the Sung monarchs had in despair cast himself into the sea, Khublai in 1279 became emperor of all China.

The military misfortunes of the Sung did not prevent the dynasty from synchronizing with one of the great creative periods of Chinese culture. Painting, under the influence of Buddhism and Taoism, reached a very high point. Philosophical schools contended with each other, and one, culminating in Chu Hsi (A.D. 1130–1200), gave Confucianism the form which until the 20th century was to be regarded as orthodox. Notable histories were written, among them that of Ssu-ma Kuang. An interesting experiment in economic and political reorganization was made under the leadership of Wang An-shih (A.D. 1021–86). Wang An-shih was a brilliant and thorough-going radical. He sought to change the existing educational system and make it of more practical use. He issued original commentaries on the classics, reading new meanings into these ancient documents. For 18 years, as prime minister, he inaugurated and superintended what resembled the later European socialism. His object was to make the state better fitted to cope with its foreign enemies. To this end he would have the government take over the entire management of commerce, redivide the land, regulate prices, make loans to farmers at moderate rates of interest, and place more of the burden of taxation on the rich. He also put upon every family the burden of military defense and appointed a commission to fix a national budget. Wang inevitably had many enemies and critics, one of the chief being Ssu-ma Kuang. These eventually forced his retirement and restored the *status quo*.

The Mongol Dynasty (A.D. 1280–1368).—The Mongol or, as it was officially known, the Yüan dynasty, was not of long duration. The reign of Khublai was brilliant. From his capital at Khanbaliq, or Cambaluc, on approximately the site of the present Peiping, he ruled not only over China but over most of the vast Mongol empire, with its western frontiers in Mesopotamia and Europe. Expeditions were sent into Champa, Annam, Burma and Java, and against Japan. Under him, however, Mongol power reached its climax. The invasions to the south ended in a somewhat inglorious retirement, the attempt on Java was unsuccessful and the armadas against Japan met with overwhelming disaster. The Mongols ruled China largely as conquerors and brought in many foreign troops and hordes of foreign officials. After Khublai the ability of the monarchs rapidly declined, rebellions arose, the Mongols were expelled and in 1368 the most successful of their opponents, an ex-Buddhist monk, Chu Yüan-chang, became the first emperor of a new dynasty, the Ming.

The Yüan dynasty, brief though it was, was not without notable developments. The Grand Canal was completed, and drama and the novel first became important. The safety of the trans-Asiatic trade routes under Mongol rule and the Mongol method of government brought many foreigners into China. Nestorian Christianity had survived on the edges of the empire since the T'ang and now reappeared in China, Muslims entered in fairly large numbers, and even Armenians were to be found. Now for the first time western Europeans made their way to China. The eastward expansion of Europe in the crusades and Italian commerce, and the burst of missionary enthusiasm through the Franciscan and Dominican orders brought Europeans to the western fringes of the Mongol empire. It was natural that European merchants and missionaries should make their way to China—or Cathay, as they called it. Most notable among the merchants were the Venetians, Nicolo and Maffeo Polo, and the son of Nicolo, Marco. Marco Polo was for years in the service of Khublai and, returning to Venice, wrote the account of his travels which has made him famous. Friars were sent as envoys to the Mongol rulers in central Asia, but so far as we know the first to reach China was the Franciscan, John of Monte Corvino, who arrived at Cambaluc in 1294 and there, in the ensuing three decades or more, built up a Christian community numbering several thousands. When the news of his success reached Europe he was created archbishop of Cambaluc, and reinforcements were sent him. In the course of the next few years numbers of other missionaries arrived, notably a papal legate, John of Marignolli. With the collapse of Mongol rule, however, the trade routes became unsafe, an anti-foreign reaction set in and Europeans, both merchants and missionaries, disappeared from China and the Catholic Nestorian communities passed out of existence.

The Ming Dynasty (1368–1644).—This new and purely Chinese dynasty was not noteworthy for its brilliance. Under it, however, the empire was fairly prosperous. The first emperor, Chu Yüan-chang, better known by his reign title, Hung Wu, unified the country and established his capital at Nanking. His fourth son, the third emperor, commonly known by his reign title, Yung Lo, came to the throne through a sea of blood, but proved an able ruler. He was a great builder: he established his seat at Peking, and the palaces and temples which through succeeding centuries made the city architecturally one of the outstanding capitals of the world, were largely his work. He was a patron of literature. He sent expeditions to the south and southeast as far as Java and Ceylon. One of the princes of Ceylon was brought captive to China and for years tribute came from the island. Under a succeeding monarch an expedition was sent by sea as far as the Persian gulf. Under the Ming emperors, moreover, Korea was invaded, Annam for a time became subject to China and frequent wars with the Mongols usually kept those ancient enemies at bay. As time passed, the decline which was the inevitable fate of dynasties brought weakness to the empire. The Japanese invaded Korea and for decades Japanese pirates ravaged the coasts.

In cultural achievements the Ming period is not remembered for any marked creativeness. Philosophy was dominated by Chu Hsi, and one thinker, Wang Yang-ming (1472–1528), challenged the orthodox school with sufficient originality and success to be prominently remembered. In literature most of the energy of scholars was expended in compiling encyclopaedias and in collecting and editing the works of the past. Architecture there was, and ceramics and lacquer of great beauty, but painting did not reach the heights that it had under the Sung. China was populous and wealthy but did not manifest the cultural activity shown in certain of the preceding dynasties.

The Ming period was made memorable by the renewed coming of Europeans. The European voyages and conquests of the 16th century brought the Portuguese to India, Malacca, China and Japan, and the Spaniards to the Philippines. The first Portuguese reached China about 1514 and before many years had established themselves at several ports. The first comers were so truculent, however, that before long they were driven out or massacred. For a brief time the Portuguese traded from the island of Shang-chuan, south of Canton, but shortly afterwards were permitted to form a settlement at Macao—the exact date is uncertain, but was probably between 1552 and 1560—and retained that as their base. Missionaries came. St. Francis Xavier died on Chang-chuen-shan in 1552 while engaged in a vain attempt to enter the empire. His fellow Jesuits renewed the effort and before the close of the century had established themselves in several cities in the interior. The ablest of their number was Matthew Ricci (1552–1610), an Italian, who arrived in China in 1582 and in 1601 succeeded in effecting a residence in Peking. Ricci and his associates commended themselves to the scholar-official class by their knowledge of science, especially of mathematics and astronomy, and were placed in charge of the government's bureau of astronomy in Peking.

The Manchus.—The weakening Ming dynasty was overthrown by invaders from the northeast, the Manchus. The Manchus had been welded into a formidable force by Nurhachu (1559–1626) and before his death had aspired to the empire. Their opportunity came when, in 1644, a rebel, Li Tzu-ch'eng, made himself master of Peking and the Ming emperor committed suicide. A Ming general, Wu San-kuei, joined forces with the Manchus to oust Li, and a Manchu prince was placed on the throne. Ming claimants did not tamely submit, and it was not until 1662 that the last of them, driven, after stubborn resistance, to the Burmese

borders of Yunnan, came to his end. Somewhat later, the successors of Koxinga, who had been implacable toward the Manchus and had harried the south coast and had ruled Formosa, were eliminated.

For a century and a half the Manchus provided the throne with able rulers. The monarchs, whose reigns were named K'ang Hsi (1662–1723) and, after the brief interlude of Yung Ch'eng (1723–36), Ch'ien Lung (1736–96), had, from the standpoint of foreign conquests and domestic prosperity, as brilliant careers as the empire had known. The Manchus ruled as conquerors and maintained permanent garrisons in strategic centres throughout the country, but they adopted Chinese culture, perpetuated the time-honoured administrative machinery and laws, associated Chinese with themselves in the highest boards at Peking, and opened to them all the provincial offices. They guarded against revolt by forbidding a Chinese to hold office in his native province, by frequently shifting officials, and by dividing the administrative responsibility for each province among several officers who could serve as a check on one another. They vigorously put down revolts, notably that of Wu San-kuei, to whose aid they largely owned the throne. They ruled Manchuria, they conquered Mongolia; under K'ang Hsi they added Tibet to their possessions and, under Ch'ien Lung, Ili and Turkistan. Ch'ien Lung's armies penetrated Burma, Nepal, and Annam, and Korea paid tribute. Never had the empire covered so much territory, and never had it been as populous. With the reign of Ch'ien Lung the dynasty passed its zenith, and after it the quality of the ruling house declined. In the later years of Ch'ien Lung and under Chia Ch'ing (1796–1820), Tao Kuang (1820–50), Hsien Fêng (1850–61) and T'ung Chih (1861–75) numerous rebellions kept part or all of the country in turmoil.

In culture, the China of the Manchus was largely a continuation of that of the Ming. Ceramics were elaborated, but painting did not equal that of the Sung. What were probably the greatest of Chinese novels were written. What was called *Han Hsüeh,* or Han Learning, challenged the dominant Sung philosophy and studied critically the accepted texts of the classics.

The outstanding series of events of the Manchu dynasty was connected with the increasing pressure of European peoples upon China. Catholic missionaries continued to come. To the Jesuits were added in the 17th century Franciscans, Dominicans and Augustinians from the Philippines, Franciscans from Italy, and members of the Société des Missions Étrangères of Paris. In 1692 K'ang Hsi issued what amounted to an edict of toleration, and for a number of years the Church prospered greatly. Missionaries and Christian communities were in all provinces, and by 1700 the Catholics in the empire probably numbered more than 200,000. Then came a series of reverses. A prolonged controversy over the question of what Chinese term should be used for God and of what attitude should be taken by Christians toward certain Chinese rites, among them the honours paid to ancestors and to Confucius, divided the foreign staff. When Rome finally spoke, the decision antagonized K'ang Hsi and the Chinese scholar class. Repeated persecutions arose—only in part because of the decision on the rites; in 1773 papal orders dissolved the Society of Jesus, and the Lazarists, in spite of valiant attempts, could not fully take its place. Religious indifference in Europe, due to the Enlightenment, and the French Revolution and the wars of Napoleon, cut off support from home. By 1800 the Catholics in the empire numbered only about 200,000 and were badly demoralized. Between 1600 and 1800, however, Catholic missionaries had helped to acquaint China with European science and religion and, by their writings, had spread in Europe a knowledge of China.

European merchants did not penetrate the empire as did the missionaries, but they continued to come. Although their commerce declined, the Portuguese retained Macao. The French, Dutch and British opened trade with China, and in 1784 came the first ship from the United States, the precursor of many more. By the middle of the 18th century British trade was more important than that of any other occidental people and was the official monopoly of the English East India company. Chinese teas, silks and cottons were in great demand in Europe, and for a time were paid for largely by specie. Eventually, however, the importation of opium, chiefly from India and on British ships, brought a reversal of the balance of trade.

Commerce was carried on under great restrictions. By the close of the 18th century only one port, Canton, was open to merchants from abroad. The Europeans were there confined to a small area —the "factories"—and were ordered to spend the quiet months in Macao. Business could be conducted only through an officially designated group of Chinese merchants, the co-hong. The absence of fixed tariff charges, the exactions of venal officials, the unwillingness of the Chinese to permit official intercourse on the basis of equality, the prohibition against a Chinese teaching a foreigner the language, the subjection of the foreigner to Chinese laws and courts, were all galling to the westerner. Russia had little if any better treatment. K'ang Hsi had momentarily checked the Russian advance by the capture of Albazin (1685) and there followed the first treaty to be signed with a European power, that of Nerchinsk (1689), which, with its successor, the treaty of Kiakhta (1727), provided for trade, diplomatic intercourse—in part through a resident Russian mission in Peking—and the extradition of criminals.

Repeated attempts were made to obtain better terms. Portuguese, Dutch and British embassies travelled to Peking, notably those of the British in 1793 and 1816, led respectively by Macartney and Amherst, but to no avail. The Chinese had never been accustomed to dealing with other governments on the basis of equality and regarded all foreign envoys as bearers of tribute.

The First War with Great Britain and the First Group of Foreign Treaties (1839–44).—Such a condition of affairs could not endure. The industrial revolution inaugurated a period of renewed expansion of the occident, and the west desired admission to China to market the products of its factories and to obtain raw materials. This was also the period of the important "clipper ship" trade between the United States and China.

Pressure first came from Great Britain, the European nation in which the industrial revolution began. On demand from British merchants, the monopoly of the China trade by the English East India company was abolished (1834) and increased friction between the English and Chinese ensued. Lord Napier was appointed the first "superintendent" of British trade in Canton (1834), but Chinese officials looked upon him as merely a head merchant and refused to deal with him as an equal. Lord Napier died under the strain of his anomalous position and his successors were unable to effect any improvement in the situation. Armed conflict was all but inevitable. British merchants were insisting upon more privileges than the Chinese were willing to concede, and British and Chinese ideas of international intercourse were fundamentally at variance—the one government being accustomed to a family of equal nations, the other knowing only an empire and subject peoples. Conceptions of law differed: the Chinese, with their emphasis on group responsibility, holding the entire British community liable for the misdemeanour of any of its members and insisting upon a life for a life, even when death had been accidental, and the British contending that upon the individual and not the community should be placed the responsibility for misdeeds. The conflict came to a head over the question of the importation of opium. This had long been prohibited by the Chinese government, but foreign merchants brought it in ever-increasing quantities and corrupt Chinese officials connived at its introduction. After many futile attempts at enforcement, Peking at last took vigorous action and dispatched a special commissioner, Lin Tsê-hsü, to stamp out the trade. Lin arrived at Canton in 1839 and promptly set about his task. Foreign merchants were compelled to surrender their stocks of opium for destruction, and pressure was put upon them to give bond not to engage further in the importation of the drug. The British objected to what seemed to them high-handed measures, and in November 1839, hostilities broke out. The Chinese were repeatedly defeated. The war dragged out until 1842, however, for the British contented themselves largely with attacks on centres south of the Yangtze, and their victories alternated with unsuccessful attempts at negotiation. Finally, when Chinkiang—at the intersection of the Yangtze and the Grand Canal—was

taken and Peking's communications with the south were threatened, the imperial authorities were frightened into concessions, and on Aug. 29, 1842, the treaty of Nanking was signed.

This document provided for the cession of the island of Hong Kong to Great Britain, for the opening to foreign residence and commerce of five ports, Canton, Amoy, Foochow, Ningpo and Shanghai, for liberty to appoint consuls at each port, for communication between British and Chinese officials of the same rank on the basis of equality, for an indemnity to the British, for the abolition of the co-hong, and for a "fair and regular tariff." In 1843 regulations for trade were agreed upon and published, and a supplementary treaty was signed which fixed the tariff rates, assured to the British "most favoured nation" treatment, and contained the beginnings of extraterritoriality. Other western nations took advantage of China's defeat. The Americans sent a commissioner, Caleb Cushing, who negotiated a treaty which conceded, in general, the same commercial privileges to Americans which had been granted to the British, and which, among other things, removed American citizens engaged in the opium traffic from the protection of their government, elaborated extraterritoriality, and provided for the revision of the treaty at the end of 12 years. In 1844 the French obtained a treaty which had much the same provisions for trade and official intercourse as were guaranteed by the British and American documents. At the instance of the French, imperial edicts were issued providing for the toleration of Catholic Christianity and for the restoration of the Church property which had been sequestered in the persecutions of the previous century. In the next few years the Belgians and the Swedes were also given treaties.

The Second Foreign War and the Second Group of Treaties, 1856–60.—The years between 1842 and 1856 were in effect a troubled truce. The treaties of 1842 and 1844 were satisfactory neither to foreigners nor to Chinese. From the standpoint of the foreigner they did not grant enough. No provision was made for travel in the interior, for residence in other places than the five open ports, or for direct diplomatic intercourse through representatives resident in Peking. The Chinese, on the other hand, believed that the treaties conceded too much, and since they had been extracted by force, the authorities were not disposed to abide by them any more than they were compelled to do. The Chinese were no further inclined than formerly to treat western "barbarians" as equals. Clashes were frequent. Moreover, the British treaties said nothing about opium, and the traffic in the drug continued, a constant source of friction. While the Americans, the British and the French were demanding that revision of the treaties which had been promised in the documents of 1844, war between the British and the Chinese broke out—as is often the case in times of international tension—over a comparatively minor incident, the violation by the Chinese of a British flag and the arrest of the crew, all Chinese, on a Chinese-owned but British-registered craft, the lorcha "Arrow" (Oct. 8, 1856). The French, then closely associated with the British through the Crimean War, found in the judicial murder of a Roman Catholic missionary, Chapdelaine, in Kwangsi (Feb. 29, 1856), an occasion for joining in the conflict. The two powers did not at first press the war, for they were just emerging from the struggle in the Crimea and difficulties with Persia in 1856–57, and the Sepoy mutiny, which blazed out in India in 1857, engrossed the attention of the British. Late in 1857, however, the British and French took Canton, and in the following year their squadrons went north to Tientsin, thence to threaten Peking into submission. The Taku forts, commanding the entrance to Tientsin, were captured, and to save the capital the Chinese granted the desired treaties. The Russian and American representatives, although not in the war, were on hand to profit by the French and British successes and also obtained treaties. The Russians obtained all the Chinese territory north of the Amur.

The treaties of Tientsin (1858) in general contained the following provisions: (1) the tariff was modified, and by the fixing of a rate for opium the importation of that drug was legalized; (2) the residence in Peking of diplomatic representatives of the powers was promised; (3) foreigners were to be permitted to travel in the interior; (4) the activities of Christian missionaries were sanctioned, and Christians, both foreign and Chinese, were guaranteed freedom in the practice of their faith; (5) foreign merchant vessels were allowed on the Yangtze; (6) several additional ports were opened to foreign residence and trade, including Chefoo and Newchwang in the north, one on Hainan, two on Formosa, and four on the Yangtze; (7) extraterritoriality was further elaborated; (8) regulations for trade, including the collection of customs, were developed; and (9) indemnities were promised.

When, in 1859, the envoys came to complete the ratification of the treaties and to take up their residence in Peking, they found the road by Tientsin blocked and the Chinese prepared to conduct them to the capital by the port which was used by the bearers of tribute from subject states. The Chinese, moreover, proposed the reconsideration of the treaties. The American minister chose to go to the capital by the suggested route and returned after the ceremony. The Russians were received by still another route. Neither gained much in dignity. The British and French, however, attempted to force their way past the Taku forts and were repulsed. The two powers accordingly renewed the war and in 1860 fought their way through Tientsin to Peking. Peking was captured, the emperor fled to Jehol, and the British, in retaliation for the violation of a flag of truce and the death of some of its bearers, set fire to such of the summer palace as had escaped marauding Chinese troops. The Chinese were now constrained to sign conventions by which they agreed to observe the treaties of 1858, to pay an additional indemnity, to open Tientsin to trade, and to permit—more definitely than agreed upon in 1858—the permanent residence of foreign ministers in Peking. The British were ceded the Kowloon promontory opposite Hong Kong, and through the French was obtained treaty sanction for what had been promised earlier, the restoration of confiscated Catholic Church property. In the Chinese, although not in the official (French), text of the French convention was also permission for French missionaries to lease or buy land and build houses in the interior. The Russians, still fishing in troubled waters, obtained a modification of their frontier by which the territory east of the Ussuri was awarded to them. This territory had a long stretch of coast which included the site of Vladivostok.

The treaties of 1842–44 and 1858–60 defined the legal basis on which intercourse between the occident and China was to be conducted. They were later modified in details, but until 1943 in their main outlines they were the basis of the legal status of foreigners in China. While at the time they seemed to solve a troublesome situation, they weakened Chinese sovereignty and threatened the existence of the state—partly by removing foreigners from Chinese jurisdiction, partly by their regulation of the tariff, and partly by making Christian communities *imperia in imperio*.

The T'ai P'ing Rebellion and Other Revolts and the Revival of the Manchu Power.—While the powers by their blows from without were lowering the prestige of the Manchus and were weakening the imperial structure, a rebellion which had its roots partly in foreign contacts was threatening the Manchu rule from within. This rebellion had its origin in a Hakka, Hung Hsiu-ch'üan. Hung, a school teacher and an unsuccessful competitor in the civil service examinations, in his young manhood suffered a serious illness which was accompanied by bizarre visions. These visions he later interpreted in the light of some books prepared by Protestants and which had been given him years before while he was in Canton. He believed that he was called by God to wean the Chinese from the worship of idols. To this end he preached (in the 1840s) in Kwangtung and Kwangsi. His followers formed themselves into societies, seemingly chiefly at the instance of a companion, Feng Yün-shan, and about 1848 were welded into fighting units and a political force with aspirations to the throne, probably by an adventurer, Chu Chiu-t'ao. In 1852 they seized a city of some importance in Kwangsi but there lost Chu—captured and executed by the Manchus. In spite of this loss, the insurgents moved north into Hunan and from there down the Yangtze, until in 1853 they took

Nanking. Their serious expedition to the north failed, but at Nanking they ruled for over a decade, a fanatical sect whose faith was an ill-assorted blend of misunderstood Christianity and native Chinese beliefs. They showed an utter lack of ability to organize their conquests and owed their temporary success more to the weakness of the imperial government than to their own prowess. They were eventually (1864) put down, chiefly by Tsêng Kuo-fan, but with the aid of a picturesque foreign-officered force which was headed first by an American, Ward, and later by an English major, Charles George Gordon. The rebellion had cost millions of lives and had wasted some of China's fairest provinces.

During the T'ai P'ing rebellion the imperial government, in desperate straits for revenue, resorted to *likin* (internal transit taxes on commerce) and, the crisis once past, continued it. During the rebellion, too, as a convenience for the imperial authorities, the system began of collecting the maritime customs through the agency of foreigners. This expedient was first adopted in Shanghai, but proved so acceptable to both Chinese and foreigners that it was extended to other ports. The imperial maritime customs service so developed was in 1863 placed under the direction of Robert Hart, and through his genius was officered by an able foreign staff and became not only a dependable source of revenue but an agency for the charting and lighting of the coasts and the inauguration of a postal system. Being national, not provincial, it was, moreover, a means of centralizing the government in the hands of Peking.

Other rebellions threatened the power of the Manchus, especially in Shensi, Kansu and Sinkiang, but these were all suppressed. The Manchu dynasty, indeed, for the moment took on a new lease of life. Able Chinese came to its support. The empress dowager, Tzu Hsi, who had had the good fortune to bear the heir of Hsien Fêng, ruled as co-regent during the minority of her son, the emperor T'ung Chih, and then on his death (1875) obtained the succession for another minor—known by his reign name of Kuang Hsü—and was dominant not only during his boyhood but after her nominal retirement (1889). Unscrupulous but vigorous, she probably prolonged the life of the dynasty.

Increasing Foreign Pressure on China, 1860–94.—The years between 1860 and 1894 were marked by no major crises in China's foreign relations, and Chinese life and culture went on nearly unaltered by the presence of the westerner. Pressure was steadily accumulating, however, occasional minor clashes occurred, and the stage was being set for revolutionary changes.

From time to time new ports were opened, and through these and the ones previously available foreign commerce was growing. As before 1860, the British continued to lead. In the treaty ports foreign colonies arose, and in some of them special districts were set aside, usually either as "concessions" or "settlements" (some of them dated from before 1860), which, as a development of extraterritoriality, were under the administration of the foreigners, through the consuls and some of them with a council elected by the foreign tax-payers.

Christian missionaries, both Roman Catholic and Protestant, rapidly increased in number. The first Protestant missionary, Robert Morrison, of the London Missionary society, arrived in 1807, and under the impulse of the vigorous new life of Protestantism in Europe and America, during the ensuing century representatives of many societies followed—British, American and European. Protestant missionaries emphasized the translation and distribution of the Scriptures and of religious and secular literature, preaching, schools, medical relief and the formation of churches. They were largely responsible for China's first contacts with western education and medical science. Roman Catholics reinforced their missionary staffs, emphasizing the winning of converts and the care of children in orphanages. By 1890 Protestant Chinese numbered about 50,000 and Roman Catholic Chinese about 500,000.

Occasional crises arose with foreign powers and usually resulted in fresh concessions to the westerner, either in privileges or in territory. The massacre of some foreigners, chiefly French, at Tientsin, in 1870, through anti-Catholic sentiment, and anti-Christian riots in the Yangtze valley in 1890 and 1891 were only the most prominent incidents arising out of the presence of missionaries. Interference by missionaries—usually Catholic—on behalf of converts was a constant source of friction. In 1875 a British exploring expedition was attacked, and an interpreter, Margery, was killed on the border between Burma and Yunnan. Great Britain took the occasion to demand not only redress but the adjustment of other outstanding questions. In the resulting Chefoo convention (1876) a number of new regulations for trade and official intercourse were agreed upon, and four more cities were opened to foreigners. In the '70s China and Russia nearly came to blows over the occupation by the latter, during a rebellion in Chinese Turkistan, of Ili. By the final settlement (1881) Russia restored all but a small part of the region. In 1881, after prolonged friction, China recognized Japanese jurisdiction over the Liuchiu islands. In the '80s, from difficulties arising out of the extension of French authority over Annam, the desultory Franco-Chinese war broke out. In was terminated in 1885 by a treaty surrendering Chinese suzerainty over Annam. China formally recognized (1886) the British annexation of upper Burma, with the provision that the decennial tribute-bearing mission should be continued to be dispatched to Peking. This fell into abeyance after 1900.

In spite of imperial prohibition, the emigration of Chinese was constant. Chinese had long been settling in adjacent lands to the south—the Philippines, Borneo, Java, the Malay peninsula, Siam and Burma. In the 19th century the movement was accelerated, and large overseas Chinese communities arose, chiefly in the lands above mentioned. Some of the migration extended much farther, however—to the Pacific coast of the United States, the South Sea islands, Australia, Peru, the West Indies, the Guianas and Central America. Now, as previously, nearly all of the voluntary expatriates came from Kwangtung, Fu-kien and Chekiang. Much of the emigration after the treaties was under the form of contract labour, which often was thinly disguised slavery. Many abuses were connected with it—kidnapping, and intolerable conditions on shipboard and after arrival. After much agitation and by a succession of steps, by about 1875 the worst evils were eliminated. Chinese immigration to the United States was never under contract, but it gave rise to much ill-feeling. At first welcomed, the Chinese soon met with opposition from white labour, especially in California. Several decades of trouble followed. In part with the acquiescence of China, the United States suspended for set periods the immigration of labourers. After 1900, without the consent of China, that suspension was made for an indeterminate time. Not until 1943 were Chinese immigrants placed on the quota and admitted on the same basis as Europeans.

The growing pressure of the west began slowly to take effect. Before 1895 no startling changes in the structure of Chinese life occurred, but here and there were indications that China would not remain as she had been. In the first place, she somewhat grudgingly began to enter into the diplomatic life of the world. In 1866 a Manchu was sent to Europe with Mr. (later Sir) Robert Hart to observe and report. In 1867 Anson Burlingame, who was retiring as United States minister in Peking, was asked to head a mission to present China's case to the governments of the west. Burlingame went first to the United States and there negotiated a treaty (1868) which among other things promised respect for the territorial integrity of China and freedom of immigration of Chinese labourers to the United States and reciprocal rights of residence and travel. From Great Britain and France the mission obtained assurances that pressure would not be applied inconsistent with the independence and safety of China. In 1870, after visiting several courts, and while in St. Petersburg, Burlingame died and his colleagues returned to China. The mission was much criticized, especially for Burlingame's optimistic speeches, but—with the exception of a much earlier one to Russia (1733)—it was China's first formal embassy to that west with which she must henceforth deal. Before 1880 resident envoys had been appointed to most of the leading capitals of the world. In 1873 and again in the early '90s, the foreign envoys in Peking were given audience by the emperor, but always with a subtle suggestion that they were considered as coming from tributary states.

Not until 1894 were they received on the basis of full equality.

In the '70s, at the instance of Yung Wing, who had graduated from Yale in 1854, the Chinese government sent several scores of youths to the United States to be educated, but in 1881 a conservative brought about their recall. Two government schools were founded to train men for diplomatic service. By 1894 telegraph lines and a few miles of railway were built, and some attempts were made to reorganize China's naval and military forces and to construct coast defenses according to western models. Chinese officialdom was, however, far from enthusiastic about such innovations. It was especially reluctant to borrow western capital, for foreign interference might follow.

The Chino-Japanese War and the Beginning of Rapid Changes.—China could not hope long to remain semi-isolated. The occident was continuing to expand, Japan, at China's very doors, was rapidly adopting and adapting western culture, and the Middle Kingdom must sooner or later adjust itself to the new world.

The beginning of rapid change was brought by war with Japan. Korea had long been in an ill-defined position of vassalage to China. Japanese, on the other hand, had invaded the peninsula at least twice, the latest occasion having been in the last decade of the 16th century. With her reorganization in the '60s and '70s, Japan once more adopted an aggressive foreign policy, and in doing so came into conflict with China, for the latter, under the advice of Li Hung-chang, was inclined—with some vacillation—to assert more actively than in the past her authority as suzerain. Japan refused to recognize China's suzerainty and the two nations came to blows over the dispatch of troops by both to put down an insurrection in Korea. War was declared Aug. 1, 1894, and China was quickly and overwhelmingly defeated. By March 1895, the Japanese had successfully invaded Shantung and Manchuria, had captured Wei-hai-wei and Port Arthur, fortified posts which commanded the sea approaches to Peking, and the Chinese sued for peace. By the resulting treaty (of Shimonoseki) China recognized the independence of Korea, ceded to Japan Formosa, the adjoining Pescadores Islands, and the Liaotung peninsula (in Manchuria), agreed to pay an indemnity of 200,000,000 taels, opened four more ports to trade, and promised a satisfactory treaty of commerce. Russia was not disposed to see Japan make gains which would threaten her own ambitions in the far east, and, backed by her ally, France, and by Germany—who professed fear of the "Yellow Peril"—protested against the cession of the Liaotung territory. Japan had no other recourse but submission, and the retrocession to China was made in return for a face-saving increase in the indemnity.

The victory of Japan was the signal for a scramble among the powers for leases, concessions and special privileges. The weakness of the Middle Kingdom had been unmistakably disclosed and for a few years it looked as though the powers, driven by earth-hunger and fear of one another, would partition it. Russian, French, British and German bankers angrily contested for shares in the loans through which China was to pay the Japanese indemnity. In 1895 Russia obtained permission to carry the Trans-Siberian railway directly across Manchuria instead of by the longer all-Russian route of the Amur and Ussuri. France secured a "rectification" of the frontier in the Mekong valley and railway and mining privileges in China. Great Britain, alarmed, demanded and received concessions on the Burmese frontier. Rumours were soon afloat (1896) of further grants to Russia in Manchuria and of a promise to that same power of a lease on Kiaochow bay in Shantung. Russia, too, extended her influence in Korea. In Nov. 1897, German forces seized Tsingtao, giving as an excuse the murder of German missionaries in Shantung, and the following March that port and land controlling Kiaochow bay were leased to Germany for 99 years, and railway and mining concessions in Shantung were assured her. Russia made the German seizure of Tsingtao the signal for the occupation of Port Arthur and Talienwan (Dalny), and in March 1898 a portion of the Liaotung peninsula, which included these two ports, was leased to her for 25 years. Within a few weeks France was given a 99 years' lease to Kwangchow-wan in Kwangtung and Great Britain acquired Wei-hai-wei "for so long a period as Port Arthur shall remain in the occupation of Russia." Great Britain also acquired a 99 years' lease on an additional portion of the Kowloon promontory, opposite Hong Kong.

Concurrently with the seizure of these leaseholds, the powers delimited "spheres of interest," by which they meant, by implication, prior rights to provide capital for the development of mines and railways, and the promise of non-alienation of territory to another power. In case China should be partitioned, spheres of interest might become formal annexations. In 1897 France secured from China a "declaration of non-alienation" of Hainan to any third power. In 1898 Great Britain obtained a similar declaration for the provinces adjoining the Yangtze, France for the provinces bordering on Tonkin and Japan a promise that none of Fu-kien would be alienated to any power whatsoever. Germany claimed Shantung as her sphere and Russia the territory north of the Great Wall. In 1899 Russia and Great Britain agreed not to interfere in each other's preserves. Great Britain, too, exacted from China a promise that the inspector-general of the maritime customs should be of British nationality, at least so long as the trade of Great Britain exceeded that of any other country. Several of the powers, too, took advantage of the general scramble to demand "concessions" and additions to existing settlements in some of the treaty ports.

Still another form of the struggle for a slice of the Chinese melon was the competition for the privilege of providing capital for railways. The details of the story are extremely complicated, but in general the results were that Russia acquired a monopoly on railway building in Manchuria; Belgian financiers—behind whom France and Russia were suspected to stand—provided the money for the road from Peking to Hankow; Germans furnished the capital for lines in Shantung and for the northern section of the road from Tientsin to Pukow (on the Yangtze, opposite Nanking), Britons for the southern half of the road and the line from Shanghai to Nanking, and France was granted concessions for railways in her sphere of interest—Kwangtung, Kwangsi and Yunnan. An American syndicate was given the concession for a road from Hankow to Canton, but the Belgians later acquired a controlling interest in the company, and the Chinese, irritated, bought back the grant. The French got from the Russo-Chinese bank the contract for a road connecting Taiyüanfu with the Peking-Hankow line, and a Franco-Belgian syndicate the contract for a line from Kaifengfu to Honanfu. Mining concessions, which need not be enumerated here, were also obtained by various foreign groups.

To prevent the threatened disruption of China three major and widely different efforts were made. One was by the United States. In the autumn of 1899 John Hay, the American secretary of state, asked from England, France, Russia, Germany, Japan and Italy assurances that within their respective spheres of interest they would not interfere with any treaty port or vested interest, that no preferential harbour dues or railway charges would be given their subjects, and that the Chinese government should collect the customs duties and only according to the Chinese tariffs. This "open door policy" was not, strictly speaking, new, but was founded upon the most favoured nation clauses. Nor was it entirely disinterested. The United States held aloof, to be sure, from the scramble for leases and concessions, but this was partly because Americans were too engrossed in developing the virgin resources of their own land to engage in ventures abroad. On her acquisition of Hawaii and the Philippines, however, the United States had awakened to a livelier interest in the far east, and did not wish doors to be slammed in the faces of her merchants and bankers. All the powers assented to the American note, although Russia did so with slight reservations.

The other major efforts to save China were by the Chinese themselves. After the war with Japan clubs sprang up advocating "reform"—reorganization on the occidental pattern. That, so the members urged, had been the secret of Japan's victory. The great viceroy, Chang Chih-tung, came out with a widely read pamphlet, "Learn," urging reform, although without the abandonment of the best of China's heritage. Some of the extremists,

notably the brilliant but erratic K'ang Yu-wei and his disciple, Liang Ch'i-ch'ao, a master of Chinese style, obtained the ear of the emperor and for a little over three months in the summer of 1898 edict after edict poured forth from Peking ordering some of the changes which the radicals desired. Compared with what was to happen in the next 25 years, these were moderate enough, but at the time they seemed revolutionary. The civil service examinations were to be reformed, new schools with western as well as Chinese subjects were to be founded, western military methods and equipment were to be introduced and steps taken looking toward a national army based on conscription, reforms in the courts of law were projected, a government bureau to translate foreign works, and a ministry of arts, commerce and agriculture were to be established, patent and copyright laws were to be introduced and rewards offered to authors and inventors, annual budgets of receipts and expenditure were sanctioned, and many sinecure offices were abolished.

Skilled statesmen might have succeeded in carrying through these reforms without provoking a major crisis, but the young emperor knew little of the world of men outside his palace walls, and his radical advisers had little or no experience in government. The inevitable storm was, therefore, intensified, and in Sept. 1898 the empress dowager suddenly intervened and inaugurated a third effort to save China—by a return to the conservative *status quo*. The *coup d'état* was precipitated by the emperor's plan to thwart the reactionaries by placing restrictions on the empress dowager and executing her most loyal henchman, Jung Lu. Information seems to have come to Jung Lu through Yuan Shih-k'ai, and Tzu Hsi acted promptly. On Sept. 22, 1898, she reassumed the reins of government. She kept the emperor a virtual prisoner and but for the powers might have had him assassinated. As many reformers as could be apprehended were executed, and most of the reform decrees were annulled. Tzu Hsi attempted to restore the government as it had been and to strengthen it to resist foreign encroachments.

The Boxer Uprising 1900.—On the heels of the conservative reaction, and in part as a consequence of it, came a blind attempt, largely popular, but sanctioned by the extremists, to oust the foreigner once and for all. In 1898 and 1899 unrest was widespread, induced partly by the talk of reform, partly by the aggressions of the powers, and partly by the vigorous reaction led by the empress dowager. The government, in an attempt to provide for the national defense against foreign aggression, ordered the revival of the village train-bands or militia, and put the plan into effect first in the northeastern provinces. Into these train-bands came many of the local rowdies and here and there disorderly secret societies affiliated with them. The members practised rites which they believed would make them invulnerable to bullets and came to be known to foreigners as "Boxers"—a loose translation of the Chinese name for the bands, I Ho Tuan or I Ho Ch'uan, "Righteous Harmony Bands" or "Righteous Harmony Fists." One of the favourite mottoes of the Boxers was "Protect the country, destroy the foreigner." By the autumn of 1899 the Boxers were beginning to persecute Christians—as "secondary foreign devils"—especially in Shantung, where the anti-foreign Yü Hsien was governor. The powers, alarmed, brought pressure, and while they obtained the recall of Yü Hsien, that worthy was soon appointed to the governorship of Shansi, and unrest increased. An English missionary was murdered the last day of 1899, and by the following June the attacks on Chinese Christians became more frequent and foreigners were in grave danger. In early June (1900) an unsuccessful attempt of the powers to throw additional troops into Peking aggravated the situation, and when, on June 17, foreigners seized the Taku forts to open the way to Tientsin and Peking, the storm broke. Against the counsel of saner heads, the empress dowager ordered all foreigners to be killed. The German minister was murdered, and the other foreign ministers and their staffs, missionaries, and hundreds of Chinese Christians were besieged in the legation quarter and in the Catholic cathedral in Peking. Scores of Roman Catholic and Protestant missionaries and thousands of Chinese Christians were done to death, principally in Hopei, Shansi and Manchuria. The powers declared that they were not waging war on China, but were simply seeking to rescue their nationals and to suppress the Boxers, and the viceroys in the Yangtze valley and the south accordingly remained neutral and endeavoured to repress anti-foreign outbreaks within their jurisdiction. That attitude was also taken by high officials in most of the west and north. The disorders, therefore, were chiefly confined to the northeast. An international force captured Peking on August 14, the court fled to Hsianfu, and the foreign troops proceeded to loot the capital and then to relieve scattered groups of missionaries and Christians who had been standing siege and to disperse the Boxer remnants.

Although the powers had not declared war on China, they deemed a formal settlement necessary to exact reparation and to guard against a recurrence of the outbreak. After negotiations, which were prolonged by disagreements among the victors, in Sept. 1901 a protocol was finally signed. This document provided for the punishment, by China, of some of the officials held chiefly responsible, for memorial monuments for some of the murdered foreigners, for formal missions of apology to Berlin for the death of the German minister, for the suspension for five years of civil service examinations in towns where foreigners had been killed or mishandled, for the prohibition for at least two years of the importation of arms and ammunition, for an indemnity of 450,000,000 taels, to be paid in 39 years and to be secured by the revenues of the imperial maritime customs, for the fortification and policing by foreigners of the legation quarter, the razing of the Taku forts, and the maintenance by foreign troops of communication between Peking and the sea, for edicts against anti-foreign agitation, for the amendment of the existing commercial treaties, and for transforming the foreign office (Tsungli Yamen) into the chief of the ministries of state, under the name of the Wai Wu Pu.

1900–11. The Era of Change to the Overthrow of the Manchus.—The Boxer year inaugurated momentous changes. The empire was clearly at the mercy of the powers, and foreigners acted as though they were living in a conquered country. With the exception of Manchuria, encroachments on Chinese sovereignty were not as marked as in 1898 and 1899. The Russians continued their aggressions. The disorders of 1900 had spread to Manchuria and thither Russia quickly dispatched large bodies of troops, ostensibly to protect her subjects and her investments. The Russian forces ruthlessly suppressed all opposition and occupied much of the three provinces. Late in 1900 an agreement between China and Russia promised the latter extensive control in southern Manchuria and was modified only on protest from the other powers. Both Great Britain and Japan were alarmed, the former because of her general fear of Russia in the east and the latter because of the threat to Korea, where Russian machinations were increasing. In defense against the common foe, the Anglo-Japanese alliance was formed (Jan. 30, 1902). Russia, subjected to pressure from these two powers and the United States, promised to respect the commercial rights of all nations, and agreed with China (April 8, 1902) gradually to withdraw her troops from Manchuria. However, she found pretexts for delays and sought from China, in return for evacuation, compensations which would have strengthened her hold on the debated territory.

Great Britain, the United States and Japan sought to check Russia. Japan was especially concerned and strove by direct negotiations with St. Petersburg to obtain recognition of her interests in Korea and the promised evacuation of Russian troops from Manchuria. Russia was obdurate and Japan had recourse to arms (Feb. 1904). In the ensuing months the Japanese captured Port Arthur, drove the Russians out of southern Manchuria, and destroyed the Russian fleets. In 1905 President Theodore Roosevelt proffered his good offices, hostilities were suspended, and by the resulting Treaty of Portsmouth (Sept. 5, 1905) Russia recognized Japan's interests in Korea, transferred to Japan her rights in the Liaotung peninsula, ceded to her the southern section of the Manchurian railway, and the southern half of Sakhalin, and both powers agreed to withdraw their troops from Manchuria, to use the railways in Manchuria, except those in the Liaotung peninsula, only for economic and industrial and not for strategic purposes, and not to obstruct "measures common to all countries

which China may take for the development of the commerce and industry of Manchuria."

In this struggle over her territory China was a helpless spectator. Both belligerents promised to respect her neutrality, but the Chinese were not very successful in enforcing it. In a treaty with Japan (Dec. 22, 1905) in which China confirmed the treaty of Portsmouth in so far as it concerned her, secret protocols were inserted which Japan later used in an effort to close the door in Manchuria to other railways than her own.



BY COURTESY OF THE Y.W.C.A.
COTTON MILL WORKER AT SHANGHAI

The war merely substituted Japan for Russia in southern Manchuria, and the former was no more scrupulous in respecting China's rights than was the latter. Many Japanese contended, indeed, that having spent blood and treasure for Manchuria they had better rights there than the Chinese. By the annexation of Korea (1910) Japan moved her boundary to the southeastern edge of Manchuria and strengthened her interests in Kirin and Fengtien, the southern two of the three provinces. Almost immediately after the war complaints began to be made that Japanese authorities in Manchuria were discriminating against the nationals of other countries. Great Britain's hands were tied by the Anglo-Japanese alliance—renewed in 1905—but the United States, in contrast to a pronounced friendliness during the war which President Theodore Roosevelt had almost cemented into an alliance, actively strove to secure the open door in Japan's new sphere of influence. Americans offered to buy parts of the railways. The department of state supported American capital in seeking a railway concession in Manchuria, and in 1909 Secretary of State Knox proposed to neutralize the Manchurian roads by a joint loan from the powers for the purchase of existing lines and the construction of new ones. The Knox proposal brought Russia and Japan together in a convention (1910) to safeguard their respective interests in the three provinces.

The suppression of the Boxer outbreak by the powers and the subsequent war between Japan and Russia seriously weakened China. The governmental machinery, which had worked fairly well as long as China had not been in intimate touch with nations as powerful as herself, proved inadequate to meet the strain imposed by the coming of the occident. The Manchus would have to show unusual ability if they were to save their throne, and the Chinese if they were to avoid anarchy.

After 1900 and especially after 1905 both Chinese and Manchus set about the reorganization of the country. Even the most conservative could not fail to read the signs of the times, and the empress dowager, doubtless reluctantly and with many misgivings, attempted to direct the reform which she could no longer avert. In 1902 the court returned to Peking and the empress dowager set herself to win the friendship of the foreigners, addressing herself especially to the ladies of the legations. Much more important was the sanction which she gave to decrees which sought to aid and to regulate the introduction of western civilization.

In 1902 orders were issued to remodel public instruction by the creation of new schools and by the introduction of western subjects in the curriculum. In Sept. 1905 a decree was promulgated abolishing that most characteristic feature of the old educational system, the civil service examination. Partly as a result of these orders and partly in consequence of the general movement for reform, schools teaching Chinese and western subjects sprang up by the thousand. The old examination stalls were razed and on some of the sites rose buildings dedicated to the new learning. Many a temple was converted for educational purposes. By the end of 1910 there were 35,198 government schools, with 875,760 pupils. Protestant mission institutions, once the unpopular representatives of a new learning, were now thronged and new ones were opened. Students by the thousand flocked to Japan, there to study in modern schools, and hundreds went to Europe and America. When, in 1908, the United States announced its purpose to return a portion of its share of the Boxer indemnity, the sums remitted were set aside for scholarships to enable Chinese to study in America. With the new schools came a flood of literature treating of western ideas, and publishing houses, notably the Commercial Press, arose to give it circulation.

With educational reform went efforts to put the country in a better state of defense. The foreign drilling of the northern army continued; throughout the country troops were trained in the new ways, greater honours were paid to military officers, and in 1906 steps were taken toward the creation of a national force as contrasted with the older provincial ones. Naval construction, however, was not seriously undertaken, although societies were started to collect funds for that purpose (1907) and in 1909 a naval commission was sent abroad to study methods of reorganization.

In 1910 slavery was abolished, but since that institution was never as prominent in China as in parts of the occident, the step did not entail marked revolution. Vigorous efforts were made to stamp out opium, an imperial edict of Sept. 1906 inaugurating the campaign. The British government, under whose protection was much of the foreign trade in the drug, in 1907 agreed to reduce the importation concurrently with the progressive abolishment of the domestic growth of the poppy, at a rate which would extinguish the trade in ten years. The restriction on poppy-growing proved so much more rapid than was anticipated that in 1911 Great Britain agreed to the complete exclusion of the foreign drug from the provinces where the culture had ceased.

Governmental reorganization was also undertaken. In 1902 a commission on juridical reform was established and in 1905 reported recommending the modification of the laws. As a beginning, torture, except in criminal cases, and certain cruel forms of punishment were ordered to be abolished. The reorganization of laws and judiciary was not sufficiently thorough-going, however, to cause the powers to dispense with extraterritoriality. The reform of the currency was discussed, but nothing effective was accomplished, and with the appearance of new coins the previous confusion became worse confounded.

Most important of all the governmental reforms was the attempt to introduce a constitution with representative assemblies. In 1905 a commission was sent abroad to study constitutional methods, and on its return, in 1906, a promise was made to introduce a parliamentary form of government. That same year, as a preliminary, changes were made in the organization of the central administrative boards in Peking. Among these was an attempt at a more direct control of the imperial maritime customs service, which resulted in the retirement of Sir Robert Hart from the inspector-generalship in which he had given such noteworthy service.

In Aug. 1908 an edict promised the convocation of parliament in nine years, but the death of the emperor and of the empress dowager in November of that year brought postponement. The new emperor, a nephew of the childless Kwang Hsü, was an infant of two-and-a-half years, and his father, Prince Chun, was appointed regent. The new reign was given the title of Hsüan T'ung. Shortly after its beginning the regency was deprived of the support of one of the strongest Chinese by the forcible retirement of Yuan Shih-k'ai, as a punishment, so rumour had it, for his alleged betrayal of the regent's brother, the late emperor, in 1898.

Constitutional reform was only delayed by the change in rulers, and that briefly. In 1909 provincial assemblies met, chosen by a limited electorate, and in Oct. 1910 the national assembly convened, one-half of it elected and half apointed by the throne. The national assembly demanded the right to legislate, but for the time could merely gain the promise of the convocation of a parliament with legislative powers in 1913 rather than in 1917.

Along with changes in education and government went other sweeping alterations in the nation's life. Several of the railways authorized before 1900 were constructed, bringing great modifications in transportation. Foreign shipping increased on the

coastal waters and the Yangtze, telegraph lines were extended, and the business of the post office multiplied. Foreign commerce more than doubled in the decade after 1901, and foreign merchandise penetrated to the remotest hamlets. The numbers of missionaries rapidly increased, and both the Catholic and Protestant communities showed a phenomenal growth.

The Passing of the Manchus.—In 1912 the rising tide of change swept aside the Manchus. Ever since the conquest in the 17th century most of the Manchus had lived in comparative idleness, supposedly a standing army of occupation, but in reality inefficient pensionaries. All through the 19th century the dynasty had been declining and in the death of the empress dowager it lost its last able leader. In 1911 the emperor was an infant and the regency utterly incompetent to guide the nation through the stormy waters ahead. The unsuccessful contests with foreign powers had shaken not only the dynasty but the entire machinery of government. The ferment of new ideas was already weakening the ancient wineskins, and only strong and wise leadership could prevent loss to both. "Reform" was in the air and secret revolutionary societies in and out of China were agitating for still more radical action. Under the circumstances almost any incident might have toppled the Manchus off the throne.

The chain of events immediately leading to the revolution began with the signing (April 5, 1911), with a four-power group of foreign bankers, of the Hukwang railway loan agreement for the construction of roads in central China. The Peking government decided to take over from a local company a line in Szechwan, on which construction had been barely begun, and to apply part of the loan to its completion. The sum offered did not meet the demands of the stockholders and in Sept. 1911 the dissatisfaction boiled over into open revolt. On Oct. 10, in consequence of the uncovering of a plot in Hankow which had little or no connection with the Szechwan episode, a mutiny broke out among the troops in Wuchang, which is regarded as the formal beginning of the revolution. The mutineers soon captured the Wuchang mint and the arsenal at Wuchang, and city after city declared against the Manchus. The regent, panic stricken, granted the assembly's demand for the immediate adoption of a constitution, and urged Yuan Shih-k'ai to come out of retirement and save the dynasty. Yuan, after much hesitation, accepted on his own terms, and at the end of October took the field at the head of the northern armies. In November he was made premier.

Had Yuan acted vigorously he might have suppressed the uprising and so have delayed the inevitable. He dallied, however, and by the end of the year 14 provinces had declared against the Manchus, in several cities Manchu garrisons had been massacred, the regent had been forced out of office, a provisional republican government had been set up at Nanking, and the arch-revolutionist, Sun Yat-sen, had returned from abroad and had been elected president.

In December, Yuan agreed to an armistice and entered upon negotiations with the republicans. On Feb. 12, 1912, the boy emperor was made to abdicate the throne in a proclamation which transferred the government to the people's representatives, declared that the constitution should henceforth be republican, and gave Yuan Shih-k'ai full powers to organize a provisional government. The Nanking authorities agreed that the emperor was to retain his title for life and to receive a large pension. To unify the country, Sun Yat-sen resigned the presidency and Yuan was chosen in his place. Li Yuan-hung, who had come into prominence in Wuchang in the initial stages of the rebellion, was elected vice-president. A provisional constitution was promulgated in March 1912 by the Nanking parliament, and in April the government was transferred to Peking.

The republic, established with such startling rapidity and comparative ease, was destined to witness the progressive collapse of national unity and orderly government. The causes for this chaos were, in the main, three. In the first place, traditional processes were being repeated. The demise of every dynasty had been followed by civil strife, in which rival military chieftains struggled for the throne. The disorder usually lasted for decades, and once, after the downfall of the Han dynasty, was prolonged for nearly four centuries. The peaceful transfer of power to Yuan Shih-k'ai under the guise of a republic for a time mitigated the struggle and even seemed to have averted it. Yuan, however, as we shall soon see, did not prove strong enough to hold the country together. Until after 1928 no one else came as near to success as did he, and the country was broken up into ever smaller fragments, most of them ruled by military chieftains. Figures came and went from the political stage with bewildering rapidity, and after Yuan's death (1916) the political map was seldom the same two years in succession.

In the second place, the chaos was accentuated by new ideas from the west. For 2,000 years a change in dynasty had been followed by no very great alteration in the form of government. Each ruling house took over, with some modification, the laws and institutions of its predecessors. This, however, was no longer possible. The governmental machinery which had on the whole worked better over a longer period than any other ever devised by man for so numerous a people, was being abandoned. It was ill adapted to the new conditions, and theoretical radicals, imbued with occidental ideas, and militarists tended to ignore it or to modify it more greatly than at any time since the Han. Such thorough-going political experimentation meant chaos, and new institutions were not quickly evolved for so enormous a section of mankind.

In the third place, the disorder was increased by the interference of foreigners. Japan was vitally concerned in the fate of its huge neighbour. Its population was steadily increasing, no adequate relief could be had through emigration, and its only recourse was to add to its income by engaging in industry and commerce. If it were to do this, it must have access to raw materials, including coal and iron, and to markets. For these it most naturally looked to the adjoining continent, and especially to China. Its life depended, therefore, upon keeping open the door into China, and it is not surprising that it sought to control portions of the republic and at times meddled in Chinese politics. To Japan were added the western powers, especially Russia. Beginning about 1922, but especially after 1925, Russian communists sought to extend their influence into China and to foment the kind of revolution which they had achieved at home.

It must be noted, however, that foreign activities helped to bring union as well as disunion. Resentment against the foreigner was the one issue on which the vocal elements of the nation could unite; railways and telegraph lines—both of foreign origin—helped to bind the country together, and the foreign-controlled customs service and the foreign-organized postal system were the only governmental agencies which continued to function over all the country.

The Republic Under Yuan Shih-k'ai.—For four years Yuan Shih-k'ai was able to delay the further disintegration of China. He faced no easy task. The radicals, who in August 1912 took the party name of Kuomintang, regarded him with suspicion, and, obtaining a majority in the parliament which assembled in 1913 under the provisional constitution of 1912, demanded a type of government in which the legislature should be supreme and the president a figurehead. Rival military leaders were beginning to appear, and grave financial difficulties faced a government whose fiscal machinery, already decrepit, had been disturbed by the revolution. The confidence of the powers, moreover, was not yet given the new regime.

In the face of all these difficulties Yuan for a time achieved marked success and gradually restored in the provinces the authority of the central government. In April 1913, after prolonged negotiations, he concluded a "reorganization" loan with a financial group representing Great Britain, France, Russia, Germany and Japan. The loan, a large one, was secured by a lien on Chinese revenues, chiefly on the income from the salt monopoly—now put under foreign supervision. His financial position and the moral support of the powers thus assured, Yuan proceeded to defy the members of the Kuomintang. The latter had sought to block the loan and saw in its conclusion grave danger to themselves. They continued obstructionist policies, and, as Yuan still prevailed, in the summer of 1913 some of them, including Sun

Yat-sen and Huang Hsing, declared a "punitive" expedition against him and for a while held Nanking. Yuan promptly put down the rebellion, and, after obtaining the ratification of the articles of the "permanent" constitution which had to do with choosing the president, and being elected under them (Oct. 1913), he outlawed the Kuomintang (Nov. 1913) and unseated its members of parliament. A few weeks later he disbanded what remained of parliament, replacing it with an administrative council selected by himself. In March 1914 the provincial assemblies were dissolved. A new constitution, framed by a body controlled by Yuan, was promulgated in May 1914. The president's power was greatly strengthened, his term was lengthened to ten years, and he might be rechosen by the council of state or control the election of his successor. In 1914 Yuan performed the imperial ceremonies in the Temple of Heaven at the winter solstice. He seemed to be winning against the opposition and in 1915 prepared to take the further step of having himself formally chosen and proclaimed emperor. In the summer of 1915 the Chou-an Hui, made up chiefly of Yuan's adherents, organized an energetic propaganda for the restoration of the monarchy, and, in spite of some plain-spoken objections, notably by the distinguished scholar, Liang Ch'i-ch'ao, and the disapproval of the vice-president, Li Yuan-hung, and even of some of his former supporters, Yuan, after going through the form of a "referendum," and, as precedent demanded, declining the initial requests of the council of state, announced the restoration of the monarchy. Opposition continued to develop, however, for radicals were not slow to denounce this usurpation by their arch-enemy, and military chiefs had no desire to see Yuan seize the coveted prize. Moreover, Japan, backed by Great Britain, Russia and France, cautioned delay. Yuan accordingly postponed the coronation. By the end of 1915 rebellion, led by Ts'ai Ao, had broken out in distant Yunnan, and by the end of March 1916 so many of the provinces had declared their "independence" that Yuan's remaining friends advised him to resign the presidency. This Yuan declined to do, but he did consent to the restoration of parliamentary government. Yuan's concessions merely strengthened the opposition and the Kuomintang leaders established a provisional government at Canton and elected Li Yuan-hung president. At this juncture (June 6, 1916) Yuan fortunately died, prostrated by chagrin and rage.

With Yuan removed, the country appeared quickly to unite. Li Yuan-hung, unopposed, succeeded to the presidency; Tuan Chi-jui, appointed by Yuan in the last few weeks of his life, continued as premier and brought to the support of the new government some of the northern military chiefs, and the parliament of 1913, reassembling, brought back to Peking many of the Kuomintang. The government seemed to be further strengthened by the election to the vice-presidency of Fêng Kuo-chang, dominant in the lower part of the Yangtze valley. The very strength of the new government was, however, its weakness, for it was made up of elements which were fundamentally discordant and which any crisis might set at loggerheads. This crisis was to grow out of international reactions in which China was inextricably involved.

Foreign Relations, 1911–17.—The revolution did not immediately bring marked change in China's foreign relations. Tibet and Outer Mongolia, at best never too firmly attached to the empire, took the opportunity afforded by the shift in governments to effect their virtual independence, and Great Britain in the former case and Russia in the latter were not slow to attempt to extend their influence over territories which abutted so directly upon their own. China recognized the autonomy of Outer Mongolia in return for the acknowledgment of her suzerainty but she was less pliant in yielding to British ambitions in Tibet. On the whole, the powers made little objection to the establishment of the republic, although recognition was more prompt on the part of some than of others.

The outbreak of World War I, however, brought serious difficulties. With Europe absorbed in internecine strife, Japan saw a golden opportunity to extend her power in China. The Anglo-Japanese alliance afforded her a welcome excuse for seeking to eliminate Germany from the far east. Accordingly, in Aug. 1914 she dispatched an expedition to Shantung, and, with the co-operation of a small British force, captured Tsingtao and the other German possessions in the province. Through her premier, Japan averred that she had "no ulterior motive, no desire to secure more territory, no thought of depriving China or other peoples of anything which they now possess," but she disregarded Chinese neutrality and protests, and later went beyond any privileges ever granted to Germany in demarcating a railway zone and establishing a civil administration along it.

The occupation of the German properties in Shantung was only a beginning. In Jan. 1915 Japan presented to Peking a formidable array of 21 demands in five groups.

1. In Shantung, China was to agree to any transfer of German possessions to Japan that the latter might obtain. China was not to alienate to a third power any territory in the province; she was to declare additional cities to be open ports and was to grant certain railway privileges.

2. In south Manchuria and eastern Inner Mongolia, the lease of Port Arthur, Dairen (Dalny), and the railways were to be extended to 99 years. Anywhere in these regions, Japanese might lease land and travel or reside. There were, too, demands for mining and railway privileges, and for the Japanese control of loans and the employment of Japanese official advisers.

3. The Han-yeh-p'ing company, the largest Chinese iron-mining and smelting concern, was to be made a Chino-Japanese enterprise and China was not to sell her interest in it without Japan's consent.

4. China was to promise not to cede or lease to any third power any harbour, bay or island along her coast.

5. China was to employ Japanese as advisers to the central government; the police departments in certain districts were to be jointly administered by Japanese and Chinese; China was either to buy 50% or more of her munitions from Japan or to establish a Chino-Japanese arsenal, which was to use Japanese materials under the direction of Japanese; Japanese were to be granted the privilege of buying land in the interior for schools, hospitals and churches; certain railway concessions in the Yangtze valley were to be promised, and Japan was to be allowed to scrutinize all proposed loans of foreign capital for mines and works in Fu-kien.

Japan attempted to keep the demands secret, but they became known and a wave of indignation swept over China and criticism was publicly and vigorously expressed in Great Britain and the United States. The Japanese were constrained to make important concessions, but they had the upper hand and knew it, and presented an ultimatum, to which China, helpless, had no recourse but submission. By a series of treaties and exchange of notes China agreed to the first three groups, with important modifications in her favour; group four was met by a presidential mandate which directed that no part of China's coast should be ceded to any power, and group five was reserved for further negotiations except for a promise from China that no nation should be permitted to construct a dockyard, a coaling station or a naval base on the coast of Fu-kien.

In Aug. 1916 trouble broke out between Chinese and Japanese troops on the Manchurian-Mongolian border which led to fresh demands upon China—demands from which, however, Tokyo subsequently largely retreated. Then, in Feb. and March of 1917, Japan made secret arrangements with Great Britain, France and Italy, whereby these powers assured her their support to her demands at the peace conference for the former German holdings in Shantung.

China's Entrance into the War and Further Internal Difficulties.—As World War I progressed, pressure was brought upon China to induce her to enter the struggle on the side of the Allies. In Feb. 1917 the United States invited the Chinese government to follow its example in protesting against Germany's submarine campaign and severing diplomatic relations, and the Franco-Japanese secret notes of March 1, 1917 promised Tokyo's support to the effort to induce Peking to take the step. On Feb. 9 the Chinese foreign office sent warning to Germany, and on March 14 broke off diplomatic intercourse.

The question of whether China should go further and declare war on Germany now aroused a discussion which loosed the bonds, never strong, between the discordant elements which had made up the national government since the death of Yuan Shih-k'ai. The country was once more plunged into civil strife—strife from which, stimulated by other factors, China was in 1926 only beginning to emerge. The premier, Tuan Chi-jui, wished China to enter the war and convened a conference of military governors which on April 26 voted for that action. A few days later the cabinet unanimously voted to support it. Members of parliament, however, alarmed at the attempt to coerce it into assent and by rumours of secret agreements between Tuan's group and Japan, held back. On May 19 parliament declined further to consider the question until the cabinet had been reconstituted. Tuan countered by demanding of the president the immediate dissolution of parliament. On May 23 the president dismissed the premier, and the latter, taking refuge with northern military leaders in Tientsin, declared his defiance. Among Tuan's supporters were the military governors of several of the provinces north of the Yangtze, and these now proceeded to set up a provisional government with an aged ex-viceroy, Hsü Shih-chang, as titular head. Since the recalcitrants had military control of the north, Li Yuan-hung found himself in sore straits. He called to his assistance the swash-buckling Chang Hsun, who with his army had been sitting astride the Tientsin-Pukow railway, and, at his insistence, dismissed parliament (June 12). Chang Hsun was, however, not content to play Li's game, and on July 1 electrified Peking by declaring the restoration of the boy emperor. Li, defenseless, sought refuge in the Japanese legation. The northern military chiefs were, however, no more favourably disposed to Chang Hsun in power under the thin disguise of a Manchu restoration than they had been to parliament. Tuan, therefore, led an army to the capital, ostensibly to defend the republic, Chang Hsun capitulated (July 12), and the young emperor was consigned once more to the tranquil dignity of his court without a kingdom. Tuan Chi-jui now resumed the premiership with enhanced prestige and power. Li Yuan-hung had so greatly lost face that he could not well reassume the presidency, and retired to private life. He was succeeded by the vice-president, Fêng Kuo-chang. Tuan and his supporters now being in control in the north, they carried through their purpose which had precipitated the crisis, and on Aug. 14, 1917 formally declared war on Germany.

The Kuomintang members of the dismissed parliament denounced the Peking government as illegal, and, under the leadership of Sun Yat-sen, in Sept. 1917 organized a provisional government which they declared to be the only constitutional one in China. The powers did not grant it recognition, however, and it maintained a precarious and chequered existence, usually with headquarters at Canton.

In the north Tuan Chi-jui and his supporters, the so-called Anfu group, were for some years in the ascendant. To give the appearance of constitutionality, an assembly was convened which revised the law for elections to parliament. This having been duly promulgated, a new parliament was chosen in time to deal with the quinquennial election of the president. Fêng Kuo-chang was passed over because he could not work with Tuan Chi-jui, and the elderly Hsü Shih-chang was selected (Sept. 4, 1918).

China's Part in the War.—In the meantime World War I was drawing to a close. China's internal discord and financial straits were such that she could take no active part in the struggle. She permitted, it is true, the recruiting of about 175,000 of her citizens for labour battalions for service behind the lines in France, Mesopotamia and Africa, but the initiative was taken and the transportation and organization were conducted by the Allies. She seized, too, the German and Austrian vessels interned in her ports, and chartered some of them in the service of the Allies.

China gained slightly by her entry into the war. She took over the German and Austrian concessions in the ports, cancelled the unpaid portions of the Boxer indemnities due her enemies and was permitted to suspend for the time payments on the sums due to the Allies. She was assured a seat at the peace conference.

In contrast with these gains, however, was an increased control by Japan. In Nov. 1917 the United States, in an effort to adjust her difficulties with Japan, entered upon the Lansing-Ishii agreement (terminated March 30, 1923), by which she recognized that because of "territorial propinquity . . . Japan had special interests in China," and so seemed to have delivered the latter over to the island empire. A "war participation board" with a Japanese adviser and an "arms contract" (Jan. 1918) betokened the growth of Japanese influence at Peking, and in May 1918 Japan and China entered into an agreement for defense against possible invasion from the north. The Anfu clique around Tuan Chi-jui concluded agreements with Japan for the construction of railways in Shantung, Manchuria and Mongolia (Sept. 1918) and borrowed extensively from the Japanese on the security—some of it extremely dubious—of railways, mines, forests, telegraphs, taxes and bonds.

The Peace Conference.—To the peace conference which terminated the war the Chinese sent an able delegation representing, by a strange but characteristic anomaly, both the Peking and the Canton governments. The delegation asked not only for the restoration to China of the former German properties in Shantung, but for the cancellation of spheres of influence, the withdrawal of foreign troops, post offices and wireless and telegraphic communications, the abolition of consular jurisdiction, tariff autonomy, the relinquishment of leased territories, and the restoration of foreign concessions and settlements. China was, however, doomed to disappointment. The American delegation favoured the restoration of the Shantung properties, but against it were the agreements of 1917 between Japan and the European Allies. By the treaty of Versailles, therefore, Japan was confirmed in the possession of her holdings in Shantung. The remaining questions were held not to come within the purview of the conference. So great was the indignation of the younger educated Chinese at this settlement that the pro-Japanese Peking government could not but instruct the Paris delegation to refuse to sign the treaty with Germany, and two members of the cabinet who had been most prominent in the loan negotiations with Japan were forced to resign. In 1919, too, a very effective nation-wide boycott against Japanese goods was instituted.

China was not, however, to emerge from the war without some gains. She obtained membership in the League of Nations by signing the treaty with Austria, for that document did not contain the objectionable Shantung clauses, and in her separate treaty with Berlin the German share of the Boxer indemnity and German extraterritorial privileges were cancelled. A significant breach had been made in the wall of foreign "rights" in China.

The Washington Conference.—After the war America continued her active participation in Chinese affairs by bringing about (1920) a financial consortium whose purpose it was to assume international control of all further foreign loans to China, and so to prevent the granting of special privileges to individual nations.

In 1921 and 1922, moreover, the United States called the Washington conference (*q.v.*) and China again had the opportunity to lay her case before the world and to ask for the elimination of the special privileges that foreigners enjoyed within her borders. Not all the agreements and treaties which arose out of the conference affected China, but the Chinese question loomed larger than any other except possibly that of disarmament. The most important actions, in so far as they concerned China, were as follows:—

1. The treaty limiting naval armaments and fortifications had the effect of confirming Japan in the domination of the north-eastern coast of Asia. No sea power could now hope easily to penetrate by force through her curtain of islands to the coast of China—as the United States and Great Britain found to their sorrow after 1941.

2. Nine powers agreed by treaty to respect the sovereignty, independence and territorial and administrative integrity of China, to give China opportunity to develop a stable government, to maintain the principle of equal opportunity in China for the commerce and industry of all nations, and to refrain from taking advantage of conditions in China to seek special privileges that

would abridge the rights of subjects or citizens of friendly states.

3. The customs schedule of duties was within four months to be raised to an effective 5%, and provision was made for the convening of a special tariff conference and for the periodical readjustment of the customs tariff.

4. A board of reference was to be established in China to which questions connected with the enforcement of the "open door" and equal railway rates could be referred.

5. A resolution expressed the sympathy of the powers with China's desire to see removed "immediately or as soon as circumstances will permit existing limitations upon China's political, jurisdictional and administrative freedom," and provided for the early establishment of a commission to inquire into the practice of extraterritoriality in China and the progress in judicial reforms.

6. On Jan. 1, 1923, foreign postal agencies in China were to be abolished.

7. The powers declared their intention to withdraw their armed forces from China as soon as China "shall assure the protection of the lives and property of foreigners," and resolved that when China requested it they would appoint representatives to see whether these conditions had been fulfilled.

8. There were resolutions concerning radios in China.

9. There were resolutions concerning the unification of the railways of China, the employment of foreign technical experts for these railways and the Chinese Eastern railway.

10. The conference expressed the hope that immediate steps would be taken by China to reduce her military forces and expenditures.

11. There was provision for machinery by which the powers were to be notified of all treaties, conventions and agreements with or concerning China.

The Washington conference also afforded Japan and China an opportunity to come to an understanding over the thorny Shantung question. Following the signing of the treaty of Versailles, Japan had made attempts to adjust the dispute, but always on conditions which had been repulsed by the Chinese. Now, however, Japan adopted a much more conciliatory attitude, and an agreement was reached whereby the former German holdings in Shantung were to be returned to China. However, the Japanese retained a share in some mines in the province and large commercial interests and land-holdings in Tsingtao. China borrowed from Japan on the security of the railways the sum needed for the redemption of the roads, and during the continuation of the loan the roads were to have a Japanese traffic manager.

Several of the promises made to China at Washington were carried out. The foreign post offices were discontinued at the designated time. A special conference on the tariff convened in Peking in Oct. 1926 and, going beyond the assurances previously given, permitted the consideration of the entire question of tariff autonomy. Because of the disintegration of the Chinese government, the gathering broke up before a treaty was framed, but the foreign delegates agreed to the removal of tariff restrictions and consented to the putting into effect the Chinese national tariff law on Jan. 1, 1929. The Chinese for their part promised to enforce the national tariff law and to abolish *likin,* long obnoxious to foreigners, on the same date.

The promised commission on extraterritoriality reported in 1926, describing the status of consular jurisdiction as then practised and of Chinese laws and administration of justice, outlining the changes desired before extraterritoriality would be removed, and suggesting immediate mild modifications of extraterritoriality and the correction of abuses.

Japan, moreover, continued conciliatory. While she declined to accede to the Chinese demand, made in 1923, for the abrogation of the agreements of 1915, until 1931 she entered upon no new marked aggression. In 1927 and 1928, to be sure, when anti-foreign agitation and civil war endangered her nationals she at times acted vigorously, but she was much more careful to respect Chinese sensibilities than she had been during World War I.

The powers also seemed about to remit the unpaid portions of the Boxer indemnity. The United States acted finally in May 1924, and Great Britain, France, Japan and Russia took preliminary steps looking toward the same end. All plans for remission, however, called for the allocation of the funds to educational or other cultural projects.

Domestic Politics After World War I.—While China was making progress toward regaining the special privileges which had been wrested by the powers, internally her government was rapidly disintegrating.

At the close of World War I, it will be recalled, Hsü Shih-chang was in the presidential chair and Tuan Chi-jui was in control. A separate government was maintained at Canton, largely by members of the Kuomintang, under the leadership of Sun Yat-sen. For a time Sun was ousted from Canton by a Kwangsi faction, but he was restored by Ch'en Ch'iung-ming, and in April 1921 he was elected "president of the Chinese republic" by such members of the parliament of 1913 as could be got together. However, he secured only a precarious foothold in Canton and a part of Kwangtung. Most of southern China was a medley of petty factions and quarrelling war lords.

Conditions were little better in the north. In 1920 the outstanding leaders were Wu P'ei-fu, his titular superior, Ts'ao Kun, and Chang Tso-lin, the master of wealthy Manchuria. In the summer of 1920 these three united to drive Tuan and the Anfu leaders out of power. Wu P'ei-fu and Chang Tso-lin could not long co-operate, and in 1922 Wu defeated the latter and drove him back into Manchuria.

Wu now took steps which he hoped would unify the country. Hsü Shih-chang resigned the presidency, Li Yuan-hung was reinstated in that office, and the parliament of 1913 was recalled to Peking. Thus the last officers on which the entire country had seemed to unite were put back into power.

Hopes for a unified China, however, proved illusory. Funds were insufficient, cabinets unstable, parliament venal, and in June 1923 Li Yuan-hung again fled from the capital. In Oct. 1923 parliament, probably as the result of heavy bribes, elected Ts'ao Kun to the presidency and a "permanent" constitution was promulgated.

In 1924 Wu and Chang renewed their war, Wu was defeated, and Ts'ao Kun was ousted. This *bouleversement* was due to the defection of one of Wu's subordinates, Fêng Yü-hsiang. Upon Wu's defeat, Chang and Fêng conferred at Tientsin with Tuan Chi-jui, and late in Nov. 1924 Tuan assumed the office of chief executive (not president) and announced a provisional government. A "reorganization conference" was called but accomplished nothing. Sun Yat-sen came north to have a part in the new regime, and on March 12, 1925, died in Peking.

Fêng and Chang could not co-operate any more successfully than had Chang and Wu, and in 1925 Fêng, since 1923 master of Peking, aided by the treachery of one of Chang's generals, compelled Chang to retire once more to Manchuria. Chang Tso-lin eliminated the traitor, however, and early in 1926 he and his quondam enemy, Wu P'ei-fu, united by their common hatred of Fêng Yü-hsiang, joined to drive the latter out of Peking and into Mongolia.

In the late spring of 1926 a new and startling factor appeared on the scene in the form of a revived Kuomintang. Sun, in dying, did more for the Kuomintang than he had been able to do when alive. He was a revolutionist, not an administrator, and as long as he was its head his party could not hope long to achieve national success. Immediately after his death, however, his party made him a national hero, and in his last will and testament to the Chinese people and in a book which he had written, the *San Min Chu I,* it found a program. This program was threefold: democratic government, a higher standard of living for the masses, and the recovery of the rights granted to foreigners. Pending the unification of the country the full realization of democracy was to be postponed and dictatorship by a single party, the Kuomintang, was to be substituted. Stress was, accordingly, laid on the last two objectives. The movement against the "unequal" treaties, growing ever since the peace conference, had been accentuated by events in 1925. On May 30 of that year the British-commanded police of the international settlement in Shanghai fired into a crowd of

students who had gathered before the police station to demand the release of their comrades arrested for agitation in connection with a strike in Japanese-owned cotton mills. Anti-foreign and especially anti-British agitation spread like wildfire over China. Aggravated by a skirmish between Shameen, the foreign settlement in Canton, and the Chinese, an anti-British boycott was instituted which was particularly effective in the south.

Russian communists, chief of whom was Borodin, led in framing and executing the Kuomintang's program. They had originally been called in as advisers by Sun Yat-sen and the small Chinese Communist party had been incorporated into the Kuomintang. Russians, moreover, drilled the officers of the Kuomintang or Nationalist army.

By no means all the leaders of the Kuomintang were in sympathy with the communists but they hoped to utilize them to achieve the Nationalists' aims.

In the summer of 1926 the Nationalist armies, led by Chiang Kai-shek, began a triumphant march northward and by winter they had driven Wu P'ei-fu into Honan and practically eliminated him, were in possession of the Wu-han cities—Hankow, Wuchang and Hanyang—and the Kuomintang had moved its capital there.

The victories had been achieved as much by skilful propaganda as by force of arms. Wherever the Nationalist forces came, trained agitators directed popular sentiment against the treaties and foreign merchants, and against Christian schools, churches, and hospitals as "imperialistic."

Enmity was chiefly directed against the British, but Americans also suffered, and Protestants were more in disfavour than were Catholics.

Kuomintang agitators also organized labourers and peasants to make exorbitant demands of employers and landlords, and in some places, notably in Hunan and Hupeh, a reign of terror followed in which many of the propertied class were dispossessed and even executed.

Educated Chinese, weary of the long civil strife and smarting over China's feeble position among the nations, hailed the advance of the Kuomintang as the harbinger of better days. That advance continued with amazing rapidity and by March 1927 the Chinese had taken over the British concessions in Hankow and Kiukiang, British and American merchants and missionaries were being evacuated from much of the Nationalist territory, Sun Chuan-fang, recently strongly entrenched in Chekiang and Kiangsu, was in full flight, his armies a disorganized rabble, and only strong forces of foreign marines kept the Nationalist armies out of the foreign settlements in Shanghai. The northern military chiefs, alarmed, had put themselves under the direction of Chang Tso-lin to stem, if possible, the oncoming flood.

The Kuomintang, however, broke down on the eve of its triumph. On March 24, 1927, Nationalist troops, entering Nanking on the heels of fleeing remnants of the northern forces, savagely looted foreign dwellings, robbed foreigners, killing three or four of them, and further loss of foreign life was prevented only by the fire of the foreign gunboats on the Yangtze. One of the effects of the outrage was to widen the breach between the communists and moderate elements of the Kuomintang. Within a few weeks Chiang Kai-shek had set up a government at Nanking which denounced the radicalism of the Wu-han leaders.

The Nationalist advance was halted by these internal dissensions and the party continued to divide. By autumn 1927 the anti-communist reaction was in full swing, Borodin and other Russian advisers were ousted from Wu-han, and in many places Chinese communists were being hunted down and executed.

In 1928 the Nationalists, reorganized under moderate and conservative leaders, and with headquarters at Nanking, began a new northward advance. Chiang Kai-shek led, in co-operation with Fêng Yü-hsiang and Yen Hsi-shan. A serious clash with Japanese troops occurred in May in Tsinan (Chinan) and a partial re-occupation of Shantung by Japan followed. In spite of this, however, the Nationalists pushed on and in June entered Peking. Chang Tso-lin was killed by a bomb as he was retiring into Manchuria, and his son, Chang Hsüeh-liang, succeeded to the command of his forces. Because of Japanese opposition, Manchuria did not formally join the Nationalists, but Chang Hsüeh-liang was given a place on the chief council of the Nanking government. The major armed opposition to their rule having been eliminated, the Nationalists moved the capital from Peking (now renamed Peiping—"Northern Peace") to Nanking, and in October set up an administration reorganized to conform to Sun Yat-sen's program, with Chiang Kai-shek as the ranking official.

Events from 1928 to 1937.—In domestic politics, the years from 1928 to 1937 were stormy, but on the whole witnessed marked progress toward a more stable regime. Throughout them all, the most prominent figure in the Central government was Chiang Kai-shek. In 1927 he married Soong Mei-ling, a sister of Madame Sun Yat-sen, and so, in a sense, strengthened his claim to the inheritance of the leadership of the Kuomintang. Much of the time, moreover, two of his brothers-in-law occupied prominent posts in the Central government—T. V. Soong, who proved an extraordinarily able minister of finance, and H. H. K'ung, who had married one of the Soong sisters. So strong and vigorous a man as Chiang Kai-shek inevitably had his enemies. However, he retained control of the army and accordingly, continued the dominant leader.

The chief internal movements against the authority of Chiang Kai-shek after 1928 can be quickly summarized. Yen Hsi-shan and Fêng Yü-hsiang could scarcely be expected to submit tamely to the leadership of this young arrival from the south. In the summer of 1930 they joined forces against Chiang. By autumn of that year, however, Chiang had vindicated his power against them. The "Young Marshal," Chang Hsüeh-liang, until the autumn of 1931 in possession of the major military machine in the north, continued loyal to Nanking and to Chiang.

More serious was the recalcitrancy of the south and west. Only slowly, and then largely because of the necessity of presenting a common front against the Japanese did Kwangtung, Kwangsi, Yunnan, Kweichow and Szechwan fall into line with Nanking.

The greatest domestic menace to Chiang Kai-shek and the Kuomintang, however, was the communists. Armed bands regarded as communist existed in a number of parts of the country, particularly in the Yangtze basin east of the gorges. In the southern part of Kiangsi and in the mountains and hills where Kiangsi bordered on Fu-kien, Kwangtung and Hunan, they entrenched themselves and offered stubborn resistance to the Nanking forces. Their leaders espoused the Russian program and objectives, but probably they obtained no direct support from Moscow. They appealed to tenant farmers and others upon whom the existing rural order bore heavily and were, in essence, a peasants' revolt. Terror was widely invoked and persons of property were cruelly dealt with.

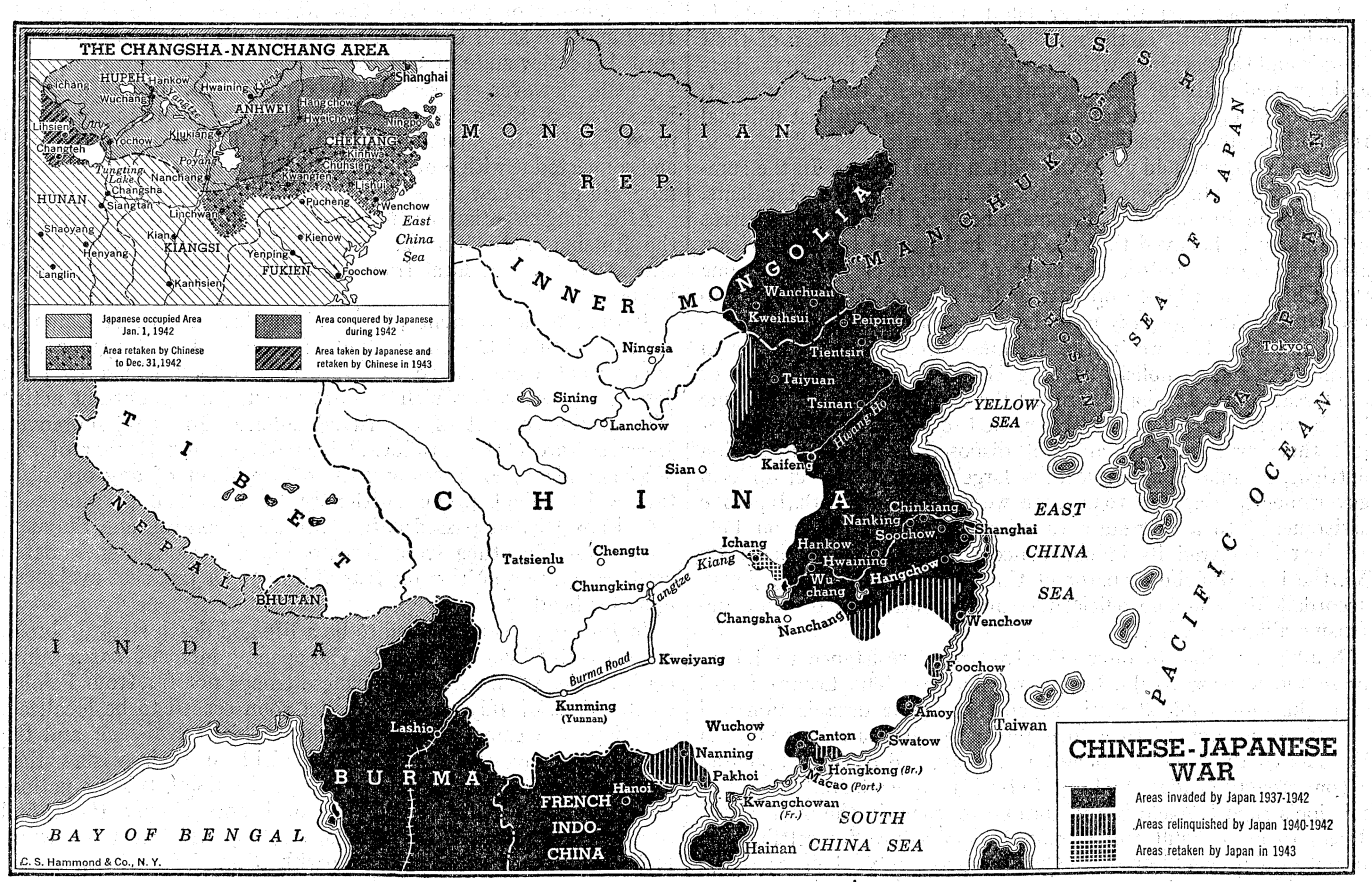
To the armed forces of Nanking the communist bands offered prolonged and stubborn resistance. Of the Kuomintang and the Nanking government Chiang Kai-shek and his armies were the chief buttress. The needed financial support came largely from the Chinese moneyed interests in the rich cities of the lower Yangtze, principally Shanghai. Chiang, accordingly, had numbers and physical equipment vastly superior to the proletarian peasant bands. In 1934 and 1935 the communist forces, compelled to retreat, skilfully made an heroic march through the mountains of the west and established themselves afresh in the northwest. With their stronghold in Shensi, Chiang Kai-shek continued to seek to eliminate them. Allied with him were the armies of Chang Hsüeh-liang. After the debacle in Manchuria (*see* below) these eventually were moved into Shensi with headquarters at Hsianfu. When, however, late in 1936 Chiang Kai-shek went in person to Hsianfu to push the campaign, he was seized by Chang Hsüeh-liang, who demanded the end of the civil war against the communists, a reorganization of the government with more toleration for the opposition, and, above all, a united front against Japan. Although Chiang Kai-shek was released without publicly acceding and Chang Hsüeh-liang was technically punished, in effect the dramatic incident was the precursor to the easing of the war against the communists and to the eventual co-operation of the latter in the defense against Japan.

In many ways advance was being registered by the Nationalist government. A better class of official was gradually introduced, partly through the initiative of Chiang Kai-shek. In many districts and in some of the provinces, men with modern training, less venal and with more of the community spirit than the typical war-lord, were coming into power. Many felt the importance of improving the conditions of those rural masses who constituted the vast majority of the population. "Reconstruction units" and other efforts were made to lift the level of those who cultivated the soil. Education throughout the country was improved, with schools of better equipment and quality and with increasing enrolments. The government, too, became increasingly interested in public health. Heretofore physicians with a modern training had come almost entirely from schools founded by Christian missionaries. Now the state was assuming more of the burden, both by the organization of schools of modern medicine and by community-wide campaigns for the control of disease. Physically, Nanking itself was a partial expression of the new day inaugurated by the Kuomintang. On a mountain outside the city rose a mausoleum for Sun Yat-sen, constructed in modern fashion but preserving the historic lines of Chinese architecture. Huge public buildings were erected. Thoroughfares were widened and new ones driven through the city.

In an attempt to improve morale, what was termed the New Life movement was officially inaugurated and pushed.

The improvement in internal order must not be exaggerated. Much of it depended precariously upon the life of one man, Chiang Kai-shek. Dissensions among leaders had not been eliminated. Over several provinces even of China Proper Nanking exercised no effective control. In the outlying dependencies, only in Sinkiang, in portions of Inner Mongolia, and here and there on the borders of Tibet did Nanking exert even a shadow of power. The world-wide financial depression brought embarrassment, especially beginning in 1934 with a marked rise in the price of silver and, accordingly, with a fall in other price levels. In the autumn of 1935 the government felt itself forced to nationalize all the silver and to go officially on a managed currency. Yet nearly every year witnessed some gains. Even those provinces which did not tolerate the interference of Nanking in their internal affairs usually permitted the Nationalist government to speak for them in relations with other nations. One post office administration and one customs service extended throughout the country. In educational matters practically all the provinces co-operated with Nanking. Painfully and with occasional relapses China was advancing toward unification and a better and more stable government. In 1937, but for one important factor, China seemed nearer its goal than at any time since the downfall of Yuan Shih-k'ai. That one factor was foreign, the policy of Japan.

For more than two years after 1928 China seemed to be making progress toward emancipation from the "unequal treaties." In 1929 the British returned to Chinese administration their concession in Chinkiang and the next year their concession in Amoy. In 1929 Belgium consented to the cancellation of her concession in Tientsin. In 1928 and 1929 nearly all the western powers formally assented to the resumption by China of her tariff autonomy, followed, in 1930, by Japan. On Feb. 1, 1929, accordingly, the Chinese government put into effect a schedule of duties determined by itself. Moreover, effective Chinese control over the customs administration increased. China, too, seemed to be making headway toward the abolition of extraterritoriality. Several of the smaller powers assented to the jurisdiction of Chinese laws and courts over their citizens. In July 1928, the Nanking government announced that all "unequal treaties . . . which have already expired shall *ipso facto* be abrogated" and that it would take immediate steps to end those "unequal treaties which have not yet expired and conclude new treaties." A number of the powers against whom China adopted specific measures protested. Eventually several assented, but only on certain conditions. However, Great Britain, Japan, France and the United States, together with some of the smaller countries, held out. In Dec. 1929, Nanking announced that extraterritoriality would come to an end on Jan. 1, 1930, but postponed putting the order into effect pending suitable provision for the trial of cases involving foreigners. The needed regulations were framed and were announced to be operative on Jan. 1, 1932. Before that day arrived, however, events in Manchuria precluded carrying out the plan.



For several years after 1927 the relations of Nanking with Moscow were much of the time either strained or decidedly unfriendly. The Nanking government had been established in an anti-communist reaction and could scarcely be expected to look upon Russia with cordiality. The joint operation by Russians and Chinese of the Chinese Eastern railway, in Manchuria, made for irritation. In 1929, indeed, the Chinese dismissed and arrested the soviet officials associated with the railway. In Jan. 1930, a Russian invasion forced the Chinese to assent to the restoration to Russia of her former share in the control of the line. Russia, moreover, had the sovietized Outer Mongolia in her orbit and appeared to threaten the remnants of Chinese authority in Sinkiang. By the end of 1932, however, Russo-Chinese relations became much more friendly, especially since both nations found common cause in their apprehension of Japan.

The Japanese Invasion.—It was from Japan, as we have suggested, that the greatest external menace arose to the territorial integrity and independence of China. Since the Washington conference the attitude of the Japanese government toward China had usually been one of moderation and restraint. Often the Chinese proved irritating, and on one or two occasions, notably at Tsinan in 1928, the Japanese struck back vigorously. On the whole, however, the latter seemed to be acting on the policy that China's friendship was desirable and could best be won by conciliation.

In the meanwhile in Manchuria a serious conflict was brewing. Here the Chinese were especially restive under the privileges held by the Japanese. Chinese formed the vast majority of the population and the legal title of the region was held by China, yet Japan controlled much of south Manchuria through her railways and her leasehold on the Liaotung peninsula, and in other ways compromised Chinese sovereignty. The Chinese began building a series of railroads which would in part encircle the Japanese lines, debouch at Hulutao, a port which the Chinese were developing, and make them partially independent of the Japanese. Chang Hsüeh-liang, the ruler of Manchuria, was disposed more and more to ally himself with Nanking and to sympathize with the Kuomintang and its desire to rid China of foreign control.

The Japanese, on the other hand, had large investments in Manchuria. Because of the rapidly increasing population of their islands and the necessity which they were under of finding markets and raw materials for the industries which were their only relief, they looked upon Manchuria as their "life line" against national ruin and as a bulwark against Russia and a source of food, coal and oil in case they should go to war with a naval power. In the summer of 1931 the friction expressed itself in minor incidents. The element in control of the main body of the Japanese forces in Manchuria believed that the time had passed for temporizing and compromise, and on the night of September 18–19, alleging that Chinese had blown up part of the track of the South Manchurian Railway company near the city, seized Mukden.

In the next few weeks the Japanese occupied other cities in Manchuria and demolished Chang Hsüeh-liang's power north of the Great Wall. Having destroyed the only effective Chinese rule in Manchuria, the Japanese, compelled to preserve order to protect their own interests and not disposed to annex the region outright, stimulated native leaders, largely Chinese, to set up local governments. Early in 1932 these were organized, with Japanese assistance, into a new state called Manchoukuo which on Feb. 18, 1932, declared its independence and called to its head Pu Yi, the last Manchu emperor of China. Later in the year Japan accorded Manchoukuo official recognition and entered into a defensive alliance with it.

Nanking, unable to offer effective armed resistance to Japan, presented its case to the League of Nations. The League found in it the most difficult crisis which that young organization had yet faced, attempted to induce Japan to withdraw its troops to the zone of the South Manchurian railway, and in time appointed a commission, headed by Lord Lytton, to investigate. The commission's report, made in the autumn of 1932, in the main found Japan to be at fault and proposed a procedure for settling the dispute which would preserve China's sovereignty. Feb. 24, 1933, the Assembly of the League took action against Japan, recommending a method of effecting an adjustment which Japan would not accept. Soon thereafter Tokyo announced its resignation from the League.

The United States, at times acting in close co-operation with the League, attempted to induce Japan to keep the peace and declined to recognize Manchoukuo. Russia, while deeply interested, was not disposed to go to war to keep Japan out of the Russian sphere of influence in northern Manchuria.

The Chinese, powerless to oppose effective military resistance, had at hand a weapon in the boycott. They invoked this at great cost to Nipponese trade. The Japanese objected, friction became acute at Shanghai, and on Jan. 28, 1932, Japanese forces occupied Chapei, a section of Shanghai, and in the ensuing fighting laid waste a large portion of the city. The Chinese offered a much more sturdy defense than had been expected, but eventually were driven back. Due in part to the good offices of the League, fighting ceased in March 1932.

Chinese anti-Japanese activities continued in Manchuria, largely through "irregulars." Chang Hsüeh-liang, for a time with his headquarters at the nearby Peiping (Peking), was a source of irritation. The Japanese, too, wished to add the province of Jehol to Manchoukuo. In Jan. 1933, Manchoukuoan-Japanese forces occupied Jehol, and Chang Hsüeh-liang, his prestige badly damaged, soon resigned and left for Europe. When he returned, it was to a post in Hupeh and then in Shensi. In April 1933, the Japanese, annoyed by raids from south of Jehol, advanced within the Great Wall. The Chinese were forced to withdraw and late in May and early in June Nanking found it advisable to enter into a truce, setting up a demilitarized zone south of the Wall, in the northeastern part of the province of Hopei. Strangely enough, however, in all this time war was not officially declared and regular diplomatic relations were maintained between the two governments. The truce of May 1933 established a *modus vivendi* which was practically a treaty of peace and which tacitly (although not explicitly) acquiesced in the Japanese occupation of Manchuria. The articulate among the Chinese, however, remained unreconciled to the existence of Manchoukuo. Moreover, for a number of years only two foreign powers besides Japan, Italy and the small Central American El Salvador, formally accorded the new state official recognition.

Japan, however, persevered in consolidating her position in Manchoukuo. She acted against banditry and entered upon a vast program of railway building which opened up more of the land and connected it with Korea. In 1934 Pu Yi was officially crowned monarch of the new state.

After long negotiations, moreover, Japan obtained the sale of the Russian interest in the Chinese Eastern railway and thus eliminated the last legal trace of the former Russian sphere of influence.

Japan was not content with confining her control of China to regions north of the Great Wall. In the spring of 1934 a pronouncement from Tokyo in effect declared all China to be a Japanese preserve in which no power could take important action without the consent of the island empire. In 1935, moreover, Japanese forced the withdrawal from Hopei and Chahar of any officials and armed forces and the disbandment of any organization which might prove unfriendly to her. The provinces of Hopei and Chahar passed partly into their control, and Suiyuan, Shansi and Shantung were threatened. Chiang Kai-shek dared not offer open opposition for fear of bringing a Japanese avalanche upon his head.

In July 1937, what proved to be a life and death struggle broke out between China and Japan. The opening incident was a minor clash between Chinese and Japanese troops not far from Peiping on the night of July 7. The conflict soon ceased to be localized. The Japanese came to feel that since Chiang Kai-shek and the Nationalist government would not yield to their wishes they must be eliminated. To the Japanese, the rising tide of nationalism in China, directed, as much of it was, against them, had become intolerable. Governments, so they held, must be set up in China which would co-operate with them.

Within the course of two years Japan obtained possession of most of the ports, of the majority of the chief cities as far west as Hankow, and of the larger part of the railways. Peiping and Tientsin were occupied in July 1937. After fierce fighting, the Chinese armies were driven out of the Shanghai area by the middle of Nov. 1937. Nanking fell on Dec. 13, 1937. The capital was moved west to Hankow. The Japanese followed, and took that city in Oct. 1938. In that same month, the Chinese lost Canton. The Japanese pressed northward and westward from Peiping along the railway lines into Shansi and Inner Mongolia. They dominated Shantung. They took possession of the Peiping–Hankow, the Tientsin–Pukow, and the Lung-hai railways and of the lines in the lower part of the Yangtze valley. They had complete command of the sea. Always superior in the air, before many months they had all but destroyed the Chinese air force and bombed Chinese cities at will. The loss of life, particularly to Chinese, both soldiers and civilians, was enormous.

The Chinese, although possessed of a much larger reservoir of manpower, were paying dearly for their tardiness in adopting the machines of the occident. In the latter half of the 19th century, when Japan was actively acquiring the mechanical appliances of the west, China had sought to hold the west at arm's length. As a result, in the industrial basis for modern war, in arms, in mechanized equipment, in naval strength, in the air, and in modern troops and officers, China, although having made improvement, was badly behind her island neighbour.

Yet the Chinese did not yield and the war was prolonged far beyond Japan's expectation. Chiang Kai-shek moved his capital to Chungking, in Szechwan, at the western end of the difficult Yangtze gorges. Much of China's leadership migrated to the far west, to Szechwan and Yunnan. In Free China, they prepared for prolonged resistance. In Occupied China Japan was unsuccessful in inducing many Chinese of standing to take office in the governments which it endeavoured to set up. Even here Japan's control was confined to the cities and the railway lines: outside these it was challenged, often successfully, by guerrilla bands which professed allegiance to the Nationalist government.

As time passed and the struggle dragged out its weary length, Japan tried to subdue Chinese resistance by the slow strangulation of blockade. China's main seaports were occupied, from the south to the north. In at least one, Foochow, the occupation was only intermittent, but in most of them it was continuous. When, in 1940, France fell to the Germans, Japan took the occasion to advance in French Indo-China and to seal access to Free China by the railroad which led from the coast to Kunming (Yunnanfu) and by crude highways from the Indo-Chinese coast to the interior. For a time Japan induced the English, fighting as they were with their backs to the wall, to close the difficult road which led from Burma to Yunnan. After a time the English reopened the road. Then, following years of increasing tension, came the sudden outbreak of war, precipitated by the Japanese attack on Pearl Harbor (Dec. 7, 1941), between the United States and Great Britain on the one hand and Japan on the other. The Japanese, taking advantage of their preparedness on the land, the sea and the air, and of their favourable geographic position, quickly made themselves dominant on the coasts of east Asia. Their capture of Hong Kong and of Burma in 1942 shut doors by which some goods had moved in and out of Free China. The only routes which now remained to connect the fighting Chinese with their friends abroad were the long and difficult roads across Sinkiang and the air passage from Assam to Free China. Over the latter, freight and passengers were conveyed by heroic airmen, and that in spite of the perils of high altitudes and of Japanese planes. Through the venality of Japanese officials and the skill of blockade-runners, some goods trickled through the Japanese lines along the coast.

Japan sought to give a show of legality to its position and to its protestations that it was not seeking conquest but only the friendly co-operation of the Chinese by setting up a puppet regime at Nanking (1940). To head this, it obtained Wang Ch'ing-wei, an erstwhile intimate companion of Sun Yat-sen, who professed to be carrying on the latter's tradition. Japan also went through the motions of restoring to Chinese administration the French Concession and the International Settlement in Shanghai, for it had taken these over after Pearl Harbor. Yet Japan was no more successful than earlier in inducing many Chinese of ability and integrity to serve in these administrations. Obviously, too, no important step could be taken by these regimes without the approval of the Japanese authorities.

By 1944 some help was beginning to come to China from the outside, chiefly from the United States. Aeroplanes and various kinds of war *matériel* were being flown from India over "the hump," as the mountain barrier was called. Chinese pilots and mechanics were being trained. No longer could the Japanese bomb Chinese cities at will. Some of their own strongholds were bombed by American and Chinese planes. Americans were also training and equipping in India Chinese forces which had taken refuge there after the fall of Burma.

Moreover, long before 1944, the Sino-Japanese conflict had settled down to a kind of stalemate. After 1938, the Japanese achieved very little territorial gain. This deadlock ended abruptly with the Russian entry into the war, Aug. 8, 1945. Thereafter events moved rapidly. On Aug. 14, Russia and China signed a pact whose major clause assured the return of Manchuria to China. By the time Japan surrendered formally (Sept. 2), most of Manchuria had been liberated by the Russians and the Chinese had regained possession of the occupied regions of China proper. (*See* WORLD WAR II.)

In China the effects of the war were seen in the absence of the goods which had formerly been imported, but especially in the inflation which was multiplying prices two hundredfold or more. This was in both Free and Occupied China. Indeed, the currency in the occupied regions issued under Japanese auspices deteriorated even more rapidly than in Free China. China was being accorded more and more recognition by Great Britain and the United States, its powerful co-belligerents. In 1943 both of these western powers entered into new basic treaties with China on the basis of full equality and thereby terminated the extraterritorial privileges of their citizens. Late in 1943, moreover, President Roosevelt and Prime Minister Churchill met Generalissimo Chiang Kai-shek at Cairo to plan the far eastern phases of World War II and issued a communiqué in which China appeared on a par with the other two powers.

In internal politics the Kuomintang remained dominant, with Chiang Kai-shek as the outstanding figure. In 1943 he became the civil as well as the military head of the government. The forms and much of the spirit of constitutional government were maintained, but some foreign observers complained that the more conservative elements were in control. Outwardly, the united front of Kuomintang and communists established in 1936 continued, but no love was lost between the two groups; each viewed the other with suspicion and from time to time friction was obvious. Relations between the two were eased considerably after conclusion of the Russo-Chinese pact of Aug. 1945 in which the soviet union pledged non-interference in China's internal affairs.

China's troubles, however, did not cease after the war against Japan. The Chinese Communists refused to acknowledge Chiang's supremacy and entered a race with the Chungking armies to seize the key cities of China then held by the Japanese awaiting surrender. This situation rapidly degenerated into civil war. Chiang's armies, frequently transported to their destinations by U.S. air and naval forces, won many of the important North China ports while the Yenan Communists established their dominance in most of Inner Mongolia and Manchuria.

The policies of the U.S., the soviet union and Great Britain with regard to China were clarified Dec. 27, 1945, at the Big Three conference of foreign ministers in Moscow. There the big powers agreed on the necessity of establishing a "unified and democratic" China and reaffirmed their policy of non-interference.

On Jan. 10, 1946, the Chinese Communist and Nationalist leaders, meeting with U.S. Gen. George C. Marshall (who had been sent to China by President Truman to mediate their differences) signed a formal truce and agreed to take part in a single administration. While this agreement seemed to remove one of the barriers to Chinese unity, the continued presence of U.S. and soviet

troops in Chinese territory led to considerable Russo-U.S. tension.

The Progress of the Cultural Revolution.—Preoccupation with political and international developments under the republic must not be allowed to obscure the changes, some of them much more significant, in other phases of China's life. These are covered more fully elsewhere in these pages, but the picture would not be well rounded if they were not also mentioned here. The impact of the occident was affecting every phase of the nation's culture and the process was hastened by the collapse of the ancient political structure. Social customs were passing, including many of the older forms of politeness. The patriarchal family was beginning to disintegrate, and youths were insisting upon making their matrimonial arrangements independently of parental control. Women were demanding greater privileges, often in bizarre ways. By a revolution comparable only to that which occurred in Europe when the vernaculars were substituted for Latin, a dignified form of Mandarin was taking the place of the older literary style. New religious and philosophical ideas were abroad and old ones were revived. Nothing, whether Chinese or foreign, was too well established to be questioned. Factories were beginning to supplant the older handicrafts and labour unions the ancient guilds. Modern means of transportation were multiplying. A few new railways were being built. Motor roads, some of them metalled, were being constructed by the hundreds of miles and were plied by motor buses. A network of aeroplane lines covered the country. These changes were naturally most marked in the cities, particularly those of the coast, and here and there in the rural districts the old China survived almost unaltered. More than any other section of the nation, the students were committed to the new ways.

China, led by her intellectuals, was in process of reorganizing her culture and fundamental convictions more thoroughly than at any time since the Chou dynasty.

BIBLIOGRAPHY.—For Chinese works *see* CHINESE LITERATURE.

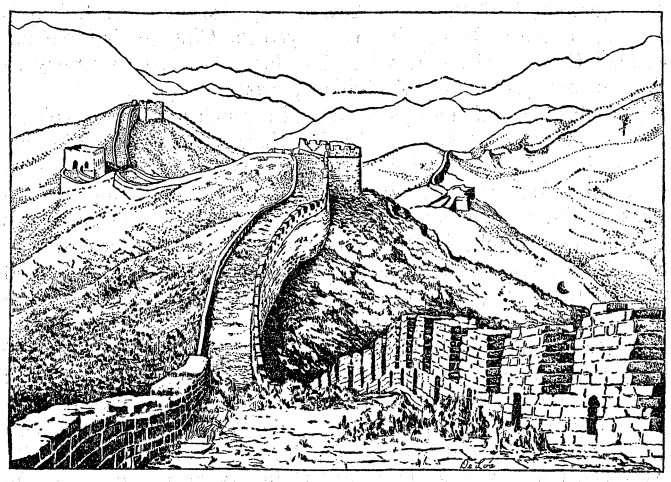
General Histories. The longest is J. A. de Moyria de Mailla, *Histoire générale de la Chine* (1777–85). Others of fairly large dimensions are Henri Cordier, *Histoire générale de la Chine* (1920); K. S. Latourette, *The Chinese: Their History and Culture* (1934). For an interesting interpretation *see* Owen Lattimore, *Inner Asian Frontiers of China* (1940). For bibliography of works in Chinese *see* C. S. Gardner, *Chinese Traditional Historiography* (1938); of works in western languages, H. Cordier, *Bibliotheca Sinica* (1904–08, 1922).

Special Phases of Chinese History.—For the ancient period *see* E. Chavannes, *Mémoires historiques de Se-ma Ts'ien* (1895–1905); H. Maspero, *La Chine antique* (1927); H. G. Creel, *The Birth of China* (1936); D. Bodde, *China's First Unifier* (1938). For biography *see* H. A. Giles, *A Chinese Biographical Dictionary* (1898); A. W. Hummel, *Eminent Chinese of the Ch'ing Period* (vol. 1, 1943). For recent history *see* P. Monroe, *China: A Nation in Evolution* (1928); J. B. Condliffe, *China To-day, Economic* (1932); L. Sharman, *Sun Yat-sen* (1934); Owen Lattimore, *Manchuria, Cradle of Conflict* (1935); T. A. Bisson, *Japan in China* (1938); E. Snow, *Red Star Over China* (1938); P. M. A. Linebarger, *The China of Chiang K'ai-shek* (1941).

For China's intercourse with the occident *see* F. Hirth, *China and the Roman Orient* (1885); P. Joseph, *Foreign Diplomacy in China* (1894–1900); Hirth and Rockhill, *Chau-Ju-Kua* (1911); H. Yule, *Cathay and the Way Thither* (new ed. by Cordier, 1916); H. B. Morse, *The International Relations of the Chinese Empire* (1910–1918); J. V. A. MacMurray, *Treaties and Conventions With and Concerning China* (1921); Soothill, *China and the West* (1925); H. B. Morse, *The East India Company Trading with China* (1926); K. S. Latourette, *A History of Christian Missions in China* (1929); A. W. Griswold, *The Far Eastern Policy of the United States* (1938); H. S. Quigley, *Far Eastern War, 1937–1941* (1942). (K. S. L.; X.)

DEFENSE

Historical.—Up to the date of the reforms of 1905–06 the Chinese constitution provided for two sorts of military organization, the Manchu army and several armies in the provinces. When the dynasty of 1644 was originally established the victorious troops, mostly composed of Manchus, but including also Chinese and Mongols, remained in Peking as a hereditary national army. Every adult male was entitled by birth to be enrolled as a soldier under one of the eight banners and, after enrolment, to draw an allowance of tribute rice, whether employed on active service or not. Some were sent to garrison such places as Canton, Foochow, Hangchow, etc., but the bulk of them, both in Peking and elsewhere, lost all military value. The other military organization, the provincial forces, was styled the army of the Green Standard, and resembled a local constabulary rather than an army. They were poorly paid, practically untrained, and badly armed. By 1894 only a few beginnings had been made at building modern arsenals and in training troops in modern ways. The soldiers were in low repute, poorly trained, and even more poorly led. In the war with Japan in 1894–95 the Chinese troops formed an easy prey for the better led, better organized, and more formidably armed Japanese forces, with their modern equipment and years of training under German expert advice. After the war, some of the corps of "braves" or irregulars were quartered near Peking and



THE GREAT WALL OF CHINA

Erected about 228–210 B.C. to keep out the northern barbarians, this wall winds for 1400 mi. over mountain, valley and river. It consists of a facing of brick, or granite, filled in with earth and, reaching an average height of over 20 ft., forms a roadway on the top 13 ft. wide. At regular intervals of about a hundred yards it is fortified with a tower.

Tientsin and became spoken of generally as the Army of the North. By 1900 this was the only real fighting force which China possessed. After the Boxer rising of 1901 an imperial decree ordered the reorganization of the military forces of the empire and something was accomplished on provincial lines, especially in Hopei, but little was done towards establishing an army on European lines until after the Russo-Japanese War of 1904–05, when various military schools and training organizations were established (or provided for on paper). By 1910 some progress had been made towards evolving an efficient body of officers. An army board was organized, and progress made with a general staff. Service, mostly voluntary, was for three years with the colours, three in the reserve, and four in the territorial army. Reservists were called up annually for training, and territorials once in two years. The Japanese system of training was followed.

China, although a belligerent on the side of the Allied powers, took no effective part in the victory which they achieved over the Central Powers in World War I. The country was in the throes of internecine strife. In the spring of 1919 the governments of Great Britain, Spain, Portugal, the United States, Russia, Brazil, France and Japan agreed "effectively to restrain their subjects and citizens from exporting to or importing into China arms and munitions of war and material destined exclusively for their manufacture, until the establishment of a government whose authority is recognized through the whole country." The governments of the Netherlands, Denmark, Belgium and Italy adhered to the agreement and the diplomatic body appealed to the Chinese government to prohibit imports. No effective action was taken, and the Russian soviet government added its activities to those of the nationals of some of the signatory powers in carrying on this traffic, with deplorable results. The import of war material, of which a large surplus remained for disposal in belligerent countries at the time of the Armistice, was largely supplemented from the resources of numerous arsenals and factories in Chinese territory, such as those at Mukden, Peiyang, Pao-

tingfu, Tehchow, Tsinanfu, Tai-yuan, Kaifêngfu, Kunghsien, Hsianfu, Hanyang, Nanking, Kiangnan, Changsha, Chêngfu, Foochow, Canton, Swatow, Kiung-chow, Yunnanfu (Kunming) and Kalgan.

Army—1944.—Any attempt to describe the army in 1944 in terms of accurate statistics is futile. For years after the Revolution of 1911 various war-lords had larger or smaller units in various stages of equipment and poor training and discipline. Most of these armies were in theory part of the national forces, but in practice they were not co-ordinated under any general staff or supreme command. Their total enrolment ran into the millions, but few if any were effective fighters. They were largely a refuge for the riff-raff and the unemployed, a way of taking care of some of the many millions who were thrown out of their normal occupations by civil strife and natural disasters in a land in which the margin of subsistence was always slender. The transition from bandit to soldier and from soldier to bandit was usually easy and was very frequent. Equipment was inferior and discipline, training and leadership worse. Battles between the war-lords were aptly characterized as "much noise, little fighting, less damage." Loss of life, except through disease and to non-combatants through starvation occasioned by the destruction of the means of subsistence, was slight. The coming of the Nationalist government in 1927 brought some improvement. The prolonged struggle against the communists and preparation against the Japanese menace, forced progress. Such leaders as Chiang Kai-shek, Li Tsung-jen, and Pai Chung-hsi, especially the first, brought advance. Schools for officers turned out a better leadership. Here and there arsenals began to supply native-made equipment, mostly small arms and trench mortars. German officers supervised the training of the army. At the outbreak of the war with Japan in 1937 the Chinese army was well past the million and possibly the two million mark. But in officers' training and mechanized equipment it was still far behind its opponent. Many of the best troops were sacrificed in the early stages of the war. New armies were recruited in "Free China," to the west of the Japanese lines. However, the loss of the ports to the Japanese cut off most of the imports of arms from abroad. Only limited amounts could come over the French railway to Yunnan, from Russia via Sinkiang and by way of Burma over the newly constructed highway. When the Japanese advance cut off access to the outside world through Indo-China and Burma, the only supplies from abroad were carried in by air from India and over the long and difficult land route from Russia or were captured from the Japanese. Some troops were being drilled and equipped in India, mainly by Americans. Adequate arsenals could not quickly be developed. Most of the railroads were in Japanese hands and motor transport and roads were backward. A supporting industry was largely lacking. Much emphasis was placed upon an organized guerrilla warfare, especially that led by communists who had evolved a skilful technique in their long campaigns against the Kuomintang. However the guerrillas, while they could annoy the Japanese and make difficult the occupations of the railroads, could not drive the enemy out of the country. The traditional Chinese strategy was one of defense, not of aggressive attack and this made it difficult to expel the invader.

Air Forces.—Air forces have been established in various areas on a small scale, machines of various types being in use. The Chinese pilots were trained by foreigners. Neither were considered satisfactory from the disciplinary point of view. All the aeroplanes have been of foreign make. In numbers the force has been far inferior to that of the Japanese, and most of the machines were lost in the early stages of the war with Japan which began in 1937. By July 1939 a new supply of aeroplanes was gradually being assembled from abroad. After 1941 these were augmented by American machines and American-trained crews.

See E. F. Carlson, *The Chinese Army. Its Organization and Military Efficiency* (1940).

Foreign Troops.—Though not strictly germane to the subject of Chinese armies, it is important, in connection therewith, to take note of the presence of foreign troops in various parts of China. In the north, Peking and Tientsin, they had the right, by Protocol of 1901, to put the legation quarter in a state of defense, and to occupy selected points between Peking and the sea. Japan had troops in the Southern Manchurian railway zone under a treaty of Dec. 1905 with a former Chinese government. Foreign garrisons in the north, distributed between Peking, Tientsin, Tangku, Tongshan, Chinwangtao and Shanhaikwan, were strongly reinforced in 1927, during the conflict between north and south. The total number at the end of 1927 was 11,880, compared with 4,740 in 1926. The nationalities, in order of numbers, were American, French, British, Japanese and Italian. The Shanghai Defense force, amounting to a mixed division with armoured cars and attached troops, was in 1927–28 gradually reduced in strength to about a brigade. The Shanghai Volunteer corps, founded in 1854, was highly efficient. It consisted of infantry, machine-gunners, field and light artillery. The total strength was about 1,400, or 1,600 with its reserves. The Japanese invasion which began in 1931 in Manchuria and by stages, chiefly following July 1937, extended to the rest of China, strikingly altered this picture. After 1931 the Japanese army dominated Manchuria. It first conquered that region and then sought to eliminate the Chinese irregulars and guerrillas who kept up an opposition. Forces of unknown size, possibly as much as a million or more men, were poised on the northern borders, ready to resist a Russian advance or to take advantage of Russian weakness to acquire eastern Siberia or Outer Mongolia. Japanese forces were also distributed widely through "Occupied China" south of the Great Wall. They may have totalled another million or more. Most of the British and American forces were withdrawn before Dec. 1941, except that the British reinforced Hong Kong. By the fall of Hong Kong (1942) British military and naval power on the coast of China was eliminated. (G. G. A.; K. S. L.)

Navy.—The beginning of a navy in China dates from about the year 1881, approximately the same period as that which saw the introduction of the telegraph into the country. An arsenal at Foochow turned out a few small composite gunboats and a training ship was bought and placed under the command of a British officer. Several armoured cruisers were ordered from England, while naval bases were fortified at Port Arthur and Wei-hai-wei. Forts were also built and guns mounted at Foochow, Shanghai, Canton and other points which appeared vulnerable from the sea. Money for those purposes was forthcoming from the customs duties on foreign trade.

The Chinese fleet had not, however, developed into a formidable force when, in 1884, France had occasion to take reprisals against that nation for attacks by irregular troops in Tonkin. A wretched collection of craft, the chief of which was the "Yang-Woo," a composite cruiser, was practically wiped out by a French squadron in seven minutes in the river Min, where it had taken cover, near Foochow.

In 1894, when China found herself at war with Japan, the former country had an appreciable fleet, in fact one which on paper was stronger than her adversary, but owing to the disorganized state of administration, only one out of the four squadrons into which it was organized took part in the hostilities. This squadron consisted of two small battleships, the "Chen Yuen" and "Ting Yuen," built in Germany, five other small armoured vessels and six sloops. It had attained a good standard of discipline and efficiency under Captain W. M. Lang of the British navy, but after his departure and by the time war broke out, the ships had deteriorated and the personnel had relapsed into their normal state of inefficiency. The squadron was defeated by the Japanese fleet at the battle of Yalu.

In 1909 an effort was made to re-establish a fleet and a naval commission under Tsai Hsün, a brother of the Emperor Kwang-su, was sent to Europe to obtain the necessary information and advice. Various societies had already started in several provinces to collect funds for naval purposes. At this time the fleet consisted of four armoured cruisers, some modern gunboats built in Japan, a few miscellaneous vessels and some old torpedo boats, but the efforts of China to create and maintain a navy have never been crowned with success, chiefly owing to the corruption of the government and the irresponsibility of the officers.

In 1928 the Chinese navy was composed of two small armoured cruisers, the "Ying Jui" and "Chao Ho" (two 6 in. and four 4 in. guns), completed in 1911, four old protected cruisers completed in 1897–98, three old destroyers, a few torpedo boats, a number of river gunboats and auxiliary vessels. Its state of efficiency was decidedly poor, while the internal disruption of the country precluded any prospect of it developing into a serious force. No marked improvement was made under the Kuomintang. The Nationalist government gave almost no attention to the navy. In their invasion of China the Japanese had unchallenged control of the sea. (E. A.; K. S. L.)

III. PRODUCTION, COMMERCE AND COMMUNICATIONS

Even on the most generous estimate of industrial prospects, China will probably remain a preponderantly agricultural country. The future relationship, however, of agriculture and manufacturing industry is a matter of great interest. Development of electric power and improvement of transport would render possible diffusion of small-scale industries better suited to Chinese traditions and genius than the large-scale factory system, and, if accompanied by the growth of co-operative agencies, may greatly improve the conditions of the countryside.

AGRICULTURE

Characteristics of Chinese Agriculture.—Chinese agriculture is primarily distinguished by its intensity. This is made possible only by the unremitting labour which the struggle for existence demands and the traditional skill born of 40 centuries of transmitted experience. The maintenance of soil fertility under constant intensive cultivation for such an immense period is in part secured by replenishment with canal mud, as in the Yangtze delta, or by the silt deposited by river-floods (otherwise disastrous), but in the main by the use of "night soil" and every possible kind of manure, applied to the land in primitive but effective fashion. Soil is composted with organic matter and ashes and then dried and pulverized to form a plant-food. De-forestation has taken place not simply to make room for more arable land but as the result of a constant quest for green manure. In hilly districts, such as the loess plateau and the Red basin, the fields on the valley slopes are terraced and rimmed so that the run-off may be retained until the suspended matter has settled. Again, in crop rotations, legumes have long been grown for fertilizing the soil. A system has been evolved whereby two, three or even four crops are grown in the same ground-space each year, while as many as three crops, each in a different stage of development, grow simultaneously in one field. In few countries has the practice of multiple cropping been so perfected. The great traditional skill of the Chinese has raised their agriculture to the level of an art; they show, moreover, remarkable ingenuity in adapting means to ends, as in the many uses to which they put bamboo or millet. Their implements, too, are effective, if primitive. On the other hand, the typical Chinese farmer knows nothing of science as applied to proper seed selection, experiments in better crop rotations or animal breeding and the fighting of plant and animal pests. His methods are essentially conservative and traditional and little use is made of chemical fertilizers. Notwithstanding great industry at certain seasons, there is much unutilized idle time in winter, especially in the north, which the development of small rural industries on a co-operative basis would employ to great advantage in the farming community. As yet there is little combination for the purchase of seeds or implements or for the marketing of produce. Important experiments to remedy these defects have been begun. Some have been undertaken by local governments. Others have been associated with agricultural colleges or departments, such as those maintained by the University of Nanking (an American union missionary college) for the development of scientific sericulture and cotton cultivation. In several areas, rural co-operatives have made a very promising beginning. Development on the lines associated with the Danish folk school movement, so closely linked with the success of the co-operative societies, is the ideal of many workers in China.

Agricultural Regions.—The salient characteristics of the major agricultural regions can most easily be summarized in relation to the scheme of the natural divisions of China already discussed, except that the essential features of crop production and farming methods in the Red basin closely resemble those of the lower Yangtze valley.

(1). The Tsinling mountain complex delimits the agricultural "province" of north China. Here severe winters and the short and rather uncertain rainy season preclude winter crops. It lies beyond the limit of the cultivation of wet rice, which as a staple crop is replaced by millets and wheat. Rice, it is true, is a subordinate crop in favoured districts of north China; it is known, however, as small rice and is really a glutinous millet. Most people live on wheat, kaoliang, and millet, while meat (other than pork) and potatoes play a part. Soybeans, too, are important. Barley and maize are extensively grown.

(*a*) The soils of the loesslands are of unusual fertility owing to their fine texture, their porous and friable nature and the presence in them of soluble mineral matter for plant nourishment. On the other hand, the region is the driest in China, and, except in the basins, is incapable of manual irrigation. Arable cultivation is therefore often precarious and there is greater reliance on sheep and cattle. In the extreme northwest pastoral products and some associated manufactures of coarse woollens and cloths are important products. Here occurs the greatest concentration of sheep, raised primarily for wool. Cattle, elsewhere in China almost exclusively draught animals, are raised in the northwest for grazing; there are distinct prospects for leather and woollen manufactures in parts of the loess belt. In the loess basins such as Tai-yuan and Tatung-fu, where well-irrigation and terrace cultivation reduce the risk of crop failure, the hardier cereals are often accompanied by fruit culture (apples, pears, plums, walnuts, apricots, strawberries and the jujube) and also by cotton. (For agriculture in the northwest *see* SHANSI and KANSU.)

(*b*) The plain of north China east of the Tai-hang-shan, which forms the edge of the loess plateau, has a slightly higher rainfall but risk of flood is much higher and the great problem is the control of the Hwang-ho, Hwai and northern rivers. Main reliance is on wheat, barley, millet, buckwheat and maize, together with vegetable crops, especially rape, beans and peas. Rice is grown in southern Shantung and northern Kiang-su, *i.e.*, on the borders of the Yangtze "province," and cotton and hemp in Shantung and Hopei, but there is little room for any but subsistence crops. In Shantung there are three crops in two years, the usual rotation being wheat in spring, beans in autumn and finally millet, which is gathered in the following September. As an alternative, wheat or barley in winter and spring may be followed by large or small millet, sweet potatoes, soybeans or peanuts in summer. Animals are less important than in the northwest, but in the parts of Hopei adjacent to Mongolia there is the largest concentration of horses, mules and draught animals to be found in China Proper.

(2). The Yangtze "province" with rich alluvial basins, relatively high, well-distributed rainfall, seasonal rhythm of moist subtropical summers and mild winters and magnificent natural waterways, is one of the most favoured agricultural regions in the world and the premier granary of China, supporting nearly half of her total population. The combination of summer "wet" crops and winter "dry" (temperate) crops give it a marvellous range of production, and most of the staple products of China, whether subsistence or commercial crops, find here their optimum conditions. It is easily first in the production of rice, the chief food of all central and south China. If Chekiang be included, it produces over 68% of the total output of silk, the oldest and most famous of Chinese commercial products, and about 60% of that of cotton, one of the chief factors in the new industrial development. It is also the largest centre of tea production. In some districts, as in parts of the Yangtze delta and the central basin, the rotation is determined by the needs of a special crop. In the normal agricultural year barley, wheat, beans and peas are sown early in winter and harvested in May (wheat in June), followed by sesamum, sown after the wheat harvest and ripe early in September, while rice may be either an early crop, planted early in April and

ready for harvesting 90 days later, or a late crop planted in early June and harvested after 110 days. If rice is grown for commercial purposes it receives special attention and the fields are ploughed and prepared in early winter. Cotton lands also require special preparation. While this is the regime of the lowland basins, the uplands of central China, especially between the Tungting and Poyang lakes, are associated with the cultivation of the tea plant and the tallow tree.

(3). The southeast China highlands are not unlike those of central China and the ranges of Fu-kien form the second great tea-district, but the valleys and basins, with more abundant rainfall and warm winters, can grow subtropical crops all the year round. In the most favoured regions such as the Canton delta there are two or even three rice crops in the year and the sugar cane finds its optimum conditions. Largely confined to this section of China are the pine-apple, spice-yielding plants as cinnamon and cassia, ginger and aniseed. The southern coast of Kwangtung and the island of Hainan, with an exceptionally high rainfall and uniformly hot conditions, are particularly associated with these tropical cultures. On the other hand the climate of southeast China is too moist for cotton and for the "dry" cereals which form the winter crops of the Yangtze valley.

(4). The southwest is the least developed of all the major regions of China. The high plateaus are scenes of pastoralism and sporadic cereal and poppy cultivation, but the deeply-cut and generally narrow valleys, with a damp, unhealthy climate, and often still choked with luxuriant jungle vegetation, have not been intensively developed as have the more open and accessible basins of the southeast.

Special Products and Associated Manufactures.—Of necessity subsistence crops are of far greater importance in China than commercial products, and this is strikingly shown by the fact that the three greatest food-crops—rice, wheat and millets—occupy approximately 69% of the cultivated area.

Rice, the staple food in central and south China, takes up no less than 28% and has first choice of the land. More than half the land under cultivation in Kiang-su, the richest province, is devoted to it. Yet only four provinces, Hunan, Anhwei, Kwangsi and Kiangsi, normally have a surplus over local needs, and in peace times large imports have to be made each year from other lands in the far east.

Wheat comes second to rice in importance, and replaces it as a food crop in north China. In some northern districts it occupies 40% of the cultivated land, but there must be considerable imports of wheat and flour. The number of wheat-eaters is steadily increasing in northern China, especially in the towns. The annual output, however, can be increased through both extension of the wheat area by "dry" farming in the marginal lands of Manchuria, and an increase of the rate of yield, at present low. Flour-milling has made notable advances, especially in Manchuria.

Millets and kaoliang (sorghum), whose distribution is rather wider than that of wheat, occupy 20% of the cultivated land area of China. They are dominant in Hopei, Shantung and Honan where they take up approximately one-third of the agricultural surface. Apart from the grain, their by-products are of great value, and in north China the stalks and fibre of the kaoliang replace, for many purposes, bamboo which reaches its northerly limit in the Wei-ho valley.

Tea has long been the chief beverage in China, and since about the 8th century A.D. the cultivation of the tea plant has been a great agricultural industry, localized mainly on the uplands of central China and on the ranges of the maritime provinces, but important also in Szechwan. Black, green and "brick" teas result from different processes of manufacture. The tea plant in China is mainly grown in patches round the homestead, and the methods both of cultivation and preliminary preparation after the picking of the leaves (usually in April, mid-May and August) are traditional and not based on scientific knowledge. Mainly for this reason the chief European markets for black tea were largely lost by China in the later 19th century, when the plantation system, with its associated scientific processes of manufacture, was developed in India and Ceylon. Of the 53,000,000 lb. of black tea exported from China in 1924 Great Britain took 22,000,000 lb. Brick tea, made by pressing damp leaves into a brick-like mould, has found its chief market in Tibet, Russia and interior Asia. Chief ports for tea-export have been Hankow (black and brick tea), Kiukiang and Foochow (black tea), Hangchow, Ningpo and Kiukiang (green tea). Experimental stations and investigation bureaus for more scientific cultivation and preparation of tea have been opened in the Yangtze valley and at Foochow, and a small beginning has been made with the plantation system.

For sericulture, the most far-famed and ancient of her industries, China has many natural advantages, including the two or more leafings of the mulberry, as compared with one in the Mediterranean countries, and abundant cheap and traditionally skilled labour in the manipulation of the cocoon and in weaving. In the production of raw silk there are many regional specializations in accordance with the variation of soil and climatic conditions. The silk of the north (Shantung and Manchuria) is chiefly "wild," the product of silk-worms fed on oak leaves and manufactured into coarse-textured tussahs and pongees; the Canton delta, where there are as many as six or seven leafings of the mulberry, produces soft Canton silk and Szechwan a special yellow variety. But the most renowned silk region is the lower Yangtze valley, the finest white silk in the world (tsatlee) coming from around the Tai-hu. The aggregate output of raw silk in China is estimated at 25% of the world's supply, but the exports to European and particularly American markets, although considerable, have in recent years been surpassed by those of Japan, which has added scientific technique to the natural advantages for silk production which she shares with China, where the industry is carried on by the peasants on traditional lines. Serious efforts have recently been made by special departments of several colleges and by the International Committee for the Improvement of Sericulture in China to improve the mulberry plantations and to eradicate silk-worm diseases, which greatly impair the prosperity of the industry. A more revolutionary change is indicated by the development of large steam filatures and weaving mills at Canton, Shanghai, Soo Chow, Hangchow, Hankow, Chefoo and Chinkiang and other towns. Even under existing conditions, raw silk and cocoons recently formed over 18% of the total value of Chinese exports and came second only to beans and bean products. In contrast, tea, which in 1820 constituted 75% and in 1867 60% of all Chinese exports, accounted for little more than 3% in 1926.

The most remarkable agricultural development in China during recent times has been the rapid growth of the bean industry. Beans have long been grown as an article of food, but the development of the culture on a commercial basis is quite modern and is due to the realization of the many valuable qualities of the soya variety, which is admirably adapted to north China, and particularly Manchuria. On the one hand, it has a higher food value than any other seed which, in conjunction with its cheapness, makes it an effective substitute for milk, meat or the staple grain foods of north China; on the other its by-products—bean-oil as a cooking sauce, as a base in soap-manufacture and as a lubricant for various purposes, and bean-cake as a fertilizer and cattle food—are of great commercial value. In the 1920s beans and bean products amounted to one-fifth of the total exports of China. They have been one of the principal factors in the rapid economic development of Manchuria. (*See* MANCHURIA.)

Of the purely industrial crops of China, cotton is the most important, and its future development will be followed with great interest. The soil and climatic conditions of many districts of the Yangtze valley and the adjacent parts of the plain of north China approximate those of the cotton belt of the United States. But the industry has suffered from many disadvantages; the short staple of the native varieties, primitive methods of seed selection and cultivation, lack of transport and of banking and credit facilities to deal with the movement of crops, and the existence of taxes, which greatly raise its price. Much important work has been done both by provincial associations and college departments (notably the University of Nanking) to improve native varieties and to acclimatize and then distribute seeds of American cottons.

It would seem to be established by experiments that late-maturing American cottons will not succeed in the Yangtze delta, with its humid early autumn climate, but can be acclimatized in the central basin and parts of north China where September and October are normally dry, sunny months. The endeavour has been made to produce longer-stapled Chinese cottons for the deltaic area.

The great development of cotton mills in China in the last 35 years has been the most important aspect of the new industrialism. They have been, however, very strictly localized. Of 118 cotton mills in China in 1927, 58 were in Shanghai, the great textile centre, and half the remainder in the Yangtze delta and the central basin. Of the grand total 72 were Chinese-owned with 2,218,588 spindles and 12,409 looms, 42 Japanese-owned with 1,302,678 spindles and 9,625 looms and 4 British-owned with 205,320 spindles and 2,348 looms. The piece-goods produced have competed in the huge Chinese market with those of Japan, India and Great Britain. Labour in the mills has been very cheap and regulations as to hours of labour, employment of women and children and safeguarding of machinery have been almost non-existent.

The opium poppy has been one of the chief and most widely-distributed products of China's fields, and the area devoted to it, reduced to a minimum by the prohibition orders of 1906 and subsequent years, greatly increased during the period of civil war, with its military exactions of illicit revenues. In west China the national government by forcible measures greatly reduced its growth. In some Japanese-controlled areas a marked increase in opium production as well as in the consumption of opium and its derivatives occurred.

Other important Chinese products, which cannot be separately described, include fibre crops, especially ramie in the Yangtze valley, tobacco (very widely distributed), ground-nuts, many kinds of vegetable-oils, cane sugar and a great variety of medicinal plants and spices.

So great is the need for subsistence crops in China that grazing grounds for sheep and cattle are virtually confined to the dry northwest and to mountain pastures. In the rest of China there is no dairy industry and cattle are used primarily as draft animals. Moreover, there is a lack of pasture grasses, due in part to the type of rainfall. On the other hand, animals such as swine, goats and poultry, which can subsist on by-products of the farm, are kept in large numbers. Of scientific animal breeding there is at present very little. Reference has already been made to the meagre resources of modern China in timber.

China has an important source of wealth in her sea and river fisheries, which are rich and varied and supplemented by artificial breeding in tanks. The coastal fisheries of Shantung, Chekiang and Kwangtung are especially valuable, and they include some of the world's greatest fishing centres. Fish, both fresh and salted, is a staple article of diet in many districts.

Mineral Wealth and Mining.—The distribution and character of the varied mineral wealth of China in relation to the structure of the country have already been discussed. It remains to examine briefly the economic aspect. Coal is by far the most important item but there is as yet no certainty regarding even the approximate amount of China's coal reserves. The revised estimate (1932) of the Chinese Geological survey of 246,081,000,000 tons, while much higher than its first estimate, admittedly very conservative, is still far short of the 994,987,000,000 tons submitted to the International Geological congress in 1913. Yet it indicates a bulk which is: (1) probably the greatest in the far east; (2) sufficient to form the fuel basis of a fairly extensive industrial development in China. Of the total amount of the revised survey estimate Shansi alone is responsible for more than one-half.

While every coal field has outcrop or adit workings to supply local consumption, about 75% of the total production of 25,700,000 tons has recently been furnished by large-scale concerns. These are all intimately related to the existing railway systems mainly concentrated in north China, and are therefore chiefly located on the small fields scattered around the edges of the north China and south Manchurian plains. The only really important mine in south China is that of Pinghsiang among the hills of the Hunan–Kiangsi border, and this too is linked with the railway system. Much the largest concerns are the Japanese Fushun and the (former) Sino-British Kailan, whose fields, though small, have each an important strategic position, being in close contact with the railway foci of south Manchuria and of north China respectively. The production of Fushun has been the larger of the two. From these and from other mines in Shantung and along the eastern fringes of the Shansi coal field, coal is exported along the railways and by coasting steamer to the commercial and industrial centres, of which the Yangtze delta is the chief. Chinwangtao, the property of the Kailan concern, has had larger coal-shipping trade than any other port east of Suez. There is also a considerable trade, in which exports exceed imports, with Japan.

China's resources of iron are more meagre than those of coal. Tegengren, for the Chinese Geological survey, estimates the reserve of ores suited to modern large-scale methods (and exclusive therefore of coal-measure ores) at only 952,000,000 tons, and holds out little hope of the discovery of new deposits. These are not sufficient to form the permanent basis of an iron industry of the magnitude of that of America, but, on the other hand, the Chinese industry has as yet a capacity of only 1,000,000 tons of pig iron and an actual output of but one-third of that amount. Thus there is room for very considerable expansion. Mining is most active along the lower Yangtze valley whose mines (Tayeh in particular) account for two-thirds of a total ore production of 1,500,000 tons. Next to it in production as an iron-field is south Manchuria, and these two regions are also the chief centres of iron smelting. To both, coke has to be carried some distance, but China has no lack of coking coal. It is a noteworthy fact that by various means Japan has acquired virtual control of 90% of the utilizable iron resources of China, and has been importing fully half of both the latter's iron ore and pig iron production.

Of fuels other than coal, such as petroleum and oil shale, China possesses only limited amounts. This is also true, among the metals, of lead-zinc and of silver, but the resources of copper and tin are by no means insignificant. Small deposits of all these metals have long been worked in many parts of the country. The most important copper and tin mines all lie in Yunnan and adjacent southwest Szechwan. Of some rarer metals, particularly antimony and tungsten, China is the leading producer of the world. In conclusion it may be said that, while the impressions, so widely prevalent in the 19th century, of China as a country of almost unparalleled mineral resources are clearly without foundation, she yet has a margin for industrial growth, and with improved transport facilities and more favourable economic conditions will develop great mining activities. (*See* SHANSI; HOPEI and MANCHURIA.)

Manufactures.—From what has been said in the preceding sections it must be clear that industrial development in the modern occidental sense of that term is (1944) in its infancy. In the older, pre-machine age, manufacturing was in the handicraft stage and was in countless small units organized by guilds. Handicrafts persist as the prevailing method of manufacture. Some have been weakened by competition with foreign machine-made goods or, in cottons, by modern factories in China. Factory development has been mainly, although not exclusively, in the manufacture of cottons. There have also been silk filatures, flour mills, match factories and some steel works. Industrial development has been retarded by civil strife and foreign wars, for these have made for insecurity and both domestic and foreign capital have been reluctant to invest extensively in equipment which might be destroyed by contending armies. Much of the industry which had been developed in the lower reaches of the Yangtze valley, was moved westward in 1938 and 1939 to escape the Japanese invasion. There was some attempt to encourage small units in "Free China" through industrial co-operatives. Yet (1944) industrially, as compared with western Europe, the United States, Japan and Russia, China has remained backward.

Currency and Banking.—At the dawn of the 20th century

China's only domestic coinage was copper, in what were known by the foreigners as "cash." This could be employed only for relatively small transactions. Larger transactions were in silver bullion. The unit was the tael (Chinese liang) which varied in weight from locality to locality and agency to agency. Silver dollars of foreign minting, largely Spanish and Mexican, had been imported and were in increasing circulation. Domestic banks were chiefly for the purpose of facilitating internal commerce and exchange, although some received deposits and made loans. In the larger ports there were foreign banks, chiefly British.

In the course of the 20th century the "cash" largely disappeared. Silver coins corresponding to the dollar and called yuan were minted and a subsidiary coinage, theoretically decimal, appeared. The yuan or dollar was legally substituted for the tael. There was much use of paper money, but silver remained the basis of the currency. In the 1930s the country was drained of much of its silver by purchase from abroad. Remaining stocks of silver were nationalized. As earlier, various kinds of money of varying exchange rates were in circulation, but the government strove to bring in uniformity. There was an extensive development of banks, both government and private, of occidental types. With the war with Japan following 1937 there came progressive inflation, both in "Free" and "Occupied" China, which attained extreme proportions. Silver had disappeared from circulation and the increasing flood of paper money rapidly depreciated in purchasing power.

FOREIGN TRADE

The origin and characteristics of the system by which the foreign trade of China has been organized from the middle of the 19th century down to the present time (1944) are explained in the section on *History*. Some impending changes of great importance are indicated below. The following tables showing the total foreign trade for 1926 according to the returns of the Chinese Maritime Customs may be taken as fairly typical of the position up to 1931 and this in spite of the disturbed political conditions.

Of the total shipping engaged 117,319 were steamers with an aggregate tonnage of 132,249,000 and 41,677 were sailing vessels (almost entirely Chinese junks) with an aggregate tonnage of 2,410,000. An important feature shown by the first two of these tables is the considerable excess of imports over exports and, with the exception of certain years in the '80s, this has been a constant characteristic of Chinese foreign trade since 1869. The interpretation of this excess is by no means easy. It cannot be explained as in the case, for example, of Great Britain, by so-called "invisible" exports in the form of shipping services paid for by imports or by interest on capital invested abroad, which again swells the import list. China has, however, an important asset, which is in some respects comparable to the latter, in the extensive remittances made to their ancestral homes by emigrants to Malaya, the Philippines, the Netherlands Indies, Indo-China, the Americas and Europe. On a calculation made by the Bureau of Economic Information from an estimate of the Yokohama Specie Bank for 1925 the aggregate total reaching China from this source in various forms amounts to about $160,000,000. This certainly more than counterbalances the swelling of the export figures by the net profits of foreign residents in China and of foreign shipping and insurance companies. But, important as this factor is, it does not seem sufficient to cover what the official returns describe as an "unfavourable balance," reflecting the present economic position of China. To quote the Maritime Customs' report on the foreign trade of China (1926): "one must conclude that the Chinese people are dependent on foreign countries for a very great quantity of goods which they cannot produce as yet, while their own products meet with a very strong competition by similar products from other countries in foreign markets." The heavy import of foodstuffs in a country so predominantly agricultural is particularly significant, for it is precisely by the export of these and of raw materials that most agricultural countries pay interest on the loans made by foreign capitalists to assist their industrial development. In the case of China many of these loans have been secured on railways and other national assets, with resulting political complications, and under the most favourable circumstances a long time must elapse before China can completely free herself from the entanglements which this indebtedness involves.

After 1918 the organization of Chinese foreign trade entered on a new and momentous phase. By the treaty of Versailles Germany surrendered her concessions at Hankow and Tientsin, and Russia, too, as a result of World War I, lost and later renounced her treaty privileges. At the Washington conference (1921–22) the Nine Power treaty on the Chinese customs tariff decreed *inter alia* "a general revision of the tariff, to make it

TABLE I. *Foreign Trade of China, 1926*

Principal articles imported (net) from foreign countries. Percentage of total value of imports indicated in brackets	In thousands of Hk. taels	Principal articles exported to foreign countries. Percentage of total value of exports indicated in brackets	In thousands of Hk. taels
Cotton goods (excluding cotton yarn and raw cotton)	177,217 (15.76%)	Beans and bean products	175,778 (20.34%)
Raw cotton	93,751 (8.34%)	Raw silk, cocoons, etc	159,025 (18.40%)
Rice	89,844 (7.99%)	Eggs and egg products	38,174 (4.42%)
Sugar	82,753 (7.36%)	Silk piece goods	30,858 (3.57%)
Kerosene oil	56,595 (5.03%)	Groundnuts and products	29,821 (3.45%)
Metals and minerals	52,347 (4.66%)	Raw cotton	29,399 (3.40%)
Tobacco and cigarettes	46,578 (4.15%)	Skins, hides, leather	28,848 (3.34%)
Woollen goods	29,653 (2.64%)	Cereals	28,722 (3.32%)
Cotton yarn	28,250 (2.51%)	Seeds and seed-cake	26,583 (3.08%)
Fishery and sea products	27,824 (2.47%)	Coal	26,189 (3.03%)
Paper	27,669 (2.46%)	Tea	26,165 (3.03%)
Coal	26,933 (2.40%)	Cigarettes	15,416 (1.78%)
Gums, oils, soap, candles, etc.	25,854 (2.30%)	Wood oil	14,962 (1.73%)
Flour	24,820 (2.21%)	Hair, feathers and wool	14,895
Cereals, seeds, etc	23,623 (2.10%)	Cotton goods (excluding yarn)	13,298
Chemicals	21,039 (1.87%)	Cotton yarn	10,812
Hemp, flax and jute goods	19,936 (1.77%)	Bristles	10,469
Wheat	17,965 (1.60%)	Wood and timber	10,314
Machinery	16,738 (1.49%)	Tin in slabs	8,738
Timber	16,144 (1.44%)	Other merchandise	165,829
Other merchandise	218,688		
Total net imports	1,124,221,253 Hk. Taels	Total exports	864,294,771 Hk. Taels

The Haikwan tael, an uncoined weight of silver used in the collections and statistics of the Chinese Maritime Customs, was equivalent to 3/1⅛*d.* in English money in 1926.

TABLE II. *China's Foreign Trade with Principal Countries, 1926*

Country	Direct imports (gross) (in thousands of Hk. taels)	Percentage of total imports	Direct exports (in thousands of Hk. taels)	Percentage of total exports	Excess of	
					Imports	Exports
Japan	336,909	29.43	211,741	24.50	125,168	..
United States of America	187,647	16.39	150,113	17.37	37,534	..
Hong Kong	124,473	10.88	93,802	10.85	30,671	..
Great Britain	116,269	10.16	55,836	6.46	60,433	..
Russia and Siberia	22,712	1.98	64,120	7.42	..	41,408
French Indo-China	51,796	4.53	18,434	2.13	33,362	..
Germany	45,678	3.99	17,760	2.05	27,918	..
Other countries	259,163	22.64	252,489	29.22	6,738	..
Total	1,144,647	..	864,295	..	280,352	..

1. In certain respects the returns for 1926 were exceptional owing to the Cantonese boycott of Hong Kong during the greater part of the year which tended to swell the returns of direct Chinese imports from other sources. In 1924 both imports from and exports to Hong Kong were nearly double those of 1926.

2. The situation was altered after 1931 through the creation of Manchoukuo. Since the statistics of Manchuria, in whose trade Japan was dominant, were henceforward not included in those of China, until 1937 the United States assumed the leading place in China's foreign trade, and Japan sank to second place.

TABLE III. *Tonnage of Vessels Engaged in Carrying Trade from and to Foreign Countries and between the Open Ports of China, 1926*

	Tons	%
British	47,645,090	35.38
Japanese	38,948,844	28.92
Chinese	28,393,631	21.09
American	6,496,351	4.83
Other Flags	13,175,690	9.78

TABLE IV. *Percentage Contributed by Principal Ports to Maritime Customs Revenue, 1926*
(Total collection Hk. taels, 80,435,962)

	%
Shanghai	41.81
Tienstin	10.15
Dairen	8.72
Hankow	6.60
Canton	5.74
Kaiochow (Tsingtao)	4.27

a more effective instrument of revenue, with the authority to increase it in return for the abolition of *likin.*" Under Resolution IV of the Washington conference, the Commission on Extra-territoriality met in Peking in Jan. 1926 and in September of that year the representatives of 13 powers signed the report recommending that, when certain conditions were satisfied, the powers concerned should relinquish extraterritorial privileges, on the understanding that their nationals would then have the right to reside, trade and enjoy civil rights in all parts of China. In 1925 and 1926 an international conference was held in Peking to deal with the problem of the tariff. In 1927 both Great Britain and the United States promised to concede tariff autonomy and to relinquish extraterritorial rights. With the establishment of the Nationalist government at Nanking, claiming authority throughout China, the fulfilment of these pledges was pushed. In 1928, 1929 and 1930, all the powers, including Japan, consented to the resumption by China of tariff autonomy. In 1929 China made these agreements effective by inaugurating a system of duties fixed by herself. In Dec. 1929, China announced the termination of extraterritoriality, but by Jan. 1, 1932, later set for assuming jurisdiction over foreigners, the hostilities in Manchuria had broken out and the Chinese did not carry out their purpose.

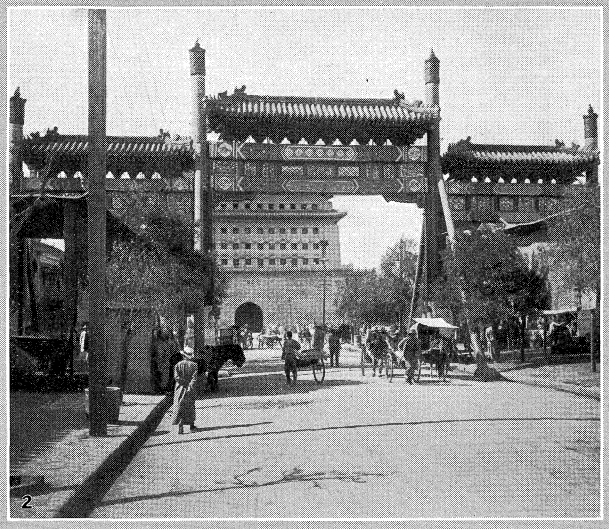
In 1927, 1929 and 1930, Great Britain surrendered several of her concessions in treaty ports. Chinese were admitted to membership of four of the major remaining concessions. The Shanghai Mixed court, in which Chinese defendants were tried, was restored to Chinese control (Jan. 1, 1927).

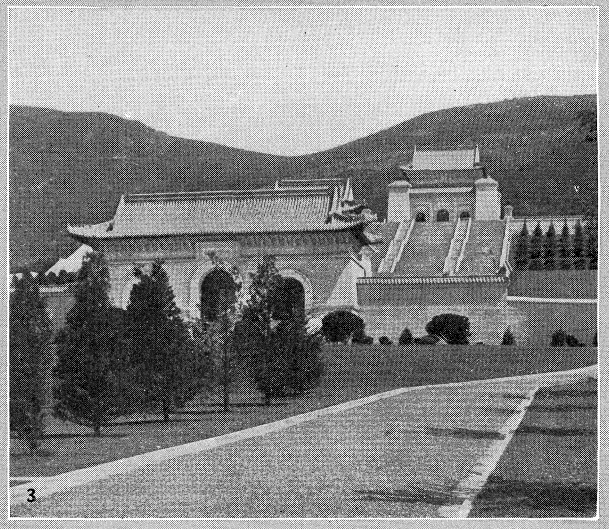
After the Japanese occupation of Manchuria in 1931 and especially after the Japanese attack on China in 1937, China's foreign trade was greatly modified by the progressive Japanese aggression. More and more, Japan endeavoured to bring within her economic empire the portions of China which she occupied. She did this in part through various companies which she organized specifically for this purpose. Obviously her plan was to integrate all of east Asia into an economic whole in which she would be dominant and in which Chinese economy would be made to subserve her ends. As the war progressed, Japan strove by the slow strangulation of an increasing blockade to cut off from the outside world "Free China." By successive steps various Chinese ports were seized, access from west China to the sea by way of French Indo-China was cut off, and the capture of Hongkong and the conquest of Burma in 1942 shut these doors to the outside world. By 1943 such foreign trade as "Free China" had was either by air transport from India, a route of extreme difficulty and danger, or through the Japanese blockade. The latter was made possible in part through the venality of Japanese officials. Under such circumstances no reliable figures could be had.

The new treaties agreed upon in 1943 between China on the one hand and Great Britain and the United States on the other, brought an end to the extraterritorial privileges of the latter two powers. Clearly when commerce can again be resumed under peacetime conditions, it will be on terms very different from those which had obtained before World War II.

Transport Conditions and Communications.—For the most part freight is still moved in China, as it has always been, by human labour, with animals as supplementary carriers. The wheelbarrow and carrying-pole are the commonest means of transport for small merchandise. In north China wheeled vehicles, mostly the springless Pekingese cart, are used to a considerable extent on the sandy tracks, while in the centre and south the sedan-chair is still in evidence, and rickshas are in general use in and around the larger cities. The Tsinling mountain belt roughly defines the northern limit of the general use of water-transport, which in north China becomes subordinate to the cumbrous cart, drawn by horse, mule, bullock or mixed team. In the utilization of inland waterways no people have excelled the Chinese. The natural routes provided by the Yangtze and its great tributaries and to a less extent by the Si Kiang and other rivers of southeast China bear an enormous amount of junk traffic, while steam boats, large and small, are increasing, especially in the lower Yangtze. From an early stage of Chinese history the rivers have been supplemented by canals. The most famous of these was the Grand canal, at its fullest development reaching from T'ung-chow, just outside Peking, to south of the Yangtze. In later years much of it has gone out of use from accumulations of silt and lack of repair. In central and south China the great bulk of inland trade is carried on by water-ways, and many millions of Chinese spend their lives in boats. At various periods of Chinese history extensive systems of "imperial" highways have been constructed, radiating from the capital, but these have seldom been kept in repair for long and now are mostly mere tracks. However, the "good roads movement," launched at Shanghai in 1921 and strongly supported by the merchant class, made considerable progress, and round many of the more progressive cities broad macadamized thoroughfares, capable of carrying heavy traffic, were constructed. Motor services are coming into existence, and thousands of miles of motor roads have been built. Most of these have only dirt surfaces, but some have been given rock dressings. Notable has been a road which, under the pressure of military necessity, the Chinese built from Yunnan to Burma. Under the pressure of the Japanese blockade, after 1937











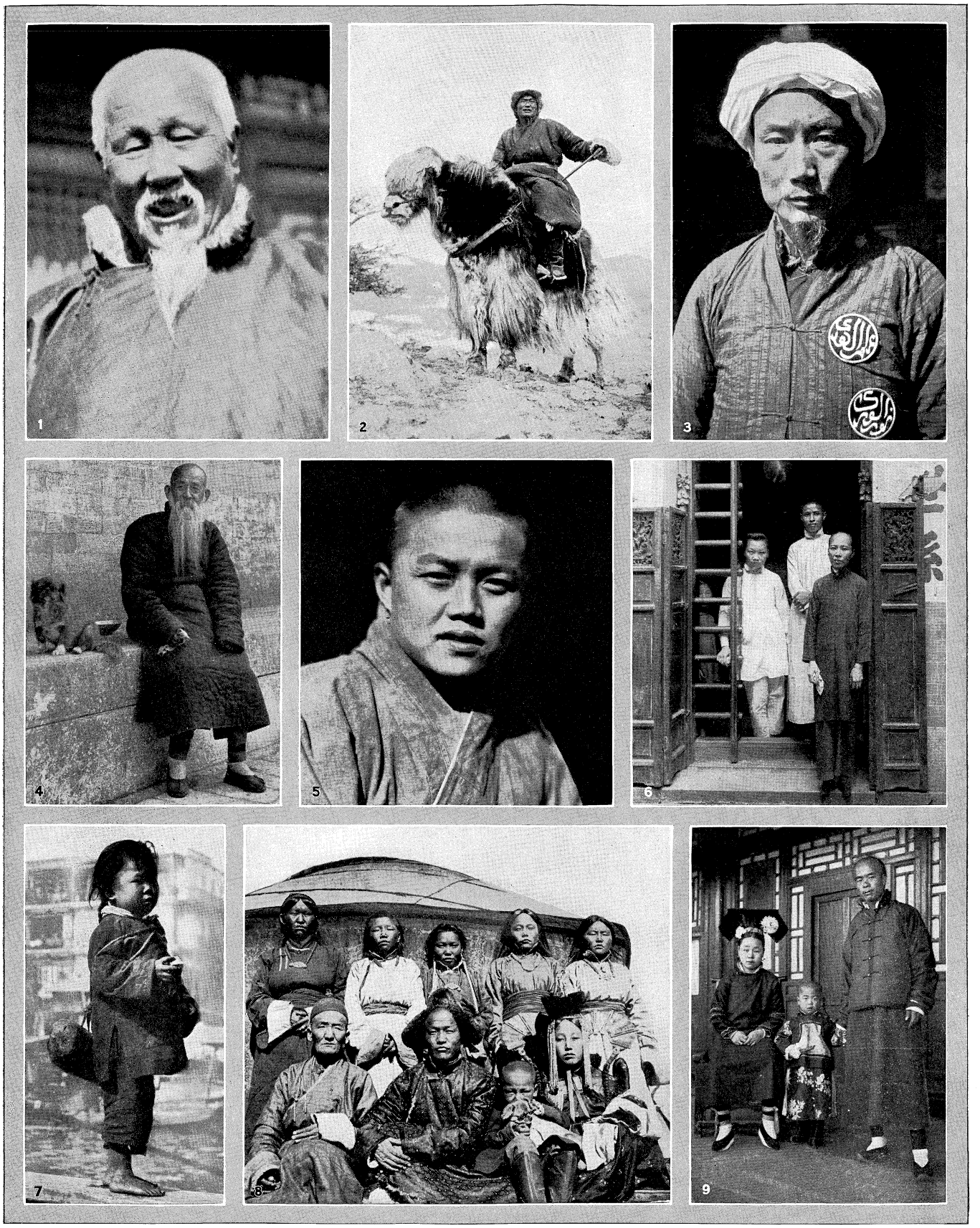


PHOTOGRAPHS, (1) PUBLISHERS PHOTO SERVICE, (3) DE COU FROM EWING GALLOWAY, (4) PHILIP D. GENDREAU, (5) PIX, (2, 6) COPR. E. M. NEWMAN FROM PUBLISHERS PHOTO SERVICE

ANCIENT AND MODERN ASPECTS OF CHINA

1. Street canal, Soochow (or Suchau), province of Kiang-su, about 50 mi. northwest of Shanghai. Soochow, like Venice, is built on numerous islands, separated by canals
2. Peking, pylon outside the water gate. Peking is surrounded by a wall with 16 city gates
3. Memorial to Sun Yat-sen, outside Nanking, with tomb in the background. The terraced grounds occupy about 50 acres
4. The bund, Shanghai. Many of these buildings were struck by bombs or shells in 1937
5. A typical open-air market in Nanking
6. Typical business street in Canton. Although some of the streets are not wider than 5 ft., Canton is comparatively clean and orderly

CHINA



PHOTOGRAPHS, (1, 3) ORIENT AND OCCIDENT, (2, 8) THE KEYSTONE VIEW COMPANY, (4) DE COU, FROM EWING GALLOWAY, (5, 7) EWING GALLOWAY, (6) E. M. NEWMAN, FROM PUBLISHERS PHOTO SERVICE, (9) HERBERT G. PONTING, F.R.P.S.

CHINESE NATIVES OF SEVERAL CLASSES

1. An old man, bearing a striking resemblance to portraits of Confucius
2. Mongolian chieftain, riding a yak
3. Mohammedan sheik, Central China. There are over 10,000,000 Muslims in China
4. A Lama (priest of Buddhist sect) and his dog, Lama temple, Peking
5. Mongolian type
6. A Cantonese family of the better class
7. Houseboat child, wearing a life-preserver—a usual part of her apparel
8. Mongolian family of the tribe Gimut-Dorgje, before their tent
9. A Manchurian family, Peking

gasoline for the use of motor vehicles became increasingly difficult to procure. As substitutes charcoal, wood oils and alcohol were employed. The displacement of human by motor transport which has already begun must involve important social consequences. Passenger and freight transport by air have also been developed. It has been both retarded and stimulated by the war with Japan.

The program of railway construction, which in the early years of the 20th century was making fair progress, was almost entirely held up during the period of civil war. It was resumed in the 1930s. The outstanding feature of the railway system, so far as it has been completed, is the concentration in north China and the lower Yangtze valley. Thence diverge:

(1) The Peiping–Kalgan–Suiyuan–Paotowchen line (597 mi.) which ascends the scarps leading to the high Mongolian plateau and is intended to develop the pastoral and potential agricultural resources of Inner Mongolia and northwest China. This line is notable as having been constructed and maintained by the Chinese without external assistance.

(2) The two great trunk railways traversing the plain of north China from north to south. (*a*) The Peiping-Hankow railway, whose route lies along the western border of the plain, and with the recently completed line from Wuchang (across the Yangtze from Hankow) to Canton, forming the north-south artery *par excellence*. (*b*) The Tientsin–Pukow railway running through the eastern part of the plain links Peiping with the Shanghai-Nanking line and the lower Yangtze valley.

(3) The Peiping-Tientsin-Mukden railway, traversing the coastal sill between the edge of the Mongolian plateau and the sea, joins the two great northern centres with the metropolis of south Manchuria and makes contact with the complex and rapidly expanding railway system of Manchuria. (*See* MANCHURIA.)

The most important transverse line is the east-west Lung-hai railway which from the new port of Haichow in northern Kiang-su crosses both the north-south trunk lines and runs through Su-chow and Kaifêng to Honanfu, Hsianfu, and Paochi, its present terminus. Continuations have been projected to Lanchow, in Kansu, and to Chêngtu, in Szechwan.

Apart from small branch lines, mainly tapping coal fields, there are two important railways connecting with the main systems: the Shantung railway joining Tsinanfu with Tsingtao (Kiaochow) and the Shansi railway linking the Peiping-Hankow line with Tai-yuan.

Shanghai is the focus of a distinct system:—(1) Shanghai–Nanking (*see* above), (2) Shanghai–Hangchow–Ningpo, (3) Shanghai–Woosung (the first railway opened in China, 1876).

From Hangchow a railroad stretches westward through Nanchang and Changsha and has been projected to reach Kweiyang and Kunming. Kiukiang on the Yangtze was connected with Nanchang. Hengyang on the Wuchang-Canton line in Hunan has been connected with Kweilin in Kwangsu.

In the south, Canton has a similar role. Apart from the Canton-Wuchang line, already mentioned, short railways connect the southern metropolis with Kowloon, opposite Hong Kong, and with Samshui. The only other important railway in China is the trunk-line, completed by the French in 1909, which runs from Haiphong in Tonkin to Kunming in southwest China, 200 mi. of its course being in Chinese territory. There are short local lines running inland from Amoy, Swatow and Macao respectively. A railway has been (1944) under construction to connect west China with Burma. Work has been begun on a number of other lines in west China designed to connect some of the main cities in Szechwan and Yunnan, and Kweichow with Hunan.

Two provinces of China Proper (Kansu and Kweichow) have no railway mileage, and several others very little.

The postal service of China has been greatly improved in recent years and has been maintained with surprising efficiency in spite of civil and foreign wars. As a result of the Washington conference and in acknowledgment of the efficiency of the Chinese postal service, all the foreign powers concerned agreed to withdraw their postal agencies from China on Jan. 1, 1923. Wireless is already fairly widely distributed.

ADMINISTRATION

Since the revolution of 1911, which abolished the imperial office and the time-honoured machinery of administration, China has passed through a bewildering series of political changes and civil wars (*see* under *History*). On the eve of the outbreak of the Chino-Japanese hostilities of 1937 a quieter phase had supervened and constructive forces were obviously at work, but the factors in the political situation were still extremely complex and the legacy of militarism, which the civil wars had bequeathed, increased the difficulty of administrative reconstruction. A constitution was promulgated (autumn 1928) embodying certain principles to which, in theory at any rate, all Chinese Nationalists adhere and the outlines of a new system seemed to be appearing. It would be rash to assume that its foundations were stable or that there was any finality in the arrangements. None the less they exhibited certain tendencies which, subject to the vicissitudes of foreign war, will probably have a greater degree of permanence since they reflect the mental attitude of a large section of the educated class. The new constitution and the administrative arrangements which it contemplates were the work of the Kuomintang or People's party, which is not only supreme in China but is the only party whose existence is recognized. Dr. Sun Yat-sen, the founder of the Kuomintang, has since his death been regarded in some sense as its patron saint and his will or statement of three essential principles is regarded as a kind of instrument of government. It is far too long to be quoted *in extenso* or even summarized here, but certain features of it, especially those which have a direct bearing on the Nanking constitution, may be briefly noticed. The "three principles of the people" have been translated as:—

(1) Nationalism ("National emancipation and racial equality").
(2) Democracy ("Political rights for the people").
(3) Socialism ("Economic rights for the peasants and workers").

Under the first principle ("Nationalism") Dr. Sun states what is necessary for the development of a strong national consciousness so that China can escape from the position of being "a colony of every Great Power." One of the steps on which he insists is that "we must organize our people into one strong organic group. This can be accomplished only by utilizing such strong units as clans and local organizations." Many old characteristics must be revived, including "our old learning as found in the *Great Learning*" and "we must revive our creative power, the power which we once had in inventing new things." He adds "we must do all these things, but, aside from that, we must also go out to learn what is best in the West." Under the second principle ("Democracy") Dr. Sun first states the case for democracy and maintains that China in this respect has little to learn from the west, since "the West has, in the last century, progressed much more rapidly in material things than in those that concern man and his welfare. In politics, very little advance has been made." He makes the interesting point that whereas the western peoples had formerly too little personal freedom and had to fight hard for liberty, in China "our people have had too much personal freedom" and, as a result, "have become a plate of sand . . . helpless in the face of foreign imperialism and its economic conquest." "So what we need now is not to fight for more personal freedom, but to sacrifice some of our personal freedom, in order to gain our national freedom." China has to face two problems, in the solution of which, he maintains, she is helped neither by her own nor by western experience: how to have a strong central government and at the same time to remove the fear of the people of such a government. To build up a powerful government machinery and to enable the people fully to exercise their power and control of the machinery two things are essential: (*a*) The organizing of government "on the five principles—legislative, judicial, executive, entrance to public office by examination, and censorship"; (*b*) safeguarding the people with "the power of election, power of recall, power of initiation of new laws, and power of revision or abolition of old laws."

Under the third main principle ("Socialism") Dr. Sun insists that "we must centre all our problems around the welfare of the people" and avoid the western mistake of taking "material problems as the central point in human history." "None of the forms of Socialism developed in the west are fitted for our own country." China has to avoid the dangers of industrialism. "Our great and immediate problem is not economic inequality but economic poverty, not a fight against capitalists, but the prevention of the rise of capitalists in the future. Our method of solving this problem is to develop State industry." He enumerates a series of measures for increasing production and concludes: "on the one hand there is an urgent need of improving our old methods of raising raw materials. On the other hand, we have to develop our own textile industry as rapidly as possible. This is at present hindered by the treaties which forbid us to have tariff autonomy. So our first step in solving the problem (of clothing) is to remove all unequal treaties so that we may carry out a policy of protection."

The official program of the Kuomintang, passed at a plenary session of the central executive committee, with delegates from all provincial committees, in Oct. 1926, at Canton, is essentially an elaboration of the main points and an application of the abstract "principles" contained in the famous will.

Sun Yat-sen contemplated three stages in the political development of the country. The first was to be military rule. This was to be followed by political tutelage under the Kuomintang, and this in turn was to be succeeded by government under a constitution which presumably would be democratic. In theory, the first stage ended in 1928. In practice, military and party rule went along together. The Kuomintang had a nation-wide organization. In May 1931, the Kuomintang brought together in Nanking a People's convention which adopted a Provisional constitution. In general the structure of government provided for in that constitution still maintains (1944).

The actual framing of the constitution, in accordance with the theoretical aims which have been briefly surveyed, was conditioned both by: (1) divergence of view as to the interpretation of the doctrines, since within the Kuomintang are both conservative and extremist groups; (2) the power of the great military chiefs and groups who assisted in the triumph of the Nationalist party. The organization of government is as yet by no means complete. Historic divergences between the north, the Yangtze Kiang basin, and the south break out when the central power is weakened and these differences, combined with rivalries of military leaders and communist elements, are important sources of difficulty. The constitution gives the views of the moderate or conservative side of the Kuomintang. The entire government was to be under the control of the Kuomintang. The following are the chief features of "the organic law of the National government," as ordained by the Kuomintang:—

1. A government council consisting of not more than 15 members, vested with supreme power. It controls the army, navy and air force and is alone competent to declare war, conclude peace and negotiate treaties with foreign states. Its chairman is the official head of the state, representing the nation in international affairs, and at the same time is commander-in-chief of all the forces.

2. Five *yüan* (or councils) for the following functions:— executive, legislative, judicial, examination and control (*i.e.*, censorship or supervision). Of these the executive *yüan* is the highest organ of the national government "and shall establish Ministries to which will be entrusted various executive duties." The presidents and vice-presidents of the five *yüan* are to be appointed from the government or state council, which shall also settle disputes arising among the *yüan* themselves. It will be observed that the five *yüan* or councils are in accordance with Dr. Sun's proposals under his second essential "principle." The control or supervisory *yüan* revives the functions of the censorate under the imperial regime. So too is revived the system of public examinations as the test of admission to public office, and a special *yüan* comes into existence to supervise it, but whereas in the old days the state was concerned only with the conduct of examinations, it is now responsible for a national system of education. This, indeed, has been in existence for several years, and notwithstanding the dislocations caused by the civil wars, has made considerable progress. The system, first established during the last years of the Manchu dynasty, has been twice reorganized under the republic, first on the Japanese and later on the American model. It now consists of:—

1. A two-year kindergarten.

2. A six-year primary school course (covering approximately the ages 6 to 12) divided into two grades: lower and higher primary, the former of four years' and the latter of two years' duration. In theory this is obligatory, but only in one or two provinces has the ideal as yet even approached realization.

3. A six-year middle or secondary school course (12–18), similarly divided into senior and junior grades, the higher tending to be vocational in character.

4. A four-year university course. In some cases there are industrial higher primary and middle schools, which are parallel and alternative to those mentioned above. There are also normal schools both lower and higher for the training of primary and middle schools teachers respectively, and also higher professional or technical colleges of various types.

In 1936 there was published the draft of what was presumably to be the permanent constitution. This had been formulated by the legislative *yüan*. Under it, the five-fold division of powers among the *yüan* was to be preserved. There was to be a president with very large powers. He was to be responsible only to a national congress, was to serve for three years, and was to be eligible for re-election. The national congress was to be elected by universal, equal and direct suffrage and was given authority to initiate legislation, to amend the constitution and to elect and recall the president, vice president and the heads and the members of the legislative and control *yüan*. However, it was to be convened only once in three years and then was to meet only for a month.

The outbreak of the war with Japan postponed the putting into force of this constitution. To meet the foreign menace, in 1937 the "united front" was formed, made up of all parties, including the communists, but with the Kuomintang still dominant. In 1938 an advisory People's Political council was formed, appointed by the Kuomintang, but comprising also members of minor parties and those with no party connections.

BIBLIOGRAPHY.—General: S. Couling, *Encyclopaedia Sinica* (1918); K. S. Latourette, *The Chinese: Their History and Culture* (1934); G. F. Hudson and M. Rajchman, *An Atlas of Far Eastern Politics* (1938).

For geography: G. B. Cressey, *China's Geographic Foundations* (1934); *see* also L. D. Stamp, *Asia: An Economic and Regional Geography* (1929).

For geology and structure: B. Willis and others, *Research in China* (1907); L. de Launay, *La Géologie et les Richesses Minérales de l'Asie* (1911); J. S. Lee, "An Outline of Chinese Geology," *Geological Magazine* (1921); A. W. Grabau, *Stratigraphy of China* (Chinese Geological Survey, 1924–); and the Bulletins and Memoirs of the *Chinese Geological Survey*.

For climate: W. G. Kendrew, *The Climates of the Continents* (1922); C. C. Chu, "The Rainfall of China," *Monthly Weather Review*. For climatic statistics: *La Pluie en Chine* and *La Température en Chine* by the Zicawei Press, Shanghai.

For vegetation and animal life: N. Shaw, *Chinese Forest Trees and Timber Supply* (1914); E. Wilson, *A Naturalist in Western China;* K. Ward, "From the Yangtze to the Irrawaddy," *Geographical Journal* (July 1923); A. de C. Sowerby, *The Natural History of China* (Smithsonian Institution, 1923).

For racial characteristics of the Chinese people: S. M. Shirokogoroff, *Anthropology of Northern China* (1923); E. Huntington, *The Character of Races* (1924); L. H. D. Buxton, *China, the Land and the People* (1929); Lin Yutang, *My Country and My People* (1935).

For population: W. W. Rockhill, *Enquiry into the Population of China* (1904); *The Christian Occupation of China,* edit. by M. T. Stauffer (1922); H. F. MacNair, *The Chinese Abroad* (1924); P. M. Roxby, "The Distribution of Population in China," *Geographical Review* (1925); Chi Li, *The Formation of the Chinese People* (1928); W. F. Willcox, "A Westerner's Effort to Estimate the Population of China," *Journal of the American Statistical Association* (Sept. 1930).

For Chinese society: H. B. Morse, *The Gilds of China* (1909); Y. K. Leong and L. K. Tao, *Village and Town Life in China* (1915); D. H. Kulp, *Country Life in South China* (1925); J. B. Tayler, *Farm and Factory in China* (1928); Pearl Buck, *The Good Earth* (1931).

For philosophy and religion: J. J. M. de Groot, *The Religious System of China* (1892–1911); W. E. Soothill, *The Three Religions of China*

(1913); Sir C. Eliot, *Hinduism and Buddhism* (1921); K. S. Latourette, *A History of Christian Missions in China* (1929); Fung Yu-lan, *A History of Chinese Philosophy . . .* (from the beginnings to *c.* 100 B.C.) translated by Derk Bodde (1937); E. R. Hughes, *Chinese Philosophy in Classical Times* (1942).

For relations with the west in addition to those under History: Sir F. Whyte, *China and Foreign Powers* (2nd ed., 1928); W. E. Soothill, *China and England* (1928).

For agriculture: M. P. H. Lee, *The Economic History of China* (1921); W. Wagner, *Die Chinesische Landwirtschaft* (1926); W. H. Mallory, *China: Land of Famine* (1926); F. H. King, *Farmers of Forty Centuries* (rev. 1927); K. A. Wittfogel, *Wirtschaft und Gesellschaft Chinas* (1931); J. L. Buck, *Land Utilization in China* (1937).

For industry: F. R. Tegengren, "Iron Ores and Iron Industry of China" *Memoir Geol. Surv. China* (1924); W. Smith, *Coal and Iron in China* (1926); D. K. Lieu, *China's Industries and Finance* (1927); H. F. Bain, *Ores and Industry in the Far East* (1927); J. B. Condliffe, *China To-day: Economic* (1932); R. H. Tawney, *Land and Labour in China* (1932); H. Freyn, *Free China's New Deal* (1943).

For commerce in addition to those under History: H. B. Morse, *The Trade and Administration of China* (1913); C. S. See, *The Foreign Trade of China* (1919); C. F. Remer, *The Foreign Trade of China* (1926); J. Arnold, *China, A Commercial and Industrial Handbook* (1926); the Annual Reports of the *Maritime Customs of China.* As General Sources: *The China Year Book; The Chinese Economic Journal* (monthly) and *Chinese Economic Bulletin* (weekly).

On government: H. B. Morse, *The Trade and Administration of China* (1913); Sun Yat-sen, *The San Min Chu I,* translated by F. W. Price and L. T. Chen (1927); C. L. Hsia, translator, *The Civil Code of the Republic of China* (1930); M. S. Bates and F. W. Price, "Kuomintang" (in *Encyclopaedia of the Social Sciences,* vol. 8, pp. 610–614); P. M. A. Linebarger, *The China of Chiang K'ai-shek* (1941).

(P. M. R.; K. S. L.)

CHINA (ware): *see* CHINAWARE.

CHINA-CLAY, so called because it is an essential ingredient in the manufacture of china or porcelain. It is also known as *kaolin,* a corruption of the Chinese Kau-ling, meaning "High Ridge," the name of a hill east of King-te-chen, whence the earliest samples of the clay sent to Europe were obtained by the Père d'Entrecolles, a French Jesuit missionary in China in the early part of the 18th century. His specimens, examined in Paris by R. A. Réaumur, showed that true porcelain was manufactured from a paste containing two essential ingredients—*china-clay,* a pure white clay, and *china-stone,* a variety of granite consisting mainly of orthoclase felspar. The china-clay confers plasticity on the paste and secures retention of form for the ware when exposed to the heat of the kiln; while the china-stone gives the translucency so characteristic of porcelain. Some of the earliest discoveries of china-clay in Europe were at Aue, near Schneeberg in Saxony, and at St. Yrieux, near Limoges in France. In England it was discovered in Cornwall about the year 1750 by William Cookworthy, of Plymouth; and in 1768 he took out his patent for making porcelain from china-clay and china-stone. These raw materials were found first at Tregonning hill, near Breage, and afterwards at St. Stephen's in Brannel, near St. Austell; and their discovery led to the manufacture of hard paste, or true porcelain, at Plymouth and subsequently at Bristol.

The china-clay rock of Cornwall and Devon is a granite with its orthoclase felspar decomposed to a soft white powdery substance which, when wet, acquires the characteristic plasticity of clay. The other components of the granite, the quartz and the mica, are unaffected and, although they are subordinate to the decomposed felspar, or kaolin, their presence retains for the rock the appearance of a weathered granite. Although kaolinization can undoubtedly result from weathering, the evidence in this case indicates that the alteration has been effected at a high temperature by vapours carrying fluorine and boron; and minerals containing these elements (*e.g.,* tourmaline and fluorspar) often occur in association with the china-clay. The alteration consists in the removal of the alkalies and the formation of a hydrated silicate of aluminium having the formula $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$. This substance, known as kaolinite (*q.v.*), constitutes the bulk of refined china-clay, the impurities of the commercial article being finely divided quartz and mica (muscovite). It is not possible to remove the whole of these impurities by washing and this accounts for the difference in composition between pure kaolinite and a refined Cornish china-clay as shown by the analyses in the next column.

	Kaolinite	*China-clay*
SiO_2	46·3	48·3
Al_2O_3	39·8	37·6
Fe_2O_3	..	0·5
CaO	..	0·1
K_2O, Na_2O	..	1·5
H_2O	13·9	12·5

(Note: 1% of alkalies in china-clay is equivalent to 8·5% of muscovite.)

The qualities for which china-clay is esteemed in the arts are whiteness and fineness of grain when it is used as a filler for paper or for dressing fabrics; and plasticity and infusibility when it is used as an ingredient of the paste of porcelain manufacturers. The absence of iron (which would be introduced by dark mica) is particularly important from the colour point of view; while the presence of light mica (muscovite) is undesirable since the alkalies thus introduced tend to lower the fusing point. Since in china-stone the felspar is only partially decomposed it contains a much higher percentage of alkalies than china-clay. This makes it more fusible and one of its uses is to impart a glaze to porcelain during the final firing. In order to prepare china-clay for the market the china-clay rock is subjected to the action of a stream of water. The bulk of the quartz and undecomposed felspar is arrested in suitably situated "sand pits," while the clay is carried away in suspension to the "button hole launder," whence it is pumped to the surface and conveyed to the "drags," which are a series of channels so arranged as to catch the coarser impurities. From the drags the clay-water passes to the "micas," a series of pits where the finer particles of mica and quartz settle down. Thus purified the liquid is led into "settling pits," or tanks, in which the finely-divided clay is slowly deposited. When it has acquired sufficient consistency it is dug out in square blocks and transferred to the "drys," *i.e.,* sheds heated by flues, where the moisture is expelled and the china-clay obtained as a soft white earthy substance. The material obtained in the micas is useful for some purposes (*e.g.,* as an absorbent and detergent in oil-refining) and is sold as an inferior china-clay. China-stone is quarried and ground without levigation. The china-clay industry of Cornwall and Devon has attained to large proportions and is very profitable. The output amounted in 1926 to 825,954 tons, three-quarters of which was exported. The number of persons employed was 4,682. The United States takes one half of the total exports. Other considerable importers are Belgium, France, the Netherlands, Germany, Italy and India. (F. H. HA.)

United States.—In the United States kaolins of the type of china-clay are found in North Carolina, Maryland, Delaware, Pennsylvania, Connecticut, Colorado and other States. The principal source of primary kaolin is North Carolina. The clay from this State differs from the true china-clay in having a coarser grain structure and so is more refractory and porous at the same degree of firing. The chemical composition approaches very closely that of typical kaolin. When properly washed, the North Carolina kaolin develops a very good white colour in firing. It is commonly used in conjunction with English china-clay in the manufacture of white earthenware pottery, wall and floor tiles, since it tends to hold the articles straight during the firing process. In addition, there are in the United States large deposits of secondary kaolin, derived from the primary kaolin of the Appalachian region. These are very fine grained and more plastic than the latter but, as a rule, fire to a faint cream colour though there are exceptions which produce a good white colour. Good examples are the deposits at Okahumpka, Fla., and other places in that State, and those of the Dry Branch and McIntyre districts of Georgia. A somewhat different secondary kaolin occurs in South Carolina. There is an increased tendency to replace the imported china-clays by these native plastic kaolins. Further west, in the States of Kentucky, Tennessee, Mississippi and Arkansas the secondary kaolins are changed to still more fine-grained, very plastic and strong clays, the so-called ball clays. A number of these fire to a light colour and for this reason are introduced in large quantities in earthenware and porcelain bodies. The increased use of these clays has done much to reduce the consumption of the kaolinitic type of materials.

In Bollinger county, Mo., white, kaolin-like clays are found which are the residue of decomposed limestone and carry a large amount of fine silica. A peculiar type of an indurated, hard clay, having very nearly the composition of kaolin, is found in Edwards county, Texas, and at King mountain, Nev. These clays require to be reduced to powder before they can be made to develop plasticity. When ground in water they show colloidal properties and dry to a horn-like strong mass. They fire to a pure white colour. The Texas "kaolin" has the peculiarity of producing translucency in bodies in which it is used even though the firing is not carried close to the point of vitrification. (A. V. B.)

CHINAN or **TSINAN,** a large and historic city and the capital of the province of Shantung in North China, 36° 43′ N., 116° 37′ E. Chinan is situated at the northern base of the ancient Highlands of Shantung (near Tai-shan the sacred mountain) where they sink beneath the alluvium of the Hwang-ho (Yellow) river, and along an important spring-line which fostered very early settlement. Its early history is bound up with that of the ancient states of Chi and Lu in the classical (Chou) period and when the present province of Shantung—closely corresponding to the territory of the two feudal states—was created under the Ming Dynasty (1368–1644) Chinan, a natural focus of mountain and plain, was selected as administrative centre. The change in the course of the Hwang-ho in 1854 brought it within 5 mi. of Chinan. But the destruction of the dykes as a war measure in 1938 turned most of the water into the regions south of Shantung, while in 1943 the Japanese military began work to divert the Hwang-ho north into the Wei river. Formerly, Chinan controlled the Hwang-ho bridge of the Tientsin-Pukow railway (completed 1912). This railway runs parallel to, and fulfils the function once served by, the now dilapidated Grand canal. Chinan is the junction of this arterial railway with the Shantung railway running eastwards by way of the Poshan coalfield to the port of Tsingtao on Kiaochow bay which from 1898 until 1915 was leased territory in control of Germany and then fell into the hands of Japan. Although by the Shantung treaty, arranged at the time of the Washington conference (1922), Japan on certain conditions surrendered Tsingtao to China, her influence and interests in the Shantung railway were still very strong, as was shown by the despatch of Japanese troops to Chinan in 1928, when the Nationalist armies were advancing northwards. In contact with foreign influences along the two railways, in communication with the sea by a canal fed from the local springs and the market for one of the richest parts of the Great Plain, Chinan has been much affected by western industrial methods, seen especially in flour milling and cotton manufacture. The city was voluntarily opened to foreign commerce in 1904 and a large "settlement" has grown up in the Shang-pu or trading quarter, outside the west gate of the city. Pop. (est. 1936) 472,300.

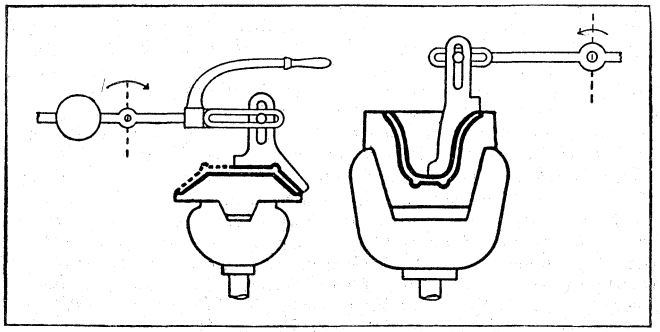
The Shantung School of Medicine, an important centre of medical training, formerly situated in Chinan was moved after the Japanese invasion to Wanhsien in Szechuan province.

CHINANDEGA, an important city of Nicaragua, Central America, capital of the department of the same name. It is 13 mi. N.N.E. of the Pacific port of Corinto, on the Pacific railway; population (1940) 14,967. It is 22 mi. from León and 74 mi. from Managua, the national capital. Chinandega is the centre of the sugar-producing area of Nicaragua and a high grade of sugar is manufactured and exported to the western United States and to other Central American countries. Corn, rice, potatoes, vanilla and cotton are also grown. Chinandega was partly destroyed by fire during one of the battles of the revolution of 1927 in which American marines and aeroplanes took an active part.

CHINAWARE, a name given to a hard, translucent pottery. (For *United States Chinaware see* p. 554.)

Earthenware is sometimes quite thin, and it is a common error not to discriminate between this and the ware which is properly called china. A simple test for china is its translucency, which allows the outline of a finger to be seen if held between a piece of ware and the light. Another and more accurate test is that of applying red ink to the ware *under the glaze.* If the ink is absorbed, then it is considered that the ware is not china. A portion of the glaze must be thoroughly removed before the ink can be applied.

The actual meaning of "vitrified" causes some trouble and the following is the definition: "Vitrified pottery is non-porous; unvitrified pottery is porous." "Vitrified china" has been defined as follows: "Vitrified china is glazed chinaware having a white body and burned to such a temperature that a dense, practically non-absorbent body is produced." "Practically" is a much abused



FROM BOURRY, "TREATISE ON CERAMIC INDUSTRIES" (SCOTT, GREENWOOD & SONS)

MAKING CHINAWARE ON THE "JOLLEY." A MOULD OF ONE SIDE OF THE ARTICLE TO BE MADE IS FIXED TO THE MACHINE AND MADE TO REVOLVE HORIZONTALLY. PREPARED CLAY IS PLACED IN THE MOULD AND SHAPED BY THE TOOL

adverb, and one is left wondering whether or not a slightly absorbent ware with a white body would pass as "vitrified."

Porcelain, which may be regarded as synonymous with china, is not easily defined in scientific terms, for several specimens of ware, which may be correctly regarded as true porcelain, will vary in actual composition. Dr. J. W. Mellor, F.R.S., has said that the most practical definition he could give is the following: "Porcelain is a body which in moderately thin layers is translucent."

CHIEF CENTRES OF PRODUCTION

Many countries have a justifiable pride in the china they produce; there are special characteristics attached to the composition of the "bodies" (the ware itself) and the decoration; they have beauties of their own and comparison is not possible.

The pottery industry has attracted the patronage of royalty and of governments. William II of Germany, for example, had a practical interest in the production of pottery, while the porcelain works at Sèvres are the property of the French Government. For years the world has known The Royal Copenhagen Potteries and in the Far East an even greater interest has been shown for centuries.

Commercially, the chief centres of production, with international importance, are the potteries of Limoges (France), Staffordshire (England), Czechoslovakia, Germany (Thuringia and Bavaria) and Japan. Copenhagen (Denmark) produces a very fine china, but this, although sold commercially, is not strictly a competitive production.

England.—Bone china, the porcelain in which bone ash is an important constituent, is made almost entirely in England, and it is claimed that it is more durable than the felspar china of the Continent of Europe.

This type of porcelain was introduced by the famous potter, Josiah Spode, of Stoke-on-Trent, in 1799. Alexandre Brogniart, director of the national factory at Sèvres, referring to this, said: "Spode produced a better porcelain than any that had yet been made in England. He endeavoured to equal the soft porcelain of Sèvres, which his paste closely resembled. He introduced, or at any rate perfected, the use of calcined bones in the body of the ware." Spode's formula has since been adopted by all the leading manufacturers throughout the five towns in North Staffordshire, and also by the Coalport, Derby, and Worcester factories.

Of the manufacturers of china in England, the greater part have their factories at Longton, one of the "five towns" mentioned above.

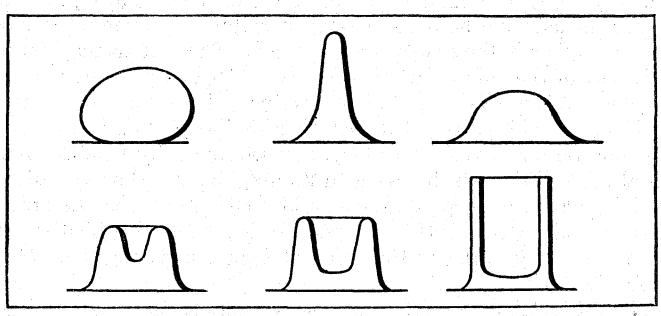
France.—There are about 42 china factories in Limoges, France, owning approximately 127 ovens, and a large export trade is done.

Czechoslovakia.—Felspar china is produced in large quantities in Czechoslovakia, in the district of Karlovy Vary, Teplice and Liberec (Reichenberg), where there are 62 factories, the largest being at Karlovy Vary. Three-quarters of the yearly output is exported. The United States is the largest customer, while England has received large quantities; but the British import duty on translucent or vitrified pottery has naturally caused a falling off in this trade. The neighbouring countries (Austria, Hungary, Rumania, Poland, etc.) take about 25% of the porcelain produced in Czechoslovakia. The conditions in the factories are somewhat different from those in England or France, boys and girls running about with bare feet. These young workers acquire great skill and carry out work that in other countries would be done by older people. A young girl in Czechoslovakia may be capable of making and fixing handles to cups at the rate of 700 per day.

Germany.—The German industry produces a large proportion of the world's domestic and industrial porcelain, but, according to a report of the industry published in 1927, only 66% to 75% of the capacity of the manufacturers is being utilized. The German potters considered various ways and means for improving trade, and co-operative advertising, standardization of patterns and grades, and price fixing agreements were suggestions put forward. All of these have been adopted by various industries in many countries; in the pottery industry standardization finds great favour in the United States. The export trade of Germany showed a decrease in 1926. Home consumption, too, decreased, being only 34% of the production, as compared with 44% in 1925.

Japan.—Some of the ware of Japan has a world-wide reputation and is distinctly oriental in its decoration; but the Japanese are rapidly copying Western methods, and the decorations of their commercial products are often distinguished from the wares of European countries only with difficulty. They have realized that in order to sell in another country, they must decorate their ware to appeal to the "taste" of the potential buyers. America is the best customer of Japan for porcelain, and is reported to take more than one-third of the total exports.

The centre of the Japanese porcelain industry is at Nagoya. Although modern machinery is employed, the decoration is largely done in the homes of the people. There are also some small crude establishments where china is made, although it is difficult to apply the term "crude" to any pottery establishment, for to the modern eye a factory producing a good ware may only appear to



FROM BINN, "POTTERS' CRAFT" (VAN NOSTRAND)

PROGRESS OF A BALL OF CLAY ON THE POTTER'S WHEEL

be crudely designed and arranged. The cheaper types of china are made in the Nagoya district, but the Imari porcelain (a high-class product) is produced at Arita.

Toy tea sets and dolls are important items in the Japanese porcelain trade, and the annual production of these wares has an average value of £130,000. Porcelain insulators are also exported in large quantities, and many users of wireless materials will probably have handled this particular ware.

Japan imports considerable quantities of raw materials, but maintains an export trade in spite of this handicap. Cheap labour is said to be the principal contributing factor, particularly in sustaining exports of copies of European designs; but the ware of native characteristics makes an appeal to Western people apart from the price, and is in no sense competitive.

RAW MATERIALS

The raw materials needed for the manufacture of china are china clay or kaolin, china stone, bone and felspar.

China Clay.—This mineral is found in many parts of the world. China clay is said to have resulted from the decomposition of granite through many centuries. Its main constituents are silica and alumina, and may be described generally as a white, amorphous powder. The clay is not usually mined in the ordinary way, but is washed down from the sides of the mine by huge jets of water thrown down out of hose pipes at a high pressure. The water brings down the fine clay to the bottom of the mine, where any sand is allowed to settle out. The watery mixture of clay is then pumped up to the ground level, and run through a series of troughs, known as "micas," where it undergoes a process of levigation. It is the china clay that gives plasticity to the mixture of materials used by the potter.

China Stone.—This is an important ingredient in the china "body," and it is mined by inserting explosive charges in holes drilled by compressed air boring machines.

The stone has four recognized qualities or grades: hard purple (a white, hard rock with a purple tinge); mild purple (similar but softer); dry white or soft (a soft white rock); buff (similar to dry white, but with a slight yellow tinge).

Silica is the principal constituent, amounting to over 80% in the two purple and the buff varieties, and about 74% in the dry white. Alumina is the next important ingredient, amounting to about 18% in the dry white and from 7 to 10% in the other varieties. The most effective constituents are the alkalies and lime which make up the balance of the composition. China stone gives the china "body" its translucency owing to its felspar content. Its function, hence, is that of a flux.

Bone Ash.—This, as already stated, is used in the English china industry, where the "bone china" is almost exclusively produced. Animal bones are used and, owing to its vast business of cattle rearing and slaughtering, South America is the chief source of supply. The bones are calcined and ground to a fine powder.

Felspars.—The felspars are silica compounds of alumina and alkalis (chiefly potash and soda), with small proportions of iron oxide, lime and magnesia. Norway is the principal source of supply, producing about 40,000 tons per year, but large quantities are found in Czechoslovakia, whose annual production is about 30,000 tons. Canada is growing in importance as a felspar producing country, although the production fell to 26,000 tons in 1925, after reaching over 44,000 tons in 1924. The production in 1926 was a little short of that in 1925.

The Norwegian felspar is largely used in Europe. The mineral is exported both in lump and as a powder.

Czechoslovakia is also an exporter of felspar, sending out about 6,000 tons yearly, chiefly to Germany. The export trade of Canada is increasing, and is in the region of 30,000 tons a year.

MAKING THE WARE

The "Slip."—The "slip," it should be explained, is the china clay and other ingredients mixed with water to a thin consistency. Metallic impurities, which would spoil the finished ware, are removed by a series of magnets, which, in one method, are arranged in what is known as a "cascade," *i.e.*, the watery mass flows over small falls, the metallic parts being retained by the magnets and the remainder passing on. As the "slip" has to pass over a series of small falls in cascade fashion, any pieces of metal are certain to be extracted. (Prior to this process the various ingredients have been weighed and mixed in an agitator known as a "blunger.")

The "slip" is, of course, too thin in consistency for moulding into ware, and must be made into a firm and plastic condition. This is done in a filter press, an appliance used in many trades. Briefly, this consists of a number of cloth bags in square frames, which are screwed together horizontally, the whole resembling a

"square" loaf, cut into slices, but retaining the shape of the loaf. By pressure, the surplus water is removed and the clay, now in flat slabs, is rolled up and passed on to the "pug mill." This piece of machinery may be likened to the domestic mincer or meat grinder. Blades, revolving in a manner popularly known as the "spiral," knead the clay and force it through a circular opening, from which it emerges as a huge "sausage."

In the pottery industry, as in all other artistic crafts, mechanical means cannot effectively replace the dexterity of man or woman. The "pug mill," *e.g.*, is an admirable method for kneading the clay, but it cannot do it so effectively as an experienced pottery worker. Such a man would cut a lump of clay into two pieces and bang one on to the other, a process which he repeats many times. Obviously this is a slower and more expensive method, and cannot be used for the cheaper types of ware.

Throwing.—The clay is now ready for making into the ware. Everyone has heard of the potter's wheel, but many have probably not seen one or have an incorrect impression of this simple appliance, which plays such an important part in the making of some delightful pieces of pottery. It is not a wheel, as generally understood, but a circular, horizontal disc, which revolves at the will of the thrower. A ball of clay is thrown on to the "wheel," and then the "thrower," after getting it into the condition of plasticity he considers most correct, deftly transforms the ball of clay into whatever shape he is proposing to make, by pressing it with his fingers as the "wheel" revolves. In this way a symmetrical form is obtained. The art of the potter is infinite, and it is little wonder that his skill in transforming an ugly ball of clay into a bowl or vase of beautiful contour has moved poets to acclaim his craft.

For domestic articles, such as cups, the thrower may be aided by a mould, which is made of plaster of paris. The inside of the mould will correspond to the shape of the outside of the cup. It is a simple matter—to the experienced thrower—to press the clay into the mould until the desired thickness is obtained. The plaster of paris absorbs some of the moisture in the clay, which, besides contracting, becomes correspondingly harder, and therefore much more easily handled by the potter. The cup is then passed on to a man who turns (or trims) it on a lathe. The cup, of course, is not complete without a handle, which could not be thrown on the wheel. It is therefore "cast," the clay taking the shape of a plaster of paris mould. After trimming, the handle is affixed to the cup by dipping the ends in some "slip." When joining together two pieces of clay, it is important to ensure, as far as possible, that the percentage of moisture is approximately the same in each, for if one is drier than the other, unequal contraction will take place, with the result that the two will part company. This is one of the many contingencies that the potter has to guard against, and it will readily be seen that a large amount of skill and experience is necessary for the production of good pottery.

Turning.—This important operation in the manufacture of pottery has been mentioned above. It will be obvious that the products from the thrower's hands will need trimming if a smooth finish is required. Some potters, particularly those known as "artist potters," who, however, usually work with coarser "bodies" (heavier types of clay), like to leave the marks of the thrower's hands, just as some take a pride in the hammer marks on hand-wrought silver ware. In commercial production, particularly if moulds are used, as mentioned in the previous paragraph, a little trimming is necessary. When the ware is moulded, a process that will be described later, turning will be an essential operation.

It must be remembered that the clay, when it reaches the lathe, is becoming harder; at this stage it is known as "green hard," a condition which has been likened to hard cheese, while another description is "leather hard." In such a condition the cup or other article can be shaved or trimmed on a lathe just as a piece of wood can. Any unevenness can be removed, while, if a "foot" for the ware is required, this can be formed by the turner. An additional advantage of the lathe is the speed with which the ware may be "embossed" with decorations, such as beads, etc. While the ware revolves, the turner presses against it a little wheel, which has the decoration engraved upon it, in reverse.

The lathe used for this work resembles in many respects the machine used for wood or metal turning. The principal difference is the method of holding the article to be turned. In the pottery industry, the ware is placed in a "chum," a hollow drum that grips the piece at about half its length. When the exposed half has been finished, the ware is reversed and the process continued.

In the case of cups, and other ware requiring handles, it will be obvious that the turning must be done before the handle is applied.

Jolleying.—Although the methods of the early potter have remained almost unaltered in many respects, the large output of the modern factories makes it necessary to provide a means whereby a more rapid production of ware can be maintained. The "jolley" takes the place, to some extent, of the thrower; but man's skill is still needed to ensure the output of good pottery. Again, we have a small revolving disk, and on this a mould of the exterior of the article to be made is placed. Into this a slab or "bat" of clay is thrown. The mould forms one side of the piece of ware (the exterior), and the interior is shaped by a "profile" which is brought down by a lever and cuts away the clay to the desired thickness, the mould on the platform being revolved during the process.

For flat ware, such as plates and saucers, the procedure is slightly different. Such pieces are made upside down, the bottom of the plate, or saucer, being uppermost. The mould in this case will furnish the shape of the interior or top of the ware, while the profile, which is lowered on to the revolving slab of clay by the lever, will form the underside.

When the piece of ware has been fashioned on this machine, it is taken, still on the mould, to a drying chamber. Here the clay contracts and the saucer, or whatever it may be, is lifted away and passed on for finishing. This means the trimming of the edges, and smoothing with a flannel and fine sandpaper. It it should be a cup, a handle has, of course, to be applied.

Pressing.—This process consists of placing soft clay, which has been beaten out to the required thickness, into plaster of paris moulds, which may form one half of the ware. When the halves have been made they are brought together to form the whole, the joints being finished off. After sufficient water has evaporated, the ware can be removed, and handles, knobs, feet, or any other parts which have been fashioned in a like manner, are then attached.

Casting.—Many will have a passing acquaintance with this process, for the method of casting metals is well known; in the pottery industry the "slip" takes the place of the molten metal. The "slip" is poured into plaster of paris moulds, which absorb some of the moisture, leaving a layer of clay. When the clay is of sufficient thickness, the surplus "slip" is poured away, and the mould, with its clay lining, is taken to the drying room, where the ware contracts and hardens, making it suitable for removing and finishing off as in the case of pressed ware. The moulds may form only part of the finished article, the remainder being made in other moulds. When ready, the pieces from each mould are joined together. It will be seen that casting is similar to pressing, except that the potter is able to commence with an easily handled material (the "slip") which, owing to its limpidness or low viscosity, rapidly takes the shape of the mould. The process is therefore simpler and, consequently, cheaper. It is a method which lends itself admirably to the reproduction of figures and other modelled ware.

Mould-Making.—Plaster of paris moulds have been frequently mentioned in the various processes already described, and it will be useful to interpose here a brief description of the making of these moulds, as, undoubtedly, it is an important feature in modern pottery manufacture.

Plaster of paris is made from gypsum, a naturally occurring mineral composed of calcium sulphate. Gypsum is hydrated, *i.e.*, it contains a certain amount of combined water, which can be driven off by heat. When it has been calcined an amorphous powder is left, known as partially hydrated calcium sulphate, or plaster of paris.

This material has a peculiar property in that it swells when water is added, forming an absorbent solid, which lends itself

readily to the formation of various shapes by carving, turning on the lathe, etc. Every cup, jug, or other piece of ware produced, must, of course, have had an original from which it is duplicated. The original is modelled in clay and is solid, *i.e.*, it gives the shape of the *exterior* only. From this model the plaster of Paris mould is prepared. This is a process that needs special care, for upon the mould the accuracy of all the reproductions depends. The mould may be in three parts, two halves, forming the sides, and a bottom. From this mould a duplicate of the original can be produced, and, in turn, moulds for reproductions. The number of pieces of a mould will depend upon the shape of the article to be made.

Modelling.—As stated above, every piece of ware produced must have had an original, which may vary from an ordinary teapot to a dainty shepherdess, or a group of several figures. The modeller's skill in this matter may be likened to that of the artist who paints a picture for reproduction. The modeller creates and the craftsman copies.

But the task is not ended when the modeller has finished his work; considerable skill is required to reproduce his work faithfully. When the modeller's work takes the shape of a figure in fanciful pose, many moulds have to be made, and the number may be as high as 28. Arms, legs, hands, head and many other parts have to be moulded separately and then joined to make the figure created by the modeller. As the pieces are often hollow, it will readily be seen that great care must be exercised by the man whose occupation it is to assemble the various parts, as undue pressure on the pieces would cause distortion and the spirit of the modeller's art would be lost.

A further difficulty, which affects the modeller, is that allowance must be made for contraction. The mould from his model will, of course, give a piece of ware corresponding, in its raw state, to the original; but when the reproduction has lost its moisture and has been further contracted by the firing, the figure (or whatever it may be) will be much smaller. This shrinkage may be as much as one-tenth. Obviously the modeller must keep this in mind when at work on an original.

Firing.—The processes described have led up to the first firing of the ware, when what is known as "biscuit" is produced.

The shape of a pottery oven, or kiln, will be familiar, by photographs and drawings, to many. The huge, bottle-shaped ovens are peculiar to the pottery industry. They are heated by fires placed at intervals at the base. Coal is the fuel principally employed, but electrically heated ovens have made an appearance, while oil and gas have their advocates. On the Continent and in the Far East wood often plays an important part in the firing.

As thousands of pieces of ware may be fired at one time, the arrangement in the oven needs special care. It would not, of course, be possible just to stack clay cups on top of one another; even if they kept in position, the weight on those below would, at least, cause distortion. The ware is therefore placed in "saggars," which are largely fireclay receptacles resembling big cheeses in shape. In these the "green" ware is placed, separated by ground flint, which, owing to its very high melting, or fusing point, will not affect the ware in the oven. The "saggars," when filled, are "placed" in the ovens, special care being taken to see that they are perfectly level. As a rule, hollow ware (such as cups) is placed at the top of the oven and flat ware (such as plates) at the bottom. When filled, the ovens are sealed up and the heating is commenced, continuing for about 50 to 60 hours. For the first 24 hours the firing is slow, *i.e.*, the temperature is not raised unduly, to drive out the moisture. The temperature will then be increased until it reaches about 1,300° C. A necessary precaution is to ensure that the temperature never falls back. This is part of the fireman's responsibility; he must also know when the firing is complete. He has means of testing the rate of progress of the firing, but the control of the temperature and the length of time given needs skilful judgment. Very useful pyroscopes for determining the proper heat treatment attained in an oven are employed frequently. Some are small tetrahedra, called cones, compounded from a series of ceramic mixtures. These cones are placed in the oven where they may be observed by the fireman. As a certain temperature is reached, depending somewhat on the rate of temperature increase, they bend so that the apex gradually touches the base. The finishing point of the firing may thus be indicated. These pyroscopes are called Seger cones after their inventor. Other temperature indicators are Holdcroft's thermoscopes. These are small bars supported at their ends in a horizontal position. When the critical temperature of a bar is reached it sags in the middle. The Seger cones and Holdcroft's thermoscopes are given a variety of numbers, the refractoriness of the cone or bar increasing as the numbers go up. Pyrometers, scientific instruments for measuring heat, may be employed instead of the pyroscopes. When the firing is complete the oven is allowed to cool; this takes about the same time as the firing—50 to 60 hours.

The biscuit ware, when it leaves the oven, must be translucent, and it is the aim of all the makers to obtain a ware with a perfect translucent body, free from blemishes.

Glazing.—When the "biscuit" ware produced by the first firing has been sorted (for the rejection of any pieces containing flaws), and cleaned, it is ready for the "dipper," the man who dips the piece into a tub of glaze. The glaze is made from a variety of ingredients which, when fused, form what might be termed "glass," for the glaze on a piece of china is really a glass. Lead is an important ingredient in many glazes and the question of lead poisoning has long been a problem in the pottery industry; but this is being overcome by the introduction of low-solubility glazes.

It may appear a simple matter to dip a cup into a tub of glaze, but here, as in most of the processes through which the ware has to pass, the skill of the worker is all important.

The ware, with its coating of glaze, has now to be fired again, when the opaque covering will be rendered translucent. The china is arranged in saggars, the round, cheese-shaped, fireclay receptacles already mentioned, but this time the saggar will be glazed inside, otherwise trouble would arise owing to absorption. The saggars are "placed" or stacked in the oven. This oven is known as the "glost" oven, and the man who stacks the saggars containing the glazed ware is called a "glost placer." Before the ware reaches the "glost placer" it passes through a drying room and is cleaned. Where there are small holes in the ware, in pepper pots, for instance, any glaze filling the openings must be entirely removed.

The saggars are arranged in the oven, as in the case of biscuit ware, but this time rolls of fireclay are placed between the saggars. This clay, by the pressure of the saggar above, effectively prevents any products of combustion from reaching the glaze, which, obviously, would be spoiled.

Decorating.—In the early days of pottery making, decoration was not as we understand it to-day—it was confined more to shapes than applied colours. Those who are familiar with the Greek urns will readily appreciate the beauty of the outlines; but in the 20th century pottery is judged more by the decorative scheme. Our modern potters do, of course, pay considerable attention to shapes; but the general public, with an appetite for colour, looks for applied decoration.

The limitations, and the great skill required by the pottery artist, are little known to the average purchaser in a retail establishment. Unlike most other decorative processes, the colours, especially if under the glaze, have to be subjected to a very high temperature for the glaze itself demands this, and therefore many pigments are unsuitable, as they would be destroyed by the heat. Metallic oxides are used, such as cobalt oxide for blue, uranium oxide for yellow, chromium oxide for green, iron oxides for reds and reddish browns.

Underglaze decoration is particularly suitable for household ware, as it is indestructible, and cannot be worn off in use. On the commoner types of domestic china the design would probably be "printed," a process which is carried out as follows. A copper plate is engraved with the design, which is filled with colour mixed with oil. The printer cleans off any surplus colour and then applies a sheet of tissue paper (which has been water sized) to the plate. The copper plate, with the paper above, is then passed through a roller press, which causes the decoration to adhere to the paper. The tissue is now pressed on to the ware, and on its removal, by

soaking in water, the decoration remains behind. The design will probably be in outline and this may be filled in by hand, an operation cleverly carried out by girls. When the decoration is complete the next step is to remove the oil, for this would interfere with the application of the glaze. To do this the ware is placed in a kiln, where it is fired at a low temperature, though a sufficiently high one to destroy the oil and leave the colour "fixed." The china is now ready for the glaze, and is finished as already described. Hand-painted work can also be done under the glaze—with a limited palette.

For overglaze decoration a much wider range of colours is possible. A flux is added so that the resulting colours are really glasses, although enamels, as they are called in the industry, is a better term, which will be readily understood if one thinks of the enamelled ware in jewellers' shops—not the air-dried enamel used by house decorators.

Many pieces of domestic ware have a gold band or a gold treatment somewhere in the decoration. This is applied in two forms: "best" gold and "liquid" gold, which is an alloy. The "best" gold comes out of the kiln in a dull condition, but can be burnished to a bright tone. The "liquid" is bright when it leaves the kiln, but it has not the beauty or the wearing qualities of the other. There is a type of decoration known as "acid gold." A design is etched on to the glaze with hydrofluoric acid, which eats away the glaze unprotected by a "resist." The etched part may be coated with "best" gold, which, after being fired, is burnished, with the result that the gold in the depressions formed by the etching remains dull, while the burnished part is bright.

The decoration particularly suitable for rapid production is that of lithography. Lithographed designs are quite common for the cheaper classes of ware, and, while they may not always appeal to the critical eye, nevertheless satisfy a large percentage of the population.

The design is made up on several stones, one for each colour. These colours are transferred to sheets of paper, so that the complete decoration is obtained on one sheet. We have now what is commonly termed a "transfer." This is applied to the ware, the design remaining after the removal of the paper. The colours are fired in the enamel kiln.

A type of decoration that has not been employed to any great extent since the 19th century is that obtained by building up flowers, in clay, petal by petal, on the ware. This calls for exceptional skill on the part of the artist.

Very fine effects are obtained with a process of decoration known as "pâte-sur-pâte." Commercially various designs are modelled in white clay and affixed to the ware.

THE USES OF CHINA

Owing to its acid and heat resisting properties china finds a special use in chemical industries. It will often be found in large industrial concerns where cleanliness is of great importance. It is even employed in grinding—porcelain balls pound materials in a cylindrical machine known as a "ball mill." Porcelain is also used for the linings of these mills.

It is a splendid material for insulating, and consequently is much used by the electrical industry. In Central Europe the bowls of tobacco pipes are composed of porcelain.

Its use in domestic ware is well known, while almost everyone possesses a dainty figure or some other piece of ornamental porcelain. (*See* also POTTERY AND PORCELAIN; EARTHENWARE.)

See Emile Bourry, *A Treatise on Ceramic Industries* (trans. from the French with some additional notes by Alfred B. Searle), giving a complete description of pottery processes; *The Manual of Practical Potting* (ed. Charles F. Binns); Rudolf Hainbach, *Pottery Decorating* (English trans. published); William Burton, *Porcelain,* describing the nature, art and manufacture of porcelain; A. Malinovzsky, *Ceramics,* a book for chemists and engineers in the pottery industry; C. F. Binns, *The Potter's Craft,* for the studio potters, schools, etc.; Chas. J. Noke and H. J. Plant, *Pottery,* a small popular book by two men well known in the pottery industry; *A Text Book for Salespeople engaged in the Retail Section of the Pottery and Glass Trades,* written by an expert committee in conjunction with the Education Committee of the Pottery and Glass Trades' Benevolent Institution for the guidance of students. (G. C.)

UNITED STATES CHINAWARE

Earthenware.—The tableware made in the United States represents to a very large extent a high grade of white earthenware, also called semi-vitreous or white ware. This product is made in 60 potteries and its composition is approximately as follows: Ball clay 24%, feldspar 12, china clay or Kaolin 29, flint 35. The use of American clays has steadily replaced the imported materials. The biscuit firing is done at about 2,282° F, pyrometric cone 9, the glost firing at 2,150°, cone 5, and the decorating firing at 1,330°, cone .017. The glaze is invariably a boro-silicate of the alkalies, lime, lead and zinc. The operations are practically the same which prevail in Staffordshire (England) except that both the bisque and the glost firing are carried to a higher temperature.

The use of tunnel kilns for all three firings has become very extensive. Ivory coloured ware is produced in large quantities and this colour is obtained through the use of larger amounts of American ball clay and the introduction of yellowish firing kaolins. The tendency towards the application of vivid coloured glazes is very marked at the present time. Considerable under-glaze decoration is applied. The principal centre of the white earthenware industry is near East Liverpool, O., including potteries located just across the Ohio river, at Newell and Chester, W. Va. Within a short distance of East Liverpool factories are operating at Sebring, East Palestine, Minerva, and Carrollton, O. Formerly, a considerable quantity of white ware was produced at Trenton, N.J. But this activity has diminished to comparatively small operations.

Vitreous Ware.—The demand for non-absorbent, vitreous table ware for hotels and restaurants has stimulated the American potters to develop such a product quite obviously from the semi-vitreous type of body through the increase in fluxing material and the raising of the bisque firing temperature. Thus, the composition of a vitreous body would be as follows: Feldspar 15%, flint 38, ball clay 6, china clay or kaolin 40, whiting 1. The biscuit firing is carried to cone 11, or about 2,300° F. The resulting product shows the "stony" type of vitrification as distinguished from the "glassy" structure, possesses great toughness and mechanical strength and is translucent but markedly less so than the hard fire porcelains of continental Europe and bone china. The processes are essentially the same as practised in the earthenware manufacture except that, previous to the biscuit firing, the green flat ware is sanded, in which operation sand is shaken between the individual plates of a bung. The glaze is practically the same as that of earthenware though it is fired to a somewhat higher temperature. Under-glaze decoration is used to a large extent though largely confined to lines and plain printing. However, increased application is being made of polychrome lithographic transfer, decalcomania, as the development of the industry extends to the production of household china. Over-glaze decoration is also applied. The vitreous tableware industry is scattered and factories are located at Trenton, N.J., Syracuse, N.Y., Beaver Falls, Pa., New Castle, Pa., Wheeling and Clarksburg, W.Va., and Wellsville, O.

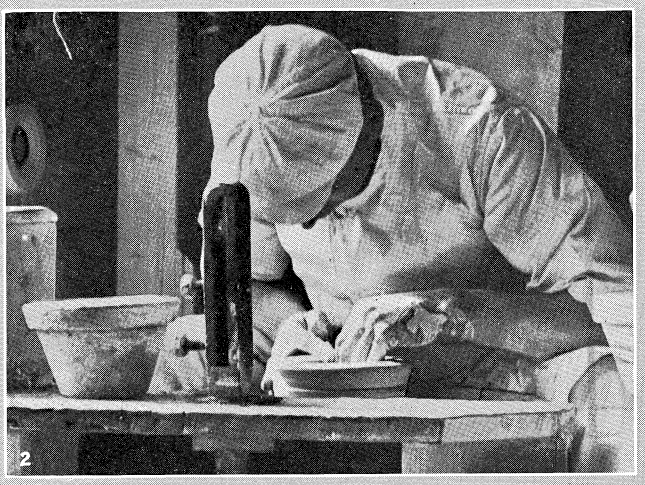
Belleek China.—There is produced in the United States a highly decorated grade of china, known as the Belleek type, which is named after a similar porcelain produced in Ireland. This product has attained an international reputation under the name of Lenox china. The porcelain is highly translucent, of an ivory colour and has a texture well suited for ornate decoration. The main flux of the body is a pre-fused, glassy mass, composed of feldspar, flint and alkalies. The body thus consists of this flux, feldspar, china and ball clay. The biscuit firing temperature is considerably below the maturing point of the other types of porcelain. The glaze is a very brilliant boro-silicate of the alkalies, lime, lead and zinc.

The principal production of this type of china is at Trenton, N.J.

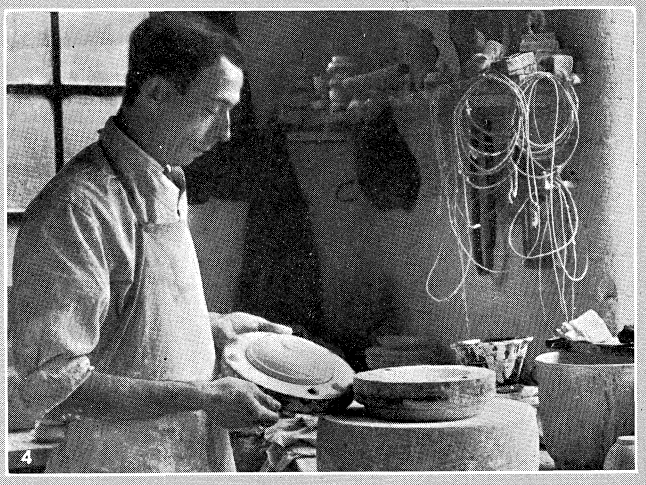
Hard Fire China.—Hard fire china, similar to the porcelains of Austria, Czechoslovakia, France and Germany, with a low temperature biscuit and high glost fire, is produced only by two factories and on a comparatively small scale. The body employed is somewhat more silicious than the typical European product,

CHINAWARE

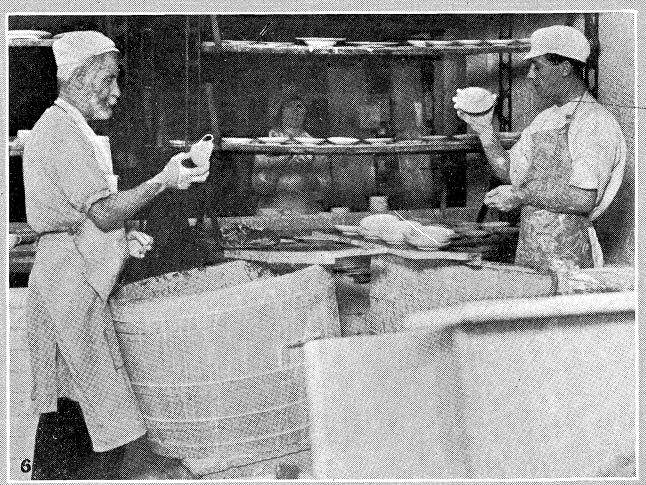

1


2


3


4


5

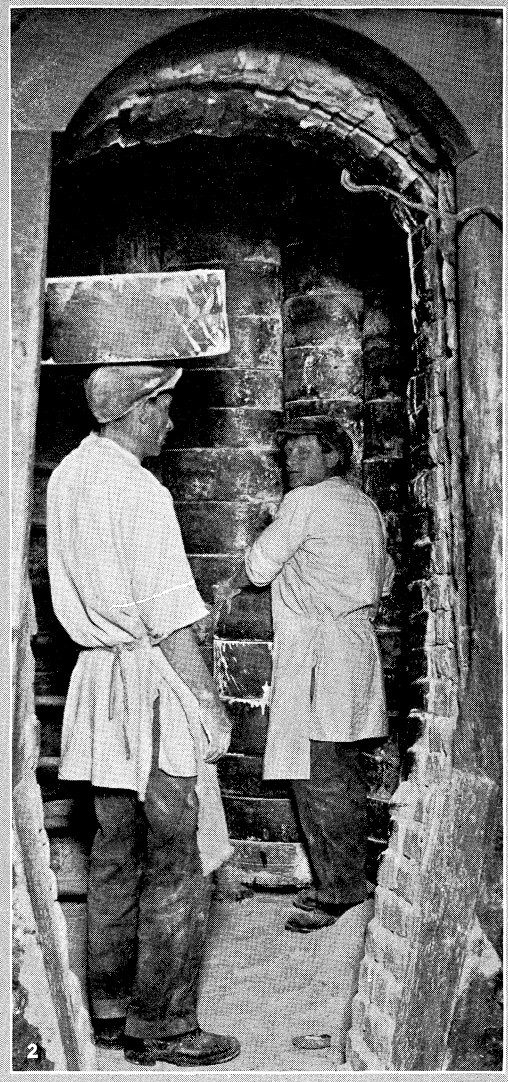

6

STAGES IN THE MANUFACTURE OF POTTERY AND CHINAWARE

1. An artist-potter transforming a lump of clay into a piece of pottery on the potter's wheel. The potter presses the soft clay into shape while the wheel revolves
2. Showing the "thrower" in a factory pressing a cup into shape in a plaster-of Paris mould, a process that requires considerable skill. The handle of the cup is made separately and put on afterwards
3. Fashioning a saucer in the "jolly." Clay has been thrown on the mould, which is on a revolving platform, and the operator is bringing down a lever to which is attached a tool which shapes the underside of the saucer
4. A workman showing a plaster-of-Paris mould for a saucer into which is poured the "slip," a thin mixture of clay and other ingredients with water. When the mixture is solid the saucer is ready for lathe finishing and firing in the kiln
5. Trimming the "foot" of a plate on a lathe, which smooths off all uneven surfaces. By pressing a die against the ware as it revolves, it is possible by the same process to apply a raised decoration
6. Dipping cups and saucers into tubs of glaze, a process to which all china for domestic purposes is subjected. This glaze after firing in a kiln makes an extremely hard and durable finish

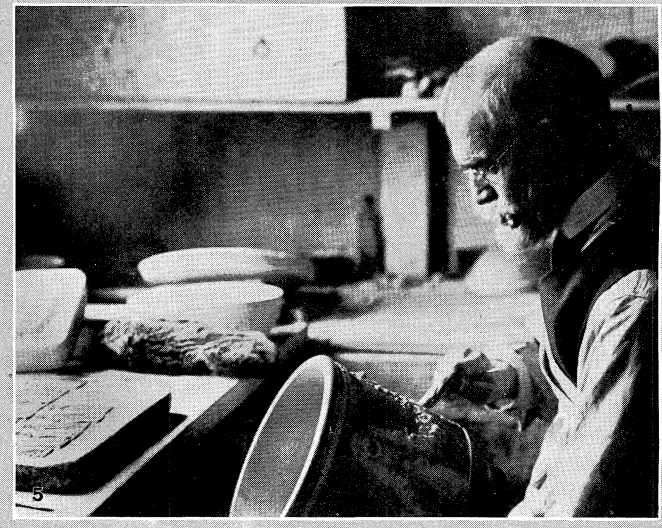
CHINAWARE











FIRING AND DECORATING CHINAWARE

1. A "sagger" in which glazed ware is being arranged for firing. The pieces are packed separately, extreme care being taken that no mark is left on the glaze. The article must touch the supports at the bottom, and it is sometimes possible to see these marks on the finished pottery
2. Oven in which the ware is fired. "Placers" are putting the saggers in place. When the oven is full the opening is closed and sealed and the fire is lighted.
3. Decorating cheaper types of ware by means of transfer. Conventional designs are printed on sheets of paper, which are cut into strips. These are pressed on to the cups. When the paper is removed the design remains and is hardened in a kiln
4. Painting designs on pottery. Often, the outline is first printed on the ware and the colour filled in by the artist. Colours used must be able to withstand the high temperature required for firing
5. Decorating ware with clay decorations. The ornamentations are first fashioned in moulds and then pressed on the ware. This process is known as *pâte-sur-pâte*

which has approximately the composition: Kaolin, 50%, feldspar, 25% and flint, 25%. The glost firing temperature is somewhat lower than that of European practice, being close to 2,410° F, or cone 12. There are indications that a considerable expansion in the production of hard fire porcelain is to be looked for in the near future. Laboratory and technical porcelain is being produced by two factories.

The subject of high fire porcelain cannot be dismissed without referring to an American development which works with exceedingly high temperatures. Through the introduction of synthetic mixtures or of natural minerals of the sillimanite group which have the general composition, $Al_2O_3SiO_2$, aluminous porcelains are produced which show remarkable mechanical strength and resistance to thermal shock. These properties are associated with the extensive development within the fired body, of a crystalline compound, mullite, which has the composition, $3Al_2O_32SiO_2$. This compound is formed in all porcelains but in these special bodies, through the deliberate exclusion of nearly all crystalline silica and its replacement by the aluminum silicate just referred to, a very large proportion of the mass consists of mullite. The porcelains are fired at temperatures between 2,650–3,000° F, cones 17 to 30. The dense crystalline structure and the low thermal expansion are responsible for the high mechanical strength and resistance to thermal shock. This type of porcelain is marketed in the form of insulators for spark plugs and other electrical purposes, laboratory and technical ware, special refractories, etc. Products of this kind have become known on the market as sillimanite porcelain.

Bone china, as made in England, is produced in the United States only in relatively small quantities, owing to the lack of the specially skilled and trained workers required in its manufacture. (A. V. B.)

CHINCHA ISLANDS, 14 or more small islands in the Pacific Ocean, about 12 mi. from the coast of Peru, to which country they belong, opposite the town of Pisco, and 106 mi. from Callao, 13° 38′ S., 76° 28′ W. The largest of the group, known as the North Island or Isla del Norte, is only four-fifths of a mile in length, and about a third in breadth. They are of granitic formation and rise from the sea in precipitous cliffs, worn into countless caves and hollows, which furnish convenient resting-places for the sea-fowl. Their highest points attain an elevation of 113 ft. The islands have yielded a few remains of the Chincha Indians. They were formerly noted for vast deposits of guano, and its export was begun by the Peruvian government in 1840. The supply, however, was exhausted in 1874. In 1853–54 the Chincha islands were the chief object in a contest known as the Guano war between President Echenique and General Castilla; and in April 1864 they were seized by the Spanish rear admiral, Pinzón, in order to bring the Peruvian government to apologize for its treatment of Spanish immigrants.

CHINCH BUG, a North American heteropterous insect (*Blissus leucopterus*) occurring in most parts of the United States, but particularly destructive to grain crops in the valleys of the Mississippi, Missouri and Ohio rivers. It is probably the most destructive native insect, and has frequently damaged crops to the extent of many million dollars in a single year. It was first noticed in North Carolina, at the close of the Revolutionary War, was first described and named by Thomas Say in 1831, and with the growth of agriculture in the Middle West, soon became a pest of the first importance.

In 1871 it damaged the wheat, oat and barley crops of Illinois, Iowa, Indiana, Nebraska, Missouri and Kansas to the estimated amount of $30,000,000.

The loss in 1887 to maize, wheat and oats was estimated at $79,000,000, and in 1934 at $56,000,000.

Originally the chinch bug fed upon wild grasses, but when the cultivation of wheat reached its native haunts it multiplied enormously. It is a small black and white insect, about $\frac{1}{6}$ in. long, and when full grown has a long-winged and a short-winged form. The adult bugs hibernate in sheltered places, usually clustering about the roots and bases of grassy plants. In the spring they lay their eggs behind the lower blades of the grain or in the ground around the plants.

The young, when hatched, are bright red in colour, and begin at once to suck the sap of the plants. They grow rather rapidly and shed their skins five times, the adult being the sixth stage. (*See* fig. 6 under HEMIPTERA.)

By the time the majority are full grown, or even before, the wheat has become too hard to suck, or harvest begins, and they are then compelled to migrate in search of food.

The cropping systems prevalent in the Middle West offer at once new sources of food.

In seasons of abundance the bugs march in throngs from the wheat to the maize. The full-grown individuals do not generally take wing, but walk along the ground. Occasionally, however, at this time they take wing and scatter. There is generally a second generation on maize, the adults appearing in the autumn and flying back to their winter quarters at the roots of wild grasses or other sheltered places.

The chinch bug is most susceptible to weather conditions, and with wet weather in the late spring and toward the end of July the young are either destroyed by the water or develop an epidemic fungous disease.

In dry weather, however, they flourish. Seasons in which they occur in great numbers are rarely consecutive. Outbreaks have lasted for two or three years, but, in the same locality, years of abundance are apt to be separated. Serious damage may be obviated by proper cropping of farms, reducing the acreage of small grains and using the land for immune crops. Resistant varieties of grains have also been found.

At the time of migration, millions may be destroyed by barriers of various kinds, including ditches, and lines of coal tar, creosote or gas tar, or creosoted paper fences.

See *Farmers' Bulletin* No. 1780, U.S. dept. of agriculture; and *Iowa Extension Circular* No. 213. (L. O. H.; X.)

CHINCHILLA, a small gray hopping rodent (*Chinchilla lanigera*), the size of a squirrel, inhabiting the eastern slopes of the Andes in Chile and Bolivia, at altitudes between 8,000 and 12,000 ft. It typifies not only the genus *Chinchilla,* but the family Chinchillidae (*see* RODENTIA). The chinchilla is about 10 in. in length, exclusive of the long tail, and in the form of its head somewhat resembles a rabbit. It is covered with a dense soft fur of a delicate French gray, darkly mottled on the upper surface and dusky white beneath, the ears being long, broad and thinly covered with hair. Chinchillas live in burrows. They associate in communities, forming their burrows among loose rocks, and coming out to feed in the early morning and towards sunset. They feed on roots and grasses, and when eating they sit on their haunches, holding their food in their fore-paws. The fur (*q.v.*) of this rodent was prized by the ancient Peruvians, and the skins are exported in numbers to the markets, where they are made into muffs, tippets and trimmings. That chinchillas have not under such circumstances become extinct is owing to their fecundity, the female producing five or six young twice a year. The Peruvian chinchilla (*C. brevicaudata*) is larger, with relatively shorter ears and tail; while still larger species constitute the genus *Lagidium,* ranging from the Andes to Patagonia, and distinguished by having four in place of five front toes, more pointed ears, and a somewhat different skull.



THE CHINCHILLA, A NATIVE OF THE SOUTH AMERICAN ANDES. ITS FUR IS EXTREMELY VALUABLE AND THE SPECIES IS NEARLY EXTINCT

(*See* also VISCACHA.)

CHINDE, a town of Portuguese East Africa and the seat of a district in the province of Zambezia, is situated at the mouth of the Chinde branch of the Zambezi river in 18° 40′ S., 36° 30′ E. Pop. (1936) was 3,894, of which some 150 were Europeans. Chinde, having superseded Quelimane, is the chief port for the Zambezi valley and the starting point for river traffic to the interior (to Tete and Sena). The harbour, which at high water has

a depth of 18 to 19 ft., has remained undeveloped, serving primarily the lower Zambezi valley where sugar, cotton, ground-nuts and sisal are grown. A slip serves the stern-wheel river steamers which connect with the steamers visiting the port and ply up and down the river to Chindio and Tete. After the completion of the railroad from Beira to Tete and British Nyasaland in 1939, it lost much of its former importance which depended largely on the shipping to the British protectorate.

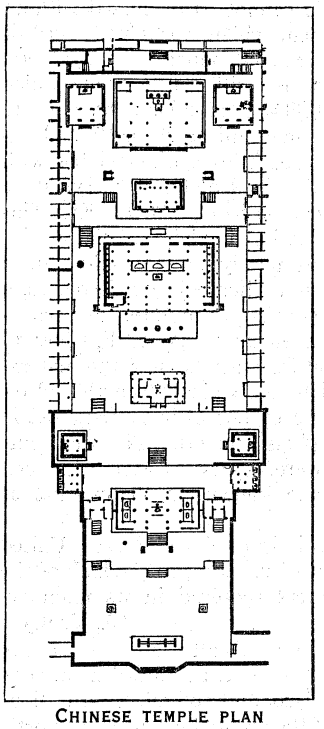
Unlike most Portuguese towns in East Africa, Chinde is a new settlement owing its origin to the discovery by D. J. Rankin in 1888 that the Chinde branch of the Zambezi was navigable from the ocean. In 1891 the British government leased a British concession of 20 ac. in order to permit storage and the entry of duty-free goods destined for Nyasaland. When, in 1923, following the opening of the Beira-Chindio in 1922, the concession ceased to exist, Chinde's commercial decline began. Previous to this the town was almost completely destroyed by a cyclone on Feb. 24, 1922, at which time more than 100 persons were killed.

The climate of Chinde is tropical and during the southern winter rather healthful; during the rainy season, which lasts from Dec. to March, it is unpleasant, particularly on account of the prevalence of malaria. Rainfall is rather heavy (about 58 in. annually), contributing to erosion, which makes the continual reconstruction of Chinde's buildings necessary. (H. A. Wf.)

CHINDWIN, river of Burma, the largest tributary of the Irrawaddy, called Ningthi by the Manipuris. It is formed by the junction of the Tanai, the Tawan and the Tarôn or Turông, but there is doubt as to which is the main stream. The Tanai rises on the Shwedaung-gyi peak of the Kumôn range, 12 m. N. of Mogaung, and flows due north until it reaches the Hukawng valley, when it turns to the west and meets the Tarôn or Turông river. The last-named flows into the Hukawng valley from the north. Its sources are in the hills to the south of Sadiya, rising from 10,000 to 11,000 ft. above sea-level. It flows in a general east to west direction as far as its junction with the Loglai. It then turns south and breaks into the Hukawng valley a few miles north of Saraw and meets the Tanai about 10 m. above Kintaw village. Below the Hukawng valley the Chindwin is interrupted at several places by falls or transverse reefs. At Haksa goods have to be transhipped from large boats to canoes. Not far below this the Uyu river comes in on the left bank at Homalin, and from this point downwards steamers ply for the greater part of the year. The Uyu flows through a well-cultivated valley, and during the rainy season it is navigable for a distance of 150 m. from its mouth by steamers of light draught. Below Kindat, the only considerable affluent of the Chindwin is the Myit-tha, which drains the Chin hills. The Chindwin rises considerably during the rains, but in March and April is so shallow in places that navigation is difficult even for small steam launches. Whirlpools, narrows and sandbanks also cause great trouble. The extreme outlets of the river are 22 m. apart, the interval forming a succession of long, low, partially populated islands. The most southerly mouth of the Chindwin is, according to tradition, an artificial channel, cut by one of the kings of Pagān. It was choked up for many centuries, until in 1824 it was opened out by an exceptional flood.

CHINDWIN, UPPER and **LOWER,** two districts in the north-west border division of Burma. Upper Chindwin has an area of 16,037 square miles. Pop. (1941), 209,575. Lower Chindwin has an area of 3,480 square miles. Pop. 427,340. For further details *see* Burma.

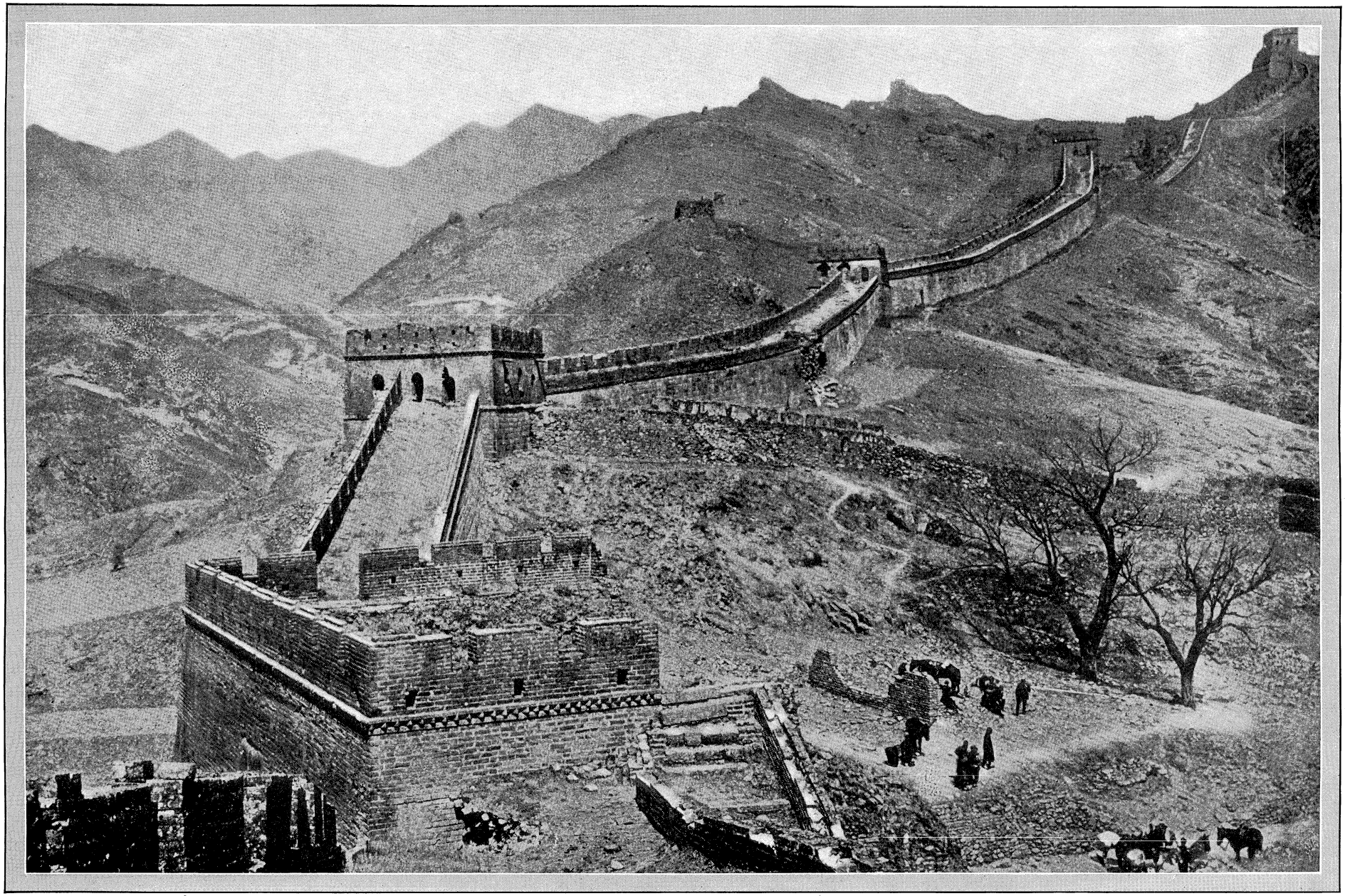
CHINESE ARCHITECTURE. The art of building in China has always been closely dependent on the intimate feeling of the Chinese people for the significance and beauty of nature. They arranged their buildings with special regard to the "spirits of earth, water and air," their ambition being not to dominate nature by their creations, as Westerners mostly do, but to co-operate with it, so as to reach a perfect harmony or order of the same kind as that which is reflected in the creations of nature. It was less the outward forms that interested them than the inner meaning, the underlying creative forces. This is most evident in the arrangement of some of the great tombs and shrines or in open-air altars dedicated to the divinities of heaven and earth. But it is also reflected in profane buildings such as the imperial palaces, which were planned and built according to sidereal or cosmological considerations. This appears even from the name used for the present and some earlier imperial palaces: Tzu Chin Ch'eng, the so-called Purple (or Violet) Forbidden City, of astronomical origin: the Heavenly Lord or Ruler Above was supposed to occupy a circumpolar constellation composed of 15 stars called the Purple Protected Enclosure, and as this was situated in the centre of the celestial world, so was the palace of the emperor, the human representative of the highest divine principle, supposed to be in the middle of the human world.



CHINESE TEMPLE PLAN
Showing the usual arrangement of placing the main buildings in a row, the one behind the other

The general arrangement and planning of the Chinese buildings have indeed very little in common with such artistic points of view as have been applied in Western architecture; they result rather from religious and philosophical ideas which have their roots in most ancient traditions. This accounts also for the uniformity, not to say monotony, of early Chinese architecture. The principles of construction have remained the same during many centuries, as have also the plans of the temples and palaces. The modifications of style which have been introduced are of comparatively small importance. It thus becomes possible to draw some conclusions from relatively late examples about the earlier buildings, which unfortunately are practically all destroyed; the wooden material has poorly withstood the ravages of fire and warfare, and the people have never made any serious efforts to protect their old buildings. It was mainly for the dead that the Chinese created more permanent abodes, and thus the tombs are the most ancient architectural monuments still existing in China. Besides these there are some cave temples hollowed out in the mountain sides and a few stone and brick pagodas of early date which will be mentioned later.

The Walls of China.—The earliest architectural monument above the soil in China is the "Great Wall," a massive fortification running along the northern and north-western frontier of the country. It was erected by the great Emperor Ch'in Shih Huang Ti shortly after he had reunited the different parts of the country into an empire (228 B.C.). No doubt minor parts of such a wall had existed before his time, but he planned his defence against the nomadic tribes on a very much larger scale than had any previous ruler. It is stated that nearly 750km. of the wall were built during his reign. Whatever truth this statement may contain, the fact remains that he laid the foundation of one of the world's grandest constructions, which, after many enlargements and restorations in the course of time, is still of great importance. The structural character of the wall is quite simple. It is built mainly of earth and stone, varies in height between 6 and 10 metres and is mostly covered by a coating of bricks. On the ridge of the wall runs a passage three or four metres wide between crenellated parapets, and at regular intervals square watchtowers rise above the ridge on which fires were lighted as soon as any danger was sighted. In spite of this uniformity, the wall is intimately connected with the landscape, rising in many parts almost like one of nature's own creations, accentuating the sharp ridges of the mountain chains and winding according to the undulations of the ground. It is the greatest and most monumental expression of the absolute faith of the Chinese in walls.

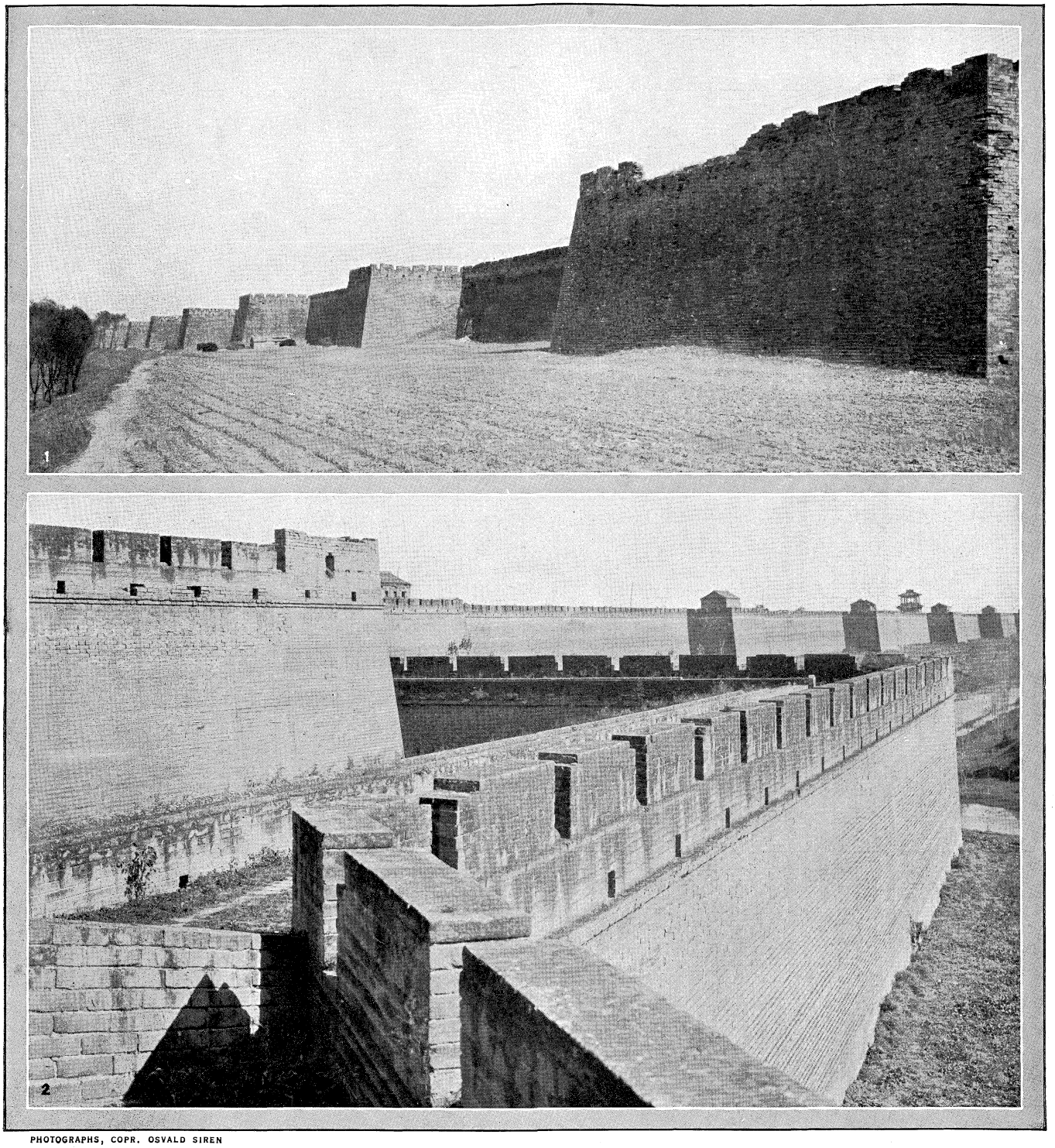


PHOTOGRAPH, COPR. OSVALD SIRÉN

THE GREAT WALL OF CHINA

The Great Wall of China at the Nank'ou pass, Chih-li; 228 B.C. It is 1,400 miles long, with square watch-towers at intervals

CHINESE ARCHITECTURE



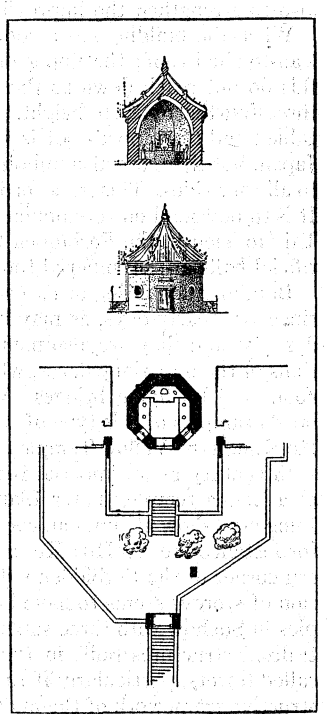
PHOTOGRAPHS, COPR. OSVALD SIREN

TWO CITY WALLS

1. Portion of the city wall of Peking; west side, outer view. It is provided with 44 bastions and coated with bricks. The battlements are beginning to crumble. It had been constantly rebuilt or repaired from the end of the 15th to the middle of the 19th century. Its two gates are the Hsi Chih men (north) and Ping Tzu men (south), connecting city and suburbs

2. Portion of the city wall and the double bastion at south gate in Si-an, Shen-si, built at the end of the 14th century, and repaired in places. It encloses an almost square city, and has double gate-towers, square bastions and round corner-towers

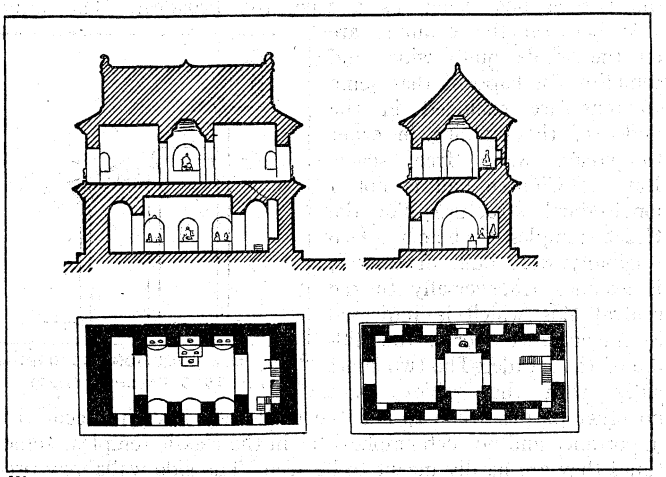
Walls, walls and yet again walls, form the framework of every Chinese city. They surround it, they divide it into lots and compounds, they mark more than any other structures the basic features of the Chinese communities. There is no real city in China without a surrounding wall, a condition which indeed is expressed by the fact that the Chinese used the same word *ch'eng* for a city and a city wall; there is no such thing as a city without a wall. It is just as inconceivable as a house without a roof. These walls belong not only to the provincial capitals or other large cities but to every community, even to small towns and villages. There is hardly a village of any age or size in northern China which has not at least a mud wall or remains of a wall around its huts and stables. No matter how poor and inconspicuous the place, however miserable the mud house, however useless the ruined temples, however dirty and ditch-like the sunken roads, the walls are still there and as a rule kept in better condition than any other building. Many a city in north-western China which has been partly demolished by wars and famine and fire and where no house is left standing and no human being lives, still retains its crenellated walls with their gates and watchtowers. These bare brick walls with bastions and towers, sometimes rising over a moat or again simply from the open level ground where the view of the far distance is unblocked by buildings, often tell more of the ancient greatness of the city than the houses or temples. Even when such city walls are not of a very early date (hardly any walls now standing are older than the Ming dynasty) they are nevertheless ancient-looking with their battered brickwork and broken battlements. Repairs and rebuildings have done little to refashion them or to change their proportions. Before the brick walls there were ramparts round a good many of the cities and towns as still may be seen at some out-of-the-way places; before the towns were built there were villages or camps of mud and straw huts surrounded by fences or ramparts of a temporary character.



YÜ HUANG MIAO ON PIAO SHAN NEAR TSINANFU

Types and Construction of Buildings.—Whether the buildings were imperial tombs, Buddhist temples or memorial shrines dedicated to great philosophers or, on the other hand, of a profane nature, such as imperial palaces, dwelling-houses or administration offices, all were arranged within walls and in closed compounds according to similar principles. Characteristic of all these extensive compounds is the clear development of a main central axis running from north to south. The principal buildings, their courts and gateways are all placed in a row, one behind the other, while the secondary buildings are arranged at the sides of the courtyards, the façades, the doors and the gates of the principal buildings all facing south, an orientation which evidently was based on religious traditions. It was not by adding to the height of the buildings but by joining more courts to the compounds that these architectural compositions could be enlarged. There are princes' palaces in Peking which have as many as 20 courtyards and some of the large temples or monasteries have a still larger number of such units. As each compound is enclosed by a high wall it is quite impossible to obtain any idea of the arrangements from the outside, and at the larger palaces the different courtyards are also divided the one from the other by secondary walls with decorative gateways. The courts vary in size and the streets follow along the walls. Through such an arrangement the inner portions of the Purple Forbidden City of Peking became almost labyrinthine.

The types of the principal buildings also remain the same, independently of their use as temples, palaces or dwelling-houses. The most common among these types is the hall, *tien, i.e.*, an oblong, rectangular room, usually divided by rows of round pillars or columns into three or more naves of which the foremost is usually



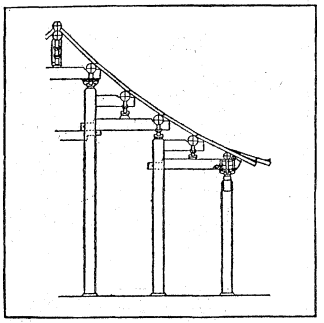
WU-LIANG TIEN, SUCHOW, A 2-STOREYED HALL WITH BARREL VAULTS

arranged as an open portico; in other cases the open colonnade is continued all around the building. The interior is, as a rule, lighted by small windows placed quite low, but exceptionally there may be a second row of windows, giving a brighter effect; these are at a higher level. Very important for the decorative effect of the buildings is the broad substructure, the terrace and the far projecting roof. When the substructure is made higher, a so-called *t'ai* is created, *i.e.*, a shorter hall or a centralized building in two storeys on a high terrace with battered walls. Such *t'ai* are often mentioned in the old descriptions of palaces and cities. They seem to have been quite common since earliest times. In the Forbidden City of Peking this type of building is beautifully developed at the outer gates as, for instance Wu Men, where the great pavilion rises on a monumental terrace. Other characteristic examples of *t'ai* are the drum and bell towers which rise in the centre of many of the old cities in northern China, but similar buildings have also been used as storehouses, watchtowers and observatories. The general name for larger, many storeyed buildings is *lou,* a name which, however, is not used for the pagodas, whereas small buildings of two or more storeys often are called *ko,* and the open small pavilions *t'ing.* Furthermore, one finds in some of the palatial compounds as well as at many private dwelling-houses, particularly where they are connected with gardens, so-called *lang, i.e.,* long open galleries which serve to connect larger buildings.

Considering the most common Chinese buildings such as the *tien,* the *t'ai* and the *t'ing* in their entirety, we may be struck by the fact that the main body of the structures appears much less than in Western buildings. It is, figuratively speaking, pushed into the background by the broad terrace and the far projecting roof which throws a broad shadow over the façade. These two elements are of the greatest importance for the general effect of the structure. The terrace may be developed in various steps and provided with marble balustrades and decorative staircases, as, for instance, at the imperial palace and many large temples, or it may be simply a stone-lined substructure with one or two steps; but it always contributes to lift the building and to form a kind of counterbalance to the projecting roof. It is, however, at the *t'ai* that the substructures become of greatest importance. They may reach a height of 10 or 12 metres and be covered by a hall or pavilion of tower-like effect.

The buildings which rise on the terraces are made of wood; their structural frame is pure carpenters' work. The walls may look massive and appear to support the roof but, practically speaking, they have no structural importance. They are simply filled with brick or clay between the supporting columns. In the larger buildings the outer wall on the façades is usually not placed in the fore-

most row of columns but this is reserved as an open gallery. In some instances the portico is double, in other cases it is reduced to a few intercolumns in the middle. The building thus consists of a nave and aisles some of which might be completely or partly divided by filled-in walls, by which various rooms are created which indeed may be quite freely increased or decreased, the middle one being, as a rule, the broadest. The intervals between the columns are on the whole quite wide, and sometimes it happens that some columns are excluded in the midst of the building in order to create more free space. But the Chinese hall is not a longitudinal structure like the Greek temples (which also originally were built of wood); it expands transversally to the central axis which is indicated by the entrance door on the middle of the façade. The two short sides with the gables serve no other purpose than to end the hall; they have no decorative importance and no such emphasis as in the classic temples; sometimes they are hardly meant to be seen. The side walls may project as a kind of ante-room to the portico or the corners may be accentuated by columns. The Chinese builders were never so particular or consistent in the placing of the columns as the classical architects. They employed a material which allowed greater freedom than the marble beams and they yielded less to purely artistic considerations than to practical wants. The beauty and strength of their architecture depend mainly on the logical clearness of the constructive framework.



ROOF CONSTRUCTION ACCORDING TO YING TSAO FA SHIH (1103)

This comparative freedom in the placing of the columns is rendered possible also by the fact that they are not supporting posts as in the classical buildings. They are not provided with capitals and they do not support the entablature, but they are tied both longitudinally and transversally by beams which may cut into, or run through, the posts. The ends of the transverse beams often project in front of the columns, and the longitudinal beams form a kind of architrave which keeps the outer colonnade together. In larger buildings of comparatively late periods brackets or cantilevers are sometimes introduced on the columns below the tie beams but the real bracketing system which serves to support the eaves of the roof is situated above these. The roof brackets are, in their simplest form, two-armed and project in the earlier buildings only from the heads of the columns; but in the later buildings they become manifolded and are placed on the beams as well as on the posts, sometimes so close together that they create the impression of a cornice. It is mainly in the modifications of the bracketing system that one may trace an evolution of Chinese architecture.

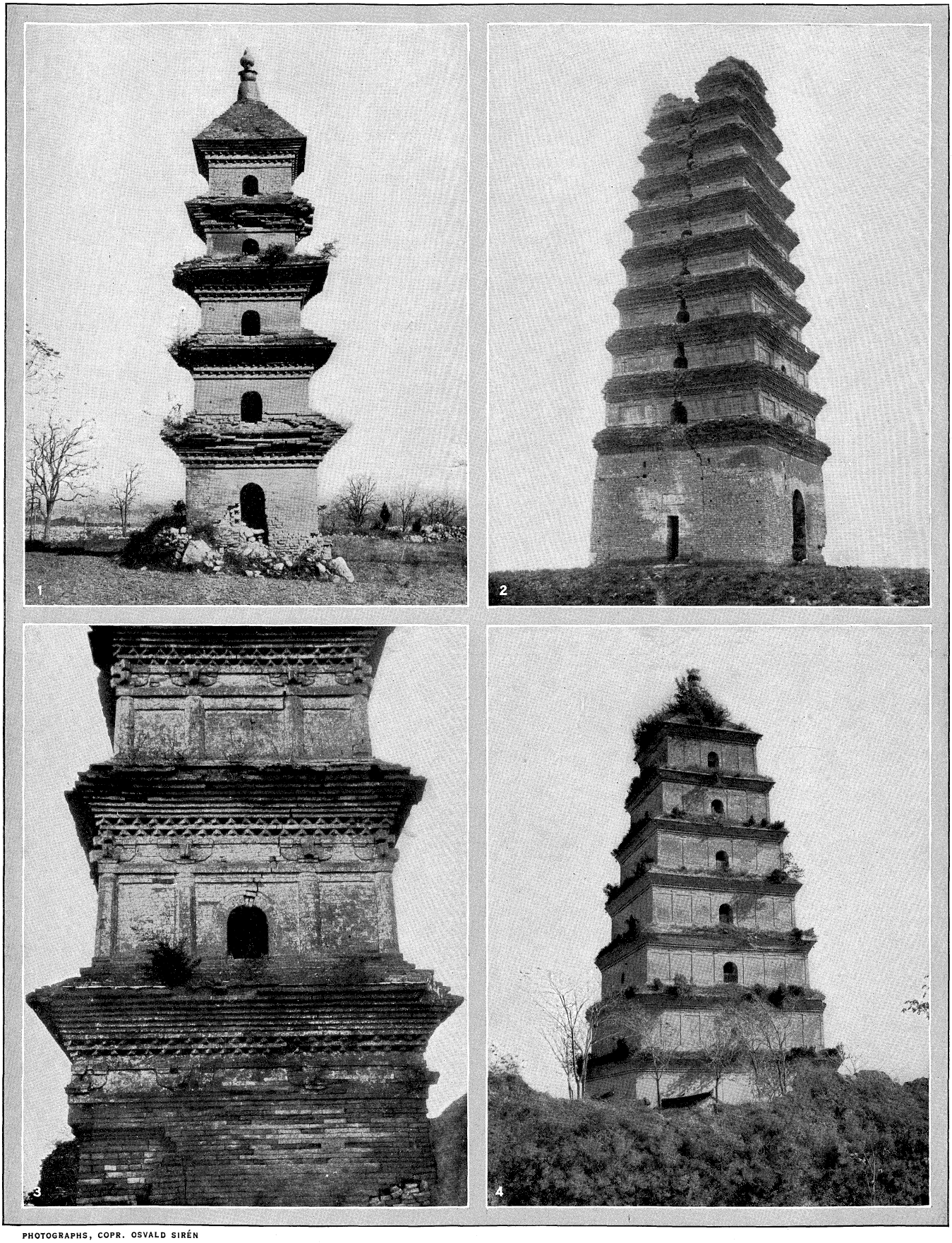
The constructive system demanded that the buildings should be developed horizontally rather than vertically. Nevertheless, many of the large halls are erected in two storeys, though the second is often nothing more than a decorative superstructure without floor or windows. The lower storey forms a kind of outer compartment to the building and is covered by a lean-to shed roof while the main span or saddle roof covers the central portion of the building which rises to a greater height. Sometimes there is a coffered or painted ceiling over this portion but more often, particularly in the temples, the trusses and beams of the roof construction are left entirely uncovered.

Roofs.—It is evident that the development of the roof on the Chinese buildings is closely connected with the placing of the entrance door. This is not to be found on the short (gable) ends of the building but in the middle of the southern façade, which usually has also a free-standing row of columns. Most of the important buildings are indeed placed so that they can be appreciated only in full-front view, and their peculiar decorative effect thus becomes dominated by the broad high-towering roof. Whatever the original reason for this particular kind of roof may have been, it was gradually more and more developed from a decorative point of view. The builders may have felt the need of modifying the impression of weight and breadth, inevitably adhering to the enormous roof masses, and this was most successfully done by curving the sides and accentuating the tension and rhythm of the rising lines. This tendency becomes perhaps more evident in minor decorative buildings such as pavilions and pagodas, not to speak of small ornamental works in clay and metal on which the roof appears almost as a crown. The common dwelling-houses in northern China have, on the contrary, much smaller and less curving roofs and, if we may judge from reproductions of earlier buildings, such as the reliefs from the Han tombs in Shantung and some small clay models dating from the Han and Wei dynasties, it seems that the curved roof was then not very far developed. In the T'ang time (7th to 9th century) the characteristic shape of the roof was, however, fully developed.

It is possible that the origin of the far projecting and strongly curved roof may be looked for in primitive thatch-covered huts of a kind similar to those which still are to be seen on the Indo-Chinese islands. If so, it would first have been introduced in southern China (where indeed the curving and projecting roof always was more strongly developed than in the north), and later on, when the whole country became more of a cultural unit, in the northern provinces. When the Chinese once had realized the fine decorative effect of these roofs, they developed them freely at the expense of the main body of the building. The larger the roofs, the stronger becomes the effect of shade under the eaves and the more they seem to be disengaged from the supporting framework and to soar in the air. In many instances the roofs crown the building rather than cover it, and their decorative ornamentation with figures and animals on the ridges and on the corner ribs serve also to strengthen the impression of a decorative superstructure.

When the building has a roof in two storeys the lower one is a lean-to shed roof; the upper one, a span-roof—but the gables of this do not reach down to the eaves: they are cut at one-half or three-fourths of their height. This peculiar combination of the gabled and the hipped-roof is very common both in China and in Japan, but there are also buildings with complete hip-roofs sloping to all four sides. This is, according to the Chinese, the finest form. It is to be found on ceremonial edifices such as the big central hall Tai Ho Tien in the Forbidden City, Peking, and some of the sacrificial halls at the imperial tombs.

Buildings consisting of two superimposed halls have been in use since very early days, as may be seen on some reliefs of the Han dynasty, and they are also mentioned in many of the old descriptions of the imperial palaces, where such buildings sometimes were connected by flying bridges. Very characteristic and well-developed examples of this type of structure are still to be seen at Yung Ho Kung (the Yellow Temple) in Peking, which was erected in the 17th century as an imperial residence but afterwards consecrated as a Llama temple. Later Llamaistic buildings (from the Ch'ien Lung era) show at times an even further development in height, as for instance the Yu Hua Ko, a temple standing at the north-western corner of the Forbidden City. In southern China the distribution of storeys seems to have been still freer; there are large temples in Suchow with three superimposed halls and other more centralized structures built in the same way, which indeed may be called towers, particularly if they are placed on terraces. The constructive framework of the main roof consists generally of various beams arranged step-wise one above the other and supporting on their ends the purlins (*q.v.*). In smaller buildings all the transversal beams may be supported by columns which increase in length towards the middle of the room, the central one reaching up to the main ridge. It is, however, more common that only the lowest or the two lower beams rest directly on pillars, while the upper ones are carried by brackets and small posts rising from the lower beams. The purlins laid on these supports are arranged rather closely, so that the rafters may be stretched in curves, the projecting ones being spliced and bent upwards. The well-developed system of brackets and cantilevers which support this projecting part of the roof will be specially discussed later because it is in this that one may follow the development and decay of Chinese archi-

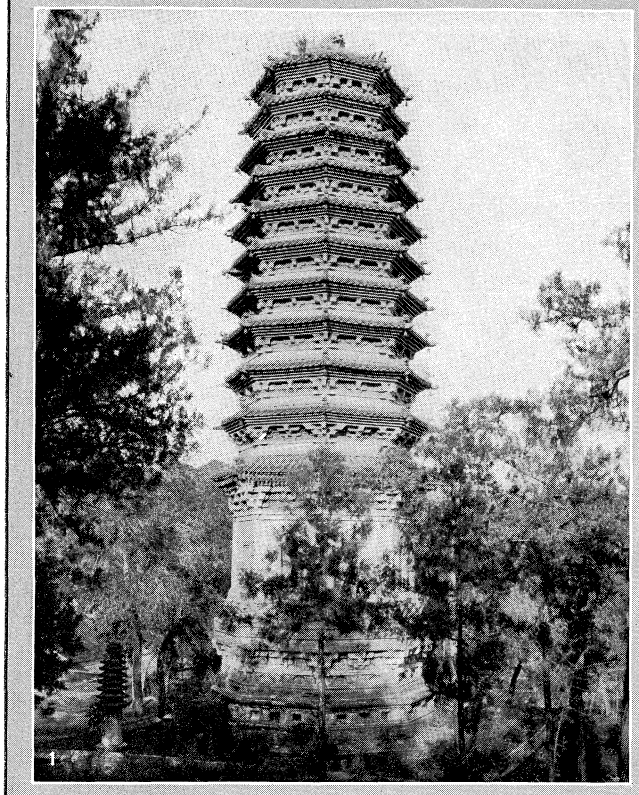


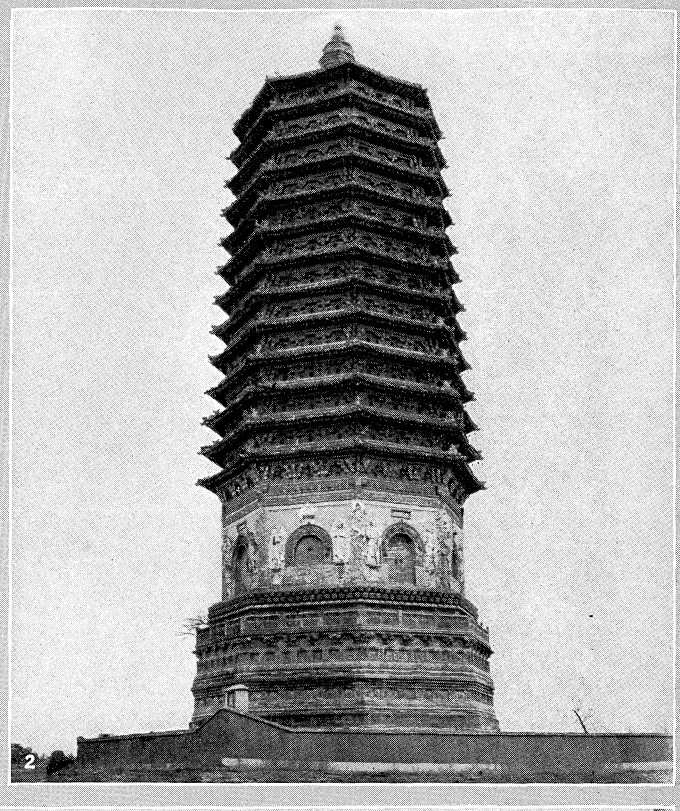
PHOTOGRAPHS, COPR. OSVALD SIRÉN

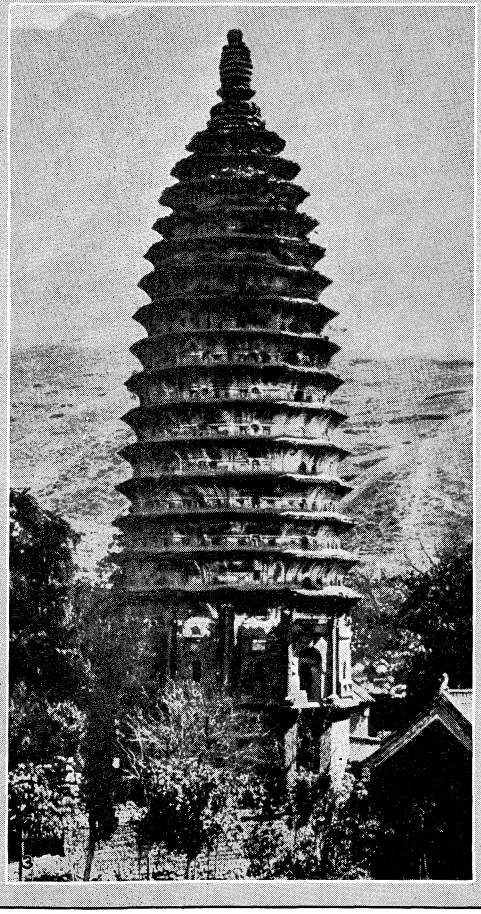
PAGODAS AT SI-AN, SHEN-SI

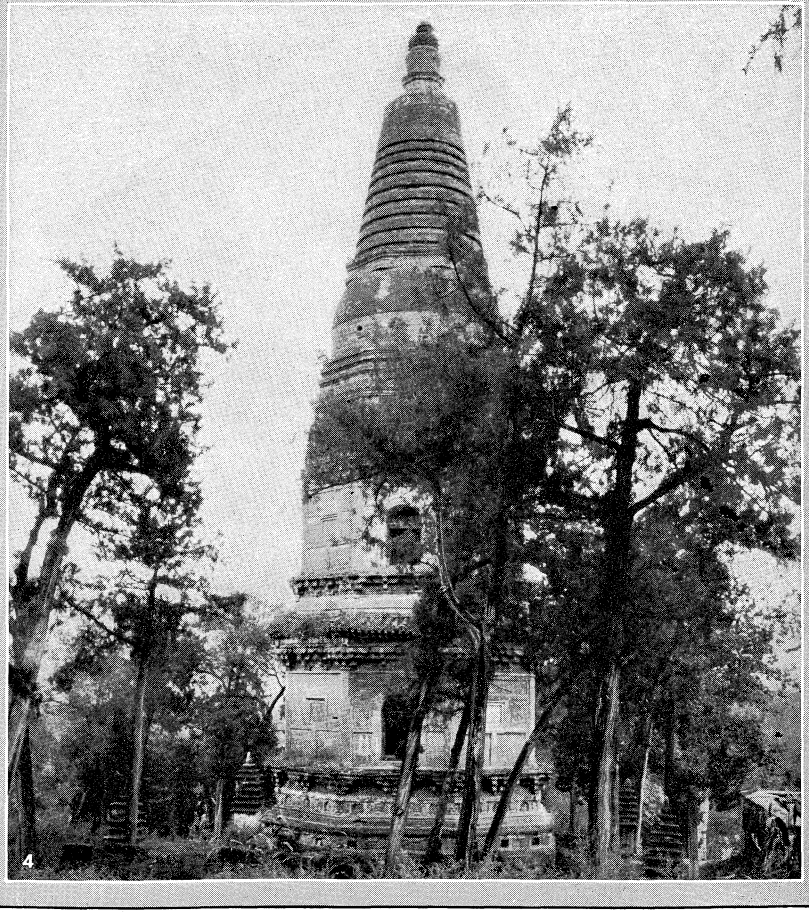
1. Pai T'a Ssu, small pagoda south of Si-an; 10th–11th centuries
2. Hsiang Chi Ssu near Si-an; erected 681
3. Portion of Hsing Chiao Ssu pagoda near Si-an; about 839
4. Ta Yen T'a, the Great Pagoda of the Wild Geese, Si-an; founded 652; partly rebuilt in the 10th century

CHINESE ARCHITECTURE









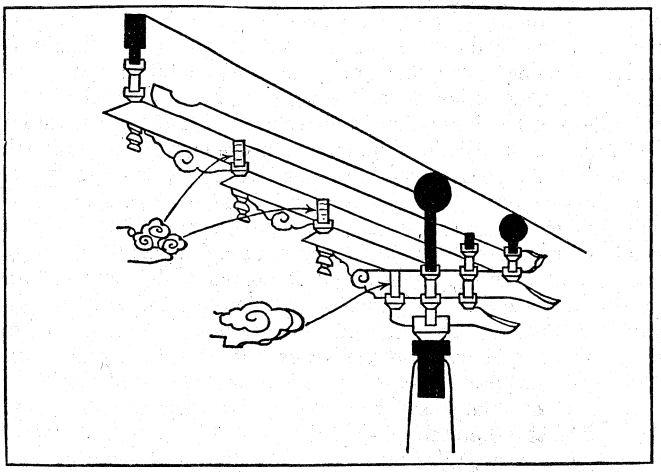
PHOTOGRAPHS, COPR. OSVALD SIRÉN

EXAMPLES OF THE CHINESE PAGODA, OR TEMPLE-TOWER

1. The Nan t'a (south tower), at Fang Shan, Chih-li; 11th century
2. The Pa Li Chuan pagoda near Peking; 13th century
3. Pagoda of Sung Yueh Ssu, at Sung Shan, Hon-an; A.D. 523
4. Pei t'a (north tower), at Fang Shan, Chih-li; 8th century

tecture.

The outer aspect of the roof is determined by the alternatively convex and concave tiles and the strongly accentuated corner ridges which curve at the ends in a kind of snout and often are provided with series of fantastic human and animal figures, called *k'uei lung tzŭ.* The main ridge-post is very high and decorated at both ends with a kind of fish-tailed owl, called *ch'ih wen,* which



BRACKETING SYSTEM FROM A PAVILION AT THE CONFUCIUS TEMPLE IN CHÜFÜ. YÜAN PERIOD

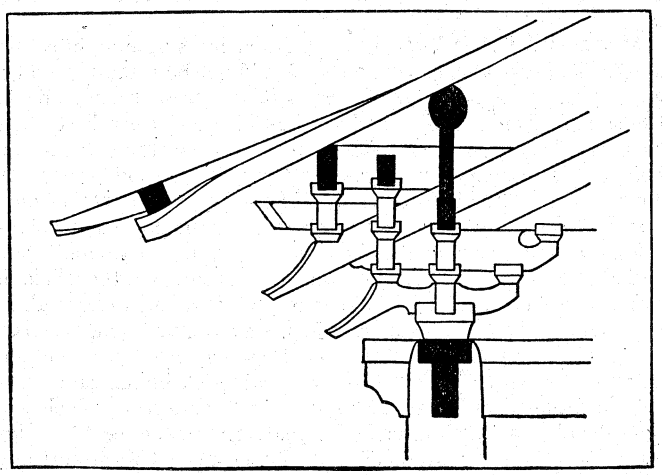
had a symbolic significance and served to protect the building against fire and other calamities. On ordinary buildings the roof tiles are of unglazed, lightly baked grey clay, but on the present imperial buildings all the roofs are laid with yellow glazed tiles, while some of the temples and smaller buildings erected for various members of the imperial family have deep-blue roof tiles. Green tiles are sometimes used on pavilions, gates and walls.

The columns as well as the filled-in walls between them have usually a warm vermilion tone which becomes most beautiful when softened by dampness and dust. The beams and the brackets below the eaves are painted with conventionalized flower ornaments in blue and green, sometimes with white contours. The door panels of more important buildings are provided with ornaments in gold, but their upper part serves as windows and is fitted only with open lattice-work. On the whole it seems as if later times had tried to gain by decorative elaboration whatever of constructive significance and beauty had been lost.

Minor Pavilions and Gateways.—Besides the longitudinal halls in right angle to the central axis, indicated by the entrance door, there are more centralized structures on a quadrangular, polygonal or round plan, *i.e.,* pavilions or towers, which may be more than two storeys high. The most primitive type of pavilion is a square hut with corner posts which carry a flat or tent-shaped roof. Such pavilions are often seen in pictures representing famous philosophers meditating on nature. Unless they are quite open the walls may be made of bamboo or basket-work. The more elaborate pavilions on a polygonal or round plan developed in connection with the Chinese garden and have been abundantly used in the imperial parks since early times. Such kiosks, tea-houses and pavilions were placed on spots with historical associations or on hills or promontories where the view was particularly beautiful. Their shape and style were developed with a view to the rockeries and the growing trees; how well they fitted into such surroundings may still be seen in the wonderful gardens around the sea palaces in Peking. These small pavilions, half hidden between the trees, clinging on the rocks or rising on stones out of the mirroring water, often give us a more vivid and immediate impression of the charm and naturalness of Chinese architecture than the larger buildings. It was also pre-eminently through such small decorative structures that Chinese architecture became known and appreciated in the 18th century in Europe.

On the larger pavilions the roofs are usually divided into two or three storeys, thus adding greatly to the picturesque effect of the building, particularly when it is erected on a polygonal plan which gives it a number of projecting corner snouts. Beautiful examples of this kind of pavilion may be seen at the "Coal Hill" in Peking as well as in Pei Hai and other imperial parks. They have no walls, simply open colonnades supporting the roof which may give the impression of hovering in the air. When the portions between the successive roofs are enlarged and provided with balconies or colonnades the pavilion becomes a real tower, such as for instance the Fo Hsiang Ko (Buddha's Perfume Tower), which rises above the lake at the Summer palace.

Related to the pavilions by their open decorative effect, yet forming an architectural group of their own, are the *p'ai lou, i.e.,* free-standing gateways with three or more openings, which span the streets in many Chinese cities or mark the entrance to some sacred precincts, such as tomb or temple areas. The object of their erection was often to commemorate some outstanding local character or some important event in the history of the place or simply to mark a spot notable for its beauty or its sacredness. The earliest *p'ai lou* were, no doubt, simply large gateways made of wood and provided with inscribed tablets. These could easily be developed into more important structures by adding at the sides more posts and gateways, and they were soon executed in stone as well as in wood. From an architectural point of view they may be divided into two principal groups: the one consisting of *p'ai lou* with very tall side posts reaching above the transversal beams (which may be covered by small roofs); the other, of *p'ai lou* with shorter side posts covered by the roofs, so that the whole gateway has more likeness to a façade or an open flat pavilion. The supporting masts, which may be 4 or 8 or 12 according to the size and importance of the structure, are placed on stone plinths, sometimes decorated with lions, and tied together not only by cross-beams in two or three horizontal rows, but also by carved or painted panels or, in the case of stone *p'ai lou,* by flat slabs decorated with reliefs. Over each one of the openings is a separate small span-roof resting on brackets and usually covered with glazed pantiles. The *p'ai lou* thus contain some of the most characteristic features of traditional Chinese architecture, viz., the supporting posts, the curving saddle-roofs on double or triple rows of brackets, and the carved or painted friezes. They are essentially wooden structures. The whole character of these buildings as well as their decoration has been developed with a view to the special requirements of the material, but that has not prevented the Chinese from

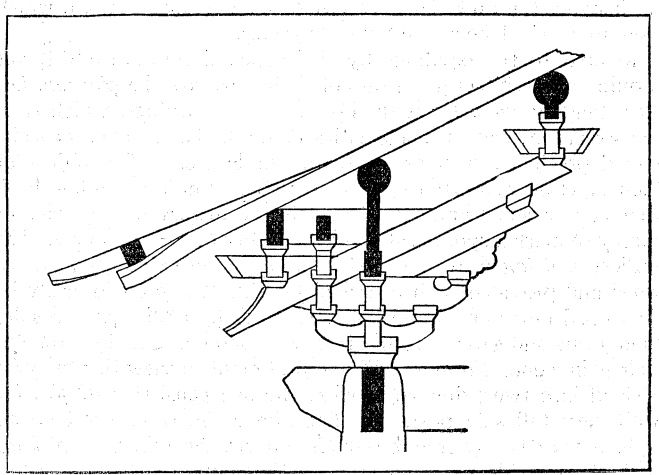


BRACKETING SYSTEM ON BELL-TOWER AT SHAO LIN SSU. YÜAN PERIOD

executing the same type of structure also in brick and in stone. The largest among them stand at the Ming tombs near Nankow and at the tombs of the Ch'ing emperors at Hsi Ling and Tung Ling, but the most elaborately decorated marble *p'ai lou* may be seen in some of the old cities in Shantung, such as Chüfu and Weihsien.

Closely connected with the *p'ai lou* are those highly decorative sham façades which used to be erected in front of important shops. They also consist of tall masts tied by cross-beams with manifold rows of brackets which support small roofs in one or two storeys.

Under these are panels decorated with human figures in relief or with brightly coloured floral designs in open-work into which the signboards of the shops are inserted. High masts or pillars are indeed much in favour in China; they are mostly used pair-wise, either free-standing in front of palaces (as the *hua piao*) or at the gateways of the dwelling compounds. Another type of gateway which is quite common consists of broad pillars made of masonry



BRACKETING SYSTEM FROM THE CH'U TZU AN, SHAO LIN SSU. SUNG STYLE

and coated with glazed tiles, often with ornaments in various colours. When a span-roof connects the deep pillars a kind of small gatehouse may be created.

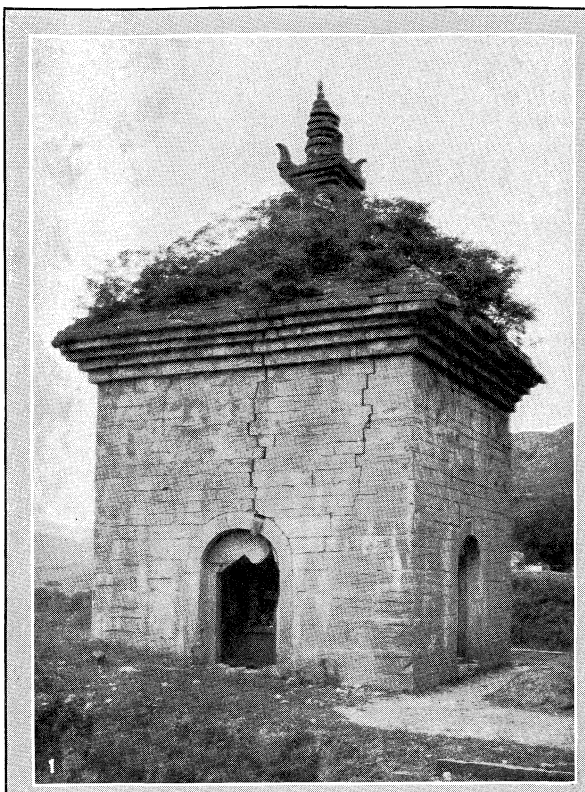
Of considerable importance also for the outward effect of the Chinese buildings are the balustrades which line the terraces and staircases in front of the buildings. They are in northern China mostly made of white marble and composed of square posts ending in sculptured finials between which ornamented panels and moulded railings are inserted. Such marble balustrades may be seen at most of the important temples and, in their richest development, on the terraces of the Three Great Halls (San Ta T'ien) in the Forbidden City in Peking. Here they are repeated in three different tiers and broken in many angles, according to the shape of the terraces, producing a splendid decorative effect, particularly as the white marble stands out in contrast to the red colour of the buildings.

Stone and Brick Buildings.—Although Chinese architecture is principally wood construction, it should not be forgotten that a great number of stone and brick buildings have been made in China, including bridges, for which the Chinese since earliest times have used brick and stone. The great majority of the still existing buildings in masonry are of comparatively late periods; very few indeed can be dated before the Wan Li era (1573–1619). The only important exceptions to this general rule are the pagodas made of brick and mud, several of which may be ascribed to the T'ang period (618–907) and a few to even earlier times. On the whole, it seems, however, that the Chinese regarded brick and stone work as material fitted for storehouses, walls, substructures and the like, but hardly for real architecture in the same sense as wood construction. It is a characteristic fact that brick buildings are not even mentioned in the standard work on architecture which was published by imperial order in the year 1103 under the title *Ying Tsao Fa Shih* (The Method of Architecture). This beautifully illustrated work in eight volumes (which has been issued in a modern reprint) is founded on the practical experience of architects and decorators, which the author, Li Chieh, collected from various sources. It gives everything that an educated Chinese towards the end of the Sung period considered the fundamentals of architecture. No stone or brick houses are mentioned, not even columns, door-frames or floors of stone. The only stoneworks particularly described are the plinths and corner pilasters, stairs, balustrades, dragon heads on staircases, thresholds and stones for the door-posts, besides canals, sluices, platforms, terraces, etc. The measures and instructions for the execution of all these various kinds of stonework are very accurate, but they are of no great importance for the architectural style. The constructive methods are treated only in the third part of the book, which contains "Rules for large work in wood," *i.e.*, framework of buildings, posts, trusses, rafters, etc. Then follows a chapter called "Rules for smaller works in wood," *i.e.*, doors, windows, partition walls, coffered ceilings, screens, cornices, gutters, staircases, door-panels, balustrades, besides Buddhist and Taoist house shrines, or *Fa yüeh*, decorative gate-façades erected in front of important houses, etc. Then follow "Rules for works in carved wood," concerning decorative details, and at the end of the book, "Rules for exterior roofing," also concerning the ornamental figures on the roofs, etc. The author devotes some paragraphs to bricks and to roof tiles but he gives no rules for construction in such materials.

Turning to the existing monuments in China, we may notice the Ssu Men Ta, at the temple Shen Tung Ssu in Shantung, as the earliest and most important example of architectural masonry work. The building, which in spite of its name—the Four-Gate pagoda—is no tower but a one-storeyed square house (each side about 7·35 metres), was erected A.D. 534. It is coated with finely cut and fluted limestone slabs, but the interior body of the walls may be partly of mud. It has an arched entrance on each side and a cornice consisting of five corbelled tiers but no other architectural divisions. The pyramidal roof is made of corbelled stone slabs and supported by a large square centre pillar crowned by a small stūpa. The solid and self-contained aspect of the building together with its fine proportions make it one of the most remarkable of Chinese architectural monuments. It is possible that similar buildings existed in earlier times when stone and brick may have been more freely used; the type may be observed, for instance, in the more or less house-shaped tomb pillars of the Han dynasty in Szechuan and Honan.

The next in date among the masonry buildings are some real towers or pagodas of the Sui and T'ang periods which will be mentioned later; most of them are made of packed clay or dirt in combination with stone or brick. Still more common is the combination of brick and wood construction. It can be carried out in different ways, either by lining a real wooden structure with brick walls or by placing a bracketed span-roof on strong brick walls, eventually adding pillars for interior support if the walls are too wide apart. This method of construction has been used in most of the outer city gate-towers, of which the oldest now preserved are from the beginning of the Ming period, and also in numerous watchtowers and storehouses on the walls that enclose the cities of northern China. A particularly fine example is the famous bell tower at Peking, often considered as a monument of the Yuan dynasty, though it was completely renewed during the reign of Chi'en Lung. All these buildings exhibit on the outside massive brick walls more or less regularly divided by windows or by rows of square loopholes which give to the battered façades of the big gate-towers a fortress-like appearance. The shape of the high roofs is, however, the same as on ordinary wooden structures, and if one examines these masonry buildings more closely, one usually finds wooden columns inserted in the walls as well as detached in the interiors.

The substructures of the gate and bell towers are in most cases pierced by tunnels or barrel vaults serving as passages. These may be either round or somewhat pointed, as for instance on the drum tower in Peking which actually dates from the Yuan period. The vaults are constructed with great care and precision, sometimes reaching a span of nearly 15 metres. Vaulting (but not the system of voussoirs) was undoubtedly known in China in early times; it was used in the tomb chambers which were covered with bricks, in the tunnels leading to these; when heavy brick walls were erected around the cities, barrel vaults followed suit for the entrances. The step from such constructions in brick to the building of cupolas is not a very long one. We do not know exactly when cupolas first came into use, but we have reason to assume that they were well developed in the T'ang period. As an evidence of this the mosque in Hangchow may be mentioned because the farthest rooms of this building are covered by three cupolas on pendentives (*q.v.*). The mosque may have been renewed in later times but in close adherence to the original model which, of course,





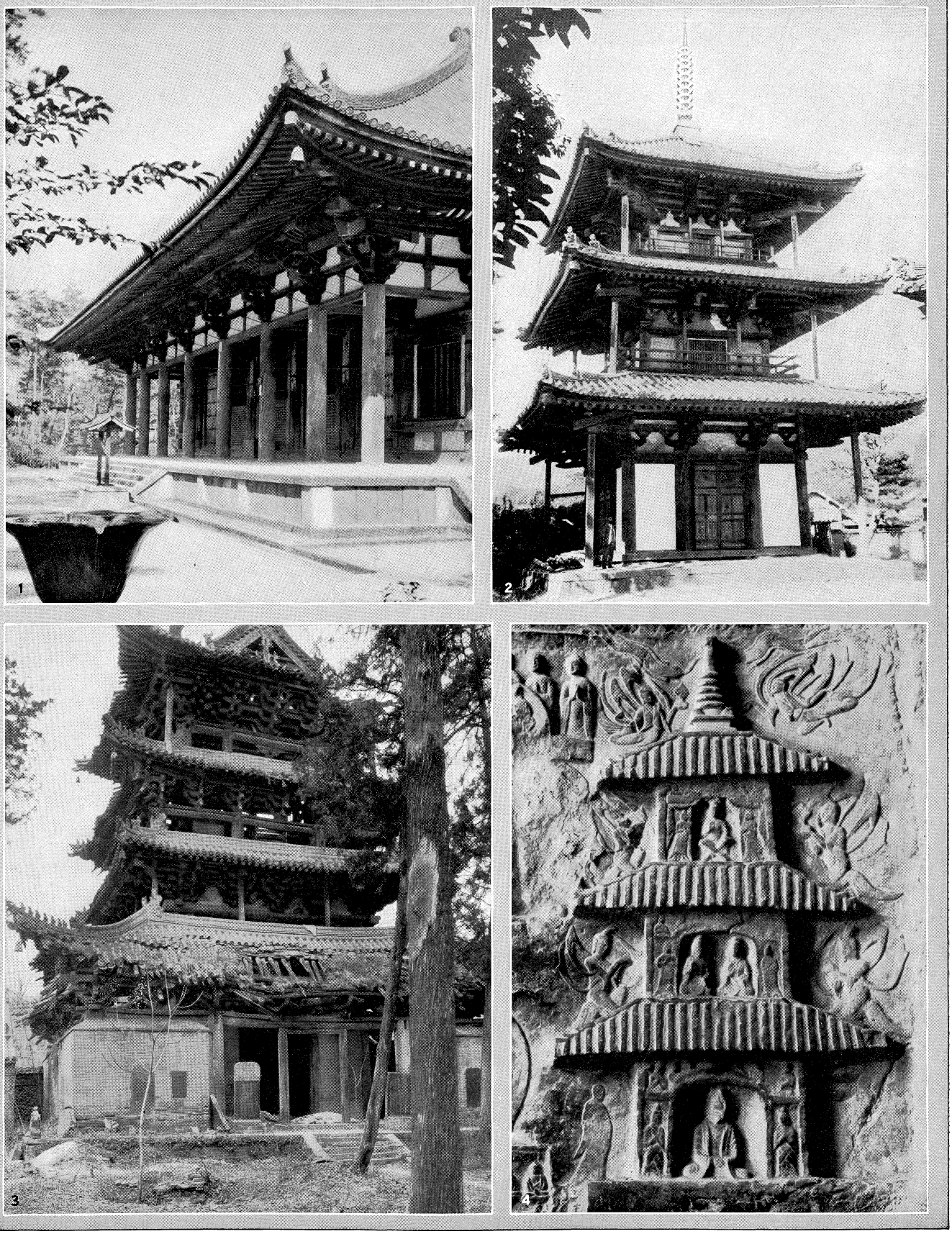


PHOTOGRAPHS, COPR. OSVALD SIREN

BUDDHIST BUILDINGS

1. Ssu Mên T'a, the Four Gate pagoda at Shen Tung Ssu, Shantung; middle of 6th century
2. Wu Liang Tien, a temple in Su-chow, Chakiang; 17th century
3. The Drum Tower in Peking; erected in 1273

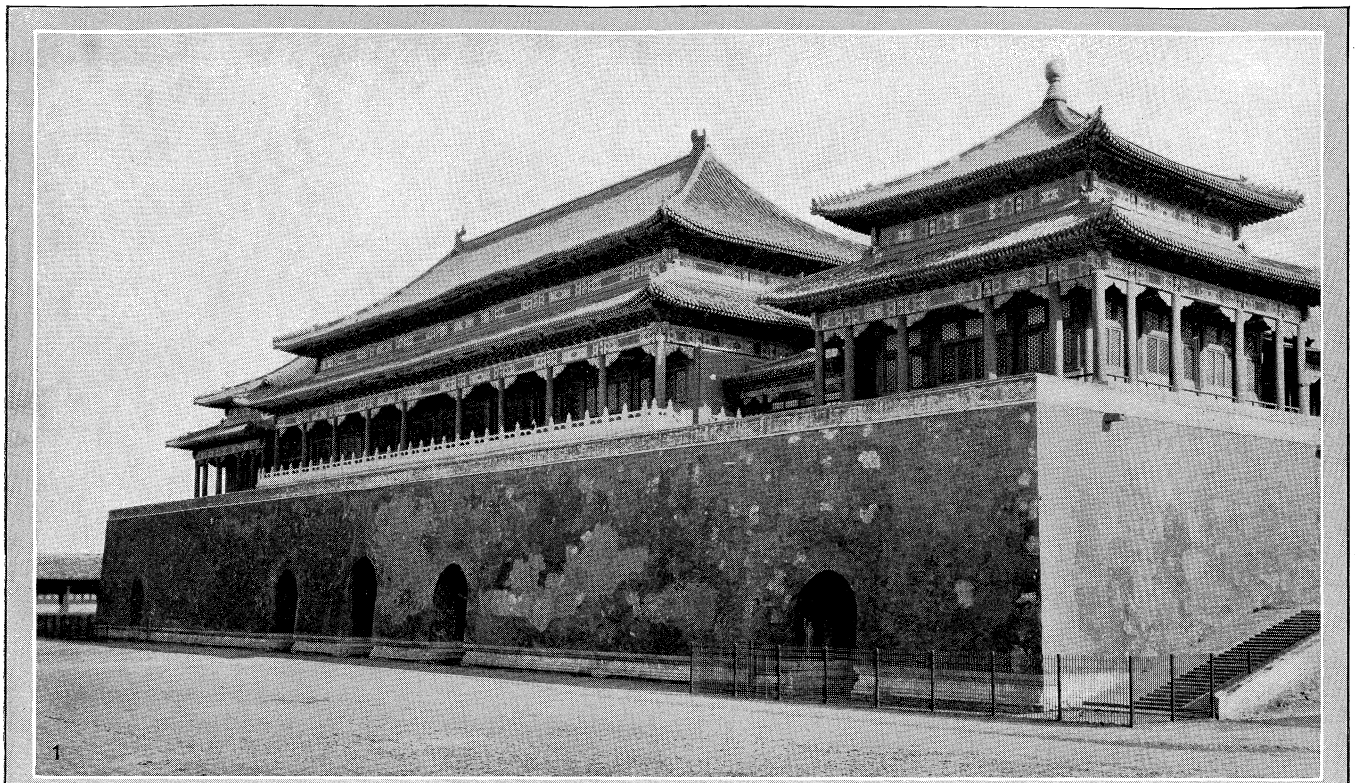
CHINESE ARCHITECTURE

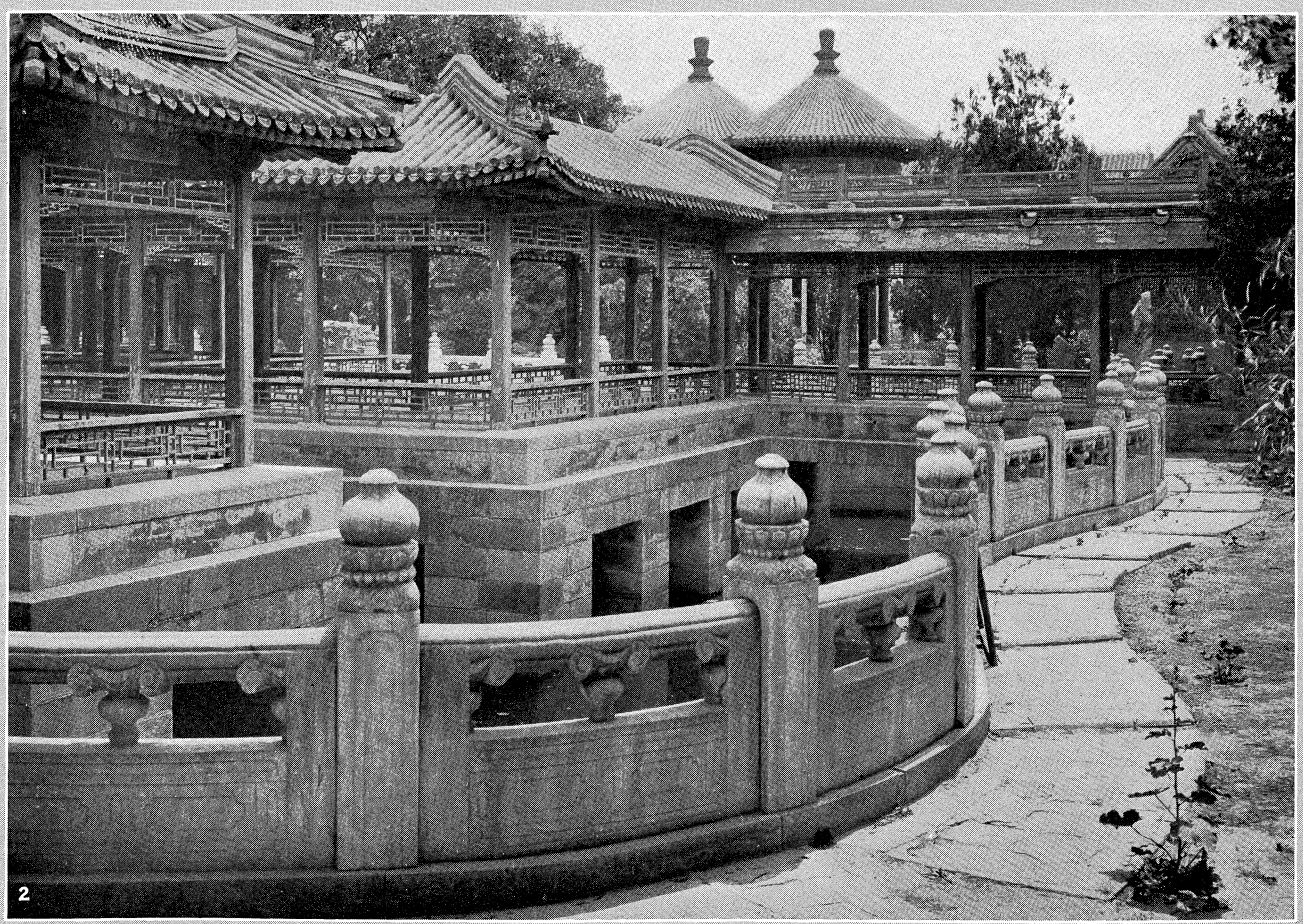


PHOTOGRAPH, COPR. OSVALD SIRÉN

THE CHINESE STYLE IN JAPAN AND CHINA

1. Kodo of Toshodajij, Nara, style of T'ang period; 8th century
2. Wooden pagoda, Hokiji, Nara, Japan; erected in 7th century
3. The Drum Tower, *c.* 1300, on Sung Shan, Hsiao Lin Ssu, Hon-an
4. Stone relief of pagoda of Northern Wei dynasty (6th century), Lung Men





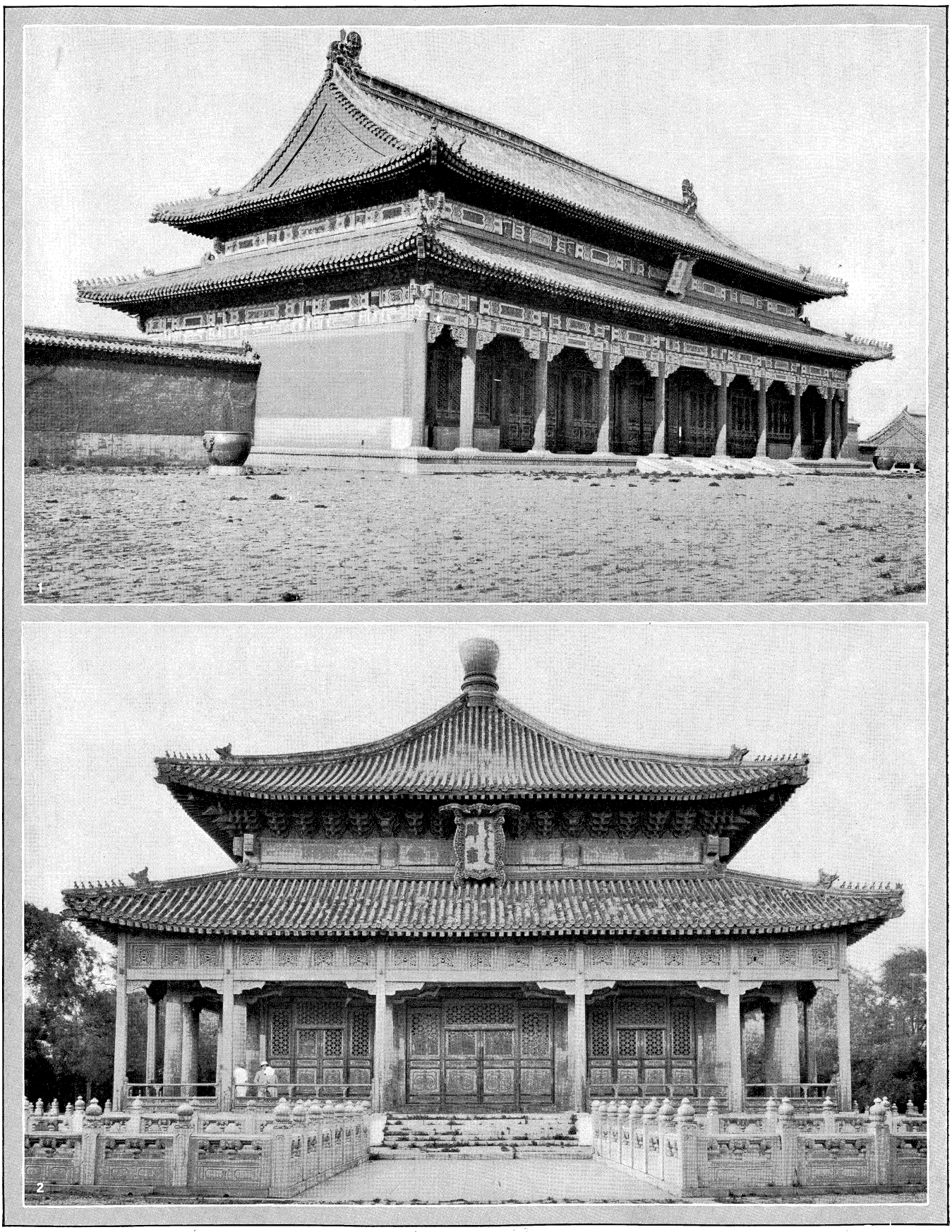
PHOTOGRAPH, COPR. OSVALD SIRÉN

A GATE AND AN OPEN GALLERY, PEKING

1. Wu Mên from the north; the main south gate of the Forbidden City, Peking; reconstructed in 1647, repaired 1801

2. Wan Tzu Lan; an open gallery along a canal in swastika form, at the Sea Palaces. It was erected in the rule of the Empress Dowager, 19th century

CHINESE ARCHITECTURE

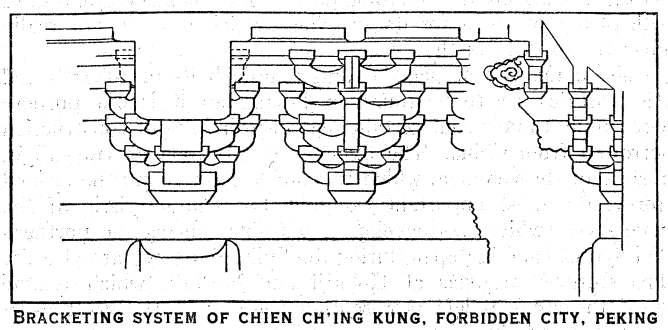


PHOTOGRAPHS, COPR. OSVALD SIRÉN

TWO HALLS IN PEKING

1. Pao Ho Tien, one of the Three Great Halls, in the Purple Forbidden City, Peking; built 1627, repaired 1765
2. The Hall of Classics, at the Confucius Temple, Peking. The upturned lines of roof corners suggest aspiration, as, in another form, the Gothic is said to do. The tent form is sometimes regarded as the possible origin of the characteristic shape of Chinese roofs

was of Persian origin. Another kind of cupola is to be found over the hall of the big bronze elephant on the Omi mountain in Szechuan erected during the reign of Wan Li (1573–1619). The transition of the square room into a round cupola is here also accomplished by means of pendentives but outwardly the building is covered by a tent-shaped roof. One of the small sanctuaries on Piao shan near Tsinanfu is an example of a more pointed cupola.



BRACKETING SYSTEM OF CHIEN CH'ING KUNG, FORBIDDEN CITY, PEKING

At the end of the Ming period buildings with classical orders in one or two storeys began to appear. Internally these were covered by longitudinal or transversal barrel vaults, but outwardly they were provided with the usual span and shed-roofs. Among the best examples of this kind of building may be mentioned the Wu Liang Tien in Suchow and Shuan Ta Ssu in Taiyuanfu, besides the two halls on Wu Tai Shan. The façades are divided by arches and columns, but these are partly inserted in the wall and the capitals are stunted or turned into cantilevers, the entablature reduced to an architrave, the cornice replaced by rows of brackets above which the upturned eaves project in the usual manner. This combination of classical orders and Chinese brackets is indeed characteristic evidence of how foreign the principles of Greek architecture always remained to the Chinese. Such buildings may have been inspired by Indian models, but the Chinese modified them quite freely by grafting on the pseudo-classical models elements inherited from their indigenous wooden architecture.

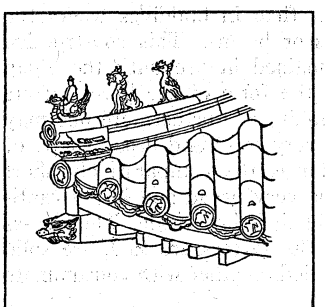
An entirely different type of masonry work is illustrated by the buildings made after Tibetan models mostly as late as in Ch'ien Lung's reign. The towers and sham fortresses on the slopes of the Western hills in Peking, which were erected in order to give the Chinese soldiers an opportunity to practise assaults, are well known by all tourists. Still larger and more important Tibetan buildings may be seen at Jehol, the famous summer resort of the Manchu emperors in northern Chihli, where an entire Llama cloister was erected after the model of the famous Potala in Lassa, the residence of the Tibetan pope-kings. This enormous brick façade in some nine or ten storeys must in its absolute bareness have appeared quite dreary to the Chinese. They have tried to give it some life or colour by surrounding the windows with pilasters and canopies made of glazed tiles, but the sombre and solid character still dominates, giving evidence of a foreign culture transplanted into Chinese surroundings.

Historical Development.—Buddhist temples and pagodas have existed in China since the end of the Han dynasty, and though the earliest ones are no longer preserved, we may obtain some idea about them from old reproductions and contemporary Japanese buildings made after Chinese models. The first messages of the new religion were brought to the Chinese at the beginning of our era, but it was not until the 2nd century A.D. that it became more widely spread, largely due to the pilgrims who journeyed between China and India. They brought news not only of the writings and images of the new religion but also of its buildings. It has been reported that small bronze models of the famous stūpa of Kanishka at Peshawar (erected in the 1st century A.D.) were brought to China by Hui Sheng, a monk who took part in a mission to India in the year 518. No doubt, other pilgrims did the same, and there may have been many small models of this much admired religious monument in China. As far as one may judge by later Indian reproductions, reverting more or less directly to the famous pagoda of Kanishka, it was built on a square platform, but the main section of it seems to have been round or bottle-shaped and divided by projecting cornices into three or more storeys. Very characteristic of this pagoda was the high mast with its nine superposed metal disks and crowning lotus bud. At present there are no such pagodas preserved in China, but ancient engravings on stone give us reason to believe that they have existed.

The oldest pagoda in China still standing is at Sung Yüeh Ssu, a temple on the sacred mountain Sung Shan in Honan. According to historical records, it was built about 523, when the palace previously existing here was consecrated as a temple. The tower is made of mud and brick on an octagonal base and reaches a height of nearly 30 metres. The lowest section consists of a plain plinth above which follows a main storey divided by pilasters and windows in a kind of aedicula (*q.v.*). The upper section of the tower has the shape of a convex cone, divided by narrow cornices into 15 low, blind storeys. It is crowned by a large bud or cone with nine rings, an equivalent to the mast with the metal disks which is usually found in the wooden pagodas. The early date of the building is verified by the style of the lion reliefs and the mouldings of the main storey.

The character of the whole structure is solid and severe, at the same time the incurvation of the outline prevents any impression of rigidity.

There is no other pagoda of as early date but the type returns with some modifications in some later pagodas, as for instance, the Pei T'a (the North tower) and the Nan T'a (the South tower) at Fang Shan in Chihli. The former, which was built at the beginning of the 8th century, shows a more typically Indian style with its bottle-shaped top, part being on a terraced substructure while the latter, which was built at the beginning of the 12th century, has a stiffer appearance without any incurvation of the outline or narrowing towards the top. It is divided by bracketed cornices into 11 storeys and reveals by its form and details a closer connection with traditional Chinese constructions. To the same group of buildings belong also the pagodas at Chêngtingfu, Mu T'a (T'ien Ning Ssu) built about 1078 in nine storeys with wooden cornices, and the Ching T'a built at a somewhat later period, and furthermore the two big pagodas near Peking, known as Pa Li Chuan and T'ien Ning Ssu, which were erected during the Chin and Yüan dynasties (in the 12th and 13th centuries). They show some likeness to the Nan T'a at Fang Shan, but their dimensions are much larger and their high plinths are richly decorated with figure reliefs in baked clay. Both have 13 low blind storeys and make quite an imposing effect by their great height, but they lack the elastic incurvation which gives to the pagoda at Sung Yüeh Ssu such an harmonious character.

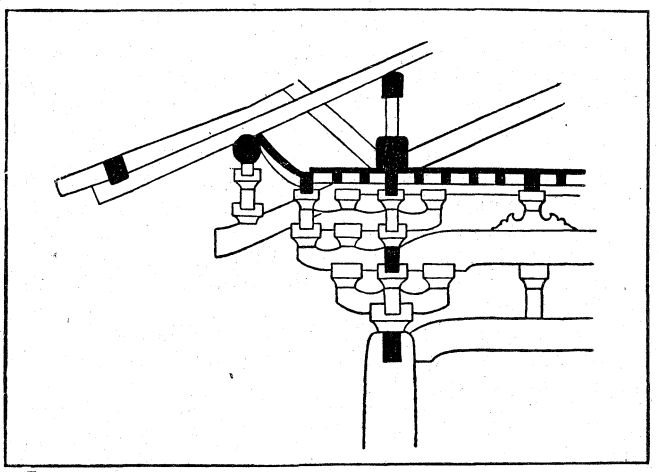


ROOF TILES ON A HALL IN THE FORBIDDEN CITY, PEKING

Many of the early pagodas in China were, no doubt, constructed of wood and have perished, because of the unresisting material. There are records of a very large wooden pagoda erected in A.D. 516 at Lo-yang at the order of the Empress Dowager Hu. According to Chinese chronicles this was 1,000ft. high (a statement which must not be taken literally but merely as a general indication of unusual height) and consisted of nine storeys. Above the tower rose a mast 100ft. high carrying 30 gilt metal discs which, as well as the chains by which the mast was tied to the four corners, were hung with no less than 500 gilt bells. This noble edifice became, however, the prey of fire in 534. The description must have been based on hearsay, but it nevertheless has some interest as testimony of the existence of wooden pagodas in China at an early date. It is also confirmed by several reproductions of pagodas found among the cave sculptures from the beginning of the 6th century at Yun Kang and Lung Men. Here one may see executed in relief pagodas with

three as well as with five storeys illustrating exactly the same architectural type as found in the earliest Japanese pagodas from the beginning of the following century. They are built on a square plan with corner posts and projecting roofs over the successive storeys and crowned by high masts carrying discs and ending in the form of large buds or small stūpas. In the successive storeys on some of these pagodas are placed Buddhist statues.

Excellent examples of the same type of pagoda may be seen at some of the old temples near Nara in Japan, as, for instance,



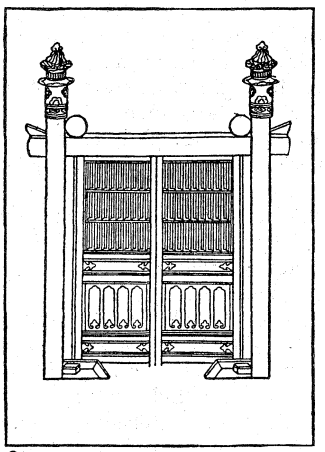
BRACKETING SYSTEM ON THE KONDO OF TOSHODAIJI. T'ANG STYLE

Horyuji and Hokkiji which were erected at the beginning of the 7th century in the Suiko period by builders from Korea or China. The pagoda at Hokkiji has five storeys; the bracketed roofs project quite far but narrow gradually towards the top so that the appearance of heaviness is avoided. Each side has four carrying posts with projecting cantilevers, which at the corners are placed diagonally and cut into the shape of clouds, a motif which is particularly characteristic of this period. The rafters are square and rather substantial; the far projection of the eaves is produced by a very clever construction which no doubt was developed in China before it was introduced in Japan, although the earliest Chinese examples no longer exist. The principle of this system consists in the redoubling of the rafters below the eaves: instead of placing the outermost purlins directly on the cantilevers, which project from the posts, supporting shorter rafters are introduced which are fastened in the beams and trusses of the roof and which carry by means of vertical struts or cushions the further projecting upper rafters. These may be made longer and the roof is lifted higher, the effect becoming lighter than in buildings where the purlins rest directly on cantilevers or beams. This constructive system with redoubled rafters remained in use until the Yüan period, perhaps even later, though the form of the lower rafters as well as other details becomes modified. Furthermore one may notice in these early buildings the very solid and broad shape of the various members, as, for instance, the comparatively short columns with entasis (*q.v.*) and the very broad and heavy cantilevers cut into the shape of clouds at their lower side. The trusses and beams of the roof, to which the rafters are tied, are solid and strong, the various parts being tied together with consummate skill.

The essential parts of the buildings and the method of construction are the same in the pagodas and in the temple halls of this period, as may be learned from a closer study of the Golden Hall or Kondo of Horyuji, an oblong, quadrangular room with a colonnade and a roof in two storeys. A very important member added to the pagodas is, however, the mast which runs through the whole height of the tower. The purpose of this mast is not really constructive, it is not meant to support the tower, but simply to form a spire rising high above the roof and carrying the nine metal rings or discs. The builders usually did not tie the mast very tightly to the framework of the tower, because if the whole structure were suspended on the mast, the security of the tower would be jeopardized by the unavoidable swaying of the mast. In some comparatively recent examples one may find the mast suspended in the beams of the tower, but here the intention evidently was to lift it a little above the ground in order to avoid the still greater danger that might arise through the gradual sinking of the tower which would then, so to speak, be carried by the mast or hang on it. In the oldest pagodas which for the longest time have withstood storms and earthquakes the mast is a relatively free-standing post within the structure, always with plenty of room for its swayings, which thus do not really affect the security of the tower.

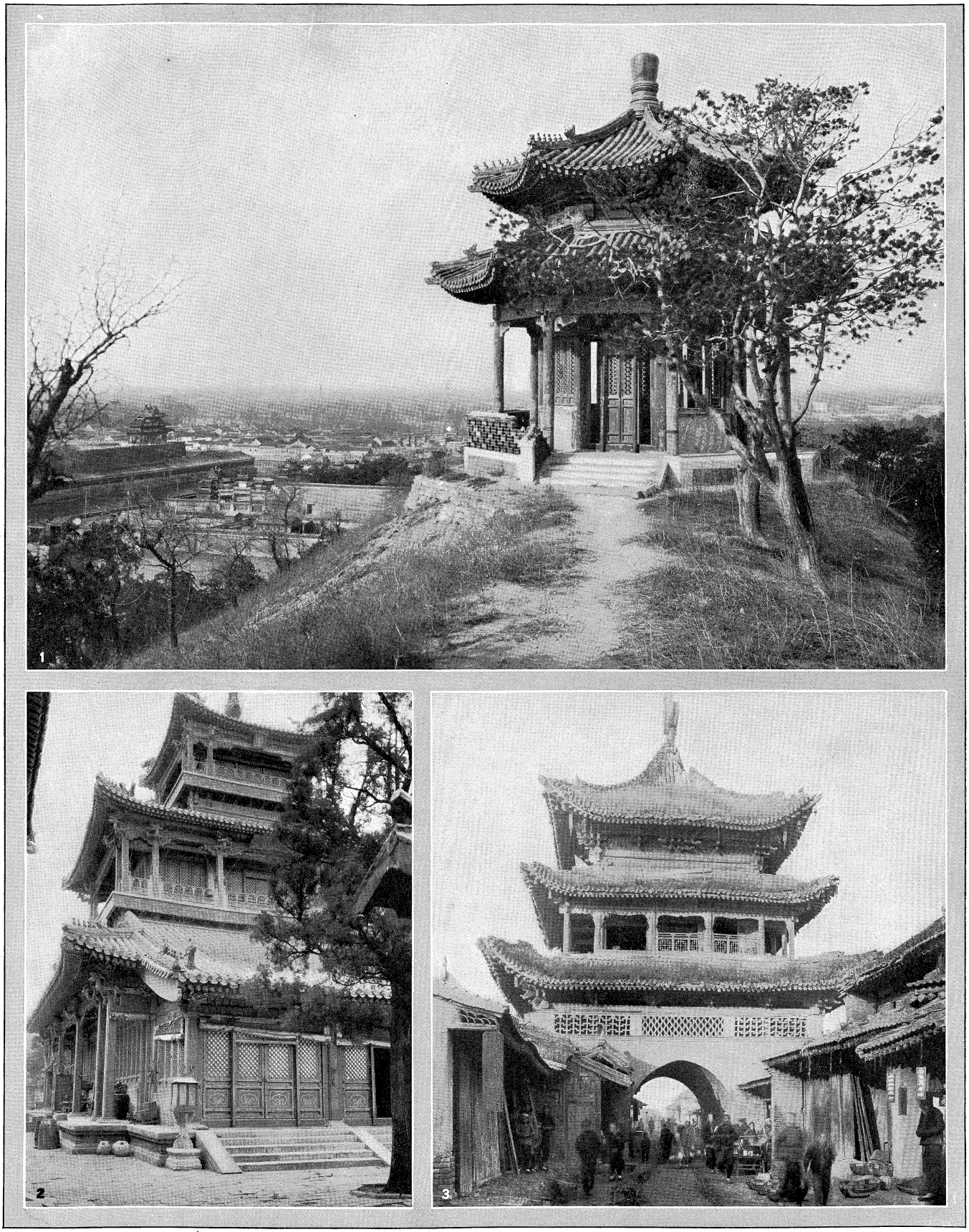
Quite a number of pagodas and temple halls of the 7th and 8th centuries are to be found in Japan, but it is our purpose here simply to point out certain general principles of construction borrowed from China. The five-storeyed pagoda at Horyuji is, in spite of the verandah which was added later round the ground storey, the most important example, but characteristic of the same style (which was developed in China, during the northern Wei dynasty and in Japan during the Suiko dynasty) are also the three-storeyed pagodas at Hokkiji and Horinji, which remind us of the stone reliefs representing pagodas in the grottoes at Lung Men and Yun Kang.

Important modifications of the old style may be observed on the beautiful pagoda of Yakushiji which was erected at the beginning of the 8th century in close adherence to Chinese constructions from the beginning of the T'ang period. It is a three-storeyed tower, but each one of the storeys is provided with a closed balcony carried on cantilevers, so that the pagoda at first sight gives the impression of a six-storeyed building. The intermediate shed-roofs are of the same shape, though smaller than those which cover the main storeys; a kind of rhythmic division is thus created, and the decorative effect becomes more interesting than in the earlier pagodas. Of great importance for the horizontal articulation are also the far-projecting carrying beams of the balconies, as well as the repetition of the three-armed brackets in double tiers under the eaves of the six successive roofs. The bracketing system has here attained its highest development, the lower brackets being used as supports for the upper ones which reach farther out and are provided with cushions. Their transversal arms replace the formerly used cantilevers, and on the top of them may be one more tier of similarly shaped brackets, as on other buildings of the same period. It should be observed that all the brackets are complete, the lower ones being so arranged that they carry a continuous beam and also the transversal arms of the upper brackets, while these serve as supports for the upper beams under the eaves and for the rafters. In order to strengthen the vertical construction, struts with cushions are often placed on the hammer-beams in the intervals between the brackets.



OUTER GATEWAY ACCORDING TO YING TSAO FA SHIH (1103)

The same characteristic forms and constructive features return in some contemporary temples and pagodas which thus also testify that the parts to which we have paid special attention are typical features of the architecture of this period. Interesting in this connection are the two large temple halls at Toshodaiji, another temple not far from Nara, *i.e.*, the Kodo (Hall of Teaching) and the Kondo (the Golden Hall). The former once formed a part of the imperial palace at Nara but was moved to its present place when the temple was erected in 759. The building is quite simple, an oblong, one-storeyed hall with double rows of columns all around, the inner row standing free in the room, the outer being filled out to form a wall. The columns are not quite as heavy as on the buildings of the preceding period and the inter-columns are very long. The brackets are introduced only in one tier but between them are struts which contribute to support the roof.



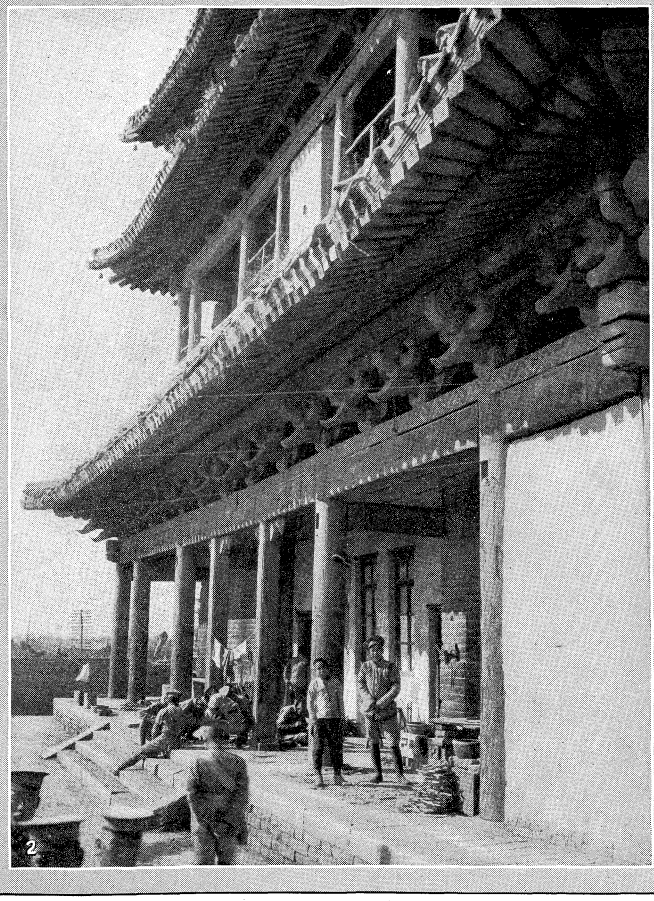
PHOTOGRAPHS, COPR. OSVALD SIRÉN

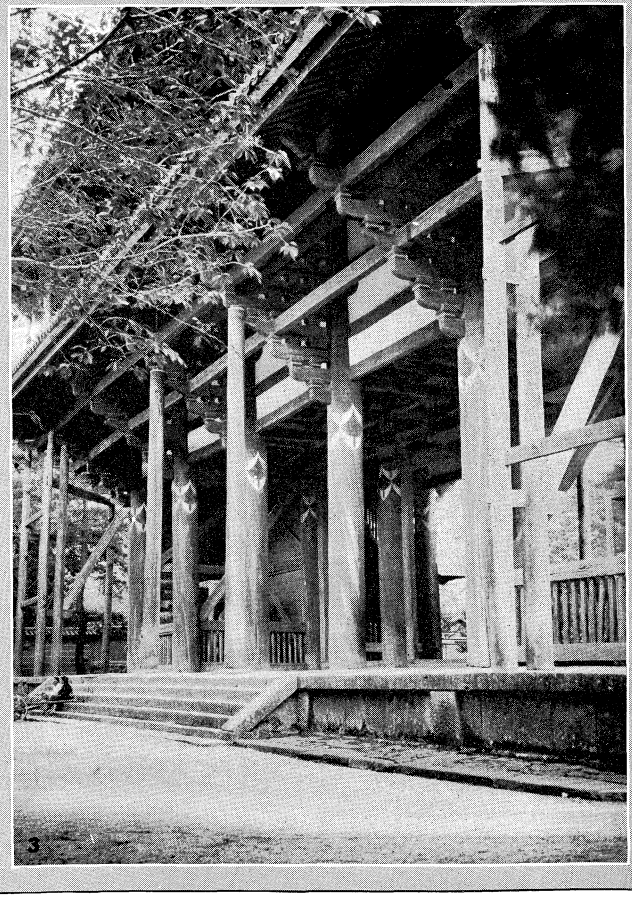
CHINESE TOWERS AND PAVILIONS

1. One of the pavilions on the Coal Hill, Peking
2. Yu Hua Ko, a Taoistic building in the Forbidden City, Peking
3. The Drum Tower, Haien Yang, Shen-si. Drums were ordinarily beaten to give directions for the change of night watches and, in rare instances, to warn the citizens of some disaster

CHINESE ARCHITECTURE



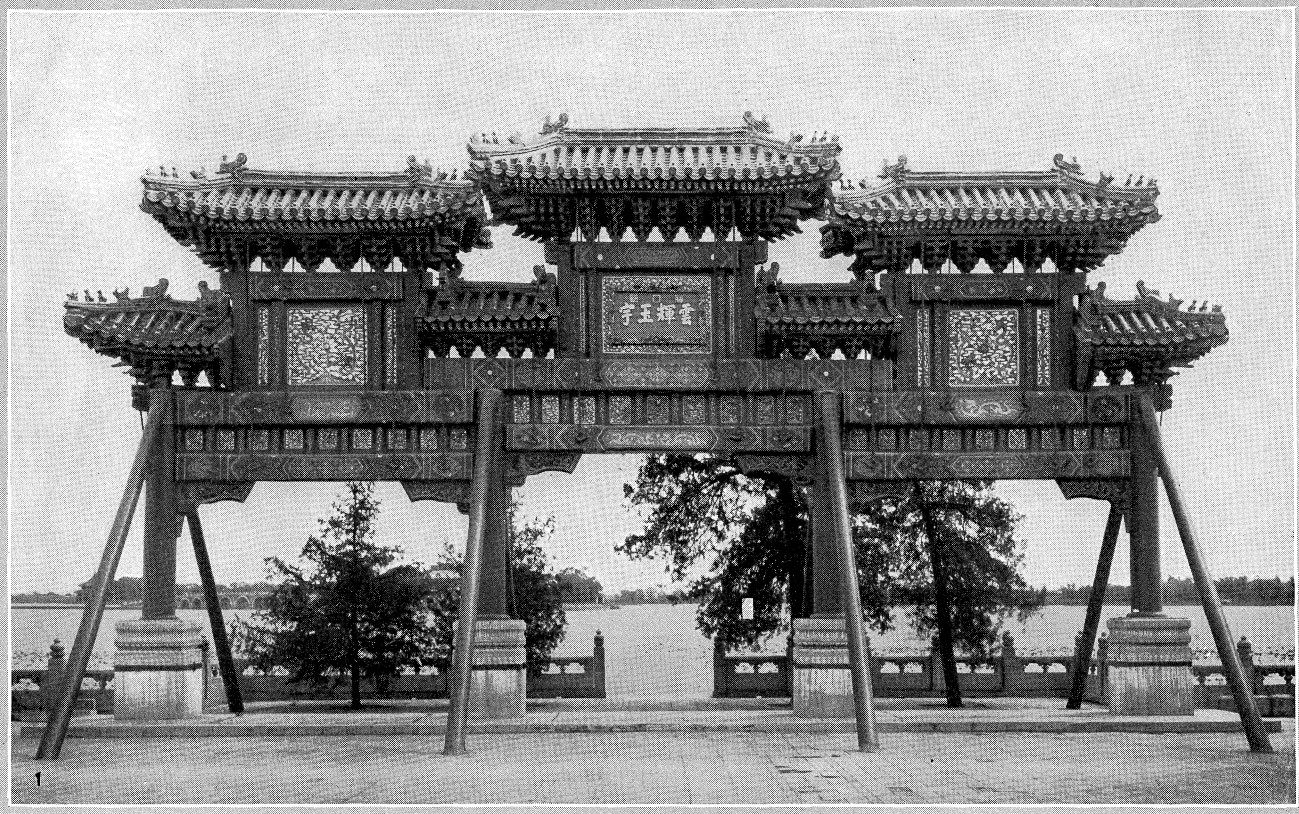


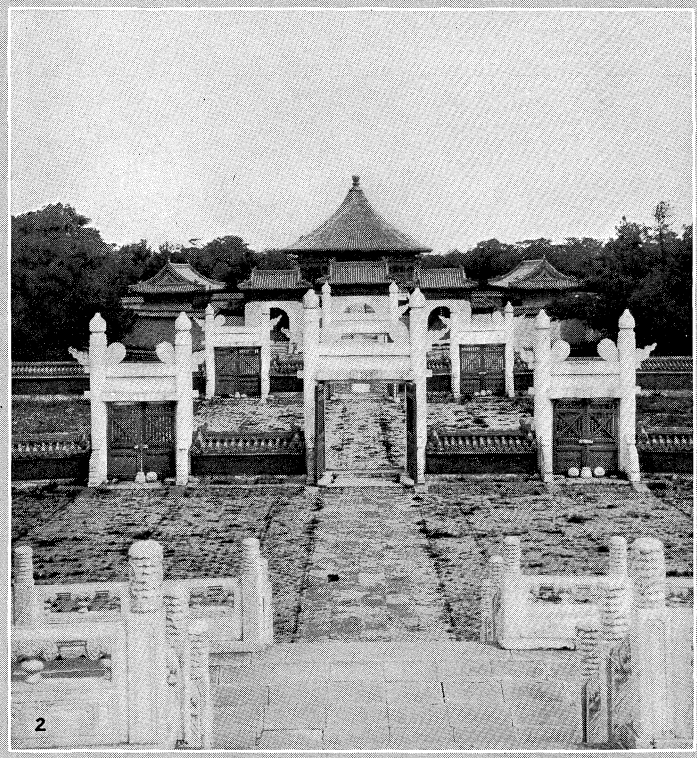


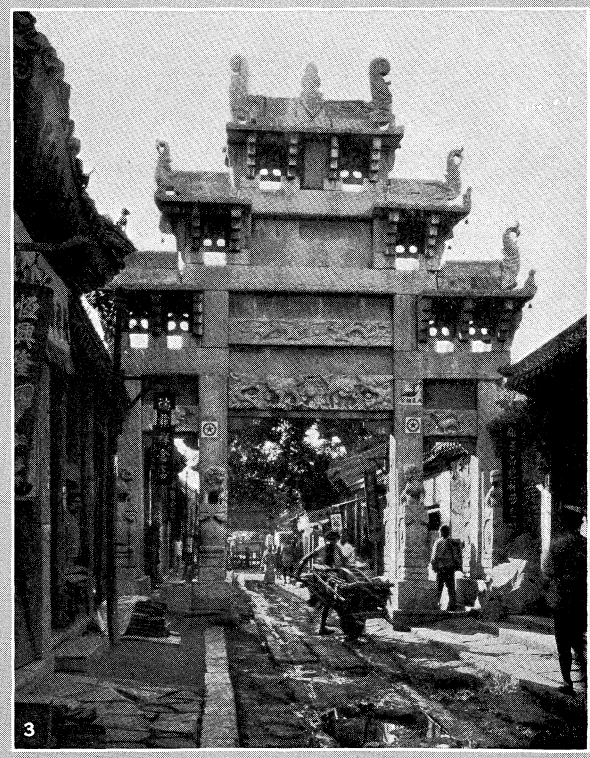
PHOTOGRAPHS, COPR. OSVALD SIREN

BUDDHA'S PERFUME TOWER, AND TWO GATEWAYS

1. View of the Fo Hsiang Ko (Buddha's perfume tower) and the buildings in front of it at the Summer Palace, Peking; 19th century
2. Portion of the bell tower in Si-an, Shensi; erected 15th century
3. Portion of Nandaimon gate, temple of Todai-ji, Nara, Japan; *c.* 1199







PHOTOGRAPH, COPR. OSVALD SIRÉN

CHINESE MEMORIAL GATEWAYS

1. P'ai-lou or memorial gateway built of wood, at the lake of the Summer Palace, Peking. These characteristic structures, usually of wood, mark the entrance to a sacred or beautiful spot or commemorate some event or person
2. Marble P'ai-lou at the Altar of Heaven, Peking. This illustrates the type of p'ai-lous with tall side-posts reaching above the transverse beams
3. Marble P'ai-lou over the main street in Wei-hsien, Shantung. In this type of p'ai-lous, the shorter side-posts are covered by roofs, making the gateway resemble an open pavilion. This is one of the more elaborate examples, with three openings and storeyed roofs

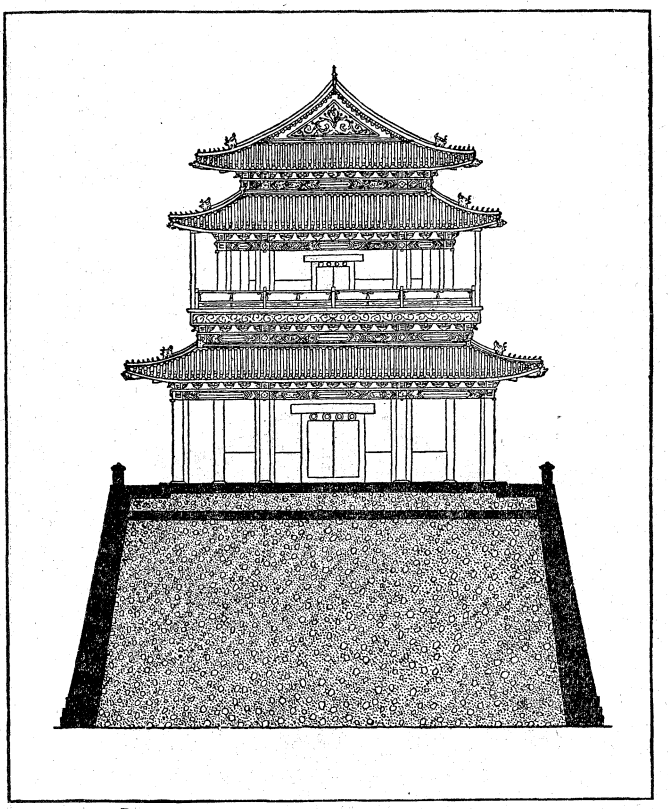
The same principles of construction are still further developed on the Kondo of Toshodaiji which, with the exception of its entirely rebuilt roof, is an unusually imposing example of T'ang architecture. The building stands on a comparatively broad and high platform, but it is provided with a colonnade only on the front. The columns have a slight entasis and rest on moulded plinths. They are tied together, as usual, by a long architrave-beam and provided with quadrangular cushions from which the three-armed brackets project. These carry the upper longitudinal beam and a second tier of brackets. Above this follows a third row of brackets which is almost hidden below the far projecting eaves. The rafters project between the arms of the uppermost brackets and abut against the tranversal arms of the second row of brackets. The rafters are doubled, the upper ones being supported by struts which also carry the outermost purlins, and the two layers are furthermore tied by braces. The whole system is carried out with perfect logic in a method which may be termed the highest perfection of wooden construction.

How closely this building depends on Chinese models is proved by the reproduction of a similar temple hall on a large stone gable above one of the gateways to the Ta Yen T'a pagoda at Sianfu. This remarkable engraving which we reproduce from a copy executed by a Japanese artist for Prof. Sekino, is of great historical importance, because it evidently reproduces a Chinese temple on which we may observe the same constructive details as pointed out on the Kondo of Toshodaiji. It matters little that the columns have been made spiky and the roof too small, as long as we recognize the principle of the whole constructive system, *i.e.*, the brackets and the struts, of which the lower ones have the same kind of curving legs as may be seen on some Japanese buildings of the 9th and 10th centuries.

Before following the further development of the traditional wooden construction during the Sung and the Yüan dynasties it is necessary to mention a group of buildings which illustrates another side of T'ang architecture. These are pagodas in what is popularly called the "Indian style," that is to say, buildings made of packed mud and brickwork which rise in terraces on a square plan. The most important among these pagodas stand in the neighbourhood of Sianfu within or just outside the district which once was occupied by Ch'angan, the capital of the T'ang emperors. In the first place should be mentioned the Ta Yen T'a (the Large Pagoda of the Wild Geese) which was founded in the year 652 by the great Buddhist pilgrim and teacher, Hsüan Chuang. It was then made of clay and brick in five storeys; later on, though still in the T'ang period, some storeys were added, and after some vicissitudes, the tower was rebuilt between 931 and 933. Later repairs have been carried out in the Ming and Ch'ing periods. The present pagoda, which has five storeys, seems however to correspond quite well to the T'ang building. It stands on a fairly high terrace and is at the base about 25·5 metres square, its full height being almost 60 metres. Its general shape reminds us of an elongated pyramid with truncated top. The successive storeys, which are accentuated by corbelled cornices, grow lower and narrower towards the top. The uppermost has a pyramidal roof crowned by a glazed cone which is now well covered by small trees and bushes. The coating of the walls is made of yellowish, lightly burnt bricks. They are quite plain except for some very thin pilasters and the arched gateways and a window on each side. The interior division is made by beams and wooden floors and the staircase which still exists makes it possible to ascend to the top. The imposing effect of this tower depends on its fine proportions and well balanced, massive form, which is strengthened by its position on a natural elevation.

Not far from this stands a smaller pagoda called Hsiao Yen T'a (the Small Tower of the Wild Geese), erected 707–709. This tower had originally 15 storeys but of these hardly 13 are now preserved. The storeys are very low but, as in the previous instance, accentuated by corbelled cornices. Only the ground floor is a little higher and on the northern and southern side provided with vaulted entrances. The upper storeys have small vaulted windows on the façade but otherwise no openings or divisions, and it is impossible to know whether they ever had any floors because there is no longer any staircase. Externally the tower differs from the Ta Yen T'a by the fact that it is not a stepped pyramid but a square tower with a slight curve on its middle part.

In still worse repair is the Hsiang Chi Ssu, situated a little farther southward from Sianfu. It was erected in 681 according to the same general design as Hsiao Yen T'a, probably in 11 or more storeys, of which, however, only ten remain. The outline

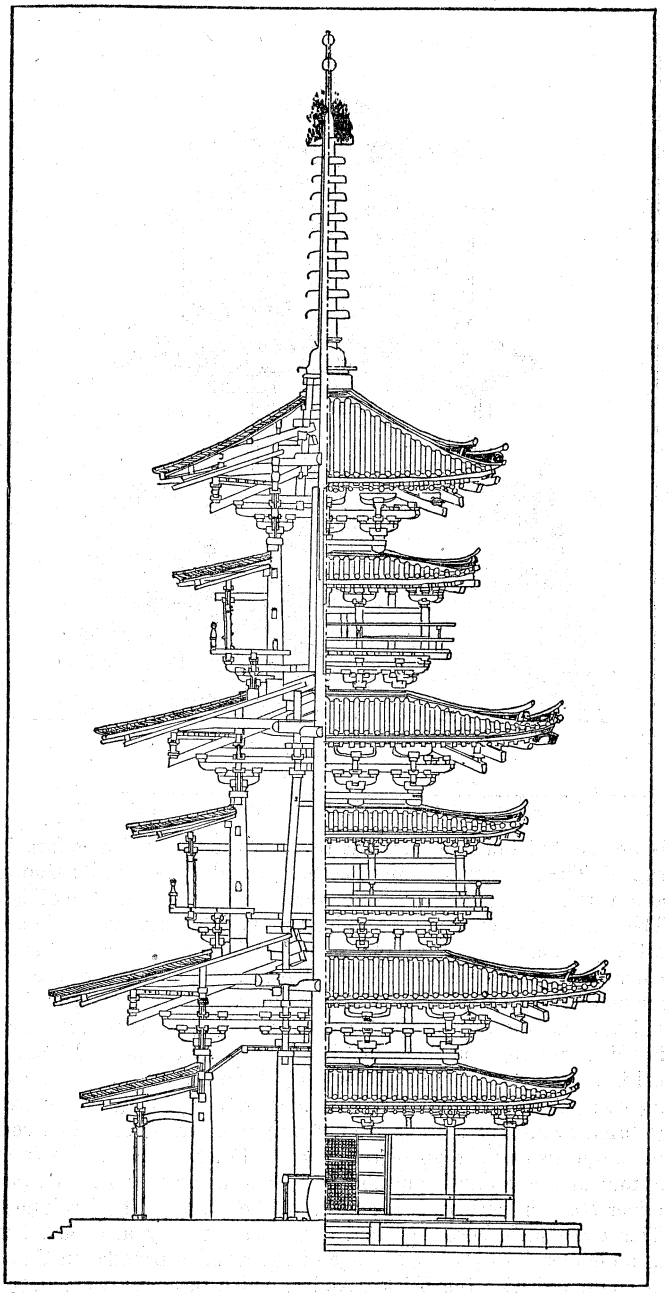


P'ING TZU MEN, INNER GATE-TOWER, PEKING

is not curved but rises straight towards the top which is largely ruined. The storeys are quite low but provided with an horizontal and vertical moulding possibly suggested by wooden buildings. The dependence on wooden architecture is still more evident in another pagoda situated in the same neighbourhood called Hsing Chiao Ssu, which was erected in 839 at the place where the remains of the great pilgrim, Hsüan Chuang, were removed in 669. It is a comparatively small tower measuring only about 20 metres in height and 5·35 on each side, but it presents an unusual historical interest by the fact that some of the most characteristic elements of wooden architecture have here been faithfully reproduced in brickwork. The storeys are not only marked by corbelled cornices but also with rows of three-armed brackets which rise from a kind of horizontal beam and provided furthermore, in the two upper storeys, with carrying posts in the shape of half columns. This close adherence to wood constructions may also be taken as an evidence of the greater age of the wooden pagodas in China as compared with the brick pagodas, which probably were developed through influence from India.

On each side of the Hsing Chia Ssu are smaller three-storeyed pagodas erected to the memory of other monks, both having three divisions without any cornices. Such minor quadrangular towers of three to five storeys dating from the T'ang, Sung and Yüan dynasties are often to be found on tombs or other memorable places. One of the largest and most beautiful among them is the Pai T'a Ssu in the same neighbourhood south of Sianfu; others are to be found at Shen Tung Ssu in Shantung and at Fang Shan in Chihli. The same architectural shape may also be observed in the celebrated pagoda Pai Ma Ssu near Honanfu which was not built until the Sung period, though it often has been mentioned as one of the oldest pagodas in China, probably owing to the legend connected with the Pai Ma Ssu temple. It is supposed to have

been founded by Indian missionaries, who carried the first *sutras* to China, but as a matter of fact, the present pagoda was preceded by an earlier one in wood, which perished by fire in 1126. Other characteristic buildings are the Chiu T'a Ssu, or Nine-towered Pagoda, near Lin Cheng in Shantung, and the Lung Kung T'a at Shen Tung Ssu, an impressive square tower in three high divisions, which are encumbered by sculptural decoration.

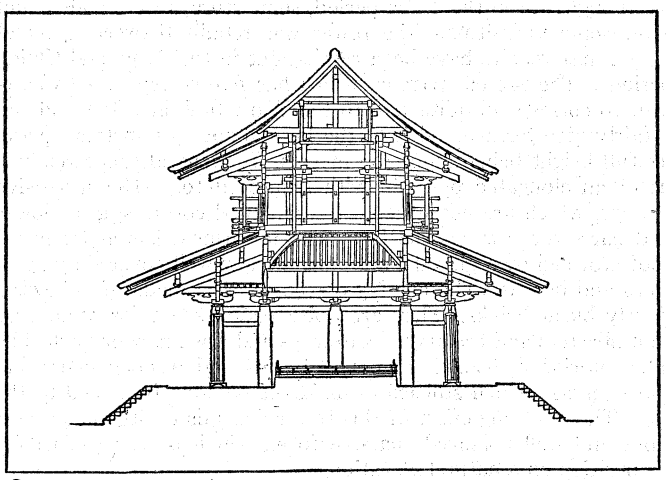


CROSS SECTION AND ELEVATION OF YAKUSHIJI PAGODA. 8TH CENTURY

Although the greater part of the buildings which still remain in China from the T'ang and Sung dynasties are pagodas made of mud and brick there are also some examples of temples constructed at least in part of wood, dating from the end of the Sung period. The most authentic and important of these is the Ch'u Tzu An hall at Shao Lin Ssu, the famous temple on the slope of Sung Shan in Honan, where the miraculous Bhodidharma, the founder of the Dhyana or Zen Buddhism, is said to have remained several years. According to an inscription, the Ch'u Tzu An was erected about the year 1125 or shortly before. It is a small, square building (measuring about 11 metres on each side) standing, as usual, on a stone terrace. Each side has four hexagonal stone pillars but only those of the façade are even partly visible, the others being completely embedded in the brick walls. In the room are two pairs of smaller and two pairs of larger hexagonal pillars, all decorated with Buddhist reliefs, and the gateway is framed by carved stone beams. Thanks to these solid stone supports the building still stands, but the roof, which is made of wood, threatens to fall in (if it has not already done so). At the writer's visit to the place in 1921 large pieces of the eaves were missing, and perhaps now the building has no other roof than the sky. The most interesting parts of this structure, however, are not the carved stone pillars but the brackets under the eaves which illustrate how these were used in the Sung period. The modifications in comparison with the bracketing system of the T'ang dynasty are quite noteworthy. Thus we find that the brackets emerge not only from the pillars but also, between these, from the horizontal beam. They are placed more closely together than previously, forming a kind of cornice. In the lower tier the brackets have three arms but in the upper tier the transversal arms have been cut by the under rafters, which are pointed and project like beaks or long paws. They are tied by means of braces to the brackets and carry at both ends struts (vertical posts) on which the purlins or corresponding beams rest. This change may be said to imply that the lower rafters have lost their original character and become a sloping cantilever transversing the lower brackets which they lengthen, thus making them better fitted to support the far projecting roof. The modification has evidently a practical purpose, though it hardly improves the original bracketing system, as exemplified on the T'ang buildings.

The evolution continued in this same direction; the three-armed constructive brackets gave place to two-armed ones transversed by thin sloping beams or rafters, cut like beaks at the end. These project successively, the one tier reaching beyond the other, each one carrying its row of brackets which serve to support the longitudinal beams or a kind of struts for the purlins. The former system may be observed on the Bell Tower at Hsiao Lin Ssŭ, which according to an inscription was erected about the year 1300, where the third storey has no less than four tiers of gradually projecting brackets with beaks. The latter method is quite common; as an example may be mentioned one of the pavilions at the Confucius temple at Chüfu, also of the Yüan dynasty, where the horizontal pieces form a support for several sloping cantilevers (or rudimentary lower rafters) which have been joined into a kind of bed for the struts and purlins of the roof.

Chinese buildings dating from the Sung and Yüan dynasties are scarce indeed, but our knowledge of the architecture of these



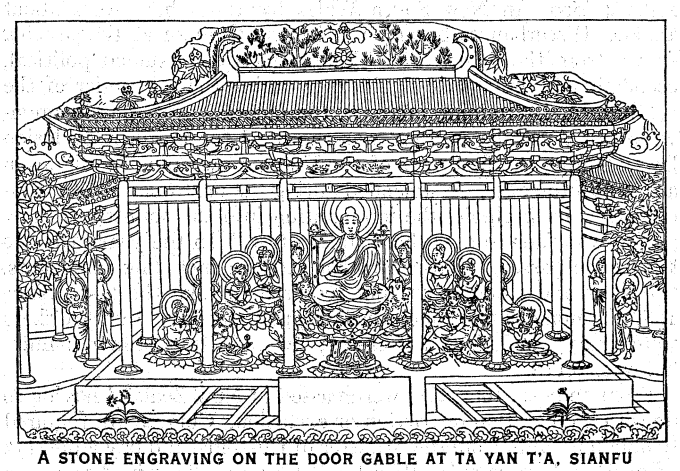
CROSS SECTION OF THE KONDO OF HORYUJI, BUILT IN 7TH CENTURY

times may be supplemented by observations on Japanese buildings from the 12th and 13th centuries, *i.e.*, the Kamakura period. In Japan this was a time of great building activity and, according to the best informed Japanese authorities, remarkable for its close imitation of the contemporary Chinese models. Quite important in this respect is the Shariden (Chu Tsu An) of the Zen temple Engakuji in Kamakura, built according to the same principles as the above-mentioned Chinese hall, though with an

extraordinarily large and high roof covered with straw. This is carried by brackets of the same type as those which were observed at Chu Tsu An of Hsiao Lin Ssu. The brackets are placed so closely together that they form a continuous cornice. The purely Chinese origin of the constructive system of the Shariden of Engakuji may be confirmed through a comparison with some of the illustrations in the above-mentioned architectural treatise *Ying Tsao Fa Shih* published in 1103. On the buildings or schematic designs reproduced here we find brackets of exactly the same type as those described above, though their significance is partly obscured by the addition of some large transverse beams which probably have their origin in the imagination of the draughtsman.

The Japanese called this constructive system which they have borrowed from northern China, "karayo," while another somewhat different contemporary method was called "tenjiku," because it was considered to have been derived from India via southern China. It was used principally at large gates and temple buildings, to which one desired to give a particularly imposing appearance by the development of their upper portions. This was achieved by multiplying the brackets and transforming them into straight arms or cantilevers projecting stepwise from the posts. A good example of the *tenjiku* style is the Nandaimon gate at Todaiji, which was erected in 1199. It has five spans of columns on the long sides and a roof in two storeys, of which the lower one is supported by seven tiers and the upper by six tiers of cantilevers projecting from each column. At the corners are added diagonal cantilevers to form a support for the corner beaks. This kind of construction seems, however, never to have won much popularity in northern China; it is so simple and natural that it hardly can be credited with particular artistic importance. Projecting roof beams have indeed been used in many countries to support the eaves, but the characteristic feature of the *tenjiku* buildings is that the cantilevers are multiplied or massed together by the insertion of intermediate pieces into large composite brackets.

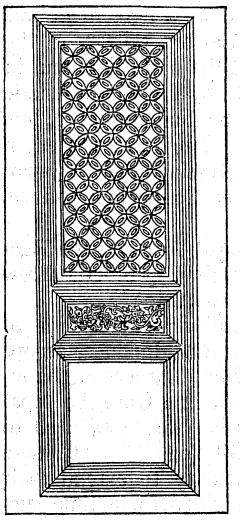
The further development of the wood construction in China after the end of the Yüan dynasty is a question which hardly needs



A STONE ENGRAVING ON THE DOOR GABLE AT TA YAN T'A, SIANFU

to be discussed, because no real progress can be observed, but rather a gradual decline, which becomes evident in the more and more arbitrary treatment of the bracketing system. At the beginning of the Ming dynasty one may still find buildings constructed in the same style as those of the Yüan period, *i.e.*, with beak-formed pieces laid transversally across the brackets, but the projecting pieces become often clumsy and out of proportion to the brackets. A fine example of early Ming architecture is the Bell Tower in Sianfu, the lower roof of which rests on a double row of brackets of the same type as those of the Yüan buildings. On the other hand, the tower of the eastern gate of T'a Tung Fu, erected in 1371, shows beak-shaped pieces projecting from very feeble brackets.

The question how long a really constructive bracketing system remained in use in China is difficult to answer without more detailed investigations than have hitherto been made. It is evident however, that already during the latter half of the Ming period simpler methods were applied, as may be seen for instance on the earliest buildings in the Forbidden City in Peking. It is true that the outer appearance was kept up by fixing multiple rows of brackets and pointed beaks below the eaves, but these have no real constructive function. The purlins rest on projecting beams or on struts standing on the columns. The closely arranged and freely multiplied brackets and beaks which we find on the big palace halls and imposing gate towers in Peking are nothing but ornamental cornices, the decorative effect of which nobody will deny. The roof would indeed rest just as well on the building even if these sham brackets were taken away. The forms are still the same as before but they have lost much of their significance because they lack inner necessity. The particular quality and importance of the old architecture of China depended on its firm and clearly developed wood construction. It was purely carpenters' art, and based on the special requirements of the material. Each part had a definite function which was not concealed by any superimposed decoration. This architecture was logical and purposeful and it remained a living art as long as the original principles of construction were kept up, but once these were encroached upon by purely decorative tendencies, both vitality and further growth were at an end. (*See* also JAPANESE ARCHITECTURE.) (O. S.)



DOOR PANEL ACCORDING TO YING TSAO FA SHIH (1103)

BIBLIOGRAPHY.—The only original Chinese work on architecture is the *Ying Tsao Fa Shi* (1103; 2nd ed., 1145; reissued by the Shanghai Commercial Press). Good accounts of the work were given by P. Demieville in *Bulletin de l'École Française d'Extrême-Orient,* tome xxv. (1925), and Percival W. Yetts in the *Burlington Magazine* (March, 1927), the latter containing a discussion of earlier European books dealing with Chinese architecture. Of greater importance are, however, the works published by various Japanese authorities on their own early buildings since these are closely connected with those of China. See *Japanese Temples and their Treasures* (last ed. 1915); also articles in the *Kokka* and other Japanese reviews, especially C. Ito and J. Tsuchija's report about the imperial palaces in Peking, in the *Bulletin of the School of Engineering of the Tōkyō Imper. University* (1905), a kind of text for the portfolio publications; *Photographs of Palace Buildings of Peking* and *Decoration of the Palace Buildings of Peking* (1906). *See* also Boerschmann, *Baukunst und religiöse Kultur der Chinesen* (1911–14) and *Chinesche Architektur* (1925); Osvald Sirén, *The Walls and Gates of Peking* (1924), and *The Imperial Palaces of Peking* (Paris, 1926); Tokiwa and Sekino, *Buddhist Monuments in China* (Tōkyō, 1926–27), of which only one part has been issued in English.

The drawings of this article are executed partly on the basis of sketches by Prof. Sekino and partly after photographs by the author.

CHINESE EASTERN RAILWAY. In 1895 there was formed, under Russian charter, but with a predominance of French capital and with some capital owned by the Chinese Government, the Russo-Chinese Bank. When, in 1896, Russia obtained from China permission to shorten the Trans-Siberian railway by building a line across Northern Manchuria, the bank formed the Chinese Eastern Railway Company. Only Russians and Chinese were to be shareholders, and a Chinese appointed by Peking was to be president. After 80 years the line was to revert to China free of charge, or the Chinese Government might purchase it at the end of 36 years. The original board of directors was entirely Russian, and the capital stock was all owned by the Russo-Chinese Bank. In 1898 a convention between China and Russia provided for the construction by the company of the South Manchurian line of the Chinese Eastern railway from Harbin to Port Arthur and Dairen (Dalny). The roads so provided for were completed in 1905 and for that purpose the Russian Government advanced about 800,000,000 roubles. In 1905, as a result of the Russo-Japanese War, the South Manchurian railway south of Changchun passed into the hands of Japan.

In 1910 the Russo-Chinese Bank was amalgamated with the Northern Bank to form the Russo-Asiatic Bank, and the new institution became heir of the Russo-Chinese Bank's interest in the Chinese Eastern railway. The new bank had a Russian charter, but the majority of its stock was in French hands. The Chinese Government remained a part owner. In 1915 an agreement was formed for the operation by the Chinese Eastern railway of the short private line connecting Tsitsihar and the main line, and in March, 1916, an agreement was entered into by the Russo-Asiatic Bank and the Chinese Government for the building of a line from Harbin to Blagovyeshchensk with a branch from Mergen to Tsitsihar. In a treaty of July 3, 1916, Russia ceded to Japan 6om. of the Chinese Eastern railway between Changchun and the Sungari river.

The Railroad and the War.—The World War and the Russian revolution and the consequent disintegration in Siberia threw the traffic and finances of the railway into confusion.

In pursuance of the Chino-Japanese military agreement of 1918, made after China entered the World War, Japanese troops appeared in the Chinese Eastern railway zone. Largely at the insistence of the United States, and to save the line from the Japanese, an international, interallied commission was appointed to operate the road. This control lasted until 1922. The Chinese saw in the disturbed conditions an opportunity to extend their control over the railway, and beginning in 1920 for a time successfully asserted themselves.

At the Washington Conference in 1921–22, a resolution was adopted stating that better protection should be given the railway, that the personnel should be more carefully selected, and the funds more economically used. The Powers other than China also made reservations under which the consular body in Harbin interfered when in Aug. 1923 the Chinese attempted to seize the land department of the railway.

The 1924 Agreement.—The Russo-Chinese agreement of May 31, 1924, contained a long article which, among other things, had an assurance that China might buy back the railway and a provision for a conference to settle more definitely the future of the road. Simultaneously, another agreement was adopted for the joint administration of the railway pending the final adjustment.

In July 1929, sharp dissension culminated in the seizure of the road by the Chinese.

A Russian invasion, however, compelled the restoration of the *status quo*.

After the establishment of the Japanese-dominated State of Manchoukuo relations between the joint owners became strained. To remove the friction, negotiations were begun in 1933 for the sale of Russia's share. These resulted in an agreement, Sept. 19, 1934, whereby Manchoukuo was to pay the equivalent of 140,000,000 yen (1 yen=$.4985 at par), one-third in cash and the remainder in kind. The transfer was completed March 23, 1935. The road was renamed the North Manchurian railway and became part of the system operated by the (Japanese) South Manchuria Railway Company. (K. S. L.)

CHINESE IMMIGRATION. The first recorded Chinese immigrants to the United States reached San Francisco in 1848; not until 1852 did they begin to arrive in considerable numbers, when at least 18,000 were in the country. During the next eight years their numbers almost doubled. Some became miners, servants, laundrymen and farm hands; many engaged in the building of railroads. There being more work than laborers, the Chinese at first were generally welcomed, although there were protests against their free entrance, especially in California.

Although emigration to the islands of the Pacific and Indian oceans had been going on for hundreds of years, the Manchus, who ruled China after 1644, discouraged it. The ban upon emigration was lifted locally in the province of Kwangtung in 1859. In 1868 the Imperial Government reversed its non-emigration order by signing with the United States the Burlingame Treaty. The increased entry of Chinese into the United States subsequently caused economic and social difficulties. The Chinese were able to live on a lower scale than Americans or European immigrants, and were willing to do work scorned by white men. The thrift and economy of the Chinese, their lack of desire or ability to amalgamate, the funds sent by them to China, the ultimate return thither of many, the fact that they were of a different race and culture, and that most of them were from the more unfortunate classes of China—all served to stir up jealousy, contempt and persecution throughout the West.

On November 17, 1880, a treaty was signed by the United States and China providing for the regulation or suspension of immigration, but not its absolute prohibition. The first of a series of Chinese Exclusion Acts aimed at labourers was passed May 6, 1882, and this was followed by others in later years. The application of these exclusion measures to the Hawaiian and Philippine Islands occurred in 1900 and 1902. In addition to the special legislation directed at Chinese, the latter come under the application of the general immigration laws of 1917 and 1924, and may be deported on departmental warrant if they enter the country in violation of law. The severity with which the laws have been applied has caused friction on numerous occasions.

Prior to 1924 the admissible classes of Chinese were teachers, including editors; students; travellers; merchants, including bankers, with their wives and minor children; officials of the Chinese government, with their wives, children and servants; persons whose physical condition necessitated immediate hospital treatment; persons shown by convincing proof to have been born in the United States, with their wives who were admitted not as citizens but as the wives of citizens, also their minor children; and seamen under prescribed conditions. The number of Chinese in the United States has fallen steadily since 1890 when 107,488 were reported to 1920, when but 61,639 were listed.

In the British Isles the number of Chinese has been negligible. The history of Chinese immigration into the English-speaking parts of the British Empire—notably Australia, New Zealand and Canada—has in many ways paralleled that of the United States. The first Chinese to enter Australia appear to be those who entered Queensland between 1840 and 1859, where they served as shepherds. The discovery of gold led to a considerable influx in the sixth decade of the century; in 1854 there were 2,341 Chinese in Victoria; by 1859 there were in the gold-fields some 42,000. In New South Wales by 1861 there were about 13,000. Disturbances began in 1860, the Chinese at times being driven from the fields. The Chinese question assumed political, economic and diplomatic significance during the remainder of the century. A determining factor in the federation of the Commonwealth of Australia in 1901 was the need for uniform exclusion laws. During the first year of the Union a sweeping immigration act went into effect. As amended during the next quarter of a century, this act prohibits the immigration into the country of "any person who fails to pass the dictation test." In the years 1905 to 1914 none passed. Non-permanent settlers, including merchants, travellers and students are not required to take the test. Since 1888 the number of Chinese has dropped steadily. In 1891 there were 38,077, including half-castes; by 1920 the estimated number was 20,118.

From 1908–23 four Acts were passed in New Zealand having to do with immigration restriction or exclusion. Chinese are required to obtain permits from the Minister of Customs, and pay a poll tax of one hundred pounds. Registered Chinese aliens in April 1920 numbered 2,376.

In Canada the mining of gold and the building of the Canadian Pacific Railroad encouraged Chinese immigration early in the '70s, immigration at that time being unrestricted. Since 1886 Chinese immigration has been controlled by a head tax ranging from $50 per entrant in 1886 to $500 after 1904. By the Chinese Immigration Act of 1923 Chinese of non-labouring classes only may enter. In 1920 it was estimated that not more than 35,000 Chinese were in the Dominion.

See bibliography under MIGRATION, and P. C. Campbell, *Chinese Coolie Emigration to Countries within the British Empire* (London, 1923); H. D. Hall, *Immigration in the Pacific: Analysis of Acts and Administration;* Institute of Pacific Relations, *Honolulu* (1925); R. D. McKenzie, *Oriental Exclusion* (Chicago, 1928); H. F. MacNair, *The Chinese Abroad* (Shanghai, 1924); M. R. Coolidge, *Chinese Immigration* (Boston, 1909). (H. F. MACN.)

CHINESE LANGUAGE. In treating of Chinese, it will be convenient to distinguish, broadly, the spoken from the written language because for reasons connected with the peculiar nature of the script, the two soon began to move along independent and largely divergent lines.

Although Chinese, like other living languages, must have undergone gradual changes in the past, so little can be stated with certainty about these changes that an accurate survey of its evolution is quite out of the question. Obviously a different method is required when we come to the written characters. We have hardly any clue as to how Chinese was spoken or pronounced in any given district 2,000 years ago, although there are written remains dating from long before that time; and in order to gain an insight into the structure of the characters now existing, it is necessary to trace their origin and development.

We find a number of dialects, all clearly of a common stock, yet differing widely from one another. Most of these dialects fringe the coast-line of China, and penetrate but a comparatively short way into the interior. Starting from the province of Kwangtung in the south, where the Cantonese and, farther inland, the Hakka dialects are spoken, and, proceeding northwards, we pass in succession the following dialects: Swatow, Amoy (these two may almost be regarded as one), Foochow, Wenchow, Ningpo and Wu. Farther north the great dialect popularly known as Mandarin (*Kuanhua* or "official language"), sweeps round behind the narrow strip of coast occupied by the various dialects above-mentioned, and dominates a hinterland constituting nearly four-fifths of China proper. Mandarin, of which the dialect of Peking, the capital 1421 to 1928, is now the standard form, comprises a considerable number of sub-dialects, some of them so closely allied that the speakers of one are wholly intelligible to the speakers of another, while others (*e.g.*, the vernaculars of Yangchow, Hankow or Mid-China and Ssŭ-ch'uan) may almost be considered as separate dialects. Cantonese is supposed to approximate most nearly to the primitive language of antiquity, whereas Pekingese perhaps has receded farthest from it. For all practical purposes Mandarin, in the widest sense of the term, is by far the most important as the native speech of the majority of Chinese and the recognized vehicle of oral communication between all Chinese officials, even when they come from the same part of the country and speak the same *patois*. All examples of phraseology in this article will therefore be given in Pekingese.

The dialects proceed from the same parent stem, are spoken by members of the same race, are united by the bond of writing, the common possession of all, and share alike in the two most salient features of Chinese as a whole: (1) they are all monosyllabic, that is, each individual word consists of only one syllable; and (2) they are strikingly poor in vocables, or separate sounds for the conveyance of speech. The number of these vocables varies from between 800 and 900 in Cantonese to no more than 420 in the vernacular of Peking. This scanty number is eked out by interposing an aspirate between certain initial consonants and the vowel, so that for instance *p'u* is distinguished from *pu*. The latter is pronounced with little or no emission of breath, the "p" approximating the farther north one goes (*e.g.*, at Niuchwang) more closely to a "b." The aspirated *p'u* is pronounced more like our interjection "Pooh!" The number of vocables in Pekingese has slowly but surely diminished. Thus the initials *ts* and *k*, when followed by the vowel *i* (with its continental value) have gradually become softer and more assimilated to each other, and are now both pronounced *ch*. Again, all consonantal endings in *t* and *k*, such as survive in Cantonese and other dialects, have entirely disappeared from Pekingese, and *n* and *ng* are the only final consonants remaining. Vowel sounds, on the other hand, have been proportionately developed, such compounds as *ao*, *ia*, *iao*, *iu*, *ie*, *ua* occurring with especial frequency. One and the same sound has therefore to do duty for different words. Some sounds may have fewer meanings than ten attached to them, but others will have many more. Thus the following represent only a fraction of the total number of words pronounced *shih* (something like the "shi" in shirt): 史 "history," 使 "to employ," 屍 "a corpse," 市 "a market," 師 "an army," 獅 "a lion," 恃 "to rely on," 侍 "to wait on," 詩 "poetry," 時 "time," 識 "to know," 施 "to bestow," 是 "to be," 實 "solid," 失 "to lose," 示 "to proclaim," 視 "to look at," 十 "ten," 拾 "to pick up," 石 "stone," 世 "generation," 食 "to eat," 室 "a house," 氏 "a clan," 始 "beginning," 釋 "to let go," 試 "to test," 事 "affair," 勢 "power," 士 "officer," 誓 "to swear," 逝 "to pass away," 適 "to happen."

Use of Couplets.—To supplement this deficiency of sounds several devices are employed through the combination of which confusion is avoided. One of these devices is the coupling of words in pairs in order to express a single idea. There is a word 哥 *ko* which means "elder brother." But in speaking, the sound *ko* alone would not always be easily understood in this sense. One must either reduplicate it and say *ko-ko*, or prefix 大 (*ta*, "great") and say *ta-ko*. Simple reduplication is mostly confined to family appellations and such adverbial phrases as 慢慢 *man-man*, "slowly." But in a much larger class of pairs, each of the two components has the same meaning. Examples are: 恐怕 *k'ung-p'a*, "to be afraid," 告訴 *kao-su*, "to tell," 樹木 *shu-mu*, "tree," 皮膚 *p'i-fu*, "skin," 滿盈 *man-ying*, "full," 孤獨 *ku-tu*, "solitary." Sometimes the two parts are not exactly synonymous, but together make up the sense required. Thus in 衣裳 *i-shang*, "clothes," *i* denotes more particularly clothes worn on the upper part of the body, and *shang* those on the lower part. In another very large class of expressions, the first word serves to limit and determine the special meaning of the second: 奶皮 "milk-skin," "cream"; 火腿 "fire-leg," "ham"; 燈籠 "lamp-cage," "lantern"; 海腰 "sea-waist," "strait." There are, besides, a number of phrases which are harder to classify. Thus, 虎 *hu* means "tiger." But in any case where ambiguity might arise, *lao-hu*, "old tiger," is used instead of the monosyllable. 狐 (another *hu*) is "fox," and 狸 *li*, an animal belonging to the smaller cat tribe. Together, *hu-li*, they form the usual term for fox. 知道 *chih tao* is literally "to know the way," but has come to be used simply for the verb "to know." These pairs or two-word phrases are of such frequent occurrence, that the Chinese spoken language might almost be described as bi-syllabic. Suffixes or enclitics are attached to many of the commonest nouns. 女 *nü* is the word for "girl," but in speech 女子 *nü-tzŭ* or 女兒 *nü-'rh* is the form used. 子 and 兒 both mean child, and must originally have been diminutives. The suffix 兒 belongs especially to the Peking vernacular. The use of numeratives is quite a distinctive feature of the language. The commonest of them, 個 *ko*, can be used indifferently in connection with almost any class of things, animal, vegetable or mineral. But there are other numeratives (at least 20 or 30 in everyday use) which are strictly reserved for limited classes of things with specific attributes. 枚 *mei*, for instance, is the numerative of circular objects such as coins and rings; 顆 *k'o* of small globular objects—pearls, grains of rice, etc.; 口 *k'ou* classifies things which have a mouth—bags, boxes and so forth; 件 *chien* is used of all kinds of affairs; 張 *chang* of chairs and sheets of paper; 隻 *chih* (literally half a pair) is the numerative for various animals, parts of the body, articles of clothing and ships; 把 *pa* for things which are grasped by a handle, such as fans and knives.

The Tones.—The tones may be defined as regular modulations of the voice by means of which different inflections can be imparted to the same sound. To the foreign ear, a Chinese sentence spoken slowly with the tones clearly brought out has a certain sing-song effect. It is absurd to suppose the tones were deliberately invented in order to fit each written character with a separate sound. It is considered that tones were the automatic result of the elision of prefixes, some of which as elsewhere may have served as classifiers. A tone is as much an integral part of the word to which it belongs as the sound itself; like the sound, too, it is not fixed once and for all, but is in a constant, though

very gradual state of evolution. This is proved by the great differences of intonation in the dialects. Theoretically, four tones have been distinguished (the even, the rising, the sinking and the entering) each of which falls again into an upper and a lower series. But only the Cantonese dialect possesses all these eight varieties of tone (to which a ninth has been added), while Pekingese has only four: the even upper, the even lower, the rising and the sinking. It appears that down to the 3rd century B.C. the only tones distinguished were the 平 "even," 上 "rising" and 入 "entering" Between that date and the 4th century A.D. the 去 sinking tone was developed. In the 11th century the even tone was divided into upper and lower, and a little later the entering tone finally disappeared from Pekingese. For centuries their existence was unsuspected, the first systematic classification of them being associated with the name of Shên Yo, a scholar who lived A.D. 441–513. The Emperor Wu Ti one day said to him: "Come, tell me, what are these famous four tones?" "They are 天子聖哲 whatever your Majesty pleases to make them," replied Shên Yo, skilfully selecting for his answer four words which illustrated, and in the usual order, the four tones in question. Not every single word in a sentence must necessarily be given its full tonic force. Quite a number of words, such as the enclitics, are not intonated at all. In others the degree of emphasis depends partly on the tone itself, partly on its position in the sentence. In Pekingese the 3rd tone (really the 2nd in the ordinary series, the 1st being subdivided into upper and lower) is particularly important, and next to it in this respect comes the 2nd (that is, the lower even, or 2nd division of the 1st). It may be said, roughly, that any speaker whose 2nd and 3rd tones are correct will at any rate be understood, even if the 1st and 4th are slurred over.

The Characters.—A page of printed Chinese or carefully written manuscript consists of a number of wholly independent units, each of which would fit into a small square, and is called a character. These characters are arranged in columns, beginning on the right-hand side of the page and running from top to bottom. They are *words*, standing for articulate sounds expressing root-ideas, but, unlike our words, are not composed of alphabetical elements or letters. Clearly, if each character were a distinct and arbitrarily constructed symbol, only those gifted with exceptional powers of memory could ever hope to read or write with fluency. This, however, is far from being the case. Most Chinese characters are susceptible of some kind of analysis. Means of communication other than oral began with the use of knotted cords, similar to the *quipus* (*q.v.*) of ancient Mexico and Peru, and were displaced later on by the practice of notching or scoring rude marks on wood, bamboo and stone. The first four numerals, as written with simple horizontal strokes date from this early period. In Chinese writing, a few characters, even in their present form are pictures of objects, pure and simple. Thus, for "sun" the ancient Chinese drew a circle with a dot in it: ⊙, now modified into 日; for "moon" , now 月; for "God" they drew the anthropomorphic figure , which in its modern form appears as 天; for "mountains" , now 山; for "child" , now 子; for "fish" , now 魚; for "mouth" a round hole, now 口; 𠂇 for "hand" now 手; for "well" , now written without the dot. These picture-characters, then, accumulated little by little, until they comprised all the common objects which could be easily and rapidly delineated—sun, moon, stars, various animals, certain parts of the body, tree, grass and so forth to the number of two or three hundred. The next step was to a few compound pictograms: 旦 the sun just above the horizon="dawn"; 林 trees side by side="a forest"; 舌 a mouth with something solid coming out of it="the tongue"; 言 a mouth with vapour or breath coming out of it="words."

While writing was still in its infancy, it must have occurred to the Chinese to join together two or more pictorial characters in order that their association might suggest to the mind some third thing or idea. "Sun" and "moon" combined in this way make the character 明, which means "bright"; woman and child make 好 "good"; "fields" and "strength" (that is, labour in the fields) produce the character 男 "male"; the "sun" seen through "trees" 東 designates the east; 家 has been explained as (1) a "pig" under a "roof," the Chinese idea, common to the Irish peasant, of home, and also (2) as "several persons" under "a roof," in the same sense; a "woman" under a "roof" makes the character 安 "peace"; "words" and "tongue" 話 naturally suggest "speech"; two hands (友, in the old form 𠬜) indicate friendship; "woman" and "birth" 姓="born of a woman," means "clan-name," showing that the ancient Chinese traced through the mother and not through the father. This class of characters, correctly called ideograms, as representing ideas and not objects, is comparatively small. As there was nothing in the character *per se* which gave the slightest clue to the sound of the word it represented, each character had to be learned and recognized by a separate effort of memory. The first step in a new, and, ultimately the right direction, was the borrowing of a character already in use to represent another word identical in sound, though different in meaning. Owing to the scarcity of vocables there might be as many as ten different words in common use, each pronounced *fang*. Out of those ten only one, we will suppose, had a character assigned to it—viz., 方 "square" (originally said to be a picture of two boats joined together). But among the other nine was *fang*, meaning "street" or "locality," in such common use that it became necessary to have some means of writing it. Instead of inventing an altogether new character, as they might have done, the Chinese took 方 "square" and used it also in the sense of "locality." This was a simple expedient, no doubt, but one that applied on a large scale would lead to confusion. The difficulty which presented itself was overcome as in speech by adding to *fang* "square," another part meaning "earth," in order to show that the *fang* in question had to do with location on the earth's surface. The whole character thus appeared as 坊. Nothing was easier now than to provide signs for the other words pronounced *fang*. "A room" was 房 door-*fang;* "to spin" was 紡 silk-*fang;* "fragrant" was 芳 herbs-*fang;* "to enquire" was 訪 words-*fang;* "an embankment," and hence "to guard against," was 防 mound-*fang;* "to hinder" was 妨 woman-*fang*. This class of characters, which constitutes at least nine-tenths of the language, has received the convenient name of *phonograms*. The formation of the phonogram, or phonetic compound, did not always proceed along such simple lines as in the examples given above. In the first place, most of the phonetics now existing are not simple pictograms, but themselves more or less complex characters made up in a variety of ways. Again, the sound is in most cases given by no means exactly by the so-called phonetic, a fact chiefly due to the pronunciation having undergone changes which the written character was incapable of recording. There are extreme cases in which a phonetic provides hardly any clue at all as to the sound of its derivatives. In general, the "final" or rhyme is pretty accurately indicated, while in not a few cases the phonetic does give the exact sound for all its derivatives. A considerable number of phonetics are nearly or entirely obsolete as separate characters, although their family of derivatives may be a very large one. 臤, for instance, is never seen by itself, yet 堅 緊, and 賢 are among the most important characters in the language.

The whole body of Chinese characters, then, may conveniently be divided up, for philological purposes, into pictograms, ideograms and phonograms. The first are pictures of objects, the second are composite symbols standing for abstract ideas, the third are compound characters of which the more important element simply represents a spoken sound. In a strict sense, even the first two classes do not directly represent either objects or ideas, but rather stand for sounds by which these objects and ideas have previously been expressed. It may, in fact, be said that Chinese characters are "nothing but a number of more or

less ingenious devices for suggesting spoken words to a reader."

The "Six Scripts."—The Chinese themselves at a very early date (probably many centuries B.C.) evolved a six-fold classification of characters, the so-called 六書 *liu shu*, very inaccurately translated by the Six Scripts, which may be briefly noticed:—

1. 指事 *chih shih*, indicative or self-explanatory characters. This is a very small class, including only the simplest numerals and a few others such as 上 "above" and 下 "below."

2. 象形 *hsiang hsing*, pictographic characters.

3. 形聲 *hsing shêng* or 諧聲 *hsieh shêng*, phonetic compounds.

4. 會意 *hui i*, suggestive compounds based on a natural association of ideas. To this class alone can the term "ideographs" be properly applied.

5. 轉注 *chuan chu*. The meaning of this name has been much disputed, some saying that it means "turned round"; *e.g.*, 目 *mu* "eye" is now written 目. Others understand it as comprising a few groups of characters nearly related in sense, each character consisting of an element common to the group, together with a specific and detachable part; *e.g.*, 老, 考 and 耆, all of which have the meaning "old." This class is concerned only with peculiarities in the use of characters.

6. 假借 *chia chieh*, borrowed characters, that is, characters adopted for different words simply because of the identity of sound. The period of "borrowed characters" did not last very long, though traces of it are thought to be seen in the habit of writing several characters, especially those for certain plants and animals, indifferently with or without their radicals.

Styles of Writing.—In the earliest inscriptions (Shang dynasty, 18th century B.C.), the so-called 古文 *ku-wen* or "ancient figures," all the above-mentioned forms occur. None are wholly pictorial, with one or two unimportant exceptions. In the following specimen only the last character is unmistakably pictorial: This is read: 申作寶鼎 "Shên made [this] precious *ting*." In 1903 a large number of inscribed bone fragments were excavated in the north of China, which have furnished a list of nearly 2,500 separate characters, of which not more than about 600 have been so far identified. They appear to be responses given by professional soothsayers to private individuals who came to them seeking the aid of divination in the affairs of their daily life. The bones were ancient but some at least of the inscriptions have been forged. It is difficult to fix their date with much exactitude. The script, though less archaic than that of the earlier bronzes, is of an exceedingly free and irregular type. Some attribute them to the Shang, or Yin dynasty (1765–1122 B.C.) in accord with Chinese tradition. Others think that they represent a mode of writing already obsolete at the time of their production, and retained of set purpose by the diviners from obscurantist motives, dating them about 500 years later, or only half a century before the birth of Confucius, long after the appearance of a new and more conventionalized form of writing, called in Chinese 篆 *chuan*, which is commonly rendered by the word Seal, for the reason that many ages afterwards it was generally adopted for use on seals. Under the Chou dynasty, as well as the two succeeding it, the meaning of the word was not "seal," but "sinuous curves," as made in writing. This epoch possibly marks the first introduction into China of the brush in place of the bamboo or wooden pencil with frayed end which was used with some kind of colouring matter or varnish, and the introduction of a supple implement like the brush at the very time when the forms of characters were fast becoming crystallized and fixed, would account for a great revolution in the style of writing. Authentic specimens of the 大篆 *ta chuan*, older or Greater Seal writing, are exceedingly rare. But it is generally believed that the inscriptions on the famous stone drums, now at Peking, date from the reign of King Hsüan, and they may therefore with practical certainty be cited as examples of the Greater Seal in its original form. These "drums," really ten roughly chiselled mountain boulders, were discovered in the early part of the 7th century, lying half buried in the ground near Fêng-hsiang Fu in the province of Shensi. On them are engraved ten odes, a complete ode being cut on each drum, celebrating an imperial hunting and fishing expedition in that part of the country. Great strides had been made in this writing towards symmetry, compactness and conventionalism. The vogue of the Greater Seal appears to have lasted until the reign of the First Emperor, 246–210 B.C. (*see* CHINA: *History*), when further modification took place. For centuries China had been split into a number of practically independent States, and this circumstance seems to have led to considerable variations in the styles of writing. Having unified the empire, the First Emperor proceeded, on the advice of his minister Li Ssŭ, to standardize its script by ordaining that only the style in use in his own State of Ch'in should henceforward be employed throughout China. This new style of writing was the Greater Seal characters in the form they had assumed after several centuries of evolution, with numerous abbreviations and modifications. It was afterwards known as the 小篆 *hsiao chuan*, or Lesser Seal, and is familiar from the *Shuo Wên* dictionary (see CHINESE LITERATURE). Though an improvement on what had gone before, something less cumbrous was felt to be necessary by the clerks who had to supply the immense quantity of written reports demanded by the First Emperor. Thus a simpler and more artistic form of writing was in use, though not universally, not long after the decree abolishing the Greater Seal. This 隸書 *li shu*, or "official script," as it is called, shows a great advance on the Seal character. It is perhaps likely to have been directly evolved from the Greater Seal. It differs from the modern character only in minor details. The Lesser Seal was evidently obsolete at the time of the compilation of the *Shuo Wên*, about 100 years after the Christian era. The Greater Seal and still earlier forms of writing had fallen into utter oblivion before the Han dynasty was 50 years old.

Out of the "official script" two other forms were soon developed, viz., the 草書 *ts'ao shu*, or "grass character" which so curtails the usual strokes as to be comparable to a species of shorthand, requiring special study, and the 行書 *hsing shu* or running hand, used in ordinary correspondence. Some form of grass character is mentioned as in use as early as 200 B.C. or thereabouts, though how nearly it approximated to the modern grass hand it is hard to say; the running hand seems to have come several centuries later. The final standardization of Chinese writing was due to the great calligraphist Wang Hsi-chih of the 4th century, who gave currency to the graceful style of character known as 楷書 *k'ai shu*, sometimes referred to as the "clerkly hand." When block-printing was invented some centuries later, the characters were cut on this model, which still survives at the present day. The script of China has remained practically unchanged ever since. The manuscript rolls of the T'ang and preceding dynasties, discovered by Sir Aurel Stein in Turkestan, show a style of writing not only clear and legible but remarkably modern in appearance.

Grammar.—No set of rules governing the mutual relations of words has ever been formulated by the Chinese, apparently because the need of such rules has never been felt. The most that native writers have done is to draw a distinction between 實字 and 虛字 "full" and "empty words," respectively, the former being subdivided into 活字 "living words" or verbs, and 死字 "dead words" or noun-substantives. By "empty words" particles are meant, though sometimes the expression is loosely applied to abstract terms, including verbs. The above meagre classification is their nearest approach to a conception of grammar in our sense. Every Chinese character is an indivisible unit, representing a sound and standing for a root-idea. Being free from inflection or agglutination of any kind it is incapable of indicating in itself either gender, number or case, voice, mood, tense or person. No Chinese character can be definitely regarded as being any particular part of speech or possessing any particular

function absolutely, apart from the general tenor of its context. Thus, taken singly, the character 上 conveys only the general idea "above" as opposed to "below." According to its place in the sentence and the requirements of common sense, it may be a noun meaning "upper person" (that is, a ruler); an adjective meaning "upper," "topmost" or "best"; an adverb meaning "above"; a preposition meaning "upon"; and finally a verb meaning "to mount upon," or "to go to." It would puzzle grammarians to determine the precise grammatical function of any of the words in the following sentence, with the exception of 何 (an interrogative, by the way, which here happens to mean "why" but in other contexts is equivalent to "how," "which" or "what"): 事何必古 "Affair why must ancient," or in more idiomatic English, "Why necessarily stick to the ways of the ancients in such matters?" Or take a proverbial saying like 少所見多所怪 which may be correctly rendered "The less a man has seen the more he has to wonder at." It is one thing, however, to translate it correctly, and another to explain how this translation can be inferred from the individual words, of which the bald equivalents might be given as: "Few what see, many what strange." To say that "strange" is the literal equivalent of 怪 does not mean that 怪 can be definitely classed as an adjective. On the other hand, it would be dangerous even to assert that the word here plays the part of an active verb, because it would be equally permissible to translate the above, "Many things are strange to one who has seen but little."

There are certain positions and collocations of words which tend to recur, but the number of qualifications and exceptions which will have to be added is so great as to render the rule itself valueless. 馬上 means "on a horse," 上馬 "to get on a horse." But it will not do to say that a preposition becomes a verb when placed before the substantive, as many other prepositions come before and not after the words they govern. If we meet such a phrase as 警寇, literally "warn rebels," we must not mentally label 警 as a verb and 寇 as a substantive, and say to ourselves that in Chinese the verb is followed immediately by its object. Otherwise, we might be tempted to translate, "to warn the rebels," whereas a little reflection would show us that the conjunction of "warning" and "rebels" naturally leads to the meaning "to warn (the populace or whoever it may be) *against* the rebels." Each particular passage is best interpreted on its own merits, by the logic of the context and the application of common sense. The beginner must accustom himself to look upon each character as a root-idea, not a definite part of speech.

The Book Language.—In the beginning, all characters doubtless represented spoken words, but there was no need to reproduce in writing the bisyllabic compounds of common speech because *chien* "to see," in its written form 見, could not possibly be confused with any other *chien*, and it was therefore unnecessary to go to the trouble of writing 看見 *k'an-chien* "look-see," as in colloquial. All superfluous particles or other words that could be dispensed with were ruthlessly cut away, and all the old classical works were composed in the tersest of language, far removed from the speech of the people. The passion for brevity and conciseness resulted often in such obscurity that detailed commentaries on the classics have always constituted an important branch of Chinese literature. After the introduction of the improved style of script, and when the mechanical means of writing had been simplified, literary diction became freer and more expansive, to some extent, but the classics were held in such veneration as to exercise the profoundest influence over all succeeding schools of writers, and the divorce between literature and popular speech became permanent. No book of any first-rate literary pretensions would be easily intelligible to any class of Chinese, educated or otherwise, if read aloud exactly as printed. The public reader of stories is obliged to translate, so to speak, into the colloquial of his audience as he goes along. There is no inherent reason why the conversation of every-day life should not be rendered into characters, as is done in foreign handbooks for teaching elementary Chinese; one can only say that the Chinese do not think it worth while. There are a few words, indeed, which, though common enough in the mouths of genteel and vulgar alike, have positively no characters to represent them. On the other hand, there is a vast store of purely book words which would never be used or understood in conversation.

The book language is nice in its choice of words, and obeys special rules of construction. Of these, perhaps the most apparent is the carefully marked antithesis between characters in different clauses of a sentence, which results in a kind of parallelism of rhythmic balance. This parallelism is a noticeable feature in ordinary poetical composition, and may be well illustrated by the following four-line stanza: "白日依山盡 The bright sun completes its course behind the mountains; 黃河入海流 The yellow river flows away into the sea. 欲窮千里目 Would you command a prospect of a thousand *li*? 更上一層樓 Climb yet one storey higher." In the first line of this piece, every single character is balanced by a corresponding one in the second: 白 white by 黃 yellow, 日 sun by 河 river, and so on. In the 3rd and 4th lines, where more laxity is generally allowed, every word again has its counterpart, with the sole exception of 欲 "wish" and 更 "further." Some of the early Jesuit missionaries, men of great natural ability who steeped themselves in Oriental learning, have left very different opinions on record. Chinese appeared to be as admirable for the superabundant richness of its vocabulary as for the conciseness of its literary style. And among modern scholars there is a decided tendency to accept this view as embodying a great deal more truth than the other.

The Chinese language has to assimilate the vast stock of new terminology which closer contact with the West would necessarily carry with it, by the conjunction of two or more characters already existing; of this 昇降機 (rise-descend-machine) for "lift," and 議政國會 (discuss-govern-country-assembly) for "parliament" are examples. Even a metaphysical abstraction like the Absolute has been tentatively expressed by 絕對 (exclude-opposite); but in this case an equivalent was already existing in the Chinese language.

A drastic measure, strongly advocated in some quarters, is the entire abolition of all characters, to be replaced by their equivalent sounds in letters of the alphabet. Under this scheme 人 would figure as *jên* or *ren*, 馬 as *ma*, and so on. But the proposal has fallen extremely flat. The vocables are so few that only the colloquial, if even that, could possibly be transcribed in this manner. Any attempt to transliterate classical Chinese would result in a mere jumble of sounds, utterly unintelligible, even with the addition of tone-marks. There is another aspect of the case. The characters are a potent bond of union between the different parts of the country with their various dialects, and the script, in spite of certain disadvantages, has hitherto triumphantly adapted itself to the needs of civilized intercourse.

BIBLIOGRAPHY.—P. Premare, *Notitiae Linguae Sinicae* (1831); Ma Kien-chung, *Ma shih wên t'ung* (1899); L. C. Hopkins, *The Six Scripts* (1881) and *The Development of Chinese Writing* (1910); H. A. Giles, *A Chinese-English Dictionary* (2nd ed., 1910); B. Karlgren, *Sound and Symbol in Chinese* (1923).

CHINESE LITERATURE is especially remarkable (1) for its antiquity, coupled with an almost unbroken continuity down to the present day; (2) for the variety of subjects presented, and for the exhaustive treatment which not only each subject but also each subdivision has received, as well as for the colossal scale on which many literary monuments have been conceived and carried out; and (3) for the accuracy of many of its historical statements, so far as it has been possible to test them.

The Chinese usually divide their literature into four great groups. Under the first of these we find the Confucian Canon, together with lexicographical, philological, and other works dealing with the elucidation of words. Under the second, histories of various kinds, officially compiled, privately written, constitutional, etc.; also biography, chronography, catalogues, government, geog-

raphy and bibliography. Under the third, philosophy, religion, *e.g.,* Buddhism; the arts and sciences, *e.g.,* war, law, agriculture, medicine, astronomy, painting, music and archery; also a host of general works, monographs, and treatises on a number of topics, as well as encyclopaedias. The fourth class is confined to poetry and essays, poetical critiques and works dealing with the rhymes —what might, in other words, be called *belles lettres.*

Poetry.—Proceeding, with only partial reference to Chinese classification, we begin with the last of the above four classes. Among the oldest Chinese records in our possession are songs and ballads. The earliest were for ritual purposes in religious ceremonies, and may belong to about the ninth century B.C. These and later poems of the Chou period are collected in the *Shih Ching,* popularly known as the odes, which forms an important portion of the Confucian Canon. The odes treat of a variety of subjects of war and love, of eating and drinking and dancing, of the virtues and vices of rulers, and of the misery and happiness of the people. Many are for religious purposes, and others are satires, or love songs, or complaints of soldiers against their commander, or are for popular festivals.

Passing over the intervening centuries we come to the most glorious age of Chinese poetry, the T'ang dynasty. From the long string of names which have shed lustre upon it, the following, all of the first rank, may be mentioned. Wang Wei (A.D. 699–759), in addition to being a poet, was also a landscape-painter of great distinction. He was further a firm believer in Buddhism; and after losing his wife and mother, he turned his mountain home into a Buddhist monastery. Of all poets, no one has made his name more widely known than Li Po, or Li T'ai-po (A.D. *c.* 705–762), popularly known as the Banished Angel, so heavenly were the poems he dashed off, often under the influence of wine. Although a genial companion and at times in high favour at court, he was of a roving disposition, and a note of melancholy, of unsatisfied longing, recurs through his verses. He had a strong Taoist strain. Apparently he dashed off his poems spontaneously and rapidly. His work is noted for its lyric beauty, and its daring and successful departure from accepted forms, and unconventional handling of older poetic styles. Tu Fu (A.D. 712–770) is generally ranked with Li Po, the two being jointly spoken of as the chief poets of their age. Tu Fu had a life marked by much suffering, disappointment, and disaster. Possibly because of this, his poetry is characterized by stark realism. He took great pains with his composition and it lacks something of the freedom of Li Po. Po Chü-i (A.D. 772–846) held several high official posts but found time for a considerable output of some of the finest poetry in the language. His poems were collected by imperial command and engraved upon tablets of stone.

The poets of the Sung dynasty (A.D. 960–1279) were many and varied in style; but their work, much of it of the very highest order, was more formal and precise. Life seemed to be taken more seriously than under the gay and pleasure-loving T'ang. The long list of Sung poets includes such names as Ssŭ-ma Kuang, Ou-yang Hsiu and Wang An-shih. A still more familiar name in popular estimation is that of Su Tung-p'o (A.D. 1036–1101), known as a philosopher, but more as a brilliant poet and essayist.

The Mongols (A.D. 1280–1368), who succeeded the Sungs, and the Mings who followed the Mongols and bring us down to the year 1644, helped, especially the Mings, to swell the volume of Chinese verse, but without reaching the high level of the two great periods above mentioned. Then came the Manchu dynasty, of which the same tale must be told, in spite of two highly cultured emperors, K'ang Hsi and Ch'ien Lung, both of them poets and one of them author of a collection containing no fewer than 33,950 pieces, the majority of which are but four-line stanzas of little literary value.

The chief moods of the Chinese poet are a pure delight in the varying phenomena of nature, and a boundless sympathy with the woes and sufferings of humanity. Erotic poetry is not absent, but it is not proportionate to the great body of Chinese verse. In his love for hill and stream, which he peoples with genii, and for tree and flower, which he endows with sentient souls, the Chinese poet is seen at his best. His views of life are deeply tinged with melancholy and often loaded with an overwhelming sadness "at the doubtful doom of humankind." In his lighter moods he draws inspiration, and in his darker moods consolation, from the wine-cup. The present day, with its use of the colloquial for literary purposes and its break with old conventions, is witnessing many interesting new schools of poetry, some of them strongly Chinese, others with Western prototypes.

History.—The oldest of Chinese histories is a series of ancient documents now passing under a collective title as *Shu Ching* and popularly known as the canon or book of history. Some of its documents are genuine remains of the Chou dynasty and a few are possibly even of earlier date, but others are fabrications of later times. The work opens with an account of the legendary emperors Yao, Shun and Yü, and continues down into the 8th century B.C. The next step brings us to Confucius. Among his other literary labours, the great sage undertook to edit the annals of Lu, his native State, basing them on the officially kept chronicle of that principality. The work is known as the *Ch'un Ch'iu* (*i.e.,* the Spring and Autumn) Annals. It consists of a varying number of brief entries under each year of the reign of each successive ruler of Lu which scarcely make possible the reconstruction in any detail of the age they profess to record. The *Tso Chuan,* a so-called commentary on the Ch'un Ch'iu, in reality is of independent origin. It is made up of one or more histories and seems to be in part at least as old as the second century B.C.

Historiography took its next great step under Ssŭ-ma Ch'ien (*c.* 145–87 B.C.), the son of an hereditary court astrologer who was also an eager student of history and the actual planner of the great work so successfully carried out after his death. By the time he was ten years of age, Ssŭ-ma Ch'ien was already well advanced with his studies, and at 20 he set forth on a round of travel which carried him to all parts of the empire. Entering the public service, he was employed upon a mission of inspection to the newly conquered regions of Ssuch'uan and Yünnan. In 110 B.C. his father died, and he stepped into the post of grand astrologer. After devoting some time and energy to the reform of the calendar, he took up the work which had been begun by his father and which was ultimately given to the world as the *Shih Chi,* or historical record. This was arranged under five great headings, viz., (1) Annals of Imperial Reigns, (2) Chronological Tables, (3) Monographs, (4) Annals of Vassal Princes and (5) Biographies. The historical record begins with the so-called Yellow Emperor, a shadowy and probably mythical figure, and continues down into the Han dynasty. Ssŭ-ma Ch'ien's great work has been accepted as the model for all subsequent dynastic histories, of which 26 have now been published. As a rule each dynasty found its historian in the dynasty which supplanted it; and as a group the dynastic histories are notable for the fairness with which the conquerors have dealt with the vanquished, accepting without demur such records of their predecessors as were available from official sources. The output of history, however, does not begin and end with the voluminous records above referred to. History has been a favourite study with the Chinese, and innumerable histories of a non-official character, long and short, complete and partial, political and constitutional, have been showered from age to age upon the Chinese reading world. One of the best is the *Tzŭ Chih T'ung Chien,* or mirror of history, so called because "to view antiquity as though in a mirror is an aid in the administration of government." It was the work of a statesman of the 11th century, whose name, by a coincidence, was Ssŭ-ma Kuang. It embraces a period from the 4th century B.C. down to A.D. 960. It is written in a picturesque style, but the arrangement was found to be unsuited to the systematic study of history. Accordingly, it was subjected to revision, and was to a great extent reconstructed under the direction of Chu Hsi (A.D. 1130–1200), the famous philosopher.

In regard to biography, the student is by no means limited to the dynastic histories. Many hundreds of biographies have been written and huge biographical collections have been compiled and published.

Geography and Travel.—There is a considerable volume of Chinese literature which comes under this head, but if we exclude

relatively few accounts of foreign countries, nothing in the way of general geography had been produced prior to the arrival of the Jesuit Fathers at the close of the 16th century. Up to that period geography meant the topography of the Chinese empire, and of topographical records there is a very large and valuable collection. Most of the prefectures and departments have their individual topographies, compiled with great fullness from records and from tradition. The buildings, bridges, monuments of archaeological interests, etc., in each district are all carefully inserted, side by side with biographical and other local details. The Chinese have been fond of travel, and hosts of travellers have published notices, more or less extensive, of the different parts of the empire, and even of adjacent nations. With Buddhism came the desire to see the country which was the home of the faith, and several important pilgrimages were undertaken with a view to bringing back images and sacred writings to China. Chief among these pilgrims, from the standpoint of the records which they left, were Fa Hsien, whose travels covered the years A.D. 399–414, and Hsüan Tsang, who was away from China from A.D. 629 to 645.

Philosophy.—In philosophy China has almost as long a history as the Occident. A brief survey can only name a few outstanding figures and indicate some of the main trends of thought. As has been hinted (*see* CHINA: *History*), the Chou dynasty witnessed the beginning of philosophical speculation and before its close the main schools of native thought had begun to take form. Most of the founders served the State as officials and the problem common to them all was one of government. The empire was broken into many warring States, injustice and oppression were rife, and an awakening conscience sought a remedy. The early philosophers, then, were concerned chiefly with social and ethical questions. They were interested only incidentally, if at all, in theories of knowledge or of a future life. What in time came to be the dominant school found its great formulator in Confucius (6th and 5th centuries B.C.). Born in the feudal State of Lu in what is now Shantung, for part of his life he was in office. His standards were too high to permit him to remain permanently in official position, and during most of his career he was a teacher, for years travelling from place to place hoping that a prince would accept his services on his own exacting terms. He believed social salvation to lie chiefly in a return to the best of the past. This he interpreted as emphasis on the cultivation of morality in the governing classes (for he believed that political problems were fundamentally ethical and that the example of the rulers determined the character of the people), on bringing into the service of the State the men of highest integrity and education, the perpetuation of the ceremonies, religious, social and political, of antiquity, and on loyalty to the chief social relations, particularly those of the family. He declined to discuss the future life and was reserved about the supernatural, but he had a profound belief that directing the universe was a righteous Being before whom man should stand in awe and conscious dependence.

Mencius, who lived in the second half of the 4th century, revered Confucius but placed greater emphasis upon the innate goodness of human nature and, as a natural corollary to it, enunciated the duty of princes to listen to the voice of the people and the right of the people to revolt against injustice in high places. Hsün Tzu, of the 3rd century B.C., reckoned as in part in the spiritual lineage of Confucius, held man to be bad by nature but capable of improvement through proper ethical standards and regulation by himself and the State. He denied all belief in the supernatural and in spirits, and depersonalized the ruling element in the universe by describing it as unvarying law.

A second school of thought, commonly called Taoism and also beginning in the Chou dynasty, has as its basic classic the *Tao Tê Ching*. The authorship of this is usually ascribed, although on decidedly dubious grounds, to a shadowy Lao Tzŭ, said to have been an older contemporary of Confucius. The *Tao Tê Ching* held up as ideal conformity to the way of nature (the Tao). Conformity to the way of nature, it maintained, involved the absence of regulations and of the artificialities of civilization. In a rough way this early Taoism corresponded to the philosophical anarchism of the West. Chuang Tzŭ, of the 4th and 3rd centuries B.C., was of the same school, and by his vivid style did much to give it currency—and prepared the way for its eventual degradation.

Mo Ti, of the 4th and 5th centuries B.C., was very influential. He held that all institutions should be judged by their ability to promote human welfare, and on that ground condemned, among other things, music and elaborate funerals. He also believed that ruling the universe is a Being whose dominant characteristic is love, and that love of man for man should be the basic principle of human conduct. He was followed by two schools, one of which developed his principle of utility into a logical method based on empiricism, and the other emphasized the religious side of his teaching.

Yang Chu, also of the 4th century B.C., was an ethical egoist, who would have each man seek happiness for himself in ways dictated by prudence, but with no care for the happiness of others.

The Legalists, who flourished chiefly in the 4th to the 1st centuries B.C., emphasized well-devised laws, adjusted to the needs of the time and enforced by an autocratic state as a means of bringing order into the disturbed society of their day.

With the Han dynasty, Confucianism was made the established philosophy of the State, and free speculation tended to die. Mohism and Legalism disappeared, although not without leaving their imprint; and Taoism, while at times popular at court, degenerated into a search for the elixir of life and a means of effecting the transmutation of metals. At least one semi-independent thinker of importance, Wang Ch'ung (A.D. 27–97), appeared, teaching, among other things, that man might be either good or bad by nature, and declaring spirits and miracles to be hallucinations. With the entrance of Buddhism in the latter part of the Han dynasty and the rapid spread of the new faith in the next few centuries, new elements were brought into Chinese philosophy. Descriptions of Buddhism and of Buddhist thought are given elsewhere and need not be repeated here. Buddhism greatly influenced Taoism, but for several centuries orthodox Confucianism was but little modified by it. During the Sung dynasty, however, Confucian scholars came to grips with some of the fundamental issues raised by Buddhism and several interpretations contended for the mastery. That finally accepted by the State had as its greatest exponent Chu Hsi (A.D. 1130–1200), who by his lucid pen aided its triumph. Chu Hsi made Confucianism an orderly philosophical system, which, while professedly grounded solidly on the ancient classics, showed distinctly the influence of Buddhism, and had a cosmology that would have seemed strange to many of the Chou period.

Until the beginning of the 20th century Chu Hsi dominated official scholarship. Here and there was an influential rebel, most prominent being Wang Yang-ming (A.D. *c.* 1472–1528), who, after attempting to arrive at knowledge in the way commended by the orthodox (the investigation of the outward world), had an experience of enlightenment resembling that of the Buddhist, and henceforth sought by looking within his own mind and heart to understand the universe. Some modern radical scholars, moreover, regard a small group in the Manchu dynasty, the Han Hsüeh or Han Learning, as having prepared the way for the intellectual revolution of today. In the present century, with the breakdown of the older structure of government and its support of orthodoxy, and with the New Tide or Renaissance movement, interest in philosophical speculation again awoke. Many schools of thought have been represented.

Arts and Sciences.—Not much, relatively speaking, has been written by the Chinese on military strategy or tactics. However, a number of works of various periods have come down to us.

Partly because of the high place traditionally accorded to farmers, who rank second only to officials and before artisans and traders, and because of the assiduity with which agriculture has been practised in all ages, a great volume of agricultural literature exists, some of it as old as the T'ang. Until the present century the standard work was the *Nung Cheng Ch'üan Shu,* compiled by Hsü Kuang-ch'i (1562–1634). It is in 60 sections, the first three of which are devoted to classical references. Then follow two sections on the division of land, six on the processes of husbandry, nine on hydraulics, four on agricultural implements,

six on planting, six on rearing silkworms, four on trees, one on keeping and breeding animals, one on food and 18 on provision against a time of scarcity.

From Chou times China has had medical works of many kinds. Until the coming of Western medical science, in the whole range of Chinese medical literature there was nothing which could approach the *Pên Ts'ao Kang Mu,* or *Materia Medica,* called the Herbal. This was compiled by Li Shih-chen, who completed his task in 1578 after 26 years' labour. No fewer than 1,892 species of drugs, animal, vegetable and mineral, are dealt with, arranged under 62 classes in 16 divisions.

Mathematics and astronomy have both been written about fairly extensively. Foreign influence has been potent in both these fields.

The practice of divination is of ancient date, more so than even the *I Ching,* or canon of changes. The *I Ching* was originally deduced from eight diagrams made up of broken and unbroken lines (thus, ☰, ☱, ☲, ☳, etc.). It is attributed, mistakenly, to Wên Wang, whose son founded the Chou dynasty. To it many of the greatest Chinese philosophers devoted much thought and it has been widely used by many different kinds of diviners. Numbers of other methods have also been adopted and have yielded a considerable bulk of literature. In like manner, geomancy is a subject on which many volumes have been written; and the same applies to palmistry, physiognomy and alchemy.

Calligraphy, in the eyes of the Chinese, is just as much a fine art as painting, but the latter occupies the larger space in Chinese literature and forms the subject of extensive works. One of the most important of these is the *Hsüan Ho Hua P'u,* the author of which is unknown. It contains information concerning 231 painters and the titles of 6,192 of their pictures, all in the imperial collection during the reign period *Hsüan Ho* (A.D. 1119–1126) from which the title is derived.

The literature of music does not go back to a remote period. The canon of music, which was formerly included in the Confucian Canon, has been lost for many centuries. The works now available, exclusive of entries in the dynastic histories, are not older than the 9th century A.D. There are a vast number of works, many of them exhaustive, on such topics as archaeology, seals (engraved), numismatics, pottery, ink (the miscalled "Indian"), mirrors, precious stones, tea, wine, chess, wit and humour, cookery, etc. Reprints of miscellaneous books and pamphlets in a uniform edition, the whole forming a "library," have long been a favourite means of disseminating information. In a similar manner it has been customary for relatives or friends, sometimes for the trade, to publish the "complete works" of important and often of unimportant writers, usually soon after death.

Novels and Plays.—Although novels were formerly not regarded as an integral part of literature proper, it was generally conceded that some might be profitably studied, if for no other reason than their style. Their first marked development was in the Mongol dynasty. The *San Kuo Chih Yen I,* an historical romance based upon the period of disruption at the close of the 2nd century A.D., is a delightful book, packed with episodes of battle, heroism, self-sacrifice, skilful strategy and all that goes to make up a stirring picture of strenuous times. Its author cannot be named for certain; it grew as a series of popular tales told and retold for centuries. From the 13th century the growth of the novel was continuous; and finally, in the 16th century, a point was reached which is not likely soon to be surpassed. The *Hung Lou Meng,* written in the 18th century, is a creation of a very high order. Its plot is intricate and original, and the *dénouement* startlingly tragic.

By an evolution probably extending over many centuries, stage-plays came into existence in China. In the earliest known ages there were set dances by trained performers, to the accompaniment of music and singing; and something of the kind, more or less ornate as regards the setting, had long been associated with solemn and festive occasions. However, not until the days of the Mongol rule, A.D. 1280–1368, can the drama proper be said to have come to full flowering. There is an excellent collection of 100 plays of the Mongol dynasty, published in 1615. There is also a large collection, issued in 1845 and in the years following.

Dictionaries and Encyclopaedias.—The *Erh Ya,* commonly classed as a dictionary, is referred by native scholars generally to the 12th century B.C., but some parts of it are at least as late as the 3rd century B.C. With the *Shuo Wên,* or explanation of written words, we begin the long list of lexicographical works which constitute such a notable feature in Chinese literature. A scholar named Hsü Shên, who died about A.D. 120, made an effort to bring together and analyze all the characters it was possible to gather from the written language as it existed in his own day. He then proceeded to arrange these characters (about 10,000 in all) on a system, by radicals, which would enable a student to find a given word without having to search through the whole book. Passing over a long series of dictionaries and vocabularies which appeared at various dates, some constructed on Hsü Shên's plan, with modifications and improvements, and others, known as phonetic dictionaries, arranged under the finals according to the tones, we come to the great standard lexicon produced under the auspices, and now bearing the name of the Emperor K'ang Hsi, A.D. 1662–1723. The total number of characters given therein amounts to about 49,000, grouped no longer under the 540 radicals of Hsü Shên but under the much more manageable number of 214, as already used in earlier dictionaries. Further, as the groups of characters would now be more than four times as large as in the *Shuo Wên,* they were subdivided under each radical according to the number of strokes in the other or phonetic part of the character.

Considering the long unbroken series of years during which Chinese literature has, in spite of many losses, been steadily gaining in bulk, it is not astonishing to find that classical, historical, mythological and other allusions to personages or events of past times have also grown out of all proportion to the brain capacity even of the most brilliant student. Designed especially to meet this difficulty, there are several well-known handbooks, elementary and advanced, which trace such allusions to their source and provide full and lucid explanations. In their desire to bring together condensed, yet precise, information on a large variety of subjects, the Chinese may be said to have invented encyclopaedias. They differ, however, from Western encyclopaedias in being made up; not of articles especially composed for the purpose, but of extracts of existing works. Though not the first work of this kind, the *T'ai P'ing Yü Lan* is an early famous example. It was produced toward the close of the 10th century A.D., under the direct supervision of the emperor. Its total number of sections is over 1,000, arranged under 55 headings. Other encyclopaedias, differing in scope and in plan, appeared from time to time. The largest ever compiled was the *Yung Lo Ta Tien,* under the orders of the third emperor of the Ming dynasty. Yung Lo's object was to collect all that had ever been written on the Confucian Canon, history, philosophy and the arts and sciences. The resulting work was too huge to be printed, for it ran to 22,937 books, and only three copies were made. Of these, two were destroyed on the fall of the Ming dynasty and the third, with the exception of a few odd volumes, at the time of the Boxer outbreak. The *T'u Shu Chi Ch'êng* was planned, and to a great extent made ready, under instructions from the Emperor K'ang Hsi and was finally brought out by his successor, Yung Cheng, 1723–35.

Recent Developments.—The intellectual revolution which is one of the accompaniments of the impact of the West upon China has resulted in a vast flood of literature. Most of it is ephemeral: newspapers by the thousand, magazines by the score, placards and pamphlets. Much of it is in the form of text-books on modern subjects issued by such publishing houses as the Commercial Press. Some is of a more original nature, such as a history of philosophy by Hu Shih, books by Liang Ch'i-ch'ao, and Liang Siuming's *The Civilizations of the East and the West and Their Philosophies.* All these are symptomatic of the greatest intellectual ferment that China has known for centuries. Much of the modern literature is in the *pei hua,* a purified form of the mandarin. Accepted standards of literature as of other phases of human thought and activity have been challenged and the end is not yet in sight.

At the conclusion of this brief survey of Chinese literature, it may well be asked how such an enormous and ever-increasing mass has been handed down from generation to generation. When the Chinese began to write in a literary sense they seem to have traced their characters on slips of bamboo with brush-pens. Under the Han dynasty paper was developed, the traditional date of its invention being A.D. 105. Printing was preceded by rubbings from inscriptions, printed silk, stencils, seals and stamps. The earliest extant examples of true printing, by means of engraved blocks of wood, date from A.D. 770 and are from Japan, but these were preceded by earlier steps in China for the purpose of reproducing the Buddhist Scriptures.

Moveable types were invented in the 11th century, but the prevailing method even today is by engraved blocks of wood, one block for each two pages of text.

BIBLIOGRAPHY.—L. Legge, *The Chinese Classics* (1861–72); A. Wylie, *Notes on Chinese Literature* (1867); E. Chavannes, *Memoires historiques* (1895–1905); H. A. Giles, *Chuang Tzu* (1889) and *A History of Chinese Literature* (1901); A. Forke, *Lun-Heng* (1907); W. E. Soothill, *The Analects of Confucius* (1910); D. T. Suzuki, *A Brief History of Early Chinese Philosophy* (1914); Y. L. Fung, *A History of Chinese Philosophy* (1937); A. Waley, *One Hundred and Seventy Chinese Poems* (1919); W. Bynner and Kiang Kang-hu, *The Jade Mountain. A Chinese Anthology, Being Three Hundred Poems of the T'ang Dynasty, 618–906* (1929); G. Margouliès, *Le Kou-Wen Chinois* (1926); Hu Shih, *The Development of the Logical Method in Ancient China* (1922); J. P. Bruce, *The Philosophy of Human Nature by Chu Hsi* (1922); *Chu Hsi and His Masters* (1923); S. Obata, *Li Po* (1922); C. H. Brewitt-Taylor, *San Kuo* (1925); Zucker, *The Chinese Theatre* (1925); C. S. Gardner, *Chinese Traditional Historiography* (1938); T. F. Carter, *The Invention of Printing in China and Its Spread Westward* (1925); H. H. Dubs, *Hsüntze, The Moulder of Ancient Confucianism* (1927); J. J. L. Duyvendak, *The Book of Lord Shang* (1928). (K. S. L.)

CHINESE MUSIC. Music played a great part in the origins of ancient Chinese civilization, the pitch-pipe of the normal pitch (called Huang-chung) was the basis of the Chinese system of measures, of the calendar and of their astronomical calculations.

A Musical System.—According to tradition, the emperor Huang-ti (*c.* 2697 B.C.) sent his minister Ling-lun to the Kun-lun mountains in north-west China to cut a pitch pipe from a species of bamboo which gave the note Huang-chung. Eleven other notes were derived from this note by the following process: a third part of the nine-inch pipe Huang-chung was cut off, thus producing a second pipe, Lin-chung, which was six inches long ($9\times\frac{2}{3}$) and gave the fifth. The second pipe was divided into three parts, and one of the third parts was added to it (8 in. or $6\times\frac{1}{3}$); this gave the descending fourth (Tai-tsu) from the second pipe, and so on. This was the origin of the 12 Chinese pitch pipes; Huang-chung (Ć), Ta-lu (Ć♯), Tai-tsu (Ď), Chia-chung (Ď♯), Ku-hsi (Ĕ), Chung-lu (Ḟ), Jui-pin (Ḟ♯), Lin-chung (Ġ), I-tse (Ġ♯), Nan-lu (Ā), Wu-i (Ā♯), and Ying-chung (B̄). The Chinese system of fifths is first mentioned in the work *Lu-Tsu-Chun-Chiu,* which dates from the 3rd century B.C.—about the time when the Pythagorean musical system was made known in Greece by the pupils of Pythagoras.

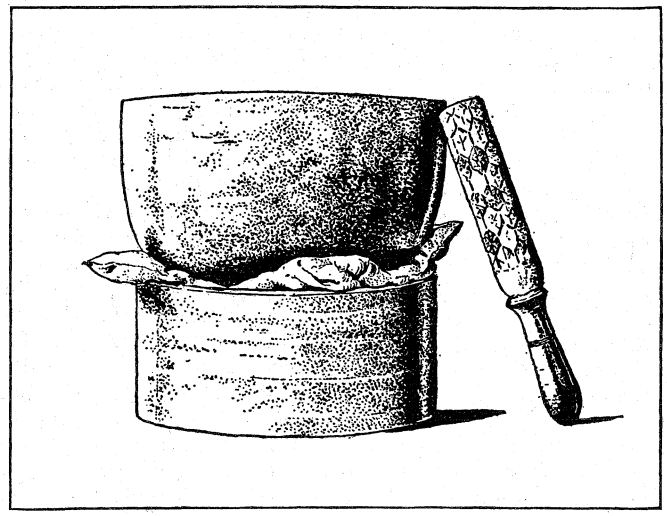
As the circle of fifths could not be closed owing to the (Pythagorean) comma, the Chinese made a number of attempts in the course of the ages to divide the octave into 60 notes (King-fang, *c.* 40 B.C.), 360 notes (Chien-lo-chih, *c.* A.D. 430), 18 notes (Tsai-yuan-ting, *c.* A.D. 1180), and 12 notes (Ho-cheng-tien, *c.* A.D. 420 and Wang-po, *c.* A.D. 958), equal and unequal temperament respectively. The old system of fifths still continued however to be the prevailing system. Finally, Prince Chu-tsai-yu, in 1595, a century earlier than Andreas Werkmeister (1691) in Europe, fixed the twelve pitch-pipes in equal temperament; in order to obtain the nearest semitone he divided the length of a pitch-pipe by 1·0594631 or $\sqrt[12]{2}$ and its diameter by 1·0292857 or $\sqrt[24]{2}$. The mathematical and physical basis was confirmed by experiment by the Belgian authority on acoustics, V. Ch. Mahillon.

The ancient Chinese scale has five tones: Kung (C), Shang (D), Chiao (E), Chih (G) and Yu (A). Later, under the Chou dynasty (1122–255 B.C.), two further notes, Pien-chih (F♯) and Pien-kung (B) were added.

Each note of this scale of five or seven notes can be used as the primary note of a scale, and this gives five or seven modes, just as in Greek music we have the Doric, the Phrygian mode, etc. As each of these five or seven modes can be transposed in twelve ways, there are 60 or 84 keys in Chinese music. (X.)

Musical Practice.—The ancient theory and the classical music of past centuries are connected almost exclusively with the rites and ceremonies of the temples of worship and of the court. One of the old literary classics, the *Li Ki* or *Book of Rites,* contains many allusions to music; and one whole section (said to be a later interpolation) is devoted wholly to music in its ethical, ritual and symbolic aspects. Until a few decades ago the Imperial Ministry of Rites included a bureau of music, but the function of this office seems to have been entirely a matter of ceremonial tradition, and to have had no connection with the practice of music in its popular forms. The performance of ritual music was continued in certain places up to most recent times with a scrupulous adherence to tradition. The solemn celebration of the highest office of the Confucian worship is accompanied by a traditional orchestra of 44 pieces. Taoist temples are content with about six instruments. In the Confucian solemn rite the Emperor himself was supposed to be the chief celebrant. The pentatonic, non-harmonic music for this celebration has often been reproduced in European notation in the books on Chinese music, particularly the solemn march to which the imperial worshipper proceeded to the door of the temple and the concluding monodic hymn to Confucius (Ta tsai K'ung tsen) in which all the instruments and voices took part.

Music outside the temples is more popular in character and has probably been subjected to more frequent changes in style; although even here the tenacious conservative instincts of the race have handed down a more archaic type of music to the present day than is known in the occidental countries. The practice of this music by individuals, particularly by amateurs of high social status for their own aesthetic satisfaction is not so widespread in China as in the West. Home or household music seems to have been more highly developed in Japan than in China. There is, in China, no well organized class of professional music teachers. Most musicians acquire their art in a purely empirical way,



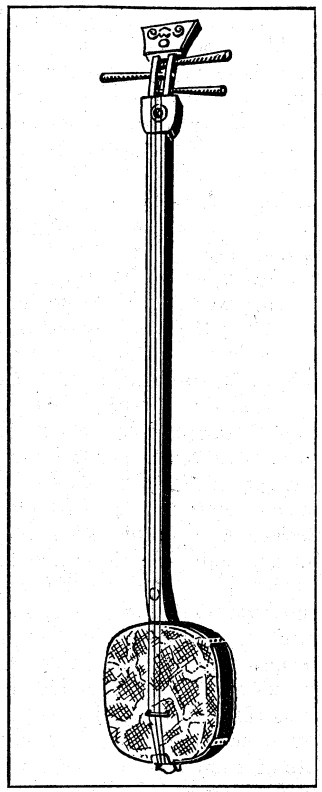
BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

CHINESE GONG AND STICK, A MUSICAL PERCUSSION INSTRUMENT NOW USED CHIEFLY IN THE THEATRE

although there is a considerable body of books containing the notations of tunes for various instruments. This notation is not a staff notation, but a tablature system, that is, a series of signs or symbols for the individual tones, frets or finger positions. Vocal music has an important place in the temples and still more in the theatre. Apart from this it is not cultivated as an art co-ordinate with instrumental music to the same extent as in Western nations, although the singing of songs and ballads is not uncommon.

Musical Instruments.—The number of instruments used by

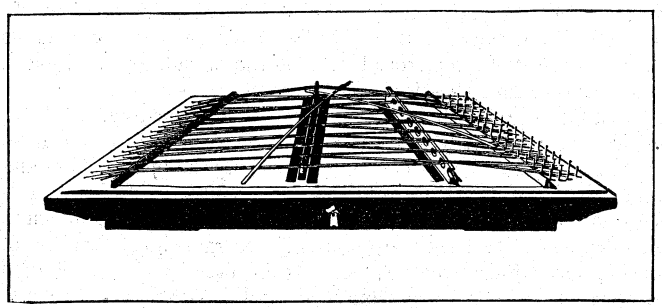
the Chinese is comparatively large. Moule lists and describes not fewer than 130. Many of them are, to be sure, mere toys or signal instruments of no great musical importance. They are used by mountebanks at fairs or markets, and by hawkers or beggars. European writers about Chinese instruments devote much space to the description of the ancient classic instruments used in temple worship, many of which have long since gone out of common use. They are largely percussion instruments, including many forms of highly ornamented drums (*Ying ku,* 應鼓; *po fu,* 搏附; *pang ku,* 梆鼓), sonorous stones single (*t'e k'ing* 特磬) or arranged in chimes (*pien k'in* 編磬) or bronze bells used in the same manner (*po chung* 鎛鍾; *pien chung* 編鍾). The *k'in* 琴 is a narrow hollow box 3 to 4 ft. in length, with slightly convex upper surface. It has five, or in more modern instruments, seven silk strings plucked with the fingers, and was still used until fairly recent times for refined artistic music. Its Japanese counterpart is the *koto.* A larger instrument constructed on the same principle, but having in earlier times as many as 50 strings, later only about 25, is the *se,* rarely used except in ceremonies. The ancient instruments were classified by the older theory according as they produced the sound of stone, metal, silk, bamboo, wood, skin, gourd and earth. The most important instruments still in use are the two-stringed fiddle, *hu k'in,* 胡琴; the four-stringed moon guitar, *y"ueh k'in,* 月琴; the four-stringed, pear-shaped, balloon guitar, *p'i p'a,* 琵琶; the three-stringed guitar with a very long neck, *san hsien,* 三絃; a first cousin of the Japanese *samisen.* Of the flute type are the straight (direct) flute *hsiao* 簫; and the transverse flute *ti,* 笛. Reed instruments are represented by the gentle *kuan tzu* 管子, a straight bamboo tube, 8 to 10 in. long, with a rice straw serving as a double reed or oboe mouthpiece; and the shrill, *so na* 鎖吶, a double reed instrument with a conical wooden body ending in a metal "bell," often called the Chinese clarinet. The *sheng* 笙 consists of a lacquered wooden body (formerly a gourd or calabash), about the shape and size of a tea cup, and a mouthpiece through which the player inhales the air. On the body are grouped 13 to 17 speaking pipes, slender bamboo tubes each provided with a thin, free reed of metal. Each tube has a hole below the reed and the pipe speaks only when the hole is stopped by the player's finger. The *yang k'in,* 洋琴, or foreign psaltery, consists of a trapezoidal sound box about 2 ft. in width over which are usually stretched 14 to 20 double, triple or quadruple sets of metal strings which are played by striking them with two light bamboo rods.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

THE THREE-STRINGED CHINESE BANJO, SHOWING LONG NECK

Modern percussion instruments, used chiefly in the theatre, include the large gong (*lo* 鑼), cymbals (*po* 鈸), a flat circular drum, struck with a pair of light sticks (*pang ku* 梆鼓) and sharply resonant wooden blocks or castanets (*pe pan* 拍板). Before the revolution of 1911–12, professional musicians had no high social standing. Those who played in the theatre commanded more respect than the players in funeral or wedding processions. Courtesans and beggars who played and sang, and ballad singers were of the lowest rank. The Chinese theatre makes copious use of music, the drama being practically a music drama. A relatively very small part of the play is given over to unaccompanied spoken dialogue. The recitative portions are either punctuated by the percussion instruments or are invested with a continuous rhythmic accompaniment of these instruments which often drown out the actor-singer's voice. The lyric portions of the performance are accompanied by the fiddles, guitars, flutes or pipes. The protagonist selects the tunes from among a large number of well-known conventional strains or motives, said to be very old. The instrumentalists accompany in unison, although, since they play without written music, embellishments and variations are produced *ad libitum,* and there are at times instances of the use of double notes and traces of an embryo type of contrapuntal invention. The Chinese ideal of good vocal performance, particularly for the male actors, requires a high, forced falsetto tone production.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

CHINESE DULCIMER (YANG CH'IN), HAVING 16 SETS OF STRINGS, 4 IN EACH SET, AND PLAYED WITH TWO BAMBOO BEATERS

All of this music, as well as the popular music of funeral and wedding processions and of street songs is, like the sacred music, distinctly pentatonic. But where, as in the popular orchestra or solo performance, the art of improvisation and embellishment has free play, the larger intervals of the five-tone scale are frequently filled out in runs and figures, as a careful analysis of phonograph records (Erich Fischer) has shown. But even here the importance of the pentatonic skeleton or foundation is beyond doubt and is easily sensed by the European hearer. Since the revolution the influence of Western music has become more marked.

BIBLIOGRAPHY.—J. A. Van Aalst, *Chinese Music* (1884); A. C. Moule, "A List of the Musical and Other Sound-Producing Instruments of the Chinese," *Journal of the North-China Branch of the Royal Asiatic Society* (vol. xxxix., 1908); Louis Laloy, *La Musique Chinoise* (1910); Erich Fischer, "Beiträge zur Erforschung der chinesischen Musik," *Sammelbände der Internationalen Musik-Gesellschaft* (vol. xii., 1911); Maurice Courant, "Sur La Musique Classique des Chinois," *Encyclopédie de La Musique* (1914); G. Soulié de Morant, *Théatre et Musique en Chine* (1926). (O. K.)

CHINESE PAINTING. The first thing to be said about Chinese painting is that very little is known of its actual achievements. We have indeed ample records of the lives and works of innumerable painters, from the first centuries of our era onwards, and a mass of criticism. Chinese paintings also exist in vast quantities. But it must be realized that of genuine, or probably genuine, works of the great masters of the best periods, very few indeed remain. It is impossible to doubt, from the evidence of what has survived, and from literary records, that Chinese painting, with its majestic and continuous tradition of more than 1,500 years, is one of the greatest schools of painting that the world has seen. But we are quite without the means of comparing Chinese painting as a whole with the paintings of Italy, or any other European school, the successive masterpieces of which are known and accessible to every student.

It is true that during the 20th century the almost complete ignorance which prevailed on the subject till the end of the 19th century has been greatly lessened. Important discoveries have been made, and it is impossible to predict what may yet be discovered. The fundamental difficulties, however, of the study of Chinese painting are likely to remain; the extreme rarity, namely, of certain and documented works, on which an accurate conception of the greater masters' style can be based. The practice of repeating famous designs with variations, of copying ancient works, which has prevailed in all ages, makes it possible to have a general idea of the styles of certain periods and certain masters.

But immense and repeated destruction accounts for the rarity of ancient pictures in China itself. In Japan collections have been made, centuries ago, and religiously preserved; and these paintings form the best foundation for study, though in many cases the traditional attributions have been abandoned by modern criticism.

General Characteristics.—Painting is the pre-eminent art of China. It is right that the art of any nation should be judged by a world standard, not merely from a national point of view. In spite of all differences and peculiarities, Chinese painting takes its place with the other pictorial arts of the world, for there is a fundamental affinity between all successful works of art.

Painting, for the Chinese, is a branch of handwriting. Both for writing and painting a brush is used; and to acquire a fine hand in writing demands a mastery in manipulating the brush and modulating its strokes such as few European painters attain. Ink is the favourite medium; but Chinese ink is a wonderful substance, capable of an immense range and an extraordinary beauty of tone. Many Chinese masterpieces are in monochrome. Coloured paintings are either light-coloured or full-coloured; but the ink-drawing remains almost always the foundation of the design. Fresco-painting, technically a different method from the fresco-painting of Europe (*see* Church's *Chemistry of Paints and Painting*, p. 307, 1915), was largely practised—and probably the grandest art of China was in this form—but the frescoes of the finest period seem all to have been destroyed. The great mass of Chinese pictures, however, are paintings on silk or, less commonly, absorbent paper, the pigments being water-colours or body-colours (*see* R. Petrucci, *Encyclopédie de la Peinture Chinoise*, 1918, a translation of a well-known treatise illustrated with woodcuts called the *Mustard Seed Garden*. *See* also Ferguson's *Chinese Painting*). Paintings are usually in the form of hanging pictures or of horizontal scrolls, in both cases normally kept rolled up. The latter form involves a mode of composition peculiar to Chinese art, though imitated by the Japanese. These paintings, often of great length, are unrolled bit by bit and enjoyed as a reader enjoys reading a manuscript. A succession of pictures is presented, though the composition is continuous. Thus, in the case of landscape, for which this form has been used with most felicity, one seems to be actually passing through the country depicted. Other forms are the framed picture and the small album picture; screens also were employed for painting.

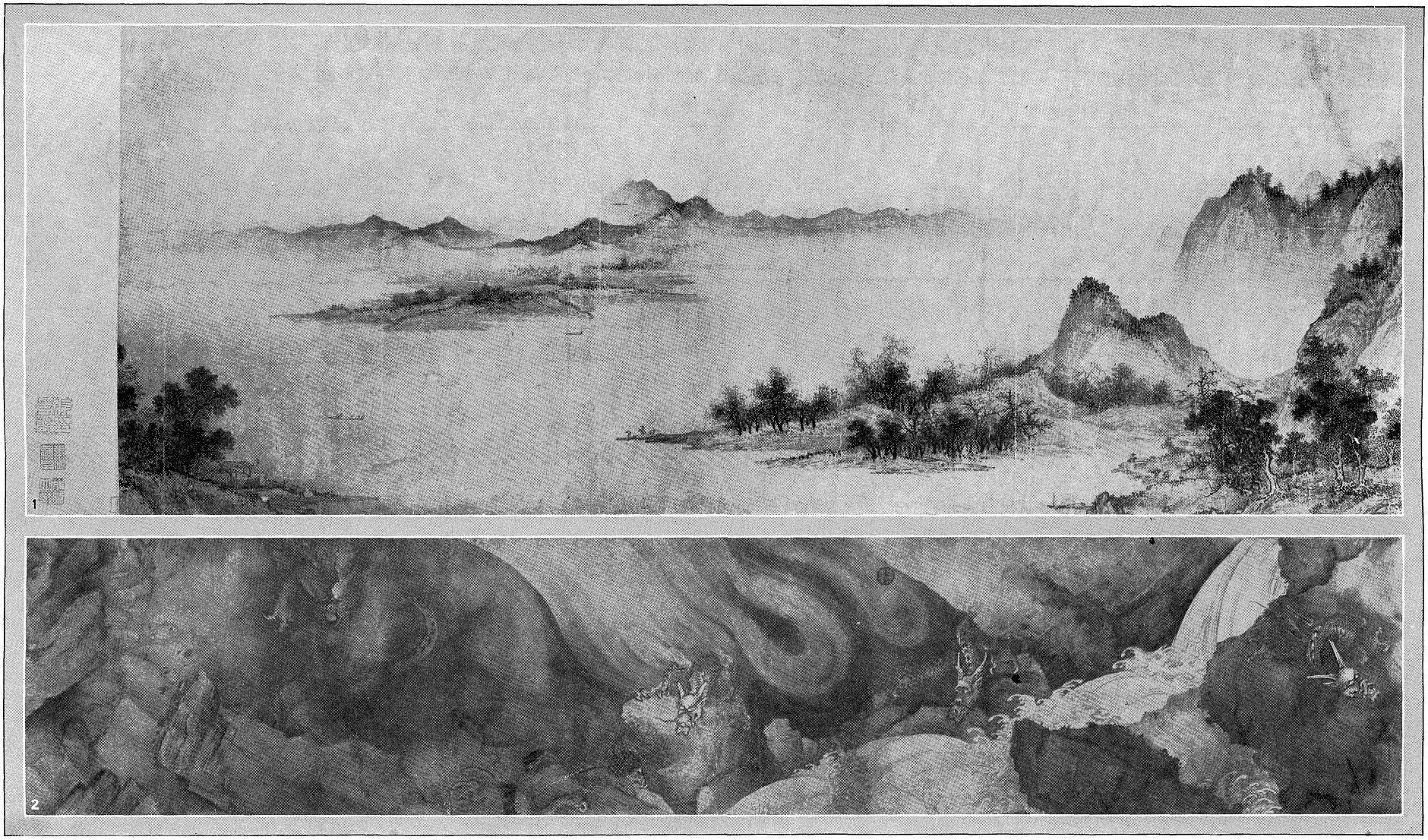
Chinese technique admits of no correction. The artist closely observes and stores his observations in his memory. He conceives his design, and having completed the mental image of what he intends to paint, he transfers it swiftly and with sure strokes to the silk. The communication through the sensitive and powerful strokes of the brush of something personal and unique must, in such an art, count for much in the spectator's appreciation. The qualities prized by the Chinese in a small ink-painting of bamboos, a favourite subject alike with beginners and masters, are those prized in a piece of fine handwriting, only there is added a keen appreciation of the simultaneous seizure of life and natural character in the subject. In the *Mustard Seed Garden* treatise cited above, it is said that in a master's work "the idea is present even where the brush has not passed." And this emphasis on the value of suggestion, of reserves and silences, is important to notice, because no other art has understood, like the Chinese, how to make empty space a potent factor in the design. It may be that Chinese painting relies too much on suggestion, presuming in the spectator a sensibility and a fineness of organization which are found but in choice societies; on the other hand it avoids that laborious accumulation of unessential phenomena which in European art has proved the death of so many pictures by accomplished hands. A certain slightness, comparatively speaking, is inevitable in Chinese paintings, partly because of the water-colour medium, partly because suggestion is preferred to statement, partly because so many of the artists were amateurs and not professionals. It is remarkable, however, how solid and structural a Chinese landscape can be. The greater painters gave much thought and pains to elaborating a convention by which the sense of shape and mass can be given to rock forms, for instance, without losing directness and vitality of brush stroke, the sense of handwriting. Each successful convention was preserved, handed down and imitated. Mountains could be painted in the manner of this old master or of that. And the Chinese, with their passion for codification, have carefully tabulated all these various methods. The painter's art is also saturated with literary associations. Certain flowers and certain birds, for instance, are painted together because their association is consecrated by a classic poem. Many of the painters were poets; some, like Wang Wei, equally distinguished in both arts. But it is less the direct illustration of a poem or story that is normally aimed at, than the evocation of a mood similar to that expressed in the poem.

When we turn to the subject-matter of Chinese painting, we are struck by the early appearance of landscape art and its actual predominance. Landscape is accounted the most important of subjects because it includes man and all living things; the whole is greater than the part. Man does not play the central and heroic part that he plays in the art of Europe, for which the nude human form is the most significant and expressive of motives. Flowers are quite as important as figures. This difference in the fundamental conception of life and the universe makes itself felt in design. Instead of the symmetry which contemplation of the human body has made the basis of Western composition, the Chinese prefer the principle of balance. They contemplated trees and saw that they were unsymmetrical but perfectly poised. Where in Europe we have Christian themes, in China we have Buddhist themes; instead of the stories of classic mythology we have the stories of Taoist legend and the fairy tale. Genre-painting (*q.v.*) is as common as in the West, though portraiture is perhaps less common. But always the life of the world outside man,—the life of animals, birds and plants—plays a much larger part than in Western art. The life of action counts for less, and the contemplative life for more.

HISTORY

Early Periods.—From literary references we can infer that painting was practised in China several centuries at least before Christ, chiefly in the form of portraiture. It is not till we come to the Han dynasty, that we have any more tangible evidence, though there exist some rude designs in red on jade which may be a thousand years earlier. Designs on lacquer of the 1st century A.D., found in Korea by Mr. Umehara, and in Chinese Turkistan by Sir Aurel Stein; some rough paintings on tiles (Eumorfopoulos collection), and other decorations; outline drawings on vases of rather later date, give some hint of what painting in the Han period was like. We see that a Chinese type of decorative design, animated by movement in the forms, was already matured. The incised stone friezes of the period are clearly translations of paintings, and these give an idea of the character of pictorial design and the range of subject—scenes from history and legend, ceremonies, dances, mythical creatures, and all the fairy world of Taoism.

In the 4th century, however, flourished an artist who ranks among China's most famous masters: Ku K'ai-chih. There exist two rolls attributed to him: one, *The Admonitions of the Instructress in the Palace*, is in the British Museum; the other, illustrating a poem on a river nymph, is in the Freer collection at Washington. These paintings are by different hands. The one in the Freer collection is altogether drier in handling, and may be a Sung copy. The British Museum roll is of a marvellous subtlety and distinction; the line is intimately expressive. Its actual date is disputed, but it is generally thought to be, if not an original, a T'ang copy. In any case there is no doubt that both of these paintings represent the design of the Chin dynasty (A.D. 265–420). They are, therefore, extremely precious documents, and their value is increased by the fact that while the British Museum roll depicts scenes of court life, with all the details of dress and accessories of singular refinement, the Freer roll, with its dragon chariot and floating fairies, gives the imaginative or fanciful side of the art of the period. In both cases the landscape element is quite primitive. The landscape introduced into the London painting is indeed in strong contrast with the consummate grace and expressiveness of the tall and slender figures,



BY COURTESY OF THE MUSEUM OF FINE ARTS, BOSTON

LANDSCAPES OF THE SUNG PERIOD (960–1279)

1. A landscape scroll by Tung Yuan, 10th century, Southern Sung school. Painted with the graceful, gentle brush strokes characteristic of this artist
2. Dragons and a waterfall among cavernous rocks, by Chen Jung (960–1127), Southern Sung school. Chen Jung was especially skilled in painting dragons, symbolic of the powers of nature

CHINESE PAINTING



BY COURTESY OF (1, 2, 3, 4) THE MUSEUM OF FINE ARTS, BOSTON, (5, 6) THE TRUSTEES. THE BRITISH MUSEUM

SIX CHARACTERISTIC PAINTINGS, 4TH TO 14TH CENTURY

1. Chinese herdsman, a painting of the mid-12th century, Sung period. 2. A man on a water-buffalo attributed to Li T'ang (*c.* 1100), of the Northern Sung school. 3. Landscape with bridge and willows, by Ma Yuan, a landscape painter of the late 12th and early 13th century. His work shows the vigor of the Northern Sung school combined with delicacy and sensitiveness. 4. Detail, from "Ladies Beating and Preparing Silk," a genre painting attributed to the artist-emperor, Hui Tsung (1082–1135), Sung dynasty. It probably preserves a T'ang design. 5. Portrait of a Buddhist priest, a Chinese fresco of the 14th century. 6. "Harmonious Family Life," part of "The Admonitions of the Instructress in the Palace," attributed to Ku K'ai-chih (4th century), one of China's earliest painters

and the air of a mature and fine civilization which they seem to breathe. Far from being primitive, the figure-drawing seems to belong to the close of a tradition rather than its beginning; and we may conjecture behind it the ruder, masculine style of Han gradually subtilized and transformed in the direction of elegance and charm. Ku K'ai-chih famed especially for his portraits, painted all kinds of subjects, including Buddhist themes. But if we may take these two pictures attributed to him as typical of the period, we find no trace of Indian influence in them.

Of about the 6th century are some of the earliest wall paintings in the rock temples at Tun-huang, on China's western frontier (*see* Pelliot, *Grottes de Touen-houang*, vol. iv.), full of animated movement, containing figures of the same slender and elegant type as those in the Ku K'ai-chih roll. But these are provincial in manner.

It was in the 6th century that the famous six canons of Hsieh Ho, himself a painter, were formulated. The exact meaning of the first and most important of these has been disputed, but it is clear that the emphasis is laid on creative inspiration, conceived not as a personal gift, but as the spirit of the cosmos entering into the artist and enabling him to produce in his forms the movement of life.

The legends of the great masters tell, not of the deceptive appearance of reality in their paintings, but of their being so informed with passionate life that they assumed material existence and motion. The emphasis on movement is significant. Even in decorative designs the forms seem to move and flow.

The T'ang Dynasty (A.D. 618–907).—In the 7th century the empire, after a period of division, was consolidated under the great T'ang dynasty, which lasted for 300 years. This was undoubtedly the period of China's grandest art. It is true that almost all the painting of the time has perished; but all the available evidence confirms the testimony of the Chinese historians and critics to the greatness of the T'ang masters. Some fragments of a painting of a spring festival, found by Sir Aurel Stein in 1914 at Turfan, and some other paintings found in the same locality by the Otani expedition, are precious relics of early T'ang art, for they show us something of the pictorial style of the early 8th century. Here we find the new T'ang ideal of feminine beauty: a more massive form, compared with the slender elegance of preceding periods; a full, rounded face, with hair heaped around and above the head, and an air of smiling health. Precisely the same types and the same pictorial motives are found in the few pictures surviving from this period in Japan. And it is from the early painting of Japan, closely modelled on Chinese prototypes, that we can most safely infer the great style of T'ang. This kind of painting is mostly Buddhistic, and the grandest T'ang works were of Buddhist inspiration. Supreme among them, according to all testimony, were the works of Wu Tao-tzū, acknowledged to be the greatest of all Chinese painters.

China, during this epoch, was open to foreign influences as she has never been since. Her empire expanded westward; her suzerainty extended as far as the Caspian. Envoys and tribute-bearers were constantly coming or going; there was a great interest in foreign ways, dresses and customs; Indians, Persians, Turks and Syrians met in the capital, which was truly a world centre. But the influence of greatest moment was Buddhism, now accepted with fervour. Great numbers of Indian monks, some of them doubtless artists, were settled in China. Chinese pilgrims journeyed to India and brought back sacred manuscripts and images. But Chinese art, strong in its own traditions, was able to assimilate the Indian formulae and create a Buddhist art of extraordinary splendour. Among the earliest of the T'ang masters may be mentioned Wei-ch'ih I-sēng, who came from Khotan to China about 630. A copy of a picture of Vaisravana by this artist is in the Freer collection at Washington; and his style is perhaps to be discerned in a remarkable roll in Mr. Berenson's collection. Yen Li-pēn (born *c.* 600), was famous for his portraits of national worthies, foreign envoys and Buddhist pictures. We know his work only through copies. With Wu Tao-tzŭ, T'ang painting underwent a transformation. His early style was fine and delicate; later, it became broad and of amazing power. He painted over 300 Buddhist frescoes, as well as paintings of all kinds of subjects on silk. All have perished. One or two of his designs have been preserved by being engraved on stone, and some paintings and drawings are extant which may be copies from his work. The majestic fresco *Three Bodhisattvas*, given to the British Museum by Mr. Eumorfopoulos, dating probably from the 12th century, presumably preserves the T'ang tradition, and from it we may infer the yet grander and more magnificent creations of Wu Tao-tzŭ and his followers. All records agree in emphasizing the overwhelming power of his creations and also the almost sculptural character of his figures. Of actual and authenticated work by a known T'ang artist we have only five portraits of priests (much damaged) painted about 800 by Li Chēn and preserved in Japan. These are in a contained and rather austere style. But our chief documents for T'ang Buddhist painting are the pictures recovered from Tun-huang, on the western frontier of China, by Sir Aurel Stein and Prof. Pelliot. These are now in the British Museum, at Delhi and in Paris. A certain number are dated, with dates of the 9th and 10th centuries. Those which are in Chinese style may be taken to reflect the central tradition of Buddhist painting, though in a more or less provincial form. Of much the same character is a large Buddhist picture of the 9th century in the Boston Museum.

The Tun-huang pictures are largely devoted to the cult of Amitabha Buddha, who presides over the Western Paradise, and of his spiritual son Avalokitesvara, or Kuan-yin, the genius of Compassion, who in later times assumes a feminine form. There are many pictures of the Paradise, in which we see a host of blessed beings presided over by a Buddha (usually, but not always, Amitabha) gathered round a sacred concert, where a dancer performs to music on a terrace raised above the lotus-lake. Some of these complex compositions, containing a great number of figures, are remarkable for the harmonious serenity of the design —there is no confusion or awkwardness in the arrangement—and the varied beauty of the colouring. Other votive pictures portray the great Bodhisattvas, especially Kuan-yin, or scenes from the Buddha legend. In the former case, the forms, draperies and ornaments are closely modelled on Indian prototypes; in the latter, types, dress and architecture are purely Chinese. From the small scenes sometimes painted at the sides of the large pictures we get a hint of the secular style of the period both in figure and landscape. The figures of donors, which are also fairly frequent, give us contemporary costume. Though mostly the work of artisans rather than artists, the value of these paintings as documents is very great, and a few are of real beauty as works of art.

In this era landscape became important as an independent art. The character of Chinese landscape is seen in the word for landscape, *shan-sui* (山水), mountain and water. Li Ssŭ-hsün (b. 651) was the first eminent painter who devoted himself mainly to landscape. He painted in greens and blues, with gold outline. None of his works exist, but copies preserve the characteristics of his style. His son, Li Chao-tao, developed this technique. A small picture in the Boston Museum, ascribed to him but probably of later date, gives a good idea of this "miniature" kind of landscape-painting. A very different tradition in landscape was founded by Wang Wei (b. 699), who was equally famous as a poet. He matured a style of ink-painting, in which the landscape became the counterpart of an emotion, more subjective and more "impressionist" in method than the work of Li Ssŭ-hsün and his school. Copies exist (one is in the British Museum, and an earlier one in the Freer collection) of a famous roll by Wang Wei, *Scenery of the Wang Ch'uan*. The painting was engraved on stone when it began to decay. Rubbings have been published by Dr. B. Laufer in *Ostasiatische Zeitschrift* (April 1912).

Ts'ao Pa and his greater pupil, Han Kan, were especially famous for their paintings of horses. Han Kan found endless subjects in the fine horses sent as tribute from Central Asia. He worked in the 8th century for the emperor Ming Huang. A contemporary, Han Huang, painted buffaloes and rustic scenes. The splendidly modelled pottery figures of horses and camels found in T'ang tombs give us a clue to the vigour and breadth

of the animal painting of these masters, whose original work has perished.

Admirable *genre* pictures and scenes from court life were also painted in this era. Chou Fang is known by versions (one in China and one in a New York private collection) of his *Listeners to Music,* a design in which the Chinese genius for eloquent spacing is conspicuous. The beautiful picture in the Boston museum of *Ladies Beating and Preparing Silk* probably preserves a T'ang design.

The Five Dynasties (A.D. 907–960).—In this short period a great many artists are recorded, of whom Hsü Hsi was famous as a flower-painter and Chou Wēn-chü for his pictures of women. Still more celebrated was Huang Ch'uan, who painted landscape, birds, flowers, etc., and who is said to have started what is called the "boneless method"; *i.e.,* painting without a drawn outline.

The Sung Period (A.D. 960–1279).—Under the emperors of the Sung dynasty China was re-united. The emperor Hui Tsung was himself a painter and a great collector. In his reign the Academy of Painting became very prominent and attracted artists from all parts. A certain realism was inculcated, but in style a fastidious simplicity was to be aimed at. The small album-painting of a bird in a bough in the Eumorfopoulos collection, and similar paintings in famous albums in Japan, some of which are attributed to Hui Tsung, illustrate the ideals of the time. Flower-painting, hardly existent in the T'ang period, was now a favourite theme, and some painters, like Wēn T'ung, specialized in ink-painting of the bamboo. Of the flower-painters Chao Ch'ang was the most celebrated. The most eminent master in landscape of Northern Sung was Kuo Hsi, who wrote an essay on landscape, partly translated by Waley (*Chinese Painting,* pp. 189–194). Mi Fei invented a new style in landscape, without outline and with boldly brushed-in wooded peaks rising above rain and mist. His style is preserved in many pictures, though again few or none are likely to be actually by his hand. Chao Ta-nien painted autumn and winter scenes; Fan K'uan was famous for his snow-scenes.

But the most famous name in the art of Northern Sung is Li Lung-mien (*c.* 1040–1106). Much of his work consisted of copies from earlier masters. He had a reverential passion for tradition. At first he painted horses, but soon abandoned such subjects for Buddhist themes. Rarely using colour, he drew with a delicate, nervous line. Copies of his works are numerous, and a few originals have been reproduced in the *Kokka.* He is revered by the Chinese as a perfect type of Chinese culture; judged purely as an artist, he would not have so great a fame.

In 1127 the Tatars occupied northern China. The emperor Hui Tsung was taken prisoner and died in exile. Hang-chow became the new capital of what is known as Southern Sung. The changed temper of the times is reflected in the art of a people no longer greatly interested in external events which they were helpless to transform. The passion for romantic solitudes, for soaring peaks and plunging torrents, which had always haunted certain minds, eager to escape from the pressure of official life and ceremonious routine, became a mastering inspiration. The Zen sect of Buddhism, now dominant, with its reliance on intuition, its contempt for all outward forms, replaced the votive picture of single or assembled Bodhisattvas, glowing with colour and gold, by pictures of Arhats in intense contemplation, or by swift ink-sketches of Zen saints; even a poising bird or blossoming spray could become in this mode of thought as "religious" a theme as the glorified Buddha. The emphasis was all on the interior mind. This temper, to which Taoist love of freedom and fluidity contributed much, gives a peculiar poetic character to the art of Southern Sung. Some there were, like Li Sung-nien, who kept to the older traditions and painted scenes from history and legend, and sets of pictures on weaving and agriculture. But the genius of the age is seen rather in Li T'ang (to whom are attributed a roll in a Japanese collection and a beautiful small picture in the Boston Museum), and still more in his famous pupils, Hsia Kuei and Ma Yüan. Owing to the enthusiasm with which the landscapes of this school were collected in Japan, we are able to judge of its productions from concrete examples. Though this school soon fell out of favour in China, it represents to Europe Chinese landscape at its finest; synthetic in conception, impassioned in execution, it unites simplicity with grandeur. Hills and high places had always been regarded with reverence as the abode of spirits. We find no counterpart to the feeling of aversion or disgust which the Alps inspired in Europeans down to so late a period. And though the Chinese have always been an agricultural people, it is not the relation of toiling man to the fruitful earth which inspires their typical landscape art. It is a more cosmic inspiration; a feeling of affinity between the human spirit and the energies of the elements,—the winds, the mists, the soaring peaks, the plunging torrents. Technically, Chinese landscape design differs from European. The high horizon precludes the need for uniting sky and ground, divided by the natural horizon of sight, by means of vertical lines and masses. The eye passes from the foreground, so often a source of trial and difficulty to the European painter, to the central motive of the picture, usually a mountain form.

The Yüan or Mongol Period (A.D. 1280–1368).—In this comparatively short period there was a tendency to go back to the style of ancient masters. Chao Mêng-fu is perhaps the most famous painter of the time. Countless pictures of horses now in Western collections are attributed to him, few of them with any probability. He also painted landscapes and flowers. Another fine painter was Jên Jên-fa, of whom there is a good example in the Eumorfopoulos collection, and others in Japan. The four chief landscape masters were: Huang Kung-wang, Wang Mêng, Ni Tsan, and Wu Chên. The two latter led roaming lives and had nothing of the professional about them. Ni Tsan painted suggestions of landscape in ink, in a reticent, delicate manner. Wu Chên, known as the "Priest of the Plum-blossom," excelled in paintings of bamboos. Ch'ien Hsüan is a master whose name is very frequently forged on paintings; he painted birds, flowers, also figures. Wang Yo-shui was famous for flowers. Yen Hui is greatly admired in Japan for his pictures of Taoist sages, but is less known in China.

The Ming Dynasty (A.D. 1368–1644).—The art of the Ming period is characterized as a whole by a gradual fading out of the interior glow which under Buddhist and Taoist inspiration had suffused the creations of earlier periods. Concentrated in herself, China had no longer any stimulating contact with the world without; and her art became concerned rather with the beauty of material things than with the expression of the interior spirit. At the same time a reverential conservatism prescribed for the painter both subject and manner of treatment. The painters of this period are so numerous that only a few outstanding masters can be mentioned. The first Ming emperor re-established the Academy of Painting, with the aim of emulating the glories of Sung art. Gifted painters flocked to his court. Lin Liang painted ink-pictures of eagles, wild geese, flowers, etc., in a style of extraordinary breadth and power. A good example is in the British Museum, which also has a fine *Fairy and Phoenix* ascribed to Wu Wei, a master who strove to recapture something of the strong brush-work of Wu Tao-tzŭ. Very typical of early Ming art are the bird and flower pictures of Pien Ching-chao (Pien Wēn-chin) and of Lü Chi, in which a certain solidity and a decorative richness of colour combine with powerful drawing in a large design. In landscape, Tai Chin, accounted one of the foremost Ming painters, led a new movement and had many followers. His style was broad and free, with little or no colour. Another school preferred minuteness of detail, with an ornamental use of colour, especially a rich blue. Of this school were Chou Ch'ēn and T'ang Yin, who also excelled in figures.

Tung Ch'i-ch'ang (1554–1636), eminent as a critic as well as a painter and calligrapher, despised these "professionals" and their laborious technique. He is associated with the "Learned Man's Painting," in which refined taste and literary associations counted for much more than mere accomplishment. Tung Ch'i-ch'ang claimed that this style originated with Wang Wei in the 8th century, the founder of the Southern school. (In distinguishing the Northern and Southern schools, he tried to give these rather shadowy terms a geographical foundation which does not really



BY COURTESY OF THE MUSEUM OF FINE ARTS, BOSTON

THE ARHANT RAKAN BESTOWING ALMS

Sung painting, 12th century, one of a set of one hundred, representing the Five Hundred Arhant. It was executed at Ming Chao in 1178, as a pious dedication. The paintings are in colours on silk and mounted as panels

CHINESE PAINTING



A SNOW SCENE

Painting, probably early Ming period, by an unknown artist—a typical landscape composition

exist.) The Southern school, adorned in the earlier part of this period by Shên Chou and Wên Chêng-ming, two much-admired masters, had by the close of the dynasty become triumphant and supreme. Among bird and flower painters of the 16th century, Chou Chih-mien may be mentioned as one of the most distinguished, though his work is rare.

The Ch'ing (Manchu) Dynasty (A.D. 1644–1911).—Painting in the 17th and 18th centuries is very largely devoted to landscape in the style of the Southern school, which in the later developments of the literary man's style becomes loose, slight, capricious and eccentric. Among gifted amateurs of the beginning of the dynasty, Chu Ta is much admired for his ink-sketches of flowers, rocks, etc. More important artists of the K'ang Hsi period are "the four Wangs," Wang Shih-min, Wang Chien, Wang Hui and Wang Yuan-ch'i.

Another great figure in the 17th century is Yün Shou-p'ing, also called Nan-t'ien, the most famous flower painter of the Ch'ing period. Wu Li, who was converted to Christianity and became known as Father Acunha, painted landscapes. The influence of the Jesuits was considerable for a time in China, but had no lasting effect on the arts. The Jesuit Giuseppe Castiglione was made to learn the Chinese style of painting under the name Lang Shih-ning. Chiao Ping-chêng, however, learnt something of European perspective and taught it to Lêng Mei and other artists. Chiao Ping-chêng's sets of pictures of agriculture and weaving were engraved in 1696. Shên Nan-pin went to Japan and stayed at Nagasaki (1731–33); his work had a very stimulating effect on the naturalistic movement in Japan. Apart from this naturalistic movement, the modern painting of China seems to show little new life, and though good painters flourished in the 19th century, they were mostly content with exercises in the various manners consecrated by the past.

BIBLIOGRAPHY.—S. Omura, *Chinese Painters*, vol. viii.–xii.; H. A. Giles, *Introduction to the History of Chinese Pictorial Art;* A. Waley, *Introduction to the Study of Chinese Painting* and *Index of Chinese Artists;* L. Binyon, *Painting in the Far East;* R. Petrucci, *Encyclopédie de la Peinture Chinoise;* F. Hirth, *Scraps from a Collector's Notebook;* J. C. Ferguson, *Chinese Painting.* (L. Bi.)

CHINESE PAVILION, TURKISH CRESCENT, TURKISH JINGLE, or JINGLING JOHNNY, an instrument consisting of a pole about 6ft. high terminating in a conical metal cap or pavilion, hung with small jingling bells and surmounted by a crescent and a star. The Turkish crescent, or "jingling Johnny," as it was familiarly called in the British army bands, was introduced by the Janissaries into western Europe, but it has fallen into disuse now, having been replaced by the *glockenspiel* or steel harmonica.

CHINESE SCULPTURE. The historical records about sculptural works in China do not begin until the Ch'in dynasty (249–206 B.C.); the earliest refer to the 12 colossal statues of "the giant barbarians" and the bell-frames in the shape of monsters "with stags' heads and dragons' bodies," which the great emperor Ch'in Shih Huang Ti ordered to be cast from the weapons of war collected throughout the kingdom. These enormous bronze statues which were placed before one of the imperial palaces near Hsien Yang, on the Wei river in Shensi, are mentioned by Lu Chia, an author who lived from the Ch'in to the Han dynasty, and by several later chroniclers such as Chang Heng (d. A.D. 139) who speaks of "the metal barbarians sitting in a row." At the end of the later Han dynasty Tung Chow melted "ten bronze men into small cash, also the bell-frames"; the two remaining ones he set up inside the Ch'ing Ming gate at Ch'angan but these were also lost during the 4th century, when a local ruler tried to remove them but found them too heavy for the muddy roads, the result being that one was melted down into cash, the other thrown into the river. Nothing, however, is known about the artistic character of these statues, but their well recorded history proves that they were considered extraordinary both for their motives and their size.

Ch'in Dynasty.—The only sculptures now remaining which possibly might be attributed to the Ch'in dynasty are some decorative animals in bronze. Most of these are of small size and placed on the lids of sacrificial vessels, but nevertheless with a well developed sculptural character. A larger example,—sometimes ascribed to the Ch'in period—is a statuette, that represents a reclining bull (now in the possession of L. Wannieck, Paris). It is said to have been found together with some bronze vessels, decorated in Ch'in style, at Li Yü in northern Shansi, but to judge by its style, it can hardly have been executed before the 6th century A.D. (Northern Wei dynasty). We illustrate it, however, as a particularly fine example of early Chinese animal sculpture.

Among other bronze animals which have been ascribed to the Ch'in period should be mentioned a large dragon or hydra with crested neck and flame-like wings at the shoulders and the loins, in the collection of A. Stoclet, Brussels. It is in marked contrast to the bull, fierce, fantastic, grotesque to the utmost without any connections with nature, and must, indeed, be earlier in date, though hardly of the Ch'in period. Other fantastic animals such as interwinding dragons or felines appear at the handles of some large bells in Ch'in style.

New efforts were evidently made in different directions during this short period which, in the field of art, was simply an introduction to the classic age of the Hans. The rigid ceremonial art of earlier times is gradually modified by a more direct and vivid interest in nature. The Chou art (1122–249 B.C.) was preeminently symbolic and geometrical. The art of the Ch'in and the Han periods aimed at the presentation of the actual rhythm of things, the inherent life and significance of the artistic forms.

The Han Dynasty.—Most of the Han monuments have evidently been destroyed; yet, to judge from those which remain as well as from minor plastic creations in bronze and clay, Chinese sculpture was at this early period much better fitted to treat animal motives than human shapes. It is only in the reliefs that the human figures reach an importance comparable to that of the animals, and these are, on the whole, more like paintings translated into stone than real sculptures. With the exception of the small tomb statuettes made as substitutes for real people, human representations are quite rare and artistically much inferior to the representations of animals. The Chinese have never considered the human figure an artistic motive in itself, but simply used it for expressing an action or a state of consciousness. They have taken greater interest in types, postures and motives of drapery than in the bodily form or the muscular organism. The case is quite different with the animal sculptures. They may adhere to certain types or formulae characteristic of the period to which they belong but their artistic importance depends mainly on the rendering of their organic form and vitality. The best among them are monumental creations, hardly inferior to animal sculptures of any other period or nation. The conventionalization, which is more or less preponderant during the early epochs, does not convey an element of immaterial abstraction but serves to accentuate the muscular organism, the energy of movement, the monumentality of the form, all that makes the animals great and convincing as works of art.

Bronze, Clay and Stone Work of the Han.—Among the great number of wild and domestic animals represented in bronze, clay and stone during the Han period we may choose as examples some bears executed in bronze. The majority of these bears are quite small, intended to serve as feet for sacrificial vessels, but there are also some of a larger size which have the character of free standing sculptures. The two best are in the Gardner museum in Boston. These are represented in a squatting posture, stretching their heads forward with a friendly roar. The modelling of the limbs is not carried very far, yet it is sufficient to awake an impression of suppleness and force. The artist has not been afraid of exaggerations in the characterization of the lumpy forms or the telling postures. The heavy weight of the body supported by the broadly placed forepaws, the elastic power of the enormous legs, the softness of the bulky paws and the long nose which seems to form a direct continuation of the ears, are rendered with a power of conviction and a sense of monumental unity that are rarely found in later animal sculptures.

It should also be noticed that in their representations of animals the Chinese have quite often combined two or more into a group. They have composed them in the most intricate positions and

built up groups which satisfy the highest requirements of plastic art. Most of these groups are on a relatively small scale, but they are nevertheless truly monumental. The finest results are achieved in groups of fighting animals, because the bodies are here represented in their highest tension, in the full development of their muscular effort, and so closely interlaced that they complete each other perfectly in the expression of the plastic idea. The same is also true of some of the animals which are composed into an architectural unity with monuments such as the tomb pillars in Szechuan (which will be mentioned below).

Tomb Statuettes of the Han.—The greatest variety of animal types may however be found among the clay statuettes made for the tombs. The material was most easily handled and thus invited all sorts of individual variations, and as these clay sculptures were executed as substitutes for living animals, which in earlier times followed their dead masters into their tombs, it was natural that they should be made as lifelike as possible. The majority are domestic animals such as horses, sheep, dogs, pigs, hens and ducks in various sizes, the smallest hardly more than two or three inches high, the largest measuring a foot or more. They were usually executed in clay moulds but sometimes modelled by hand, and the best among them have retained a spontaneous freshness and vivacity which make them very entertaining. Proportions and shapes are treated with a great deal of freedom. The dogs have enormous heads, the horses have necks which curve like high arches, and the pigs have snouts like bowsprits, yet the exaggerations serve simply to accentuate the typical features of the various animals.

Besides the animals there are human *ming ch'i*, or tomb statuettes, made as substitutes for living people, such as servants, and wives who formerly were buried alive with the husbands. Most common amongst these statuettes from the Han period are the slender ladies in long robes with wide sleeves reminding one of the Japanese kimonos. They stand usually in very quiet postures simply with a slight inclination of the large round head, but occasionally we find them represented in a dancing movement, though with closed feet, swinging their bodies and their arms in a rhythmic fashion.

Stone Sculptures of the Han.—Stone sculptures on a large scale were, no doubt, also executed in steadily increasing numbers during the Han period, though comparatively few of them have been preserved. Among the earliest which can be approximately dated are the animals at the tomb of General Ho Ch'ü Ping, situated at the Wei river some 20 m. N.W. of Sianfu. They were discoverd by Ségalen and Lartigue during their explorations in 1914 and more completely dug out by the latter in 1923. Lartigue has also published them in an article in the German magazine *Artibus Asiae* (1927) in which he presents some evidence for the supposition that these statues were executed about 117 B.C., the year of the death of the famous general. He thinks that the statues, which represent a horse standing over a fallen warrior, a reclining horse and a buffalo, were placed in front of the mound, and that their present quite irregular positions have been caused by the shifting of the mud. Besides these, complete sculptures may, however, be seen in the neighbourhood of the mound, a large block with a mythological figure, executed in relief, and fragments of some animal sculptures which seem to indicate that this large composition never was completely finished. It is difficult to appreciate the artistic importance of these large statues without seeing the originals, but if we may draw some conclusions from the reproductions, the sculptures are comparatively undeveloped from an artistic point of view. This is particularly true of the main statue, the horse standing over a fallen warrior. The composition is indeed significant but the formal treatment does not seem to do justice to the motive. The short-legged horse with an enormous head is more bulky than monumental, and the figure under its belly is simply a large block. Here is little of that intrinsic energy which is so prominent in some of the minor sculptures already mentioned. This impression is, however, to some extent counteracted by the reclining horse and the buffalo which, even if they are heavy and bulky with stumpy legs, reveal a very sensitive artistic treatment, particularly in their expressive heads. Here one may discover a touch of that excellent animal psychology which is one of the greatest assets of Han art, a characterization which, to some extent, makes up for the shortcomings in other directions.

Sculpture Developed For the Dead.—Other stone sculptures from the beginning of the Han dynasty which might serve for comparison have not come to light, though it is more than probable that they have existed, because this tomb was hardly an isolated case, and broadly speaking sculpture in stone as well as in clay had its origin in the decoration and the arrangement of the tombs. It was for the dead rather than for the living that the Chinese developed their creative activity in the field of the plastic arts. As proof of this may be quoted not only the various classes of clay and stone sculptures mentioned above, but also numerous reliefs executed for the decoration of the "spirit chambers" of the tombs and the sculptural pillars placed in front of the mounds. These monuments marked as a rule the beginning of the "shen tao" (spirit path) which led up to the tomb and which in later times was farther and farther extended in a straight line from the mound towards the south. The interior of the tomb consisted often of two or more chambers (as also may be observed in contemporary Korean tombs), the first being a kind of ante-room called the "spirit chamber," where the soul of the deceased was supposed to dwell, while the coffin was placed, together with various vessels and other paraphernalia of bronze or clay, in the back room. The main decoration, be it in sculpture or painting, was concentrated in the ante-room where the walls often were covered with representations from ancient history and mythology or with illustrations with a moral import.



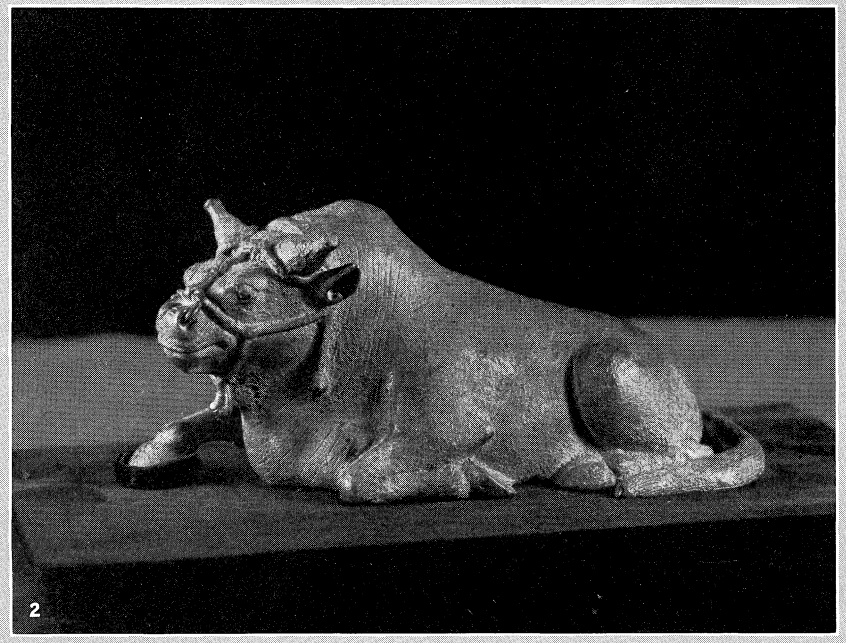
BY COURTESY OF THE METROPOLITAN MUSEUM OF ART
SCULPTURE OF THE SUI PERIOD

Tomb Pillars.—Quite a number of the decorative pillars which formed the gateway to the "spirit road" are known from central and western China, particularly the provinces of Honan, Shantung and Szechuan. They are usually constructed on a rectangular plan of large and well-fitted stone blocks reaching a total height of 15 to 18 feet. When completely preserved they consist of a moulded pedestal, a very broad shaft and a cornice over which the roof projects quite far. But the form varies somewhat in the different provinces; thus the pillars in Honan, of which the best known stand at Têng Fung Hsien on Sung Shan, are very broad and provided with projecting buttresses. Otherwise they are quite simple without any particular development of the cornices and decorated with ornaments and figures in very low relief. The earliest of these Honan pillars is dated A.D. 118, the latest A.D. 175.

The pillars in Szechuan have usually no buttresses, but they are higher and characterized by a richer architectural composition; their upper parts, the cornices and friezes under the projecting roof are particularly well developed. We find here, reproduced in stone, the beam ends and brackets so characteristic of Chinese wooden architecture, and between these are sculptural decorations executed in high relief, sometimes almost in the round. These pillars are all from the later Han dynasty, but only one of them, the pillar of Fung Huan at Ch'iu Hsien, is dated by an inscription which contains the year A.D. 121.

Symbolic Decorations of the Han.—More important for their sculptural decorations are, however, two pillars in the same neighbourhood erected at the tomb of a man called Shen. On their shafts are representations of the symbols of the four directions; *i.e.*, the red bird of the South, the white tiger of the East, the blue dragon of the West and the black tortoise of the North, animal representations which, with regard to energetic rhythm of line and grand decorative stylization, may be compared to the best works in bronze or clay known from this classic epoch. At the corners of the entablature are seated human figures which seem to carry the projecting beams on their shoulders, and, on the











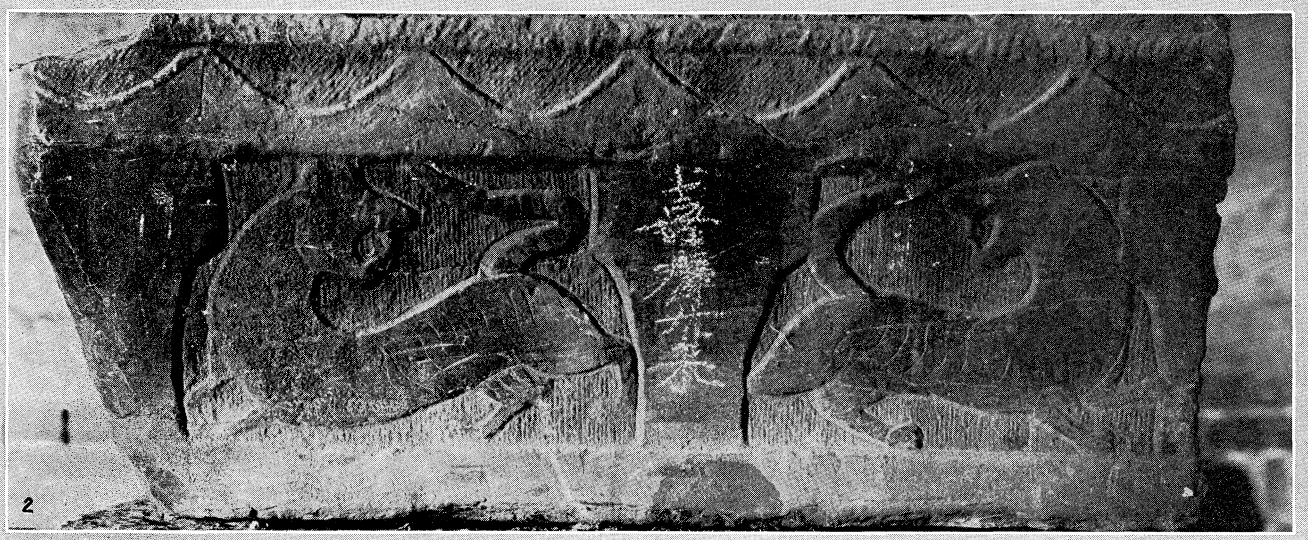
FROM (1) THE OPPENHEIM COLLECTION, (2) THE WANNIECK COLLECTION, (4) THE GARDNER COLLECTION, (5) "MISSION ARCHÉOLOGIQUE EN CHINE" BY SEGALEN-VOISINS AND LARTIGUE (PAUL GEUTHNER); PHOTOGRAPHS, (3) COPR. OSVALD SIRÉN

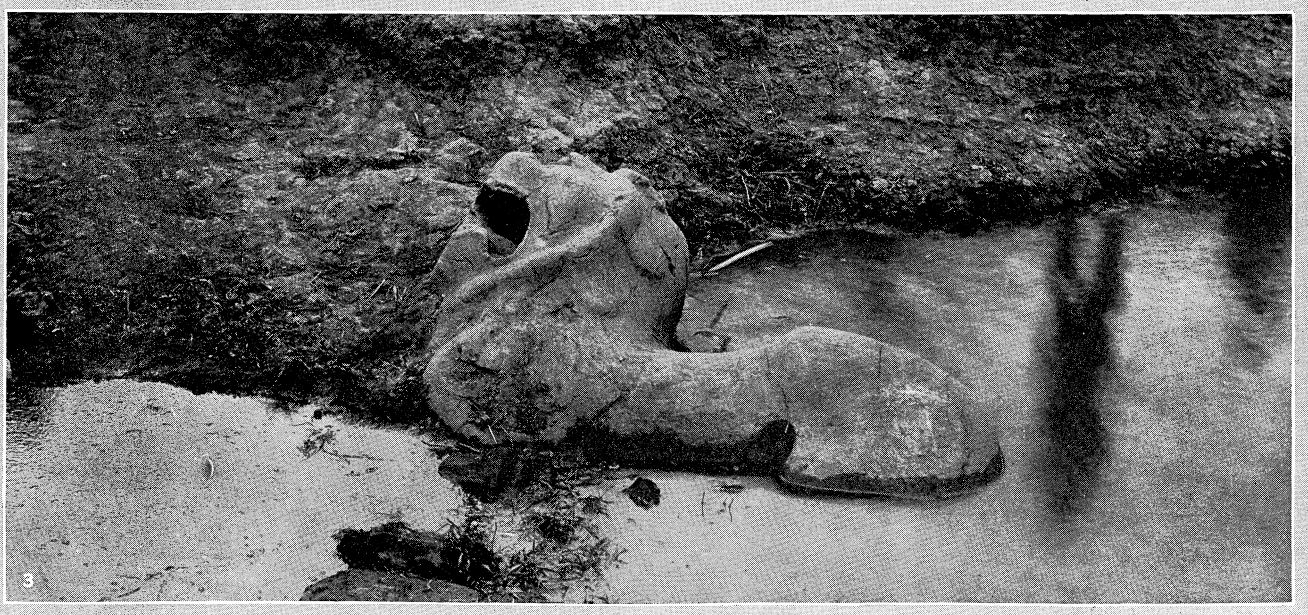
ANIMALS IN EARLY CHINESE SCULPTURE

1. Bear in gilt bronze; Han dynasty (206 B.C.–A.D. 220)
2. Reclining bull, bronze; North Wei dynasty (A.D. 386–636)
3. Dog, in clay; Han dynasty (206 B.C.–A.D. 220)
4. Two bears, gilt bronze; Han dynasty (206 B.C.–A.D. 220)
5. Reclining horse, from the tomb of General Ho Ch'iu P'ing, Shen-si, (*c.* 117 B.C.)

CHINESE SCULPTURE







PHOTOGRAPHS, COPR. OSVALD SIRÉN

SCULPTURES AT THE TOMB OF WU LIANG TZU, SHANTUNG

1. Men coming in carts and on horseback to a festival in a house; stone relief from the tomb shrine of Wu Liang Tzu; A.D. 147
2. Two tigers; stone relief from the same tomb
3. Statue of a guardian lion at entrance of the same tomb

middle of the south side, a kind of *t'ao t'ie* (glutton) appears between the beams. All these figures are executed practically in the round and most skilfully composed into the architectural scheme of the monument. The very high frieze is divided into two sections, of which the lower one is decorated with hunting scenes in quite low relief and the upper one with some larger figures in high relief. One may observe here men riding on stags, horse-like animals running along with the swiftness of the wind, and hunters who aim with their bows above their heads or grasp the passing leopard by its tail. Here is the same free-play with animal and human forms as may be observed on some of the inlaid bronze vessels or on the glazed Han urns with relief friezes. The motives seem to have some reference to the life beyond the tomb, though they represent this with a naturalness and an intensity of movement which make them appear like scenes from real life. The style reveals something of the same energy and nervous tension that characterizes the small bronze ornaments of this period, and it can hardly be explained without accepting an influence from west Asiatic sources, though the Chinese transformation of the west Asiatic tradition is more complete in the large stone sculptures than in most of the minor bronze ornaments.

Dramatic Expression of the Pillars.—The majority of the tomb pillars in Szechuan, of which at least a score were discovered by Ségalen and Lartigue during their exploration in 1914, show the above mentioned combination of friezes with flat reliefs and tri-dimensional representations of animals and human figures on the entablature. The motives vary, some being historical or legendary, others religious or mythological, but they are all more or less imbued with a dramatic expression, and executed in a form of high decorative beauty.

Much simpler than these are the pillars which stood at the entrance to the tomb of the Wu family at Ch'ia Hsiang in Shantung. They were erected about the year A.D. 147 and they are still in their original place, although the tomb-area has become a large pit, usually filled with water. The pillars are provided with buttresses and a small superior storey on the projecting roof, but their sculptural decoration consists simply of quite low reliefs representing dragons, tigers and birds, in decorative translation, besides legendary illustrations with a moral import, framed by geometrical ornaments of the same kind as may be found for instance on the mirrors of the Han period.

Reliefs of the Han.—The same kind of motive, executed in a strictly conventionalized linear style, appears also on the large stone slabs which used to be arranged along the walls of the ante-chamber in the tomb, but which are now transferred to a primitive little store-room where they stand without any kind of order. These reliefs from the Wu Liang Tzu tomb have become known all over the world through numerous series of rubbings taken of them since the 18th century, and reproduced in many Chinese and European publications. Two or three of the reliefs have found their way into Western collections, though it should be noticed that the majority of the stone reliefs, said to come from Wu Liang Tzu, are simply modern imitations, made on the basis of rubbings.

Legendary Motives.—Nothing is more entertaining than to follow, with the aid of Chavannes interpretations, the legendary motives represented in these reliefs and thus to learn something about classical Chinese examples of filial piety, matrimonial fidelity, the faithfulness of loyal citizens, the valour of great heroes, not to mention the quasi-historical traditions about the great Yü and Ch'in Shih Huang Ti or the mythological stories about the king of the East, Tung Wang Kung, and the queen of of the West, Hsi Wang Mu. Very common motives in these reliefs are the long processions of riders and carriages and the rows of men on horseback escorting a carriage, which may be representations of the journey of the deceased to Hades.

The compositions are arranged in horizontal storeys, with single rows of figures, animals, trees, houses and the like, appearing as silhouettes against a neutral background. The artistic expression lies mainly in the contours, and in the engraved lines; the modelling of the forms is very slight. These reliefs may thus hardly be called sculpture in the real sense of the word, but rather paintings or drawings translated into stone. We have reason to suppose that they were made after such patterns and reproduce popular wall paintings which existed in some contemporary palaces, a supposition which is supported by the poet Wang Yen Shou, who describes the wall paintings in the Ling Kuang palace executed about the middle of the 2nd century A.D. He mentions in his description mythological illustrations of the same kind as may be seen in the Wu Liang Tzu reliefs besides "many riotous damsels and turbulent lords, loyal knights, dutiful sons, mighty scholars, faithful wives, victors and vanquished, wise men and fools," motives which correspond more or less to those appearing on the stone reliefs from Wu Liang Tzu and other places in Shantung.

Bactrian Types.—It has been claimed that the proud horses of these reliefs were of Bactrian origin. This is possible but the Chinese sculptors were certainly less guided by observation of nature than by artistic models, be it in bronze, clay or textile. They have accepted and further developed a definite type of horse which probably existed in the art of the Hellenized west-Asiatic countries.

Less Hellenistic and more definitely Scytho-Iranian in character are the winding dragons and heraldically placed tigers which appear in one or two of these reliefs. They belong to the same great family of ornamental animals which we also met on the stone pillars in Szechuan, and may thus be said to form some additional proofs of the general acceptance of this kind of animal sculpture during the Han period.

Still more remarkable examples of the same stylistic current are the two lions which stood at the entrance to the tomb of the Wu family (at the sides of the above-mentioned pillars) but which are now more or less buried in the mud. The anatomical character of the only visible one is rather free. It is, indeed, no common lion but a descendant of those proud animals which stood at the royal palaces in Susa and Persepolis and whose artistic pedigree may be traced to Chaldean and Assyrian art. The form is supple, the body is thin, the whole animal is dominated by the broad curving neck which comes so far to the front that the head almost disappears and the neck continues in the enormous jaws. At the shoulders one may observe traces of small wings, though they have been practically worn off by time. Such a creation has hardly been shaped from nature. Even if single lions now and then were sent as tributes from western Asiatic nations to the Chinese emperor, these were hardly known by the people in the provinces, and as there were no other lions in China, we may well suppose that the inspiration for such animal representation was drawn from examples of Iranian art rather than from living models.

Animal Statues.—To the same group of animal statues from the end of the Han-epoch may also be assigned two winged tigers at the tomb of K'ao Yi at Ya Chou Fu in Szechuan, which have been published by Ségalen and Lartigue, and the enormous seated lion—which has served as a plinth for a pillar in the Okura museum in Tokyo. There are furthermore some minor animal statuettes of the same type but they hardly need detain us as they only verify what has already been said about the artistic style and derivation of these sculptures. Nor do we need to stop at the human figures executed in stone on a large scale, because their artistic importance is much inferior to that of the animals.

Animal Sculptures of the Six Dynasties Period.—During the centuries which followed the fall of the Eastern Han dynasty (A.D. 214) artistic activity in China lost some of its intensity. The times were restless, filled with war and political upheaval. The empire was again divided into several minor States, to begin with, the Three Kingdoms, Wu, Shu and Wei, and later on, after 223, into a northern and a southern half, the former being under the domination of the Tartars, among whom the Toba tribe came out the strongest and took the name of the Northern Wei dynasty, while the latter was ruled over by a number of short-lived native dynasties—Sung, Ch'i, Liang and Ch'en—which had their headquarters at Nanking. We know very little about the artistic activity during these times but it seems that the

stylistic traditions of the Han period remained in force also during the 3rd and 4th centuries of our era. Some tomb reliefs, mainly from Shantung, executed in a kind of coarser Han style, may well be of this transition period, and the same may be said of a number of minor plastic works in bronze and clay.

The general evolution can be followed most closely through the small tomb statuettes; they reflect the variations in taste and fashion better than the large stone sculptures. Among them are real *genre* figures represented in various occupations such as music-making, feeding the hens, or with children in their arms, and we may observe how the fashion is changed from the simple "kimono" to an elegantly draped mantle over a tightly-fitting undergarment and how the head-dress becomes higher and more decorative. These tomb statuettes and minor animals in terra-cotta originate mainly from Honan, whereas the larger stone sculptures of this same period are executed for the reigning dynasties in Nanking. These monuments which form one of the most important groups within the domain of Chinese sculpture, have been more or less identified and reproduced by various explorers.

The largest among these lions and chimaeras measure up to 10 or 12 ft. in length and may still be seen at their original places, but some smaller ones, 4 to 6 ft. long, have found their way to Western collections. They all represent winged, lion-like animals but it is possible to distinguish two main types, *i.e.*, the chimaeras, which are a kind of cross between dragons and lions, and the real lions which have wings on their shoulders but no feathers or scales on their bodies and no ornamental beard. The former seem to have been considered the nobler, because they were employed as guardians at the tombs of emperors, whereas the lions stood at the tombs of princes and dukes.

Early Chimaeras.—The earliest chimaera which can be dated stands at the tomb of Emperor Sung Wen Ti (d. 453). It is a colossal and, in spite of its dilapidation, still imposing animal, largely covered up by a heap of refuse, so that the statue had to be dug out whenever it was photographed. The upper part of the head is lost and the surface of the grey limestone is very much worn but it is still possible to see that the body as well as the legs have been covered by ornamental scales or feathers and that the animal had wings not only at the shoulders but also at the ears.

The second earliest in date of the chimaeras which still remain at their original sites is the one at the tomb of Emperor Ch'i Wu Ti (d. 493). The dimensions are somewhat smaller but the animal is more completely preserved. The long body has a more dragon-like character, the legs are comparatively short and the tail well developed. The most imposing part is, however, the enormous head with the open jaws from which the ornamental beard hangs like a long tongue. One may here observe three pairs of wings as well as feathers drawn in spirals over the whole body.

Sixth-century Chimaeras.—The same proud bearing characterizes the chimaera at the tomb of Emperor Liang Wu Ti (d. 549). The movement of the long and supple body is still better developed and it receives a most effective continuation in the enormous curve of the neck. The animal is moving forward in an ambling fashion; we feel its vigour and suppleness. The wings and the feathers are indicated in quite low relief or simply engraved.

This nobility and energy are carried still further in the two large chimaeras which now stand in the University Museum at Philadelphia. We have no information whence they come, but they illustrate a further evolution of the style of the chimaeras at the tomb of Emperor Liang Wu Ti, which would date them shortly after the middle of the 6th century. It is possible that they stood at the tomb of some of the emperors of the short Ch'en dynasty which followed after the Liang, such as Ch'en Wu Ti (d. 559) or Ch'en Wen Ti (d. 566). In comparison with these beasts, the earlier chimaeras appear almost like domestic animals. The fantastic wildness and the seething energy are here given free outlet. The legs are stretched, the bodies drawn, the head is wildly thrown backwards, the chest pushed forward into a large curve, and all these movements are accentuated by engraved lines which give the impression of taut steel springs. Besides these large ones several minor chimaeras are known but none of them reaches the extraordinary expressiveness of the last-mentioned.

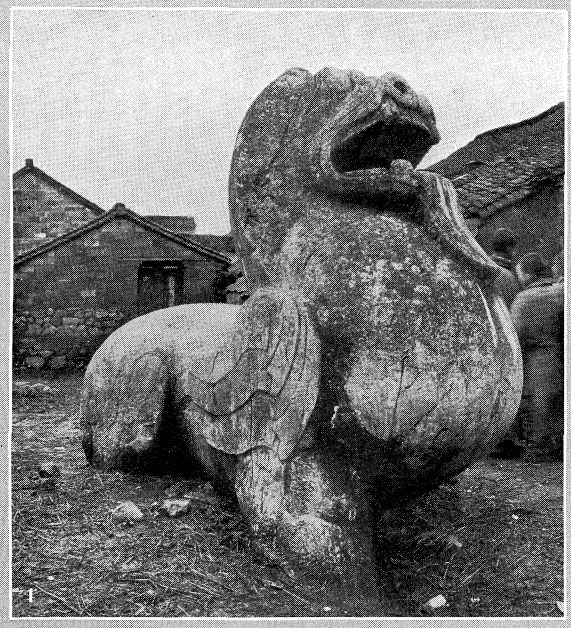
Winged Lions.—The largest of the winged lions still remain *in situ*, not far from Nanking; their weight and colossal dimensions have made their removal impossible, but some of them are so far decayed that, if nothing is done to protect them, they will soon disappear. The earliest and most important stand at tombs of various members of the Liang family, *i.e.*, the brothers of the Emperor Wu Ti, Prince Hsiao Hsiu (d. 518), Prince Hsiao Tan (d. 522) and the cousin of the emperor, Duke Hsiao Ching (d. 523). Besides these, two or three pairs of large lions are in the same neighbourhood, at Yao Hua Men, to the east of Nanking, but they are later and artistically inferior. The anatomical difference between the lions and the chimaeras is, as already said, not very important. The former as well as the latter are feline animals with an enormous curving neck and wings, but they are not provided with scales or feathers, nor do they have any ornamental beard like the chimaeras, only a large tongue which hangs down from the open jaws over the projecting chest. They are all represented in an ambling posture, majestically walking or coming to a sudden standstill, when the fore-legs are strained and the hind-legs bent. The head is lifted high on the proudly curving neck, the forms are full, the limbs heavier than in the chimaeras. Their massiveness is at least as imposing as the concentration of power in their enormous limbs. Most eaten by frost and water are the lions at the tomb of Duke Hsiao Ching which is now covered by a watery rice field in which the lions sink up to their shoulders.



SCULPTURE OF THE NORTHERN WEI PERIOD

Lions of Hsiao Hsiu Tombs.—Better preserved and more completely visible are the two colossal lions at the tomb area of Hsiao Hsiu, now covered by the village Kan Yu Hsiang, and here remains one row of the other monuments which flanked the "spirit road," *i.e.*, two large tablets with inscriptions carried by tortoises and a fluted column on a plinth composed of winding dragons. This seems to be the earliest preserved "tomb alley" in China, an arrangement known from a great number of later tombs. The lions are of the same family as those already described, the fact that they have wings is in itself a proof of their dependence on Persian art. It should, however, be remembered that the Achaemenian and Sassanian animals were descendants of the Assyrian which must be regarded as the fore-fathers of all the greatest Asiatic and a good many European lion sculptures. To what extent the Chinese really knew such models is a question which cannot be discussed here; it is in any case evident that they transformed the foreign models quite freely, not to say fantastically, in harmony with their native traditions. These animal sculptures form stylistically a direct continuation of the plastic art of the Han period. Yet, they indicate that a new wave of Western influence reached China at this time on a more southern route than through the north-western nomads. These lion sculptures do not appear in the northern provinces which were dominated by the Tartars. They belong to the more southern provinces where the old Chinese civilization and the creative spirit of the "Han people" never were completely subdued by foreign elements.

Religious Sculpture of the Six Dynasties.—When Buddhist sculpture was introduced into China it had passed through a long evolution in India and Central Asia; the principal iconographic motives, symbols and attributes were all developed into definite forms; the Chinese took them over just as they took over Buddhist scriptures; and whatever modifications they may have







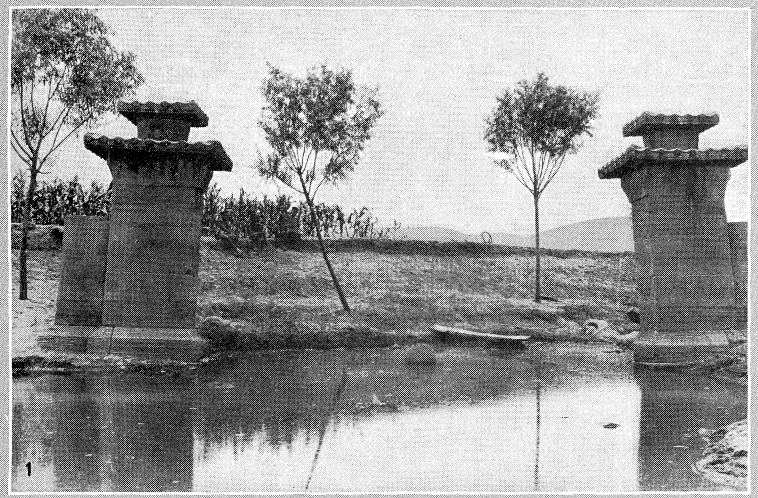


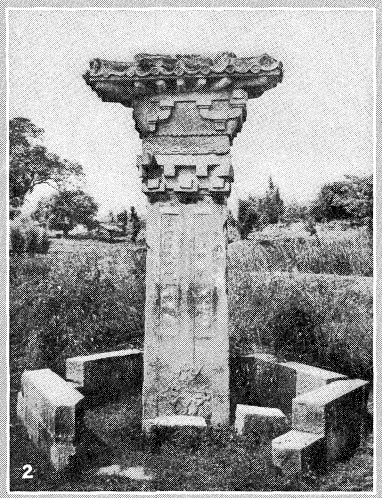


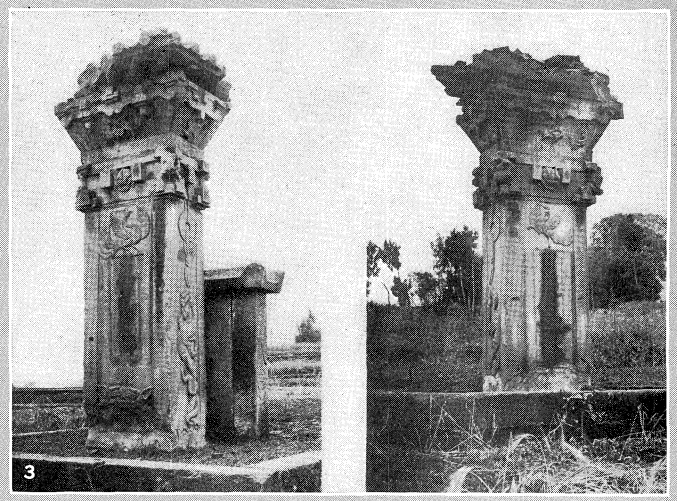
BY COURTESY OF (3, 4) THE MUSEUM OF THE UNIVERSITY OF PENNSYLVANIA, FROM (2) "MISSION ARCHÉOLOGIQUE EN CHINE" BY SEGALEN-VOISINS AND LARTIGUE (PAUL GEUTHNER); PHOTOGRAPHS, (1, 5) COPR. OSVALD SIRÉN

MONSTERS IN CHINESE SCULPTURE

1. Winged lion; statue at the tomb of Prince Hsiao Hsiu (d. A.D. 518), near Nanking. 2. Chimaera; statue at the tomb of the Emperor Ch'i Wu Ti (d. A.D. 493), near Nanking. Chimaeras usually guarded the tombs of emperors; lions those of princes and dukes; the largest are 10–12 ft. long. 3. Chimaera; statue from an imperial tomb of the 6th century A.D. 4. Chimaera; statue from an imperial tomb. 5. Statue of winged lion at the tomb of Duke Hsiao Ching (d. A.D. 523), near Nanking

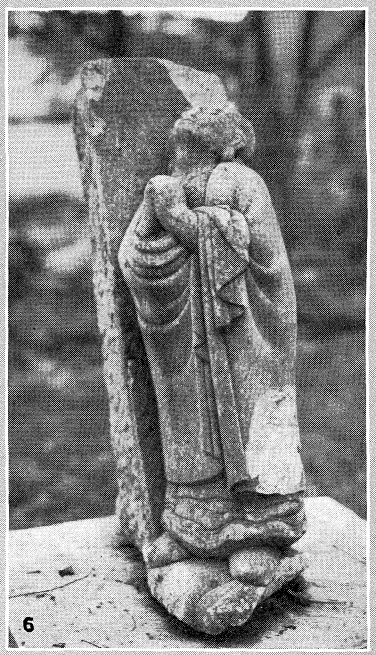








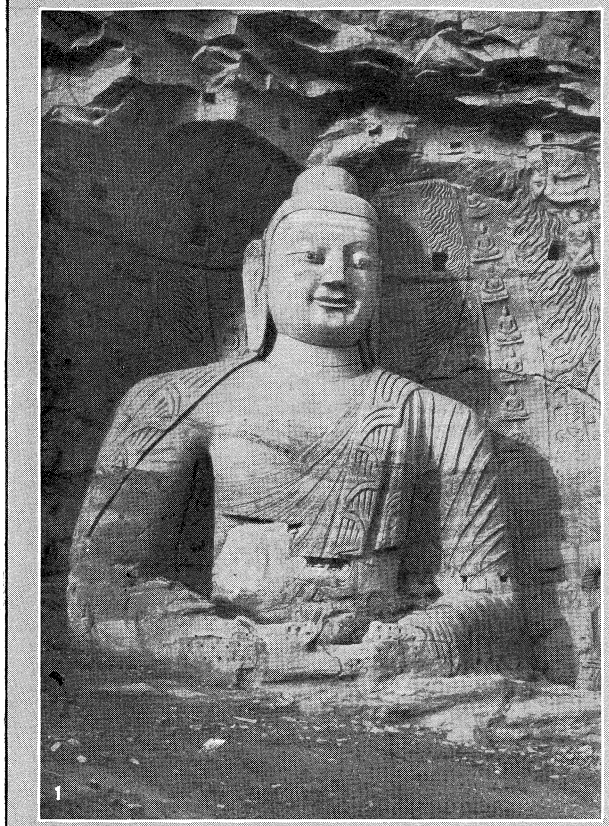




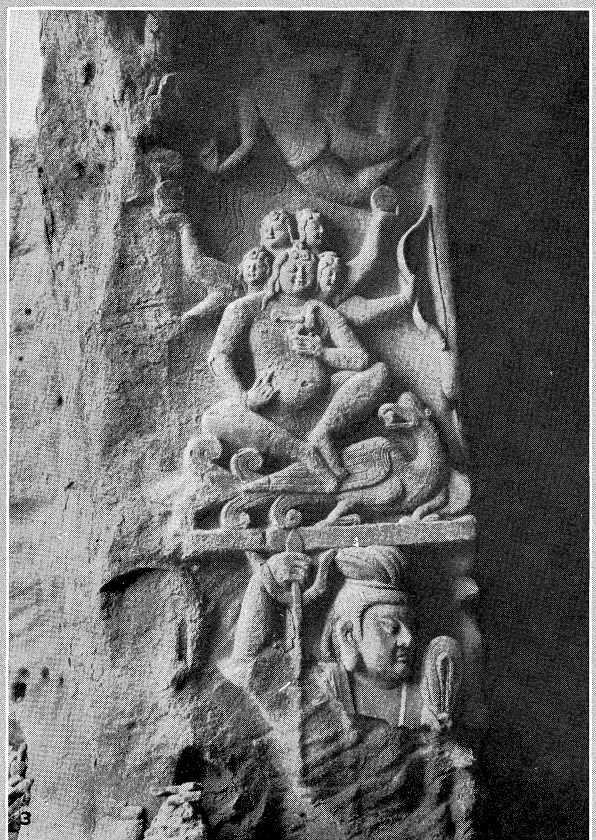
BY COURTESY OF (4) THE MUSEUM OF FINE ARTS, BOSTON; FROM (2, 3) "MISSION ARCHÉOLOGIQUE EN CHINE" BY SEGALEN-VOISINS AND LARTIGUE (PAUL GEUTHNER); PHOTOGRAPHS, (1, 5, 6) COPR. OSVALD SIRÉN

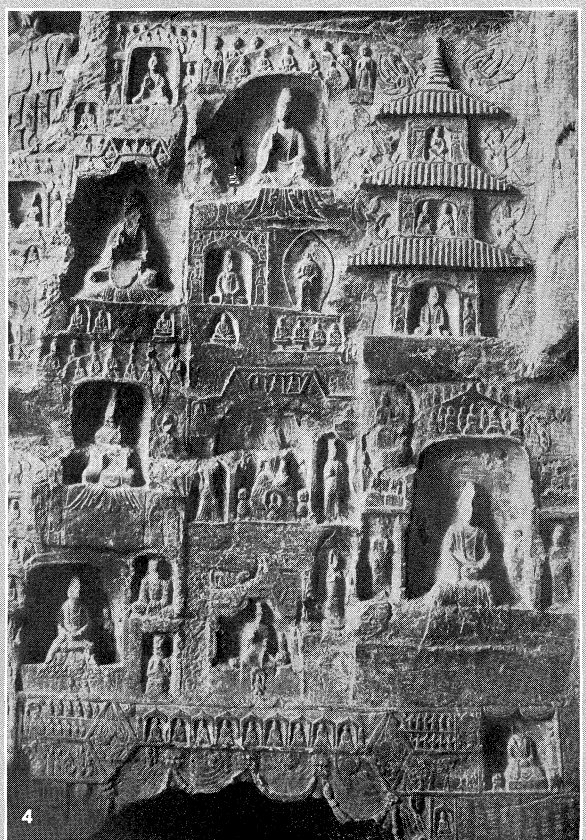
LARGE AND SMALL WORKS OF CHINESE SCULPTURE

1. Pillars forming the entrance to the tomb-area of Wu Liang Tzu, Shantung, A.D. 147
2. Pillar at the tomb of Fung Huan, Sze-Ch'uen, A.D. 121
3. Pillars at tomb of Shen, Sze-Ch'uen
4. Seated Bodhisattva, marble statue, late T'ang dynasty
5. Tomb-statuettes in clay, Han dynasty, in a private collection in Berlin
6. Praying monk, a marble statue, 12th–13th century A.D.







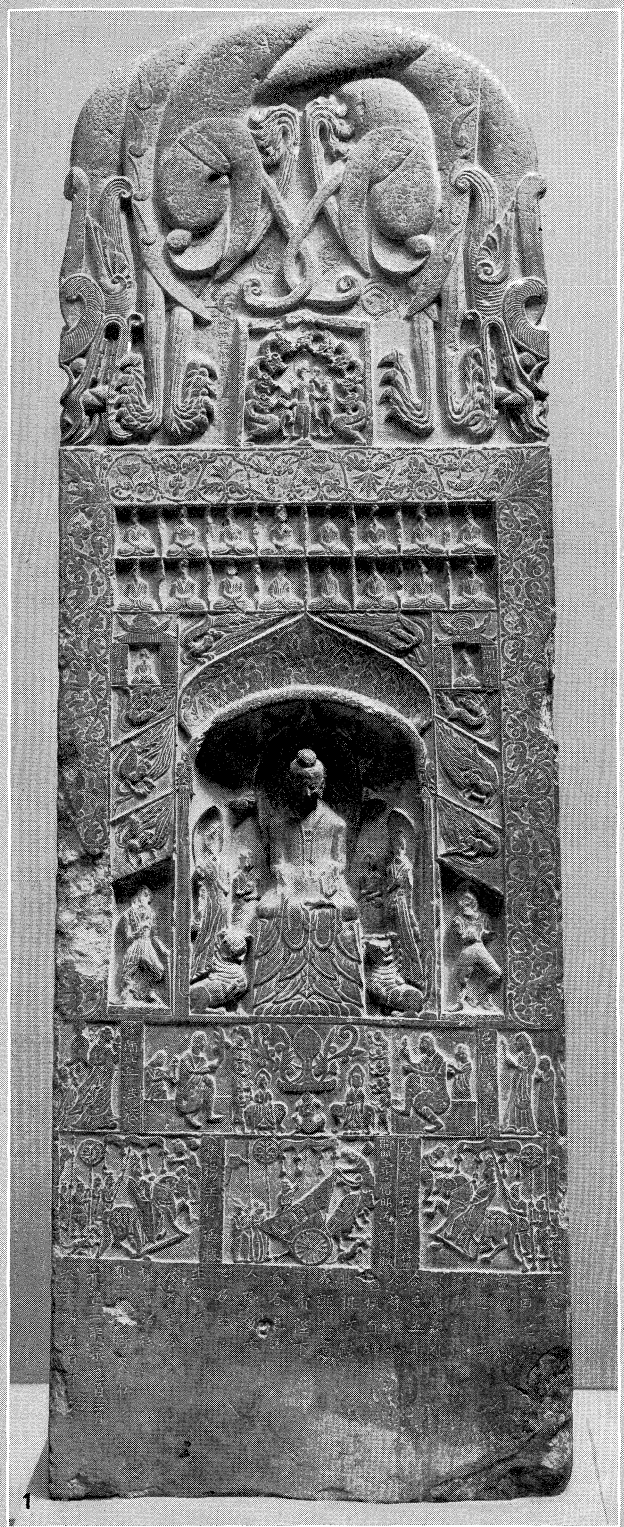


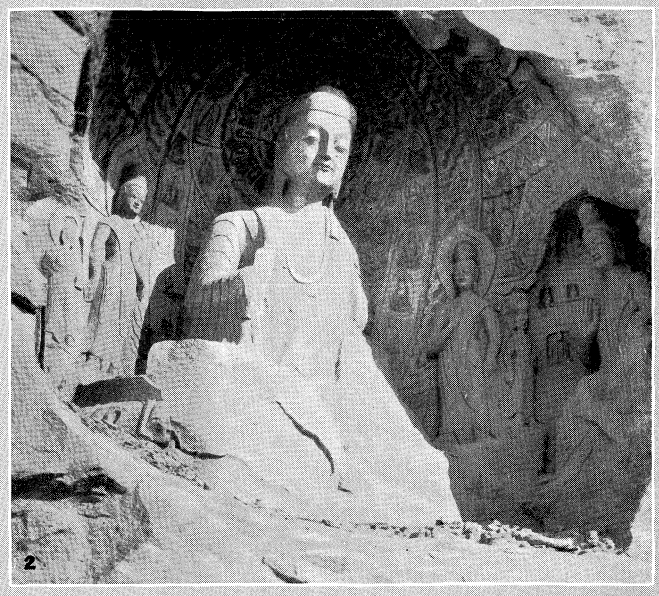
PHOTOGRAPHS, (1, 3, 4) COPR. OSVALD SIRÉN, (2) H. C. ELLIS

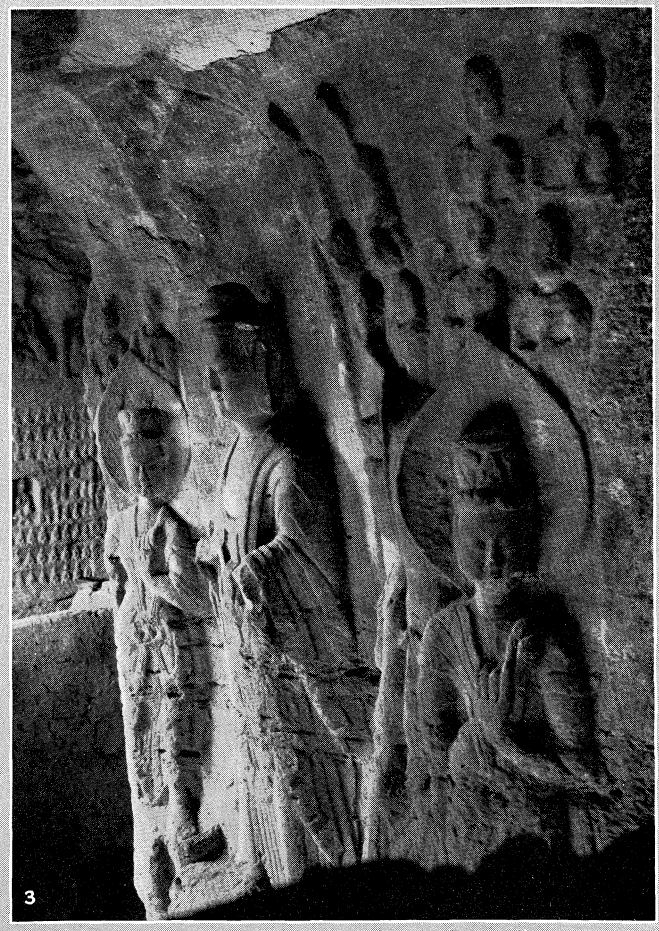
DIVINITIES IN CHINESE SCULPTURE

1. Seated Buddha, colossal statue at Yun Kang, Shan-si, 6th century. 2. Seated Bodhisattva, early 6th century, from Yun Kang, Shan-si. 3. Hindu divinities and a guardian at entrance to a cave, Yun Kang, 6th century. The sculptures of the cave temples (5th–6th centuries) show strong influences from the art of Central and Western Asia. 4. Portion of a wall in the Lao Chun cave, Lung-Men, Ho-nan, early 6th century

CHINESE SCULPTURE







BY COURTESY OF (1) THE MUSEUM OF FINE ARTS, BOSTON; PHOTOGRAPHS, (2, 3) COPR. OSVALD SIRÉN

BUDDHAS OF THE EARLY 6TH CENTURY

1. Buddhist votive stela, dated A.D. 529. The interlacing dragons at the top are of the same character as those on the slabs raised at tombs in the Han period, but their fierceness and energy of movement reveal some influence from Sibero-Asiatic art
2. Seated Buddha in a niche at Yün Kang, Shan-si; early 6th century
3. Standing Buddha accompanied by two Bodhisattvas; early 6th century, Yün Kang, Shan-si

introduced concerned more the artistic interpretation than the motives themselves. It should never be forgotten that they were greater artists than any other people of the Far East, and when Buddhist art took root in China, the country was by no means devoid of sculptural monuments. There were (as we have previously seen) artistic traditions which could not be forgotten, only modified when applied to Buddhist motives. The Buddhas and Bodhisattvas were, of course, represented in human shapes but the artists could not enhance their significance by accentuating their physical organisms or their likeness to ordinary human beings, nor could they change their general shapes or postures if they wanted to be understood. The iconographic rules are indeed much more exacting in Buddhist than in Christian art, and the motives are more limited in their artistic scope.

Religious Symbolism.—The great majority of the Buddhist sculptures represent isolated figures, seated or standing in very quiet postures without any attempt at movement, except certain symbolic gestures. The heads are made according to quite definite types, somewhat changing with the periods and localities, but it is rare to meet heads with individual expression or portraitlike features. The bodies are as a rule entirely covered by long mantles or rich garments according to the rôle or meaning of the figure; they have hardly any importance of their own but serve simply as a substratum for the rich flow of the mantle folds which, particularly in the early sculptures, conceal the forms much more than they accentuate them. Even in figures which are represented almost nude, such as the guardians at the gate (*Dvarapalas*), the representation is not really naturalistic; their Herculean forms and muscular movements are altogether exaggerated and their significance is symbolic.

The earliest dated Buddhist sculptures in China, known to us, are small bronze statuettes of a greater historical than artistic importance. Some of them are provided with inscriptions which make it possible to fix their date, the earliest being of the years 437 and 444, whereas the earliest dated Buddha in stone is of the year 457. These small statuettes represent standing or seated Buddhas or Bodhisattvas against a leaf-shaped nimbus decorated with engraved flame-ornaments. The figures are mostly of a very moderate artistic importance recalling by their types and draperies the Graeco-Buddhist art of north India. The large nimbuses behind these small figures constitute, however, a feature which is not known in Gandahara sculpture.

Yün Kang Cave Temples.—The greatest *ensemble* of early Buddhist sculptures in China is to be found at the Yün Kang cave temples near Ta Tung Fu in Shansi where the Northern Wei dynasty had its capital until 494, when it was removed to Loyang in Honan. The work at these cave sculptures started about the middle of the 5th century and was continued towards the latter part of the 6th century. Amongst the rich material displayed at this place one may observe different stylistic currents, some originating from Central Asia and India, others more closely connected with earlier forms of Chinese art. Here are ornaments of a distinctly Iranian character, and architectural forms of the same type as on reliefs from Taxila and Peshawar, but also some decorative motives recalling the art of the Han period. Among the figures there are some curious examples which form a link with Central Asiatic art, *e.g.*, the five-headed and six-armed god who sits on a large bird with a pearl in its beak. This is no doubt the Garuda-raja, the bird of Vishnu, which also may be seen in some paintings from Tun Huang. This and other Hindu divinities of a similar kind, which appear in the Buddhist pantheon at Yün Kang, testify that artistic influence from central and western Asia reached China in connection with the introduction of Buddhism.

Artistic Expression.—Most famous among the figures here are the colossal Buddhas and Bodhisattvas which, however, seem to us artistically least interesting. A certain conventional type and fold design have in these figures been enormously enlarged without any intensification of the rhythmic motives or the artistic expression. More artistic expression and beauty may be found in some other figures at Yün Kang which are less closely allied to Indian models and more imbued with the traditional Chinese feeling for rhythmic lines and elegant form. The figures themselves are quite thin and flat, sometimes hardly modelled into full cubic volume, and they are entirely covered up by very long and heavy garments. The folds of these are pressed and pleated on the very thin shapes and uniformly arranged on both sides of the figures in long concave curves, forming a kind of zigzag pattern at the border; the contours are very tense, with the elasticity of drawn bow-strings. When this type of draping is fully developed the drawn out, curving mantle-folds may suggest wings.

Temple Grottoes at Lung Men.—The same energetic style as in the best Yün Kang sculptures may also be observed in some of the statues in the famous temple grottoes at Lung Men in Honan which were begun shortly after the Northern Wei dynasty had transferred its capital to Loyang (494). During the last decade these caves have been so badly destroyed that hardly 10% of the original sculpture still remains; all the rest is either smashed or beheaded, some of the heads being replaced by clay substitutes of a very provincial type. The most beautiful and earliest sculptures at Lung Men are to be found in the so-called Lao Chun Tung cave which is decorated from ceiling to floor with a great number of niches of varying sizes in which Buddhas and Bodhisattvas are grouped, either alone or together with adoring bikshus or other attendants. The majority of these sculptures were executed in the 3rd or 4th decade of the 6th century, but only some of the minor reliefs remain still in a fair condition. Yet some characteristic positions may be observed, for instance the cross-ankled Bodhisattvas which represent Maitreya, the coming Buddha, while the Buddha Sakyamuni is seated with legs straight down. The stylization of the folds is carried out according to the same patterns as in the Yün Kang caves, but the stone is harder and the technique is superior to that of the earlier Yün Kang sculptures. Some of these Lung Men sculptures have certainly been among the finest works of their kind in China.

Another variation of the Northern Wei period style may be observed in the sculptures which decorate the temple caves at Shih Ku Ssu, near Kung Hsien in Honan. The work was here started about the same time as at Lung Men but the material is of a softer kind and the technique is not quite so fine. The large central Buddha at this place, which now stands up to its knees in mud, is a broad and block-like figure modelled in very large planes, with a remarkable cubistic tendency, which also may be observed in several minor heads from the same place, now dispersed in various European and American museums.

Buddhist Stelae.—Besides these cave sculptures of the Northern Wei period should be mentioned a large number of Buddhist stelae, *i.e.*, slabs with figures in high relief, varying in size, some up to 12 ft. high, others quite small. Their decoration consists generally of a combination of niches with Buddhist figures and ornamental borders. On the back of these slabs are often found long rows of figures in flat relief representing the donors of the monuments. This form of stelae was probably developed from the earlier type of inscribed memorial stones, as used in China since the Han dynasty. It is worth noticing that we find at the top of the Buddhist stelae the same kind of winding and interlacing dragons as on the slabs which were raised at the tombs; their fierceness and energy of movement seem to reveal their derivation from the Sibero-Asiatic art, based on Scythian traditions which, indeed, had a great influence on the development of the ornamental style of this period.

Transition Period.—The stylistic ideals of the Northern Wei period retained their importance until the middle of the 6th century. About this time a new wave of artistic influence reached China from northern India. It may be quite clearly observed in some of the monuments which were executed during the Northern Ch'i and Northern Chou dynasties (550–581). The best cave sculptures from this time existed, at least a few years ago, at T'ien Lung Shan not far from Taiyuan-fu in Shansi. They were started in the Northern Ch'i period and continued, with some intermissions during the Sui and T'ang dynasties.

Sculptures at T'ien Lung Shan.—The earliest sculptures at T'ien Lung Shan are to be found in the caves no. 2, 3, 10 and

16, probably executed between 560 and 580. The system of decoration in the first two caves consists of three large groups, one on each wall representing a seated Buddha accompanied by two Bodhisattvas and, in some instances, also by adoring monks and donors, characterized with striking realism. The main figures are executed in very high relief, giving almost the impression of free-standing forms, yet there is a certain flatness about them, noticeable particularly in the Bodhisattvas which stand turned half-way towards the central Buddha and whose garments —arranged in pleated folds—spread out in wing-like fashion at the sides. They are not very far removed stylistically from corresponding figures on later Wei monuments, though their heads are less archaic both in shape and expression.

The maturest examples of this transition period—possibly executed as late as 580—are to be found in the 16th cave at T'ien Lung Shan, where all the three walls are decorated with large groups of Buddhas with Bodhisattvas and other attendants placed on raised platforms, the fronts of which were decorated with representations of dwarf musicians. The central Buddhas are lifted into commanding positions on high pedestals in the form of lotus-flowers or altars; their shapes are full and well rounded, their heads comparatively small for the strong bodies. They are all seated in the same cross-legged posture, with bare feet and hands in the *abhaya* and *vara mudra* (gestures signifying "without fear" and "charity"). Their mantles, which are made of a very thin material, are draped only over the left shoulder, leaving the right bare, and the folds have practically no relief. Buddhas clothed in this fashion are very rare in Chinese art; they may occasionally be found in later T'ang sculpture but at this early period they are certainly surprises.

Foreign Influence.—The most probable explanation of this apparent anachronism in the style of the Buddhas seems to be that they were made from foreign models or by foreign artists while the less important side figures were carved in accordance with the indigenous principles of style. The figures are altogether Indian in spirit and form. It is hard to believe that Chinese artists would have been able to reproduce Mathura models so faithfully as we find them here, and it may at least be claimed that they have never done it better, either before or after. Possibly some Indian artist, well acquainted with the Mathura school, worked for some time at T'ien Lung Shan.

The same general types and principles of style which characterize the sculpture at T'ien Lung Shan may also be found in some isolated statues coming from this or a similar centre of sculptural activity. The most characteristic feature of all these figures is the cylindrical shape indicated in the legs and arms, as well as in the shape of the whole body, which often stands like a column on the lotus pedestal. Nothing can be more unlike the comparatively flat and angular shapes of the Northern Wei figures, which even when they have a more developed plastic form are linear rather than rounded.

Sculptures from Chihli Province.—Another provincial variation of the transition style may be seen in the sculptures from Chihli, the present metropolitan province, and particularly from Ting Chou where the supply of a beautiful white marble was abundant. The artistic quality of these sculptures is however quite uneven; the best of them stand on the highest level of Buddhist art in China, while the poorest are hardly more than ordinary artisans' work. Several figures of this group might be quoted as proofs of what already has been said about the plastic formula during this transition period. Their shapes are more or less cylindrical, their heads mostly large and heavy. One may notice a general tendency to make the figures narrower towards the feet and to broaden them towards the shoulders. The thin garments fit tightly over the bodies and their softly curving folds are indicated in quite low relief or simply with incised lines. Good examples of such statues are in the Metropolitan Museum in New York. If we place such a figure beside some characteristic example of the Northern Wei art, we may observe two opposite tendencies of style. In the earlier works the mantle folds and the contours are stretched and bent outward at the feet, the shoulders are narrow, the heads small; the rhythm is rising. In the later ones the rhythm is falling instead of rising, the tempo is slow, not without heaviness; there is no bending of the contours, they are falling almost straight down; the mantle hangs over the body and it is only towards the feet, where the circumference becomes smaller, that a certain acceleration of the tempo is noticeable.

The Sui Dynasty.—The sculptures of the Sui period (589–618) form, stylistically, a direct continuation of those of the transi-



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

SCULPTURE OF THE TRANSITION PERIOD OF THE NORTHERN CH'I DYNASTY

tion period during the Northern Ch'i and Chou dynasties. Most of them are still examples of the transition style, but a few may well be classified among the most perfect works of religious statuary in China. Conditions were particularly favourable for the flourishing of religious art, and the formal development had not yet passed the point where it becomes an end in itself. Sui sculpture is, on the whole, quite restrained in its formal modes of expression and its interest in nature is slight, but it marks nevertheless a distinct progress in the representation of actual forms.

T'ien Lung Statues.—Some good examples of the particular style of this period are to be found in the 8th grotto at T'ien Lung Shan which is in part preserved, although the soft material has been worn by time and water and some of the statues have been smashed and decapitated. Coming to these statues from a study of the sculptures in cave 16 at the same place (mentioned above), the first thing that strikes one is that they are not at all Indian in their general appearance. The Buddhas are seated in the same postures as the earlier ones but vested in the Chinese fashion with an upper garment covering both shoulders and with a less hieratic bearing of the stiff bodies. The shoulders are not so broad, the waist less curving, the forms are quite undifferentiated, but the heads have increased in size and have a more human air. They are certainly more Chinese, though in a provincial sense, and they are executed by inferior artists with little feeling for rhythmic lines and decorative beauty.

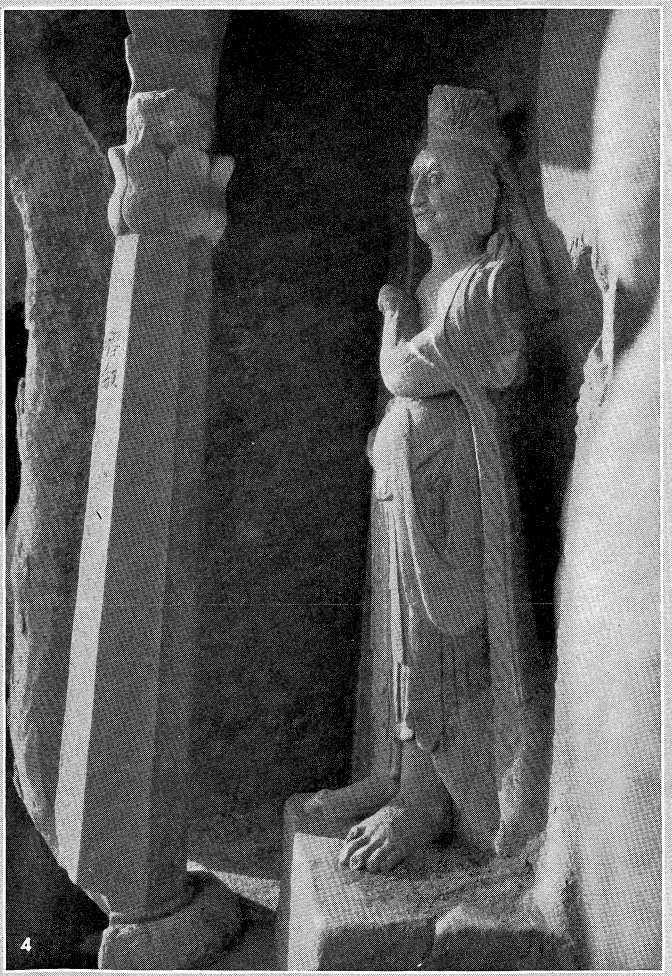
Most interesting are the two pairs of Dvarapalas (guardians) outside this cave. One pair is placed at the sides of the entrance, the other at each side of a tablet near by which still contains traces of an inscription of the Sui dynasty (said to be dated from about 589). The attitudes of these guardian figures are dramatic, not to say strained. The movement of the arms is jerky, the turning of the heads, which are looking over the shoulder, is violent. The impetuosity is, indeed, much greater in these figures than in the Dvarapala statues at the earlier caves, but whether they have gained in sculptural quality as much as in dramatic force is less certain.

Typical expressions of the plastic formula of the Sui period are also to be found among the sculptures from Chihli, easily recognizable by their material which is a micaceous white marble. Common to them all is the general shape which is no longer simply pillar-like or cylindrical, but ovoid. The contours are swelling out over the hips and elbows and gradually draw closer toward the feet and over the head. Thus a general formula is created, and it







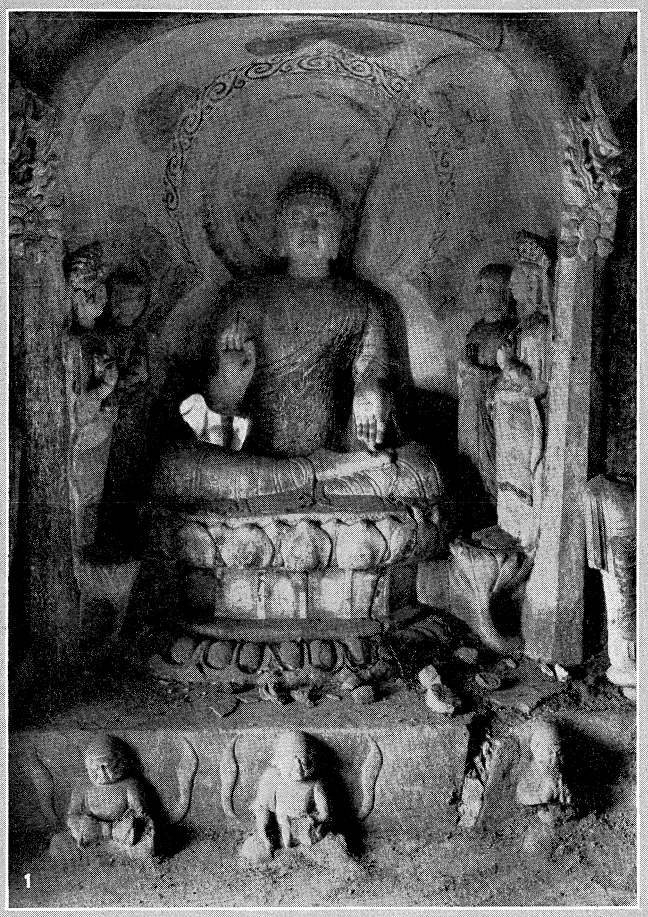


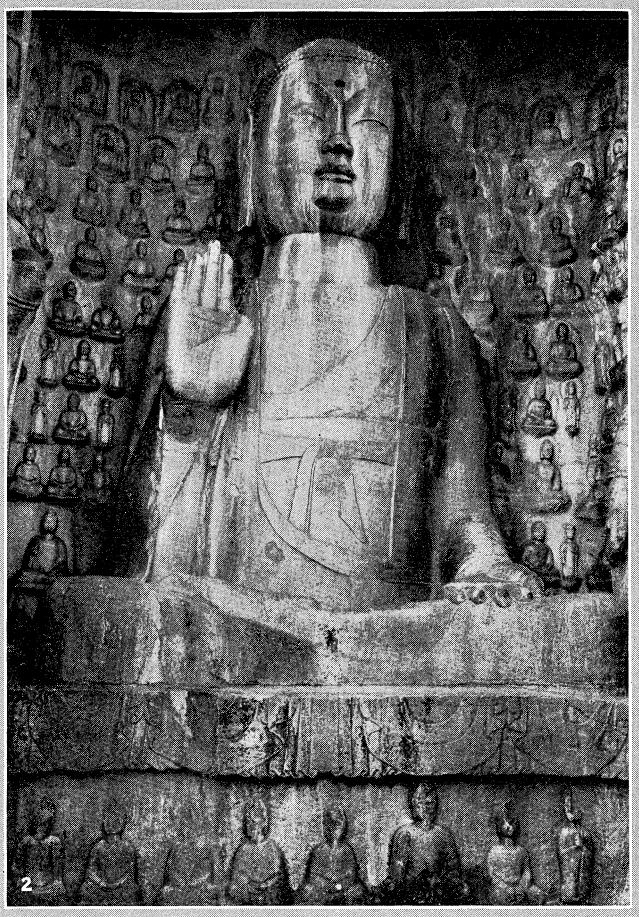
BY COURTESY OF (2) GRENVILLE WINTHROP, (3) THE MUSEUM OF THE UNIVERSITY OF PENNSYLVANIA; PHOTOGRAPHS, (1, 4) COPR. OSVALD SIRÉN

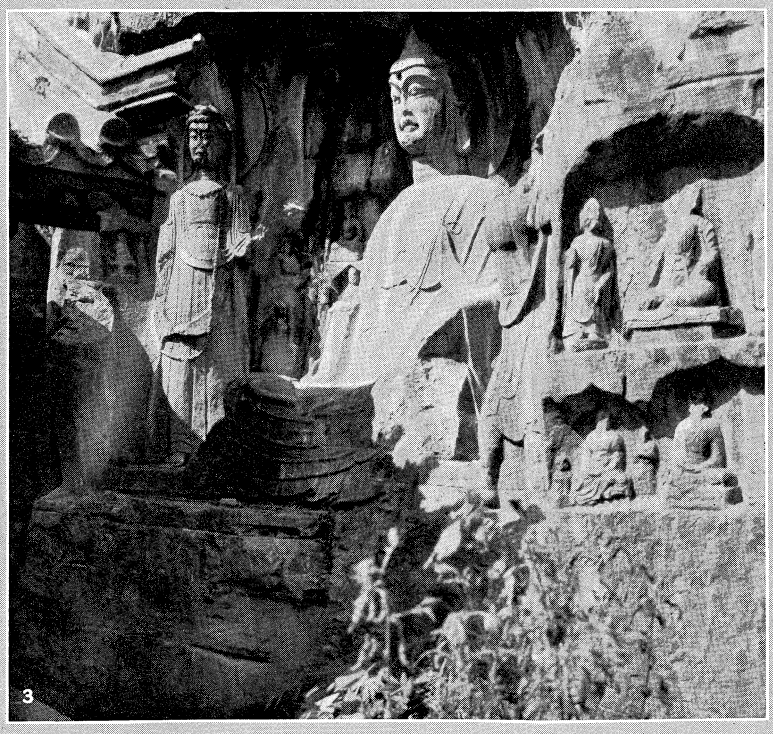
RELIGIOUS SCULPTURES OF THE 6TH CENTURY A.D.

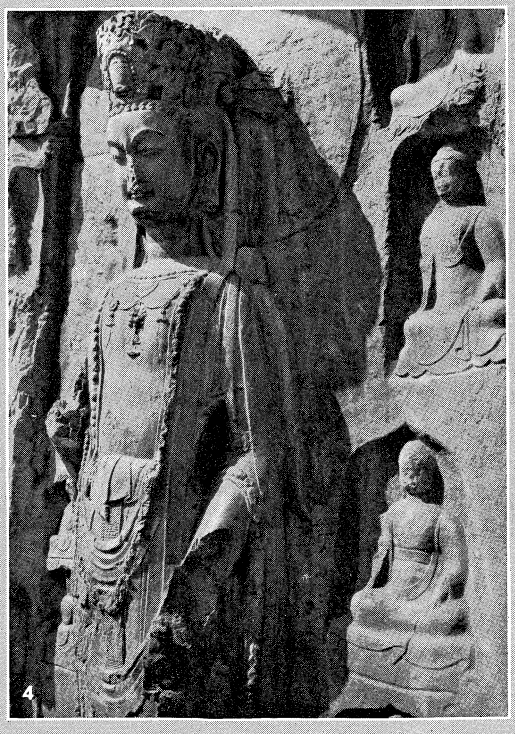
1. Buddha accompanied by two Bodhisattvas, Cave 2 at T'ien Lung Shan, Shan-si, middle 6th century. 2. Standing Bodhisattva, marble statue of Sui period, about 600. 3. Standing Buddha; statuette in gilt bronze, dated 537. 4. Guardian at entrance of Cave 8, T'ien Lung Shan, Shan-si, North Ch'i period, middle of the 6th century

CHINESE SCULPTURE









PHOTOGRAPHS, COPR. OSVALD SIRÉN

CHINESE SCULPTURES OF THE SUI PERIOD

1. Seated Buddha accompanied by two Bodhisattvas and two monks, Cave 16 at T'ien Lung Shan; Sui period, end of 6th century
2. Colossal Buddha in a cave at T'o Shan, Shantung; end of 6th century
3. Seated Buddha accompanied by a Bodhisattva, in a niche at Yun Men Shan, Shantung
4. Upper part of a Bodhisattva, Yun Men Shan, Shantung

is often repeated on a smaller scale in the heads. The same rhythm is taken up by the folds which in some of the figures form a succession of curves over the front endowing them with a more complete harmony and repose than may be expressed by any other shape or formula known to us.

Shantung Sculptures.—The richest and most varied provincial group of sculptures from the Sui period is to be found in Shantung. The religious fervour and interest in establishing Buddhist temples and sanctuaries seem to have been particularly great in this part of the country and, to judge from the sculptures still preserved in several of these caves, there must have existed an important tradition of religious art which was now revived by various masters of no common ability. The earliest caves are at T'o Shan and Yü Han Shan; at the latter place many of the figures are dated in the 4th, 5th and 6th year of the K'ai Huang era (584–586), but unfortunately they are largely restored with plaster and crude colouring.

The great sculptures in the second and third cave at T'o Shan belong practically to the same stylistic group as those at Yü Han Shan. None of them bears a definite date, but, to judge from their style, they must have been executed about the same time as those mentioned above, *i.e.*, about the middle of the '80s. The typical Sui formula for single figures has been enlarged on an enormous scale, not without some loss of plastic beauty and intimacy. The great Buddhas which are seated in cross-legged position on a low pedestal impress us more as a kind of architectural monolith than as plastically conceived sculptures. It is only the folds of the hem, falling over the pedestal, that have a livelier rhythm; here one may observe the very characteristic meandering wave-line which returns in most sculptures of the Sui period, and some overlapping larger curves divided by the no less significant ear-like curves.

Passing from the cave sculptures at T'o Shan to those at Yün Men Shan, which is situated across the valley, means moving into a quite different artistic centre. There are only a few large statues at Yün Men Shan and some of these are in a deplorable state of preservation, but whatever remains here is of remarkably fine artistic quality. No doubt, these sculptures are a little later than those in the caves at T'o Shan, though hardly more than ten years; the dates that are found in some of the small niches at the side of the main figures range from 596 to 599. The figures are not placed in real caves but in flat niches, and may thus be seen to more advantage than most cave sculptures in their original position; the actual play of light and shade adds something to the plastic effect.

The Yün Men Shan Buddha.—The principal group consists of a seated Buddha accompanied by a standing Bodhisattva and another figure which may have been a Dvarapala (now practically destroyed). Close to this is another still flatter niche which never contained any central statue, only a large tablet, which is now removed, and on each side of it two monumental Bodhisattvas.

The great Buddha is seated on a dais in the traditional posture with the legs crossed in front, and entirely covered by the wide mantle. The bearing of the body is, however, quite different; instead of the old stiffness there is a certain ease in the posture, a repose without any strain. He seems to lean against the wall of the niche, moving the head slightly forward as if intent on looking at something in front. The upper garment which is fastened with a string knot on the left shoulder is draped in quite broad curves between the knees. The folds are not simply ornamental or expressive of a linear rhythm, but modelled with fine gradations of light and shade, sometimes even undercut. They have become means of primary importance for creating a sculptural effect. The head is treated in a new individual manner with broad effects of light and shade. The eyes are not closed or half closed, as in most of the earlier Buddhas, but wide open, and the eyelids are undercut, which adds greatly to the impression of life. The lips are also separated by a deep shadow, as if they were opening. The whole treatment is quite exceptional and bears witness to an impressionistic style; strictly speaking, it remains an isolated phenomenon in Chinese sculpture.

The T'ang Dynasty.—It would indeed be wrong to imagine that there is an absolute break or a deep-rooted difference between the sculpture of the Sui and that of the T'ang period; quite the opposite. T'ang sculpture is stylistically an immediate successor to the art of the Sui period. When we, for convenience sake, use the dynastic names and dates also in the domain of art, it should be clearly understood that they do not signify here the same kind of opposites or renewals as in the political history of the country. Artistic evolution in China is a slow and gradual process, which only to a minor degree is conditioned by the political events.

It may also be recalled that the T'ang dynasty reigned during a longer time than most of the preceding dynasties (618–907), and the plastic arts remained by no means the same during this whole period. The production of sculpture was very intense during the first 100 years of the period, but became soon afterwards comparatively weak and insignificant. In speaking about T'ang sculpture we mean the art up to about 725, which may be considered the most mature and perfect kind of Buddhist sculpture in China. It reflects something of the same creative and expansive power that we may observe in other manifestations of T'ang culture. Its best products are characterized by a plenitude, not to say magnificence, that can hardly be found in the art of earlier epochs. The forms grow full and strong, the decoration becomes rich and exuberant, gradually approaching what we should call baroque.

An important element in this evolution was due to the growing inter-communication between China and the western Asiatic centres of artistic activity, particularly the Sassanian empire. Many new impulses were derived thence and grafted upon the old stock of Chinese art, modifying it more and more in the direction of Western ideals of style. Generally speaking, it may be said that the current that came from India was of the greatest importance for the Buddhist sculpture, while the influences from Persian art are most plainly discernible in the ornamentation of minor objects in bronze and silver.

In order to illustrate these two main currents, as well as other important elements of style in the plastic art of the T'ang period, it would be well to take into consideration other artistic products besides stone sculptures, such as objects in bronze, silver, clay and lacquer, which reflect the aesthetic ideals of the time, but this would carry us beyond the limits of this short study. Buddhist statues still form the most important province within the plastic arts of the T'ang period, though it should also be remembered that some large tomb sculptures were executed at this time, including magnificent representations of lions and horses at the tombs of the great emperors, T'ai Tsung (d. 649) and Kao Tsung (d. 683).

The Shensi Sculptures.—The early T'ang sculptures from Shensi, which then was the metropolitan province, are made in a very hard, grey limestone or in a dense yellowish marble. The fine quality of the material demands a highly developed technique in order to yield good plastic effects and ornamental details, and it may well be admitted that as far as workmanship goes many of these statues stand on the highest level of Chinese sculpture, but the artistic quality is often less remarkable. The earliest dated statue of this period known to us is of the year 639; it represents a Buddha seated in cross-legged position on a high, draped pedestal placed in front of a background slab which is bordered like a nimbus with flame ornaments. The figure is draped in a mantle which covers both shoulders, arms and feet, leaving only a small part of the chest bare. The folds are highly conventionalized in the form of thin, rounded creases and arranged in long curves over the body, the legs and the upper part of the pedestal. The decorative effect is altogether more powerful and concentrated than in earlier statues of a similar kind, and the execution is masterly. Although made in stone, the statue gives the impression of a work cast in bronze, an impression which is supported by the dark metallic hue of the hard stone.

Influence of Indian Art.—Some Bodhisattva statues, of which two may be seen in the University museum in Philadelphia, illustrate still better an increasing influence from Indian art not only by their costumes and decorative ornaments but also by their bearing and formal character. They stand no longer in stiff up-

right positions with the weight of the body evenly divided on both feet; the one leg is slightly curved and moved backward, the other serves as a support for the body which consequently is curving, a movement which is continued in the neck and in the more or less marked inclination of the head. The upper part of the body is bare, except for the jewelled necklaces and the narrow scarf draped over the shoulder; the chest is well developed and the waist rather narrow. The *dhoti,* which is tied with a sash round the hips, falls in a series of curving folds over each leg, and these are indicated in the same fashion as the folds of the Buddha mentioned above. It should also be noticed that these figures do not wear a crown or a diadem on their heads like the early Bodhisattvas, but a high head-dress made up of thick winding plaits, a feature which also adds to their feminine aspect.

A kind of masculine pendant to these Bodhisattvas may be found among the statues of *bikshus* or monks, executed either as individual *post mortem* portraits or as parts of altar groups (examples of such statues may be seen in the museums in Philadelphia and Boston). They are less conventionalized, less dependent on foreign models and made in closer adherence to actual life. Their heads are portrait-like, their mantles arranged in a more or less natural fashion, thus, in many instances, approaching the small clay statuettes made for the tombs during the T'ang period as well as in earlier times. Some of these portrait statues may indeed be placed on a level with the best Roman sculptures. They are character studies, not so far individualized as Renaissance portraits, but very striking types, observed in actual life. It is also worth noticing how much freer and more plastic the draping of the mantle becomes in these statues. A figure such as the headless monk in the Boston museum might have been made by a Roman artist.

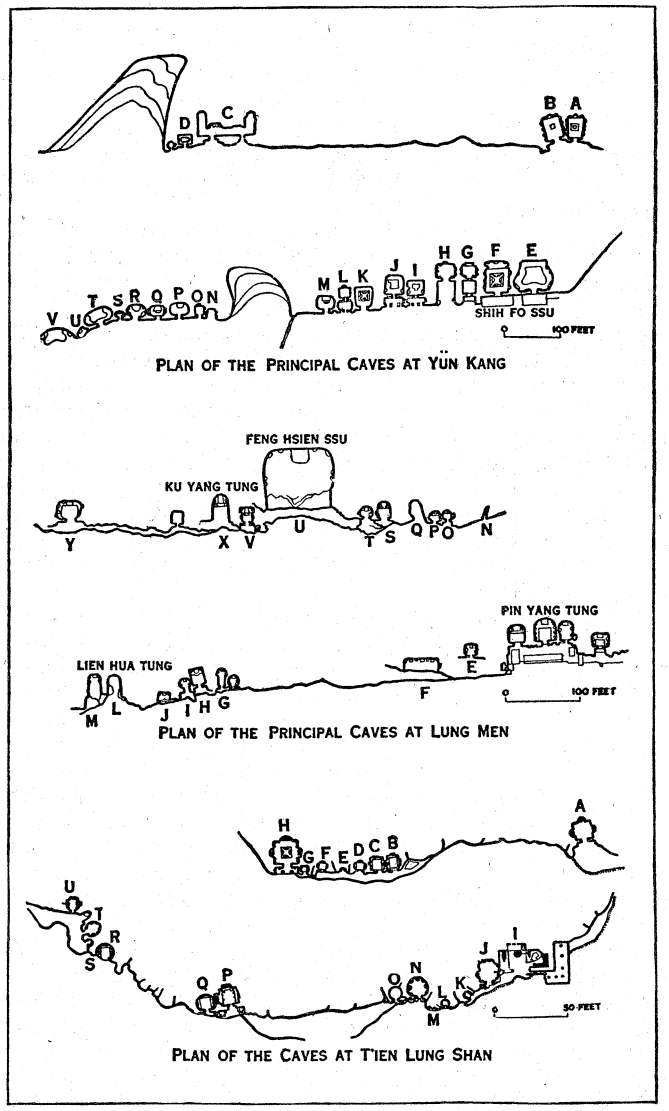
Honan Sculptures.—When we pass from the metropolitan province of Shensi into the adjoining province of Honan we may at once observe that the general character of the sculptures becomes modified. The provincial schools and stylistic differentiations seem on the whole to have become more developed at this time than at earlier epochs; it is now easier to distinguish the provincial currents.

The statues made in Honan, and particularly at the great artistic centre of Lung Men, where the decoration of the caves was continued during the 7th century, are generally more elegant than those originating from Shensi, though not always executed in such perfect technique. Unfortunately, the great majority of the early T'ang sculptures at Lung Men are partly or wholly destroyed—the heads being dispersed all over the world—so that it is now next to impossible to find there complete and good specimens of moderate size; we find them more easily in museums and private collections.

One of the finest examples is a large Bodhisattva statue, originally at Lung Men, but now in private hands in Peking. It may be taken as a representative of a large group of standing Bodhisattvas which all show the Indian influence grafted in Chinese types and shapes, a combination which in this particular instance has led to a perfectly harmonious result. The whole figure from the head-dress down to the feet is dominated by the softly gliding movement of the double S-curve (as in some Gothic madonnas) which would appear almost too accentuated, if it were not so perfectly balanced by the position of the arms. The contemporary Bodhisattvas from Shensi, represented in a similar position, appear quite stiff and hard beside this elegant and yet so dignified figure.

The Vairochana Buddha.—The colossal statues on the open terrace, which rises above the river at Lung Men, reflect in the most monumental form the religious pathos of the fully developed T'ang art. This is true particularly of the central figure, the great Vairochana Buddha; the side figures, two Bodhisattvas and two *bikshus* are decidedly inferior. The hands are destroyed, the lower part of the figure has suffered a great deal, but I doubt whether it ever made a stronger impression than to-day when it rises high and free in the open air over the many surrounding niches in which time and human defilers have played havoc with most of the minor figures. The upper part of this giant is well preserved and more dominating now than ever. Long ages have softened the mantle folds and roughened the surface of the grey limestone which is cracking all over, but they have not spoilt the impression of the plastic form. It may still be felt under the thin garment: a very sensitively modelled form, not a dead mass, though unified in a monumental sense. According to the inscription on the plinth the statue was made about 672–675.

The great power which is here reflected in such a harmonious and well-balanced form finds further dramatic expression in the



PLANS OF THE PRINCIPAL CAVES AT YÜN KANG, LUNG MEN AND T'IEN LUNG SHAN

Dvarapalas which stand at the entrance to the so-called "lion cave." The bestial heads of the figures are amazing and terrible, and even the naked form is by no means represented from a naturalistic point of view, but as a symbol of strength and vigilance. Other Dvarapalas of the same date are sometimes represented in livelier postures, bending sideways or lifting one hand to deal a killing blow to any approaching enemy. The plastic effect is decidedly of a baroque nature, a tendency which is characteristic of the mature T'ang art whenever it leaves the well-trodden path of the traditional religious imagery and ventures on more naturalistic and dramatic representations.

Later T'ien Lung Shan Sculptures.—Another fairly homogeneous local group of T'ang sculpture may be observed in some of the later caves at T'ien Lung Shan where the artistic activity must have been kept up ever since the middle of the 6th century. During all these generations T'ien Lung Shan seems to have remained a special centre of Indian influence. Unfortunately, none of these sculptures is dated, and in some respects they fall outside









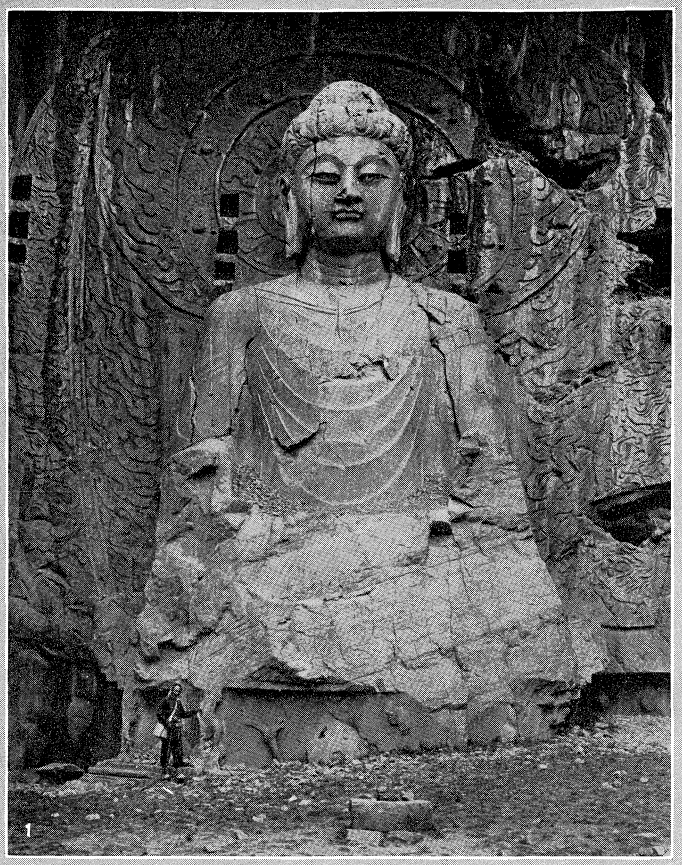


BY COURTESY OF (3, 4, 5) THE MUSEUM OF THE UNIVERSITY OF PENNSYLVANIA; PHOTOGRAPHS (1, 2) COPR. OSVALD SIRÉN

CHINESE SCULPTURES OF THE SUI AND T'ANG PERIODS

1. Seated Buddha in Cave 8 at T'ien Lung Shan, Shan-si; Sui period (A.D. 589–618). 2. Seated Buddha in stone, T'ang period, A.D. 639. 3. Standing Bodhisattva, a stone statue of the T'ang period (A.D. 618–907) showing Indian influence. 4. Statue of a priest of the T'ang period. 5. Standing Bodhisattva, stone statue of the T'ang period

CHINESE SCULPTURE





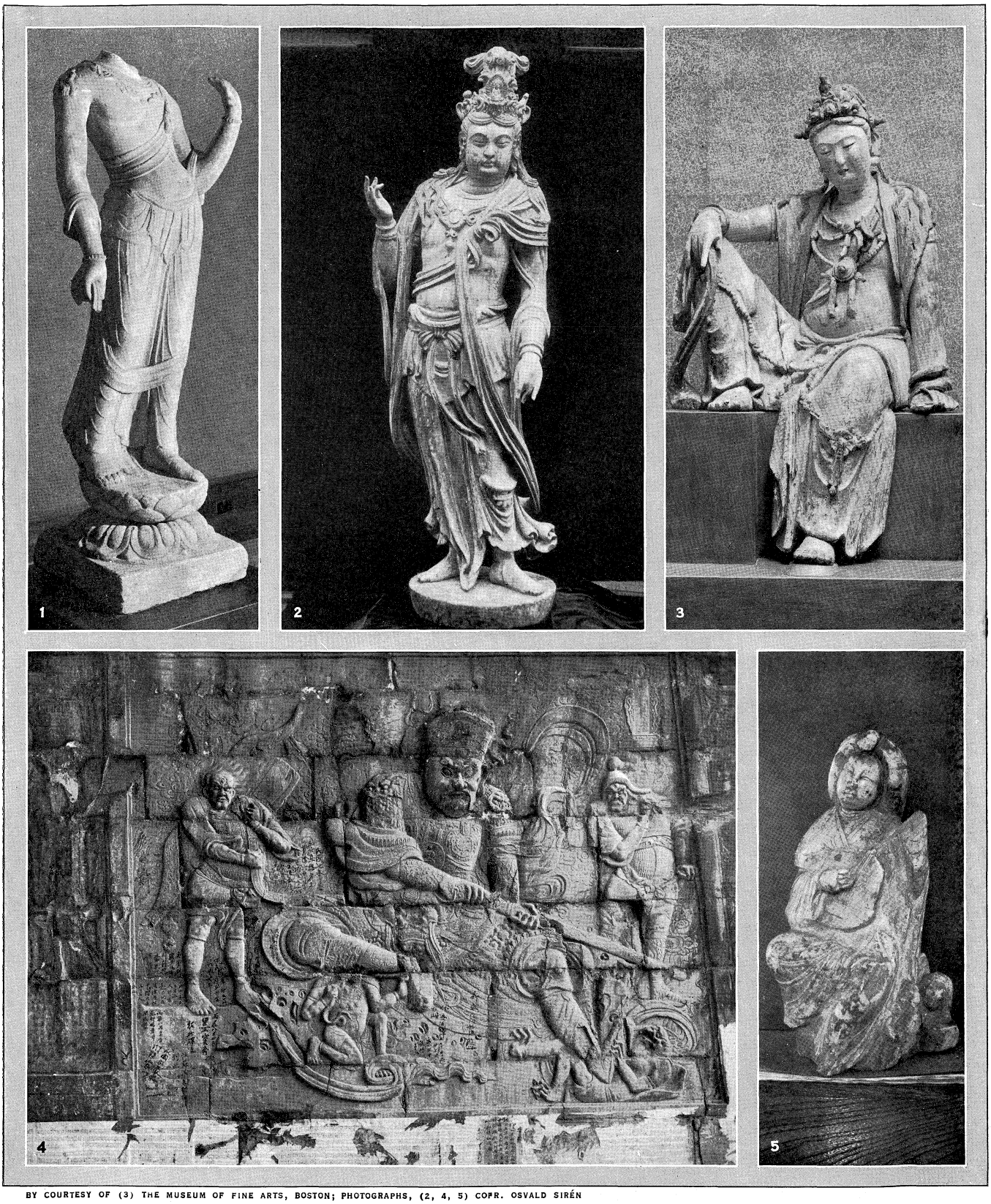




PHOTOGRAPHS, COPR. OSVALD SIRÉN

CHINESE STATUES OF THE 7TH CENTURY A.D.

1. Vairochana Buddha, colossal statue at Lung-Men, Ho-nan, about 676
2. Standing Bodhisattva from Lung-Men, Ho-nan, T'ang period, 618–907
3. Seated Bodhisattva, T'ien Lung Shan, Shan-si, T'ang period
4. Seated Bodhisattva, T'ien Lung Shan, Shan-si, T'ang period



BY COURTESY OF (3) THE MUSEUM OF FINE ARTS, BOSTON; PHOTOGRAPHS, (2, 4, 5) COPR. OSVALD SIRÉN

CHINESE SCULPTURE: 7TH, 13TH, AND 14TH CENTURIES

1. Standing Bodhisattva, marble statue, end of T'ang period, now in a private collection in the United States
2. Kuanyin Bodhisattva, wooden statue, 13th century
3. Kuanyin Bodhisattva, wooden statue, 13th century
4. Virudhaka, one of the four Lokapâlas (guardians of the universe), relief on the Chü Yung Kuan Gate, Nank'ou, Chih-li, dated 1345
5. Girl playing the lute, marble statue, end of T'ang period

the general stylistic current of T'ang art. Some of them show plastic motives which really did not come into vogue until some time after 700, but this may be due to the fact that they were made under foreign influence. The earliest among these sculptures are remarkably fresh and subtle while the later ones are comparatively heavy and commonplace works. The best specimens of the earlier types are to be seen in caves 6 and 14, while the later ones are found in caves 17, 19, 20 and 21.

The main group on the back wall of cave 6 consists of a Buddha seated cross-legged on a high pedestal accompanied by two side figures, which, however, are almost eaten away by time and running water, but there is a Bodhisattva on the side wall which can still be enjoyed. The figure is seated on a round lotus pedestal with the legs folded but not crossed. He leans toward the right side and turns slightly in the waist, a movement which is accentuated by the turning of the head in the same direction. The left hand is placed on the leg in front as if to give added support to the body and make the free attitude still more restful. The body is entirely bare, except for a jewelled necklace and the narrow scarf which is draped in a diagonal curve from the right shoulder. The ease of the posture in conjunction with the sensitive modelling of the youthful body endow this figure with a sensual charm which is very seldom found in Chinese statues. It would hold its place beside the most exquisite French sculptures of the 18th century and yet it impresses us just as much by its dignity and composure.

A similar artistic conception is expressed in a still ampler form in a Bodhisattva statue in cave 16. The posture of the figure is a kind of *lalitasana* (position of ease). It is seated with the one leg pendant, the other bent crosswise over the seat, but the foot is not placed on the opposite leg. The left elbow is practically touching the knee, as if to support the body which leans over toward the side, turning at the same time slightly in the waist. The movement of the head follows in the opposite direction, producing thus a contraposto effect which, although not very pronounced, serves to bring out the beauty of the ripe body and the supple limbs. It may not have quite the charm of the one noticed above, but it shows an astonishingly free treatment of the mantle, the material being a kind of *draperie mouillée*.

None of the other caves at T'ien Lung Shan contains statues of a corresponding importance, although there are some which reveal the strong Indian influence both in their general shapes and in the treatment of their garments. The heads, which in late years have been knocked off and spread all over the Western world, are sometimes beautiful, though less expressive than the best heads from Lung Men or earlier centres of Buddhist sculpture in China.

Changes in Style.—Similar tendencies toward a freer plastic style may also be observed in contemporary sculptures from Shensi and Chihli. Among them may be seen beautiful Bodhisattvas which not only bend in the waist but also turn on the hips, making thus quite complicated movements, which tend to bring out the beauty and significance of their corporeal form. By these freer postures their likeness to ordinary human beings becomes more striking. They sometimes remind one of the complaint of the philosopher from the end of the T'ang period who said that the artists were losing their reverent attitude toward the religious motives and were representing the Bodhisattvas in the shape of court ladies.

The difference between the religious and the secular motives seems, as a matter of fact, to become less and less important, and one meets with quite realistic *genre* figures not only in clay but also executed on a large scale in stone, very much according to the same formula as the Bodhisattvas. As a good example of this class of work may be mentioned a statue of a young lady (in the Academy of Art in Tokyo) who sits on a bank with crossed legs playing a lute, while a dog and a cat are frolicking at her feet, a statue without any religious pretext, with the same amount of free and elegant realism as we know from the tomb statuettes in clay and from some T'ang paintings. Works of this kind indicate that the sculptors no longer remained satisfied with the purely religious inspiration but turned their attention towards nature and human life. If the evolution had continued along these lines, the plastic arts in China might have become just as expressive and varied in their interpretations of purely artistic problems as Renaissance sculpture in Europe, but the creative power turned more and more from sculpture to painting.

Quite interesting as examples of the new tendencies of style are certain statues made at Ting Chou in Chihli, a centre of sculptural activity which, as we have seen, was important ever since the Northern Wei period. The best of these are surprisingly free and illustrate a new interest in movement and in the full development of the human figure. Among them may be mentioned a large statue of a headless Bodhisattva in the collection of Mrs. J. D. Rockefeller Jr. in New York, which is represented in a forward stride. The figure is composed in a similar way to some early Renaissance statues represented in a walking posture, *e.g.*, St. John the Baptist —and shows the same shortcomings in the stiff limbs and the stilted rhythm, but also the same endeavour to treat the plastic form in the full round.

There are many other statues illustrating this tendency. The most original is perhaps a bare-headed monk who stands turned sideways with hands folded before the chest and head thrown back, looking almost straight upwards (in the collection of General Munthe, Peking). The movement expresses an intense religious devotion, not in the usual restrained and well-balanced form but with the flow of human feeling which leads our thoughts away from the Orient toward the most emotional religious art of Europe, such as we know it from the late Gothic and Baroque periods. The impressionistic treatment of the soft and heavy mantle points in the same direction.

The Post-T'ang Periods.—The production of religious sculpture decreases more and more towards the end of the T'ang period. Very few dated specimens are known from the 9th century, while those from the 8th are quite numerous. During the following periods of the Five Dynasties and the Northern Sung the creative energy of the nation, which in former times, particularly when religious devotion ran high, had been largely directed to the production of sculpture, turned to painting, which now definitely took the lead among the fine arts in China. The change in the relative importance of sculpture and painting is also illustrated by the fact that sculpture responded more and more to the influence of painting, an influence which became evident not only in the new impressionistic tendencies of style but also by the fact that other materials than stone and bronze came into vogue, particularly wood, clay, iron and lacquer-work, and these were usually treated with colour. Many of the new compositions introduced about this time were derived from contemporary paintings. It is true for instance of the very popular Kuanyin Bodhisattvas in the *maharajalila* (posture of royal ease) executed in stone, clay and wood, and it may also be observed in the combination of the figures with backgrounds treated like rocky landscapes or some kind of scenery with trees, buildings, animals and small human beings.

This more or less pictorial kind of sculpture spread all over northern China during the 12th and 13th centuries, when Buddhist art enjoyed a short period of reflorescence, and wooden sculpture particularly reached a high degree of perfection. A great number of wooden statues have in later years been brought from China to various Western collections, *e.g.*, the museums in Philadelphia, Chicago and Toronto which alone contain more such statues than can be mentioned here. The majority of these represent either standing Bodhisattvas in long garments which often take on a fluttering movement toward the feet, or Kuanyins on rocky seats in the *maharajalila* posture. One of the standing figures in Toronto is said to have been dated by a tablet inserted in the figure in the year 1106, while one of the seated Kuanyins, lately belonging to the Ton Ying company in New York, carries an inscription with the date 1168. Similar ones are to be found in the British Museum, in the museums in Boston and Chicago, in the Musée Guimet and Collection Jean Sauphar in Paris, etc.

It is during this period that Kuanyin, the Bodhisattva of Mercy, definitely changes into a feminine being usually represented in a free and elegant form, whether she be seated on a rock by the water in the *maharajalila* posture, as in so many of

these wooden figures, or is standing, bending forward as if lending a listening ear to the invocations of her adorers. The womanly beauty is much more accentuated in these figures than any bodhisattvic qualities. The form has lost all its abstract serenity and become fluttering and emotional, but it is sometimes highly decorative in a new and more limited sense. Many of these figures seem to have been conceived not for a moral purpose, like the old Buddhas and Bodhisattvas, but simply to please the eye and the sentimental longings of the worshippers. Besides these wooden sculptures there are a good many made in stone, particularly series of Arhats, who are usually represented in series of 16 or 18, according to definite types and with more realistic than artistic expression. Interesting series of such Arhats executed in stone may be seen at the Yen Sha Tung and Ling Yen Ssu caves near Hangchow, as well as in the museum at Toronto. They are very uneven in quality and, on the whole, more interesting from an historical than from an artistic point of view.

Yuan Dynasty.—After the establishment of the Yüan dynasty (1280–1368) the position of the fine arts in China, including sculpture, changed considerably. The Mongols brought no new positive inspiration, on the contrary they destroyed more than they built up, except perhaps in the art of war. Art was useful to them only in so far as it could support and glorify the temporal power of the emperor and his generals. The religious attitude of the Yüan emperors was on the whole tolerant, but officialdom was then thoroughly Confucian and the Buddhists were pushed into the background. Taoism seems now to have held its place by the side of Buddhism. The cave sculptures at Hao Tien Kuan, south of T'aiyüan-fu in Shansi, executed at the end of the 13th century, are in this respect very interesting. Some of the compositions illustrating scenes from the life of the Taoist philosopher Pi Yün Ssu, besides a great number of other Immortals, reveal an evident interest in nature as, for instance, the old man on his deathbed; he is represented lying soundly asleep on the Chinese "kang" clad in a long garment. The most successful portions in these grottos are, however, the purely decorative compositions, the low reliefs on the walls representing clouds and phoenixes, and the two guardians at the sides of one of the entrances whose fluttering draperies are arranged in ornamental curves. All these decorative designs are characterized by a buoyancy and a vigour which are hardly to be found in Chinese sculpture of the immediately preceding period. The motives are used for decoration rather than for the expression of purely plastic ideas. The pictorial tendency which characterizes the sculptures of the preceding period is still existent, although it has become coarser and of a more superficial kind. The same stylistic tendencies are also quite noticeable in a number of other sculptures of the same period, such as the four *Lokapalas* (guardians of the world) on the Chü Yung Kuan gate at Nank'ou, executed in 1345, and the Buddhist figures in a niche at Lung Tung Ssu near Tsinan-fu in Shantung, executed in 1318, not to speak of minor detached statues, dated at the beginning of the 14th century.

Ming Period.—When we enter into the Ming period (1368–1644) the dramatic power of expression seems to dry up more and more and the general artistic level is certainly not raised, although the production of Buddhist sculptures goes on with increasing abundance. Among the most popular and common creations of this time may be mentioned, for instance, series of Arhats in iron (good examples of such series are in the museums at Toronto and Gothenburg) which, however, seldom rise above the level of ordinary mass products made according to standard models. Similar motives are also treated in wood and lacquer, sometimes with good decorative effect, though with no more individual characterization. The sculpture of the Ming period is generally at its best when it takes up purely realistic motives instead of the traditional hieratic figures. It may thus become quite enjoyable in minor representations of mourners, musicians or similar *genre*-like motives, presented without any tendency to archaic restraint which otherwise is so apparent in the plastic arts of the Ming.

Summary.—Trying to sum up the general course of development of Chinese sculpture from the 10th to the 15th century in a few words, we have to remember first the comparatively low level of religious sculpture towards the end of the Sung dynasty, particularly after the capital was moved from Kaifêng to Hangchow; secondly, the re-awakening of religious imagery in the northern provinces after the Tartar dynasties had got a firm hold on this part of the country (a flourishing sculptural activity, particularly in wood, developed there in the provinces of Chihli and Shansi); and thirdly, that with the Yüan dynasty a new foreign element appears which perhaps may be called Mongolian and which expresses itself on the one hand in a somewhat dry realism and on the other hand in a whirling linear ornamentation. The religious figures have still some life and expression of their own, though no real spirituality. This development was no longer continued during the Ming period. Whatever creative power may have been left did not turn towards the production of religious sculpture. It is true that a lot of statues, or rather statuettes, in bronze, wood, porcelain and ivory were produced but no great religious works, whether in stone or other materials. The Ming sculptors have given their best in the field of decorative art such as columns, balustrades, and other architectural details, but they created no new types of plastic works, whether religious or secular. They sought their inspiration much more in the imitation of earlier models than in any fresh efforts in the field of sculpture. (*See* also SCULPTURE; CHINA; BUDDHA AND BUDDHISM; INDIAN AND SINHALESE ART AND ARCHAEOLOGY; CHINESE ARCHITECTURE.)

BIBLIOGRAPHY.—E. Chavannes, *Mission archéologique dans la Chine septentrionale* (1909–15); S. Omura, *History of Chinese Art; Sculpture,* text in Japanese (1915); T. Sekino, *Sepulchral Remains of the Han Dynasty in Shantung,* text separate in Japanese (1920); S. Taketaro and Nakagawa, *Rock Carvings from Yün Kang Caves,* no text (1921); S. Tanaka, *T'ien Lung Shan, no text* (1923); L. Ashton, *Introduction to the Study of Chinese Sculpture* (1924); V. Ségalen, "Premier exposé des résultats archéologiques dans la Chine occidentale par la mission G. de Voisins, J. Lartigue, V. Ségalen," *Journal Asiatique,* tome v_3, vi_2, vii_3; O. Sirén, *Chinese Sculpture from the 5th to the 14th Century,* 3 vol. plates, 1 vol. text (1925), and *Studien zur Chinesischen Plastik der Post-T'ang Zeit* (1927); V. Ségalen, G. de Voisins and J. Lartigue, *Mission Archéologique en Chine,* no text (1926); O. Sirén, *A History of Early Chinese Art* (1929). (O. S.)

CHINGFORD, a municipal borough in the Epping parliamentary Division of Essex, England, 12 mi. N.E. of London by the L.N.E.R. Pop. (1938) 37,510. Area 4.5 sq.mi. It lies between the river Lea and the western outskirts of Epping forest. The church of All Saints has Early English and Perpendicular remains. The half-timbered Queen Elizabeth's, or Fair Mead, hunting lodge is preserved there. Chingford was incorporated in 1938 and adopted a town planning scheme.

CHINGLEPUT, town and district, British India, in the Madras presidency. The town, situated 36 mi. by rail from Madras, and a junction for a branch line to Arkonam, had a population in 1941 of 17,829. With Chandragiri in North Arcot, Chingleput was once the capital of the Vijayanagar kings, after their overthrow by the Mohammedans at Talikota in 1565. In 1639 a chief, subject to these kings, granted to the East India Company the land on which Fort St. George now stands. The fort built by the Vijayanagar kings in the 16th century, which was of strategic importance, was taken by the French in 1751, and retaken in 1752 by Clive, after which it proved invaluable to the British. It withstood Hyder Ali and afforded a refuge to the natives; and in 1780, after the defeat of Colonel W. Baillie, the army of Sir Hector Munro took refuge here. It is now partially ruined. The town is noted for its manufacture of pottery, and carries on a trade in rice. It is the centre of a Scotch Free Church mission, and has a reformatory school.

THE DISTRICT OF CHINGLEPUT surrounds the city of Madras, stretching along the coast for about 115 miles. The administrative headquarters are at Saidapet. Area 3,074 sq.mi. Pop. (1941) 1,823,955. Salt is extensively manufactured along the coast, and fishing carried on. There are cotton and silk mills, tanneries, stone quarries and soapworks.

CHIN HILLS, a constituent hill-group of the mountain arc stretching from the Arakan Yoma northwards to the Patkai hills, between Burma and India. This mountain arc, compressed at either end, has advanced farthest towards the west in the centre

where the long parallel folds are most numerous and the arc broadest. The Chin hills form the highest part of this central stretch. They consist simply of a succession of long narrow troughs and ridges, from 5,000 to 9,000 ft. high, with little flat land either in the valley bottoms or on the ridge tops. There is a marked climatic contrast between the humid tropical conditions of the deeply cut valleys and the cooler temperatures of the ridges. This contrast is reflected in the vegetation. Above 3,000 ft. the tropical forest gives way to oak and pine woods which in turn give way above 7,000 ft. to the rhododendron. A migratory form of agriculture, the *taungya* system, is practised in these hillside woods where the greater part of the population is centred. Clearings are made and the wood burnt for fertilizer. Such clearings are cultivated for two or three years and then abandoned. Bamboo, bracken and elephant grass then spring up with such vigour that natural re-afforestation is impossible. The main crop cultivated by this method is *jowar* millet contrasting with rice in the plains of Lower Burma. Some rice is, however, grown in the Chin hills on the lower slopes on terraces constructed with the help of felled timber.

The north-south trend lines of Indo-China as a whole have permitted the flooding of the region with "Mongoloid" peoples coming down from the north and have hindered east-west movement of both peoples and culture. The Arakan Yoma-Patkai mountain arc, of which the Chin hills form a part, exemplifies these features. It constitutes a frontier zone between Indian and Burmese cultures and its hill-tribes remained independent of British administration until the close of the 19th century. The Chin hills, lying on the Irrawaddy side of the watershed, were eventually occupied to prevent the raids by hill-folk on the plains of Burma. They are now administered primarily with the object of preserving the peace and of building up a sound government on the basis of the tribal system. The substitution of peaceful agriculture for raiding is producing changes in the distribution of population; the defensive hill-sites are being deserted and population is becoming concentrated on the more easily cultivable land. The whole of the southern part of the Arakan Yoma-Patkai mountain arc from the Chin hills southward into the Arakan Yoma is occupied by the Chin peoples who belong to the Southern Mongoloid race group and are linguistically a branch of the Tibeto-Burmans. The Chin hills proper are occupied by only the northern tribes of the Chin peoples. Area of the district 10,377 sq.mi. Population (1941) 186,405. (P. M. R.)

CHINKIANG, former treaty port of China on the south bank of the Yangtze Kiang, 32° 11′ N., 119° 24′ E., 160 mi. above Shanghai and 43 mi. below Nanking. It lies where the north-south route of the Grand canal from Hangchow to Peiping crosses the east-west route of the Yangtze river. So long as the Grand canal, linking the Yangtze delta with the imperial capital, remained an arterial line of communication, Chinkiang retained its significance. But traffic on the Grand canal became after 1850 increasingly local and its function as a north-south link was later usurped by the Tientsin-Pukow (Tsin-Pu) railway, which comes down to the Yangtze opposite Nanking, itself the terminus of a railway from Shanghai.

Chinkiang, although a station on the Shanghai-Nanking railway, had therefore given place to Nanking in the command of the Yangtze crossing. Moreover the port of Chinkiang was experiencing local difficulties through silting. In consequence, while, since the first decade of the 20th century, the trade of neighbouring ports had continued to increase, that of Chinkiang had been arrested.

The port was functioning for a time almost solely as a distributing place of imported goods. In 1926 the excess of imports over exports was in the proportion of 15 to 1. With the fall of Chinkiang into Japanese hands, Dec. 1937, the Japanese controlled the river trade. The population was given as 216,803 in 1937.

CHINO-JAPANESE WAR (1894–95). The causes of this conflict arose out of the immemorial rivalry of China and Japan for influence in Korea. In the 16th century a prolonged war in the peninsula had ended with the failure of Japan to make good her footing on the mainland—a failure brought about largely by lack of naval resources. In more modern times (1875, 1882, 1884) Japan had repeatedly sent expeditions to Korea, and had fostered the growth of a progressive party in Seoul. The difficulties of 1884 were settled between China and Japan by the convention of Tientsin, wherein it was agreed that in the event of future intervention each should inform the other if it were decided to despatch troops to the peninsula. Nine years later the occasion arose. A serious rebellion induced the Korean Government to apply for military assistance from China. Early in June 1894 a small force of Chinese troops was sent to Asan, and Japan, duly informed of this action, replied by furnishing her minister at Seoul with an escort, rapidly following up this step by the despatch of about 5,000 troops under Maj.-Gen. Oshima. A complicated situation thus arose. Chinese troops were present in Korea by the request of the Government to put down rebellion. The Japanese controlled the capital, and declined to recognize Korea as a tributary of China. But they proposed that the two Powers should unite to suppress the disturbance and to inaugurate certain specified reforms. China considered that the measures of reform must be left to Korea herself. The reply was that Japan considered the Government of Korea "lacking in some of the elements which are essential to responsible independence." By the middle of July war had become inevitable unless the Peking Government were willing to abandon all claims over Korea, and as Chinese troops were already in the country by invitation, it was not to be expected that the shadowy suzerainty would be abandoned.

At Seoul the issue was forced by the Japanese minister, who delivered an ultimatum to the Korean Government on July 20. On the 23rd the palace was forcibly occupied. Meanwhile China had despatched about 8,000 troops to the Yalu river. The outbreak of war thus found the Japanese in possession of Seoul and ready to send large forces to Korea, while the Chinese occupied Asan (about 40m. south of the capital) and had a considerable body of troops in Manchuria in addition to those despatched to the Yalu river. To Japan the command of the sea was essential for the secure transport and supply of her troops. Without it the experience of the war of the 16th century would be repeated. China, too, could only utilize overland routes to Korea by submitting to the difficulties and delays entailed.

By the time war was finally declared (August 1), hostilities had already begun. On July 25 Oshima set out from Seoul to attack the Chinese at Asan. On the 29th he won a victory at Sönghwan, but the Chinese commander escaped with a considerable part of his forces by a détour to Ping-Yang (Phyöng-Yang). Meanwhile a portion of the Japanese fleet had encountered some Chinese warships and transports off Phung-Tao, and scored an important success, sinking, amongst other vessels, the transport "Kowshing" (July 25). The loss of more than 1,000 Chinese soldiers in this vessel materially lightened Oshima's task. The intention of the Chinese to crush their enemies between their forces at Asan and Ping-Yang was completely frustrated, and the Japanese obtained control of all southern Korea.

Reinforcements from Japan were now pouring into Korea, and Gen. Nozu, the senior Japanese officer present, soon found himself in a position to move on Ping-Yang. Three columns converged upon the place on Sept. 15 and carried it after severe fighting.

Nearly all the troops on either side had been conveyed to the scene of war by sea, though the decisive contest for sea supremacy was still to be fought. The Chinese admiral Ting with the Northern squadron (which alone took part in the war) had hitherto remained inactive in Wei-hai-wei, and on the other side Vice-Admiral Ito's fleet had not directly interfered with the hostile transports which were reinforcing the troops on the Yalu. But two days after the battle of Ping-Yang, Ting, who had conveyed a large body of troops to the mouth of the Yalu, encountered the Japanese fleet on his return journey off Hai-Yang-Tao on Sept 17. The heavy battleships "Chên-Yuen" and "Ting-Yuen" constituted the strongest element of the Chinese squadron, for the Japanese, superior as they were in every other factor of success, had no vessels which could compare with these in the matter of protection. Ting advanced in a long irregular line abreast; the battleships in the centre, the lighter vessels on the wings. Ito's fast cruisers steamed in line ahead against the Chinese right wing,

crushing their weaker opponents with their fire. In the end the Chinese fleet was defeated and scattered, but the two heavy battleships drew off without serious injury. This battle of the Yalu gave Japan command of the sea, but Ito continued to act with great caution. The remnants of the vanquished fleet took refuge in Port Arthur, whence after repairs Ting proceeded to Wei-hai-wei.

The victory of Ping-Yang had cleared Korea of the Chinese troops, but on the lower Yalu—their own frontier—large forces threatened a second advance. Marshal Yamagata therefore took the offensive with his I. Army, and on Oct. 24 and 25, under great difficulties—though without serious opposition from the enemy—forced the passage of the river and occupied Chiu-lien-chêng. Part of the Chinese force retired to the north-east, part to Fêng-hwang-chêng and Hsiu-yuen. The Japanese I. Army advanced several columns towards the mountains of Manchuria to secure its conquests and prepare for a future advance. Gen. Tachimi's brigade, skirmishing with the enemy on the Moukden and Liao-Yang roads, found the Chinese in force. A simultaneous forward move by both sides led to the action of Tsao-ho-ku (Nov. 30), after which both sides withdrew—the Chinese to the line of the mountains covering Hai-chêng, Liao-Yang and Moukden, with the Tatar general Ikotenga's force 14,000 strong, on the Japanese right north-east of Fêng-hwang-chêng; and the Japanese to Chiu-lien-chêng, Takushan and Hsiu-yuen. The difficulties of supply in the hills were almost insurmountable, and no serious advance was intended by the Japanese until Jan. 1895, when it was to be made in co-operation with the II. Army. This army, under Marshal Oyama, had been formed in September and at first sent to Chemulpho as a support to the forces under Yamagata; but its chief task was the siege and capture of the Chinese fortress, dockyard and arsenal of Port Arthur.

The Liao-Tong peninsula was guarded by the walled city of Kin-chow and the forts of Ta-lien-wan (Dalny under the Russian régime, and Dairen under the Japanese) as well as the fortifications around Port Arthur itself. On Oct. 24 the disembarkation of the II. Army began near Pi-tse-wo, and the successive columns of the Japanese gradually moved towards Kin-chow, which was carried without difficulty. Even less resistance was offered by the modern forts of Ta-lien-wan. The Japanese now held a good harbour within a few miles of the main fortress. Here they landed siege artillery, and on Nov. 17 the advance was resumed. The attack was made on the 19th at dawn. Yamaji's division (Nogi's and Nishi's brigades), after a trying night march, assaulted and carried the western defences and moved upon the town. Hasegawa in the centre, as soon as Yamaji began to appear in rear of his opponents in the northern forts, pushed home his attack with equal success, and by 3 P.M. practically all resistance was at an end. The Japanese paid for this important success with but 423 casualties. Meanwhile the Chinese general Sung, who had marched from Hai-chêng to engage the II. Army, appeared before Kin-chow, where he received on the 22nd a severe repulse at the hands of the Japanese garrison. Soon after this overtures of peace were made by China; but her envoy, a foreigner unfurnished with credentials, was not received by the Tokyo Government.

The Japanese I. Army (now under Gen. Nozu) prepared, in spite of the season, to move across the mountains, and on Dec. 3 Gen. Katsura left Antung for Hai-chêng, which was safely occupied on Dec. 13. In the meantime Tachimi had moved northward from Fêng-hwang-chêng in order to distract the attention of the Chinese from Hai-chêng, and there were some small engagements between this force and that of Ikotenga, who ultimately retired beyond the mountains to Liao-Yang. Sung had already left Kai-ping to secure Hai-chêng when he heard of the fall of that place; his communications with Ikotenga being now severed, he swerved to the north-west and established a new base at Niu-chwang. Once on his new line Sung moved upon Hai-chêng. As it was essential that he should be prevented from joining forces with Ikotenga, Gen. Katsura marched out of Hai-chêng to fight him. At Kang-wang-tsai (Dec. 19) the Chinese displayed unusual steadiness, and it cost the Japanese some 343 casualties to dislodge the enemy. The victors returned to Hai-chêng exhausted with their efforts, but secure from attack for some time to come. The advanced troops of the II. Army (Nogi's brigade) were now ready to advance, and only the Kai-ping garrison barred their junction with Katsura. At Kai-ping (Jan. 10) the resistance of the Chinese was almost as steady as at Kang-wang-tsai, and the Japanese lost 300 killed and wounded in their successful attack. In neither of these actions was the defeated force routed, nor did it retire very far. On Jan. 17 and again on the 22nd Ikotenga attacked Hai-chêng from the north, but was repulsed.

Meanwhile the II. Army, still under Oyama, had undertaken operations against Wei-hai-wei, the second great fortress and dockyard of northern China; and it was hoped that both armies would accomplish their present tasks in time to advance in the summer against Peking itself. On Jan. 18 a naval demonstration was made at Têng-chow-fu, 70m. west of Wei-hai-wei, and on the 19th the Japanese began their disembarkation at Yung-chêng Bay, about 12m. from Wei-hai-wei. The landing was scarcely opposed, and on the 26th the Japanese advance was begun. The south-eastern defences of Wei-hai-wei harbour were carried by the 6th Division, whilst the 2nd Division reached the inner waters of the bay, driving the Chinese before them. The fleet under Ito co-operated effectively. On the night of Feb. 4–5 the Chinese squadron in harbour was attacked by ten torpedo boats. Two boats were lost, but the armour-clad "Ting-Yuen" was sunk. On the following night a second attack was made, and three more vessels were sunk. On the 9th the "Chên-Yuen" was sunk by the guns in one of the captured forts. On the 12th Admiral Ting wrote to Admiral Ito offering to surrender, and then took poison, other officers following his example. Wei-hai-wei was then dismantled by the Japanese, and the II. Army concentrated at Port Arthur for the advance on Peking.

While this campaign was in progress the Chinese despatched a second peace mission, also with defective credentials. The Japanese declined to treat, and the mission returned to China. In February the Chinese made further unsuccessful attacks on Hai-chêng. Yamaji near Kai-ping fought a severe action on Feb. 21, 22 and 23, at Taping-shan against a part of Sung's army under Gen. Ma-yu-kun. This action was fought with 2ft. of snow on the ground, the thermometer registering zero F, and no less than 1,500 cases of frost-bite were reported. It was the intention of Gen. Nozu, after freeing the Hai-chêng garrison from Ikotenga, to seize Niu-chwang port. Two divisions converged on An-shan-chan, and the Chinese, threatened in front and flank, retired to Liao-Yang. The Japanese then moved on Niu-chwang, and Yamaji's 1st Division at Kai-ping joined in the advance. The column from An-shan-chan stormed Niu-chwang, which was obstinately defended, and cost the stormers nearly 400 men. All three divisions converged on Niu-chwang port (Ying-kow), and the final engagement took place at Tien-chwang-tai, which was captured on March 9. The Chinese forces in Manchuria being thoroughly broken and dispersed, there was nothing to prevent the Japanese from proceeding to the occupation of Peking, since they could, after the break-up of the ice, land and supply large forces at Shan-hai-kwan, within 170m. of the capital. Seven divisions were at Port Arthur ready to embark when negotiations were reopened. Li Hung-Chang proceeded to Shimonoseki, where the treaty was signed on April 17, 1895. An expedition was sent towards the end of March to the Pescadores, and later the Imperial Guard Division was sent to Formosa.

It is impossible to estimate the Chinese losses in the war. The Japanese lost 4,177 men by death in action or by sickness, and 56,862 were wounded or disabled by sickness, exclusive of the losses in the Formosa and Pescadores expeditions. Nearly two-thirds of these losses were incurred by the I. Army in the trying winter campaign in Manchuria.

BIBLIOGRAPHY.—The most important works dealing with the war are: von Kunowski and Fretzdorff, *Der japanisch-chinesische Krieg* (Leipzig, 1895); von Müller, *Der Krieg zwischen China und Japan* (Berlin, 1895); Vladimir, *China-Japan War* (London, 1896); Jukichi Inouye, *The Japan-China War* (Yokohama, etc., 1896); du Boulay, *Epitome of the Chino-Japanese War* (London, 1896), the official publication of the British War Office; Atteridge, *Wars of the Nineties*, pp. 535–636 (London, 1899); Bujac, *Précis de quelques campagnes contemporaines: II. La Guerre sino-japonaise* (Paris and Limoges).

CHINON, a town of western France, capital of an arrondissement in the department of Indre-et-Loire, on the bank of the Vienne, 32 m. S.W. of Tours. Pop. (1936) 4,511. It lies under a rocky height crowned by ruins of the famous castle, its narrow, winding streets containing many turreted houses of the 15th and 16th centuries. Chinon (Caïno) existed before the Roman occupation of Gaul, and was from early times an important fortress. It was occupied by the Visigoths, and subsequently, after forming part of the royal domain, came to the counts of Touraine and from them to the counts of Anjou, in 1044. In the next century it passed to Henry II. of England, who died there, but it was won back to France by Philip Augustus in 1204, after a year's siege. Of its oldest church, the Romanesque St. Mexme, only the façade and nave are left. The church of St. Etienne dates from the 15th century, that of St. Maurice from the 12th, 15th and 16th centuries. The castle, which has undergone considerable modern restoration, consists of three separate strongholds. That to the east, the Château de St. Georges, built by Henry II. of England, has almost vanished, only the foundation of the outer wall remaining. The Château du Milieu (11th to 15th centuries) comprises the keep, the Pavillon de l'Horloge and the Grand Logis, where the first meeting between Joan of Arc and Charles VII. took place. Of the Château du Coudray, which is separated by a moat from the Château du Milieu, the chief remains are the Tour du Moulin (10th century) and two later towers. A statue of Rabelais, who was born in the vicinity of the town, stands on the river-quay. Basket and rope manufacture, tanning and cooperage are among the industries.

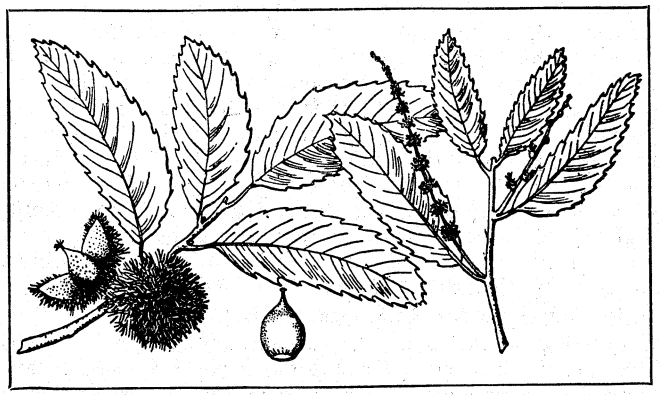
CHINOOK. This important American Indian people held Columbia river from the mouth to the Dalles, and adjacent territory. Their culture was a localized form of the North Pacific Coast (*q.v.*) type, with plank houses, good canoes, trade, slavery, potlatch distributions of property, but without secret societies or totemic art. The language is distinctive, and a selection of words from it, much simplified phonetically and the grammar wholly done away with, forms the basis of the Chinook jargon. This trade language contains also French, English, Nutka and other Indian ingredients, and prevails from Oregon to Alaska. The Chinook were organized by settlements rather than tribes; some of their divisions are known as Clatsop, Wasco and Wishram. Estimated at 16,000 in 1805, they decreased (from disease) to a twentieth in the next 50 years, and now number perhaps 200–300, known under different names on several reservations containing ethnic mixtures.

See Lewis and Clark, *Original Journals* (1904); F. Boas, *Bur. Am. Ethn.* Bull. 20 (1895); E. Sapir, *Publ. Am. Ethn. Soc.,* vol. ii. (1909). (A. L. K.)

CHINOOK, the name given to a wind which blows from west or north over the Rocky Mountains, where it descends as a dry wind, warm in winter and cool in summer. It is due to a cyclone passing northward, and continues for a few hours to several days. It moderates the climate of the eastern Rockies, the snow melting quickly on account of its warmth and vanishing on account of its dryness, so that it is said to "lick up" the snow from the slopes.

CHINQUAPIN, the name given to several North American shrubs or small trees belonging to the genus *Castanea* of the Fagaceae (beech family). The most important of these is *C. pumila,* a shrub or small tree found chiefly in dry soils from New Jersey to northern Florida and westward to southwestern Missouri and eastern Texas. In Arkansas and Texas, where it attains its best development, it occasionally reaches a height of 45 ft. and a diameter of 30 in. It is closely related to the chestnut, *C. dentata,* from which it differs in its much smaller leaves, which are white-woolly beneath, and its usually solitary nut, which like that of the chestnut is very sweet and edible.

On the Pacific slope the name chinquapin is given to two species of *Castanopsis,* a genus closely allied to *Castanea.* Golden chinquapin (*Castanopsis chrysophylla*) found from southern Washington to southern California, is a magnificent tree which occasionally attains a height of 150 ft. and a trunk diameter of 8 ft. The lance-shaped evergreen leaves, 3 to 5 in. long, are clothed beneath with minute golden-yellow persistent scales. The fruit is similar to that of the chestnut and contains one or two hard-shelled nuts with a sweet kernel. The wood is reddish-brown, straight grained, easily worked and takes an excellent finish, yet it is not extensively utilized. The bark, although devoid



CHINQUAPIN. BRANCH (LEFT) SHOWING SPINY BURR AND SOLITARY NUT; BRANCH (RIGHT) WITH MALE FLOWERS

of tannin, is sometimes used to adulterate that of the tanoak (*Lithocarpus densiflorus*), with which it is often associated in the forest. Bush chinquapin (*C. sempervirens*) is a small spreading shrub of dry mountain slopes in California. Some authorities regard it as a variety of the golden chinquapin. (E. S. Hr.)

CHINSURA, a town of British India, on the Hooghly river, 24m. above Calcutta, formerly the principal Dutch settlement in Bengal. The Dutch erected a fortified factory here in 1656. In 1759 a British force under Col. Forde was attacked by the garrison of Chinsura on its march to Chandernagore, but in less than half an hour the Dutch were entirely routed. Chinsura was taken by the British in 1781 on the outbreak of war with Holland and restored to the Dutch in 1783. Again, in 1795, during the Napoleonic wars, the settlement was occupied by a British garrison. At the peace of 1814 it was a second time restored to the Dutch. It was among the cessions in India made by the king of the Netherlands in 1825 in exchange for the British possessions in Sumatra. The Dutch church, commissioner's house, and cemetery (extended since 1825) are memorials of Dutch rule. Chinsura is included in the Hooghly-Chinsura municipality (pop. [1941] 49,081), and contains the Hooghly college.

CHINTZ, a word derived from the Hindu *chint,* spotted or variegated. This name was given to a kind of stained or painted calico produced in India. It is now applied to a highly glazed printed calico, commonly made in several colours on a light ground and used for bed hangings, covering furniture, etc.

CHINWANGTAO, 39° 56′ N., 119° 38′ E., former treaty port on the shores of the Gulf of Liaotung in northeast China; the port was created by, and the harbour is the property of, the Kailan Mining administration, which works the Kaiping coalfield some 100 miles away. Export trade originated almost entirely from the coalfield and comprised not only coal but also coke, firebricks and cement manufactured at Tangshan, the new industrial town on the coalfield. Chinwangtao had also the largest glass factory in China. As it was the only ice-free port on the shallow gulf of Liaotung Chinwangtao had developed as a winter out-port to Tientsin, and to a lesser extent to Newchwang as well. This out-port function did not remain quite so important as at the beginning of the 20th century. The navigation of the Hai-ho could be kept open whenever the winds were off-shore and much of the trade that formerly went through Newchwang had since the advent of the Japanese been diverted through the ice-free Dairen. The port was first opened to foreign trade in 1901. After the Manchurian incident the Japanese pressure led to intensive smuggling of Japanese goods into North China largely through Chinwangtao. With establishment of the East Hopei autonomous puppet regime, Dec. 1935, smuggling continued disguised as a special tariff. After the Japanese invasion trade increased from $1,024,120 (U.S.) to $21,399,938 for import and from $2,099,392

to $4,324,975 for export, 1936–39, with Manchuria and Japan holding the largest percentages. Pop. 20,020.

CHIOGGIA, a town and episcopal see of Venetia, Italy, in the province of Venice, from which it is 18½ mi. S. by sea. Pop. (1936) 23,577 (town), 42,569 (commune). Chioggia is inhabited mostly by fishermen, and is situated upon an island at the south end of the lagoons. It is traversed by one main canal, La Vena, and has some picturesque and interesting mediaeval buildings. The peculiar dialect and customs of the inhabitants still survive to some extent. It is probably the Roman Portus Aedro, though its name is derived from the Roman Fossa Claudia, a canalized estuary which with the two mouths of the Meduacus (Brenta) went to form the harbour. In A.D. 672 it entered the league of the cities of the lagoons, and recognized the authority of the doge. In 809 it was almost destroyed by Pippin, but in 1110 was made a city, remaining subject to Venice. Chioggia is connected by rail with Rovigo, 35 mi. to the southwest. (X.)

The Naval War of Chioggia (1378–1380).—The naval war of 1378–80, carried on by the Genoese and their allies against Venice, is of exceptional interest as one in which a superior naval power, having suffered disaster in home waters, was yet able to win by holding out till its squadrons in distant seas could be recalled for its defence.

Venice was mainly concerned for the safety of her trading stations in the Levant and the Black sea. The more powerful of her two fleets was sent to the eastern Mediterranean under Carlo Zeno, and the smaller to operate against the Genoese in the western Mediterranean, under Vettor Pisani. The possessions of Venice on the mainland were assailed by the lord of Carrara and the Hungarians, but this danger seemed trifling so long as Venice could keep the sea open to her trade.

At first she was entirely successful. While Carlo Zeno harassed the Genoese stations in the Levant, Pisani brought one of their squadrons to action in May, 1378, to the south of the Tiber, and defeated it. If Pisani had sailed direct to Genoa itself, which was thrown into a panic, he might have dictated peace, but he thought his squadron too weak, and followed the Genoese galleys which had fled to Famagusta in Cyprus. During the summer of 1378 he was employed partly off Cyprus, but mainly in taking and capturing the Istrian and Dalmatian towns which supported the Hungarians. He was ordered to winter on the coast of Istria, where his crews suffered from exposure and disease. Genoa now decided to attack Venice at home while the best of her ships were absent with Carlo Zeno, and sent a strong fleet under Luciano Doria. Pisani had been reinforced early in the spring of 1379, but when he was sighted by the Genoese fleet off Pola on May 7, he was slightly out-numbered, and his crews were still weak. He would have preferred to avoid action and to threaten the Genoese fleet from his base on the Istrian coast, but he was forced into battle by the Senate, and was defeated with great loss. On the other hand Luciano Doria himself was killed, and the Genoese, who had suffered severely, did not at once follow up their success. On the arrival of Pietro Doria, with reinforcements, they appeared off the Lido, the outer barrier of the lagoon of Venice, and in July began combined operations against Chioggia, co-operating with the Carrarese and the Hungarians. The Venetians had closed the passages through the outer banks except at the southern end, at the island of Brondolo, and the town of Chioggia. The barrier here approaches close to the mainland, and the position facilitated the co-operation of the allies; but Chioggia is some distance from Venice, which could only be reached across the lagoon, where the Venetians had taken up the buoys and had a light squadron. The allies, after occupying the island of Brondolo, attacked, and took the town of Chioggia on Aug. 13.

There was nothing now to prevent them from advancing on Venice itself except the difficult navigation of the lagoon. The Senate applied for peace, but the Genoese offered impossible terms. Pisani, who had been imprisoned after the defeat at Pola, was released and named commander-in-chief. The heavy Genoese vessels were much hampered by the intricate passages through the lagoon, and by using his own local knowledge, Pisani completely turned the tables on the invaders by a succession of night attacks, during which he sank vessels in the canals leading through the lagoon to Venice, and in the fairways leading from Chioggia to the open sea. The Genoese were thus blockaded, Pisani having stationed his galleys in the open sea outside Brondolo. The Venetians themselves were in great distress; Carlo Zeno had long since been ordered home, but he was delayed by the difficulty of communication under 14th century conditions, and the besiegers of Chioggia were at the end of their strength when his fleet reached Brondolo on Jan. 1, 1380. The Genoese held out in the hope of relief from home, but it was not until May, 1380, that Matteo Maruffo arrived with reinforcements. By this time the Venetians had recovered the island, and their fleet occupied a fortified anchorage so that Maruffo could do nothing, and on June 24, 1380, the Genoese defenders of Chioggia surrendered. Venice, being now safe at home, recovered the command of the sea, and before the close of the year was able to make peace as a conqueror.

BIBLIOGRAPHY.—Horatio F. Brown, *Venice* (1839); S. Romanin, *Storia documentata di Venezia* (1855); W. C. Hazlitt, *History of the Venetian Republic* (1860). (G. A. R. C.; W. C. B. T.)

CHIOS, an island on the west coast of Asia Minor (ancient Greek *Khios*) about 30 mi. long from north to south, and from 8 to 15 mi. broad. Population, 75,680. The north end is mountainous with steep coasts; southwards there is open country, and great fertility. The capital, Chios, on the east coast, has a small safe harbour, and mediaeval fortifications. Population, 22,122. The climate is healthy; oranges, olives and even palms grow freely; the figs were famous in antiquity, but wine and gum mastic have always been the principal products. The latter, collected from a wild shrub, gives flavour and name to a popular Greek liqueur (*mastícha*). Antimony, calamine and marble are worked; there is a tanning industry, and considerable coasting trade.

There are few remains of ancient Chios (on the same site as the modern); traces of a theatre and a temple of Athena Poliuchus; and about 6 m. N. of the city the curious "School of Homer," a sanctuary of Cybele, with altar and figure of the goddess with two lions, in the native rock of a hill-top. On the west coast is a rich monastery with a church founded by Constantine IX. Monomachus (1042–54). In antiquity Chios was famous for its school of epic poets, the Homeridae, who claimed descent from Homer, and probably did much to popularize the *Iliad* and *Odyssey* in early Greece.

To Glaucus of Chios was ascribed the invention of iron-welding, early in the seventh century B.C., and his masterpiece, the support of a large bowl, was shown at Delphi: for his place in ancient art and craftsmanship *see* J. G. Frazer *Pausanias*: note on x. 16. 1. (vol. v. pp. 313–4); and for the beautiful and instructive coinage, P. Gardner, *History of Greek Coinage* (index) and the *British Museum Catalogue* (*s.v.*).

The early history of Chios is obscure. There were Greek legends of Leleges, Pelasgi from Thessaly, a Cretan foundation "in the days of Rhadamanthus" (13th century), and of eventual colonization by Ionians from Attica four generations later. Early kings and tyrants are little more than names, but the long friendship with Miletus is significant and determined the hostility of Chios to its neighbours, Phocaea, Erythrae and Samos. The Chian colony at Maroneia on the coast of Thrace reinforced the wine-trade of the mother city. Like Miletus, Chios in 546 submitted to Cyrus as eagerly as Phocaea resisted him. When Miletus revolted, 100 Chian ships joined in offering desperate opposition at Lade (494). Persian reprisals were severe, and temporarily successful, for Chian ships, under the tyrant Strattis, served in the Persian fleet at Salamis. But in 479 Chios joined the Delian League and long remained a firm ally of the Athenians, retaining political independence and a navy of its own. But in 413 the island revolted, and was not recaptured. After the Peloponnesian War it renewed the Athenian alliance, but in 357 again seceded. It was reputed one of the best-governed states in Greece, for although it was governed alternately by oligarchs and democrats neither party persecuted the other severely. Late in the 4th century, however, civil dissension left it a prey to Idrieus, the dynast of Caria (346), and to the Persian admiral Memnon (333). During the Hellenistic age Chios retained its independence, supported the

Romans in their Eastern wars, and was made a "free and allied state." Under Roman and Byzantine rule industry and commerce were undisturbed, its chief export at this time being the "Arvisian wine," of the north-west coast (*Ariusia*). After temporary occupations by the Seljuk Turks (1089–1092) and by the Venetians (1124–1125, 1172, 1204–1225), it was given in fief to the Genoese family of Zaccaria, and in 1346 passed definitely into the hands of a Genoese *maona,* or trading company, which was organized in 1362 under the name of "the Giustiniani," and alone exploited the mastic trade; but the Greeks were allowed to retain their rights of self-government and continued to exercise their industries. In 1415 the Genoese became a tributary to the Ottomans and, in spite of occasional secessions which brought severe punishment (1453, 1479), the rule of the Giustiniani was not abolished till 1566. But capture and reconquest from the Florentines (1595) and the Venetians (1694–1695), greatly reduced the number of the Latins and wrecked its prosperity. Worst of all were the massacres of 1822, which followed upon an attack by Greek insurgents against the will of the natives. Many survivors fled to Syra (*q.v.*) and founded its prosperous carrying trade. But the island's natural resources made its recovery sure, and its efficient and peaceable inhabitants passed quietly from Turkish to Greek rule during the Balkan War of 1912.

BIBLIOGRAPHY.—Strabo xiv. pp. 632 f.; Athenaeus' vi. 265–266; Herodotus i. 160–165, vi. 15–31; Thucydides viii. 14–61; *Corpus Inscr. Atticarum,* iv. (2), pp. 9, 10; H. Houssaye in *Revue des deux mondes,* xlvi. (1876), pp. i. ff.; T. Bent in *Historical Review* (1889), pp. 467–480; Fustel de Coulanges, *L'Ile de Chio* (ed. Jullian, Paris, 1893); for coinage, B. V. Head, *Historia numorum* (Oxford, 1887), pp. 513–515, and NUMISMATICS: *Greek Coins.*



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

CHIPMUNK (TAMIAS STRIATUS), FOUND IN EASTERN UNITED STATES AND CANADA

CHIPMUNK, the name for small striped ground squirrels (*Tamias striatus* and numerous species of the genus *Eutamias*) found in North America and eastern Asia. They are 5 or 6 in. long, with a tail about 4 in., reddish or grayish brown in colour.

(J. E. HL.)

CHIPPENDALE, THOMAS (*c.* 1718–1779), the most famous of English cabinet-makers, was the son of John Chippendale, a joiner of Otley, Yorkshire. He was baptised at Otley on June 5, 1718. The materials for the biography of Chippendale are scanty, but it is known that he came to London when he was about 20, and at the end of 1749 established himself in Conduit court, Long Acre, whence in 1753 he removed to No. 60, St. Martin's lane, which with the addition of the adjoining three houses remained his factory for the rest of his life.

It has always been exceedingly difficult to distinguish the work executed in Chippendale's factory and under his own eye from that of the many copyists and adapters who throughout the second half of the 18th century plundered remorselessly. Apart from his published designs, many of which were probably never made up, we have to depend upon the very few instances in which his original accounts earmark work as unquestionably his. For Claydon house, in Buckinghamshire, he executed much decorative work, and the best judges are satisfied that the Chinese bedroom there was designed by him. At Harewood house, in Yorkshire, we are on firmer ground. The house was furnished between 1765 and 1771, and both Robert Adam and Chippendale were employed upon it. Indeed, there is unmistakable evidence to show that certain work, so closely characteristic of the Adams that it might have been assigned to them without hesitation, was actually produced by Chippendale, whose bills for this Adam work are still preserved. For Nostell Priory, Yorkshire he made a quantity of fine furniture in 1766, the bills for which are also in existence there. Stourhead, the famous house of the Hoares in Wiltshire, contains much undoubted Chippendale furniture, which may, however, be the work of his son Thomas Chippendale II.; at Rowton castle Shropshire, Chippendale's bills as well as his works still exist.

Our other main source of information is *The Gentleman and Cabinet Maker's Director,* which was published by Thomas Chippendale in 1754. This folio, the most important collection of furniture designs issued up to that time in England, contains 160 engraved plates, and the list of subscribers indicates that the author had acquired a large and distinguished body of customers. There was a second edition in 1759, and a third in 1762.

The *Director* contains examples of each of the manners which Chippendale practised. Occasionally we find in one piece of furniture a combination of the three styles which he most affected at different periods (Louis XV., Chinese and Gothic) and it cannot be said that the result is as incongruous as might have been expected. Some of his most elegant and attractive work is derived directly from the French.

The primary characteristic of his furniture is solidity, but it is a solidity which rarely becomes heaviness. Even in apparently slight work, such as the ribbon-backed chair, construction is always the first consideration. It is indeed in the chair that Chippendale is seen at his best and most characteristic. From his hand, or his pencil, we have a great variety of chairs, which, although differing extensively in detail, may be roughly arranged in three or four groups, which it would sometimes be rash to attempt to date. He introduced the cabriole leg, which, despite its antiquity, came immediately from Holland; the claw and ball foot of ancient Oriental use; the straight, square, uncompromising early Georgian leg; the carved latticework Chinese leg; the pseudo-Chinese leg; the fretwork leg, which was supposed to be in the best Gothic taste; the inelegant rococo leg with the curled or hoofed foot; and even occasionally the spade foot. His chair-backs were very various. His efforts in Gothic often took the form of the tracery of a church window, or even of an ovalled rose window. His Chinese backs were distinctly geometrical, and from them he would seem to have derived some of the inspiration for the frets of the glazed bookcases and cabinets which were among his most agreeable work. The most attractive feature of Chippendale's most artistic chairs (derived from Louis Quinze models) is the back, which, speaking generally, is the most elegant and pleasing thing that has ever been done in furniture. He took the old solid or slightly pierced back, and cut it up into a light openwork design exquisitely carved (for Chippendale was a carver before everything) in a vast variety of designs ranging from the elaborate and extremely elegant ribbon back, to a comparatively plain but highly effective splat. His armchairs, however, often had solid or stuffed backs. Next to his chairs, Chippendale was most successful with settees, which almost invariably took the shape of two or three conjoined chairs, the arms, backs and legs identical with those which he used for single seats. He was likewise a prolific designer and maker of bookcases, cabinets and escritoires with doors glazed with fretwork divisions, cases for long clocks, and a great number of tables, some of them with a remarkable degree of Gallic grace. He was especially successful in designing small tables with fretwork galleries for the display of china. His mirrors, which were often in the Chinese taste or extravagantly rococo, are remarkable and characteristic. Some of Chippendale's most graceful work was lavished upon the woodwork of the lighter, more refined and less monumental four-poster. His claims to distinction are summed up in the fact that his name has by general consent been attached to the most splendid period of English furniture.

Chippendale was buried on Nov. 13, 1779, at the church of St. Martin-in-the-Fields. Of his 11 children, THOMAS CHIPPENDALE II. succeeded to the business of his father and grandfather, and for some years the firm traded under the style of Chippendale and Haig. The factory remained in St. Martin's lane, but in 1814 an additional shop was opened at No. 57, Haymarket, whence it was in 1821 removed to 42, Jermyn street. Like his father, Thomas Chippendale II. was a member of the Society of Arts; and he is known to have exhibited five pictures at the Royal Academy between 1784 and 1801. He died at the end of 1822 or the beginning of 1823.

See Oliver Brackett *Thomas Chippendale, a Study of his Life, Work and Influence* (1924).

CHIPPENHAM, market town and municipal borough in the Chippenham parliamentary division of Wiltshire, England, 94 mi. W. of London by the G.W.R. on the south side of the Upper Avon. Pop. (1938) 10,120. Area 1.9 sq.mi. St. Andrew's church, originally 12th century Norman, has been enlarged in different styles. Chippenham (*Chepeham, Chippeham*) was the site of a royal residence where, in 853, Aethelwulf celebrated the marriage of his daughter Aethelswitha with Burgred, king of Mercia. The town figured prominently in the Danish invasion of the 9th century, and in 933 was the meeting-place of the witan. In the Domesday survey Chippenham appears as a Crown manor. The town was governed by a bailiff in the reign of Edward I; it was incorporated in 1553, but in 1685 received a new charter which was soon abandoned in favour of the original grant. The derivation of Chippenham from *cyppan,* to buy, implies that the town possessed a market in Saxon times. The neighbouring Cotswold hills preserve many relics of early man, and their grasslands produced the sheep which gave Chippenham its fame as a woollen centre from the 16th century. On the decline of this trade the grain and cheese markets developed. Condensed-milk making, bacon curing and engineering are carried on.

The town sent two members to parliament until 1867, and one until 1885.

CHIPPEWA. The Canadian branch of the Chippewa, one of the largest tribes north of Mexico, lives in the woodlands north and west of Lake Superior. Their culture was typical in many respects of the central Algonquians. Moose, deer, beaver and rabbits were snared or killed with arrows; wild-fowl were shot or clubbed, and fish were speared or taken with hook and line. Wild rice was collected as a staple food in the vicinity of Lake Superior; maple sugar was manufactured, and nuts, berries and edible roots are still gathered in large quantities. In their search for game the Chippewa travel long distances, by canoe in summer, or in winter on snow-shoes, dragging their goods on toboggans. These wanderings, however, usually lead back to semi-permanent settlements, where formerly bark houses were used in warm weather, and oval, rush-covered lodges in winter. In pre-Columbian days, utensils were almost entirely of wood or bark, basketry being weakly developed. Clothing was of skins, while bags, belts and garters were woven on heddle looms out of bark or wild hemp fibre. Expert artificers in wood, Chippewa stone work was limited to arrow points and a few tools, while native copper, mined near Lake Superior, was pounded into serviceable shapes.



BY COURTESY OF THE SMITHSONIAN INSTITUTION

CHIPPEWA INDIAN, IN HIS TRIBAL DRESS

Politically, there is no Chippewa "tribe," since the numerous sub-divisions have no single, central authority. Each inhabits a certain locality, and the members enter into definite relations with one another. There is an ill-defined kind of council, consisting of practically all the males of the community, which elects a chief, whose powers are even more shadowy than those of the body that selects him. Social divisions are more definite, since, in addition to the family, there are exogamic patrilineal clans of a totemic nature. Individual ownership of material objects prevails, but land was probably held, in former times, by groups of kindred.

The Chippewa have firm belief in a cosmic force animating all nature which frequently manifests itself in animals, mythical or real. Like their eastern kinsmen, the concept of a guardian spirit was important, and shamanism with conjuring flourished. Entry to the next world depended largely upon membership in the *Midéwiwin,* "Great Medicine Society," a secret organization entered after elaborate initiation. Symbolic pictographs drawn upon bark were perhaps originally connected with this society. (See *Handbook of the American Indian,* 1906.)

CHIPPEWA FALLS, a city of northwestern Wisconsin, U.S.A., on the Chippewa river, 100 mi. E. of St. Paul, the county seat of Chippewa county. It is on federal highway 53, and is served by the Chicago and North Western, the Chicago, Milwaukee, St. Paul and Pacific and the Soo Line railways. The population in 1940 was 10,368. The city has machine shops and a packing plant, and its manufactures include woollen goods, shoes, gloves, pumps, sashes and doors, milk products and cement silos. The first settlement was made in 1837. The city was chartered in 1870.

CHIPPING CAMPDEN, market town, Gloucestershire, England, 29 mi. N.E. from Gloucester by the G.W.R. Pop. (1931) 1,645. It is situated toward the north of the Cotswold hills. A ruined 16th century manor house, some almshouses and the church complete a picturesque group of buildings. The house of William Grevel (d. 1401), a great wool merchant, is noteworthy.

Apart from a mediaeval tradition that a conference of Saxon kings was held there, the earliest record of Campden (*Campedene*) is in Domesday, when earl Hugh held it. The manor passed in 1173 to Hugh de Gondeville, and about 1204 to Ralph, earl of Chester. These lords granted charters which are known from a confirmation dated 1247. In 1605 Campedene was incorporated, but was never represented in parliament. The corporation was abolished in 1885. Camden speaks of the town as a market famous for stockings, a relic of its mediaeval importance as a mart for wool which gave it the name of Chipping.

CHIPPING NORTON, municipal borough, Oxfordshire, England, 16 mi. N.W. of Oxford by a branch of the G.W.R. Pop. (1938) 3,369. It lies on the steep flank of a hill, and consists mainly of one very wide street. Chipping Norton (*Chepyngnorton*) was of some importance in Saxon times. At the Domesday survey it was held by Ernulf de Hesding and assessed at 15 hides with three mills. It returned two members to parliament as a borough in 1302 and 1304–1305, but was not represented after this date. Fairs were granted in 1205 to William Fitz-Alan and in 1276 to Roger, earl of March. In the reign of Henry VI the market was held on Wednesday, and a fair was held at the Translation of St. Thomas Becket. James I annulled the former two fairs, and granted others. He also granted the first and only charter of incorporation. The church of St. Mary the Virgin on the lower slope is a fine building in the Decorated and Perpendicular styles. The trade is still mainly agricultural, though woollen goods are manufactured. The borough is in the Banbury division of Oxfordshire. Area, 3.8 sq.mi.

CHIQUITAN, an independent linguistic stock of South American Indians, so called from the Chiquitos who are the best known of its tribes. The stock occupies a considerable area in eastern Bolivia, in the forested hilly country on the northern border of the Chaco. In recent times they have held the area between the headwaters of the Guapore on the north and the hills on the northern bank of the Otuquis river on the south, and between the San Miguel river in the west and the Paraguay in the east. It is probable that they formerly extended farther west to the foothills of the Andes and may have been forced eastward as a result of the displacements of peoples consequent on the invasion and settlement of the Chiriguanos in the early 16th century. The Chiquitos were a rather warlike and originally mainly nomadic hunting and fishing folk of simple culture. Their name, meaning "little ones" in Spanish, was given them on account of the very small doorways of their tiny thatched huts, through which one had to crawl on hands and knees. They seem to have had some palisaded strongholds and to have used poisoned arrows. Some of the tribes made good pottery and simple textiles. They had no canoes. Monogamy was the rule except for the chiefs, who were not hereditary but chosen for valour and ability. The youth before marriage lived apart in a special house. The shamans appear to have used snakes a good deal in connection with their religious ceremonies. The best known tribe of this stock to-day is the Lenguas.

See J. P. Fernandez, *Relacion historial de las missiones de los Indios que llaman Chiquitos, etc.* (Madrid, 1726).

CHIRICAHUA NATIONAL MONUMENT, a tract of 4,480 ac. in the Coronado national forest in Arizona, U.S.A., set apart as a Government reservation in 1924 and remarkable for its

"pinnacle" formations. It is administered by the Department of Agriculture.

CHIROL, SIR VALENTINE (1852–1929), British journalist, was born on May 23, 1852, and educated in France and Germany. He graduated Bachelier-ès-lettres of the University of Paris. From 1872 to 1876 he was a clerk in the Foreign Office and afterwards travelled throughout the Near and Far East. He succeeded Sir Donald Mackenzie Wallace in 1899 as foreign editor of *The Times*. He retired from the service of *The Times* in 1912, and then became a member of the Royal Commission on Indian Public Services (1912–16). He wrote authoritative works on India, Egypt and the Far and Near East, and in 1927, he published a volume of reminiscences entitled *Fifty Years in a Changing World* to which a second volume, *With Pen and Brush in Eastern Lands,* was added in 1929. He was knighted in 1912 and died in London on Oct. 22, 1929.

CHIROMANCY, the art of telling character or fortune by studying the lines of the hands (*see* PALMISTRY).

CHIRON or **CHEIRON,** in Greek mythology, one of the Centaurs, the son of Cronus and Philyra, a sea nymph. He dwelt at the foot of Mount Pelion, and was famous for his wisdom and knowledge of the healing art. He offers a remarkable contrast to the other Centaurs in manners and character. Many of the most celebrated heroes of Greece were brought up and instructed by him (Apollodorus iii, 10. 13). Accidentally pierced by a poisoned arrow shot by Heracles, he renounced his immortality in favour of Prometheus, and was placed by Zeus among the stars as the constellation *Sagittarius*.

CHIROPODIST (Podiatrist). One who diagnoses and treats conditions affecting the feet. The first podiatrist was Dr. Lyon who, in 1785 in England, applied for a licence to limit practice to the foot alone. Chiropody practice in the United States was governed by law in all but two states in 1941. Competent podiatrists have the degree of doctor of surgical chiropody (D.S.C.) from recognized schools.

CHIROPRACTIC, "a system of therapeutics based upon the theory that disease is caused by interference with nerve function. Its theory is based upon the premise that all other systems and physiologic processes of the human body are controlled and coordinated by the nerve system. Its therapeutics attempts to restore normal function of the nerve system by manipulation and treatment of the structures of the human body, especially those of the spinal column." Daniel David Palmer began to formulate its theory in 1895, and established the Palmer School of Chiropractic at Davenport, Ia., in 1903. Later others were founded in different parts of the United States and, by 1941, the National Chiropractic association had extended accredited ratings to 12 colleges teaching a scientific course of four collegiate years. The practice of chiropractic has been accorded legislative recognition in 42 states, the District of Columbia, Alaska, Hawaii and several provinces of Canada. It is estimated that there are about 18,000 chiropractors practicing in the United States and Canada.

CHIROPTERA, the order of mammals containing the bats. They are the only members of this class which can truly fly and their forelimbs are modified to form wings, whence the name Chiroptera (from the Greek, meaning "hand-wings").

Bats not very different from those that still exist have been found in the early part of the Eocene period, indicating that the order is an ancient one. No animals are known that connect the bats closely with other groups of mammals, but the great resemblances between them and some of the Insectivora (*q.v.*) indicate these are probably the most closely related order. The existence of the so-called "flying lemur," *Cynocephalus,* suggests how the transformation from tree-living to flying took place. This animal possesses extensive folds of skin connecting its neck, wrists, ankles and tail, and even between the fingers and toes. These membranes enable it to glide long distances between trees and even to control its course somewhat during the glide. The ancestral bats progressed further in this direction. They developed extremely long forearm and fingers and extended the skin web between these. Their breast muscles increased in power until they were able to beat the forelimbs and wing membranes against the air and thus propel themselves through it. The side and tail membranes support bats in the air between wing beats, and the latter acts as a powerful brake when the end is brought forward under the body. The impervious nature of the wing membranes, their elasticity, and the manner in which they fold up on the fingers, somewhat as an umbrella does on its stays, tend to make the flight of bats both efficient and erratic.

Once this ability to fly was achieved, the bats underwent evolutionary diversification chiefly in minor details. Often the various stages in these modifications still persist in the various living species, and it is possible partly to reconstruct the changes. The upper armbone, or humerus, in the weaker flying bats has its usual simple ball-and-socket articulation with the shoulder blade, while the groups which fly best, the families Vespertilionidae and Molossidae, have developed a second joint between the greater tubercle of the humerus and the scapula. These swift-flying bats have a short upper arm as compared with the forearm, and the third finger is much longer than the others. The humerus has a small but well developed crest for the attachment of the deltoid and pectoral muscles; its shaft is rounded and it varies in shape from somewhat curved in the lower bats to almost straight in the higher groups. Of the two bones generally found in the forearm, the radius alone is well developed, the ulna being little more than a thread and often almost completely fused with the radius. A bone is developed in the tendon of the triceps muscle near the elbow, somewhat resembling the kneecap and with a similar function. The wristbones, six in number, are small. The metacarpal bones, except for that of the thumb, are greatly lengthened, forming the chief supports of the wing. The short thumb is separate from the rest of the wing; its claw is sharp and hooked in most bats, and it is used to grapple the surface in crawling; and some species occasionally swing from branches by the thumb. In certain bats the thumb is provided with a round adhesive disk by means of which they can rest upside down on a smooth surface, such as a banana leaf (fig. 18).

The second, or index finger, except in the fruit bats and the mouse-tailed bat, has lost its terminal joints, consisting only of the metacarpal and a poorly developed cartilage. This finger is generally closely associated with the middle, or third finger, and strengthens it. The third, fourth and fifth fingers have three joints or phalanges as a rule, but the last of these is usually cartilaginous. When bats rest, the phalanges are often bent, sometimes in zigzag fashion to fold the wing more completely.

The shoulder girdle is well developed, with a stout curved clavicle, or collarbone, and broad scapula, or shoulder blade. The coracoid process of the latter is large, usually curved outward but occasionally inward and dorsally. Its base articulates with the secondary articular process developed from the greater tubercle

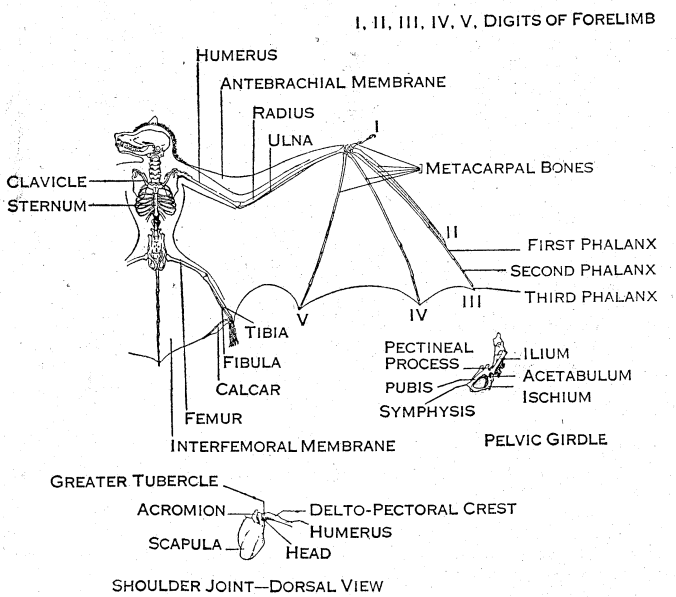


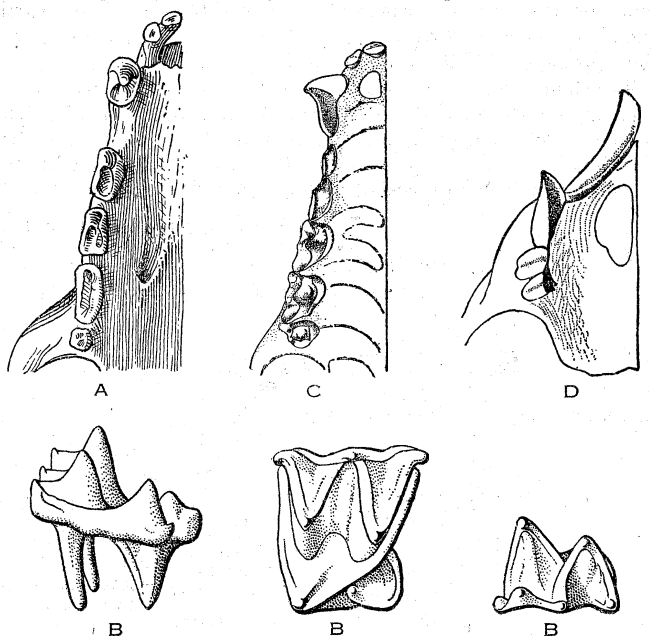
FIG. 1.—SKELETON AND WING MEMBRANES OF A BAT (MYOTIS)

of the humerus. The sternum, or breastbone, consists of three parts, the more or less T-shaped presternum or manubrium, the body of the sternum and the xiphisternum. The presternum is large, strongly keeled for the attachment of the flying muscles of the breast, while the lateral processes articulate with the clavicle and first rib. The keel continues down the body of the sternum, gradually becoming lower. The xiphisternum is short, often expanded posteriorly and partly cartilaginous.

The thorax is capacious, to accommodate the large heart and lungs, and the ribs are often flattened and close together. The first rib consists of two parts; it is usually thickened and much shorter than the others. The ventral segment frequently articulates with the clavicle. In the horseshoe and leaf-nosed bats (Rhinolophidae) the first or first two ribs are fused with both the sternum and their vertebrae to form a solid ring supporting the shoulder girdle. The pelvic girdle is weaker than the pectoral; its dorsal border is usually almost straight and almost on the same plane as the sacrum. The ilia are generally narrow but occasionally shelflike, while the pubis and ischium are generally narrow. A well developed pectineal process extends forward from the pubis and in the Hipposiderinae it unites with a process from the ilium to form a large foramen. The acetabulum or hip socket is often incomplete, dorsally or ventrally or both.

The hind limbs support the side membrane and that of the tail. The head of the femur is almost in the same axis as the shaft, so that the thigh projects almost at right angles to the body. The knee bends outward and backward rather than forward like that of terrestrial mammals. The foot is weak—the toes all about the same size and armed with sharp hooked claws by which the bat hangs, as a rule, when resting. The heel bone bears a long cartilaginous process, the calcar, rarely rudimentary or absent, which supports part of the posterior margin of the interfemoral membrane extending from the tail or hinder part of the body to the hind limbs.

The tail varies greatly in the different groups of bats; in primitive forms it is long and generally free from the membrane. Only one of the fruit bats has a long tail, as long as the hind limbs, the genus *Notopteris,* found in the southwestern Pacific. In other fruit bats the tail is either very short or absent. Most of the insectivorous bats have a well developed tail, but the mouse-tailed bat, *Rhinopoma,* has a long tail almost completely free from the interfemoral membrane. In the sheath-tailed bats (Emballonuridae) the tail is partly enclosed in the membrane but its distal end projects through the dorsal surface. In most other families the tail extends to the end of the large interfemoral membrane, as its median support.



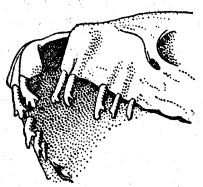
FROM (A) MILLER IN UNITED STATES NATIONAL MUSEUM BULLETIN; (B) MILLER, "THE FAMILIES AND GENERA OF BATS" (SMITHSONIAN INSTITUTION); (C) H. ALLEN, "ON THE GLOSSOPHAGINAE" BY COURTESY OF THE AMERICAN PHILOSOPHICAL SOCIETY; (D) MILLER, "THE FAMILIES AND GENERA OF BATS" (U.S. NATIONAL MUSEUM)

FIG. 2.—DENTITION OF BATS

A. Upper dentition, *Pteropus,* typical fruit bat; B. Side and crown views of molars of typical insectivorous bat, showing W-pattern of main cusps. Lower molar on left; C. Modified insectivorous dentition of *Glossophaga,* a tropical American fruit-eating bat; D. Trenchant dentition of *Desmodus,* the vampire bat

The skull varies a great deal in the different groups and it is used to characterize these. There is a tendency for the facial portion to become shortened in the more progressive forms, but all extremes are found from elongate snout to a short massive one.

The teeth comprise incisors $\left(\frac{2-1}{3-0}\right)$ canines $\left(\frac{1}{1}\right)$, premolars $\left(\frac{3-1}{3-2}\right)$ and molars $\left(\frac{3-1}{3-1}\right)$, totalling from 38 to 20. The cheek teeth of fruit bats have poorly marked cusps, their squarish crowns bearing a large outer and a smaller inner cusp, which become gradually reduced toward the posterior end of the series. The pattern of these teeth of fruit bats has probably been simplified from the insectivorous pattern. In the molars of insectivorous bats the cusps on their surfaces show a W-pattern in both upper and lower teeth, the upper ones broader, with an additional shelf and "talon" cusp. They thus resemble closely the teeth of certain insectivorous mammals of similar food habits, the hedgehogs, the jumping shrews, moles and shrews. The cusps on the cheek teeth of the vampires are greatly simplified, the teeth being specialized into blades for cutting. The milk teeth are quite unlike those of the permanent series, being slender and hooklike, sometimes with forked or trifid tips, and are soon shed.



FROM MILLER, "THE FAMILIES AND GENERA OF BATS" (SMITHSONIAN INSTITUTION)

FIG. 3.—DECIDUOUS DENTITION OF PROMOPS, AN INSECTIVOROUS BAT

The brain is not highly developed; the cerebral hemispheres are smooth or only slightly furrowed and do not extend back over the cerebellum. However, bats have a delicate sense of touch; tactile hairs exist on the region around the mouth, on the flying membranes and ears. Each hair is provided with a nerve ending that surrounds its base. The expanded ears and noseleaves may also serve as organs of touch, although special nerves are not known. The sense of scent appears to be only moderately well developed, but hearing is keen, especially for notes higher than those heard by the human ear. This is of great importance in flight, for the bat emits high-pitched cries continuously and solid objects reflect these sounds, warning the bat of obstacles. The eyes of bats, although small, are far from blind; bats see fairly well but depend more on their hearing to find food and to avoid collisions. In no animal are the ears so developed or so variable in form; in many insectivorous species they are longer than the head, while in the Eurasian long-eared bat their length nearly equals that of the body. The "earlet," or tragus, is generally large in the insectivorous bats but is never present in the Megachiroptera nor in the insectivorous Rhinolophidae.

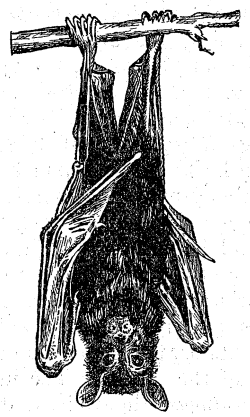
The stomach is of two types, corresponding to the two suborders, Megachiroptera and Microchiroptera. In the latter group the stomach is simple and almost spherical. In the fruit bats the narrow oesophagus gradually enlarges just before reaching the stomach. The stomach is enlarged transversely, with a large cardiac sac and a tapering pyloric portion which gradually passes into the intestine. The vampire bat, one of the Microchiroptera, feeds on blood; its stomach has a long tubular cardiac portion, folded on itself, but the pyloris is hardly distinguishable from the small intestine. The intestine is short in insectivorous bats, in some of which it is shorter than in any other mammal, but may be four times the body length in the fruit-eating types.

As a rule bats produce only a single young at a birth, but among the insectivorous types two or even four young may occur. These are born with closed eyes and nearly naked; they are able to climb up the mother's skin to the nipples, where they attach by the delicate hooklike deciduous teeth. The young bats remain attached to the mother for some time and she may fly about with them while hunting her prey. In many species of the northern hemisphere the mating period is in the fall; the sperm remain

inactive during the winter. Early in spring, when the bats become active again, ovulation occurs in the females and the egg cells are fertilized. The penis is pendulous; often there is a bone in its distal part. The uterus of females is primitively double; in some species the uterus consists of a rounded body with long horns, while in others the horns are greatly reduced. A simple uterus is formed in some of the Phyllostomidae. The placenta is discoidal and deciduate, as in the Primates. Bats are divisible into two suborders: the Megachiroptera and the Microchiroptera.

MEGACHIROPTERA

The first of these suborders comprises the fruit bats, generally of large size. The crowns of their cheek teeth show only poorly marked cusps which never form a W-pattern. The bony palate extends behind the last molar, narrowing slowly backward. The greater tubercle of the humerus is poorly developed and does not articulate with the scapula. The second finger is partly independent from the third and retains three phalanges, the terminal one generally with a claw. The margins of the ear unite to form a ring at the base. The tail, often absent, is free from the interfemoral membrane. This group is limited to the tropical and subtropical parts of the eastern hemisphere. All the members of this suborder are included in the single family Pteropodidae, which may be divided into four subfamilies.



REDRAWN FROM A PHOTOGRAPH, NEW YORK ZOOLOGICAL SOCIETY

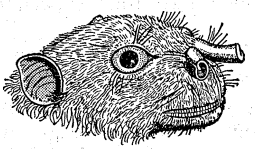
FIG. 4.—FLYING FOX (PTEROPUS)

The subfamily Pteropodinae contains a large majority of the frugivorous genera. It is characterized by having a normal tongue, blunt-crowned cheek teeth, canines which are vertically directed and the lower pair separated from each other by the incisors, and premaxillary bones which are separated or only barely united.

The Pteropodinae may be divided into three tribes. The pteropodine tribe is characterized by having the occipital part of the skull deflected (the alveolar line projected backward passes above the occipital condyle); the muzzle is long, about equal to the postorbital part of the head. The first representatives of this group, the flying foxes (*Pteropus*) are found from the Comoro Islands and Madagascar to southern Japan, Samoa and Tasmania; they have foxlike faces, two lower incisors on each side and no tail; the occiput of the skull is elongated and tubular. Most species have a brilliantly coloured mantle, although this varies from light yellowish buff or even whitish to dark brown or blackish. *Styloctenium wallacei* of Celebes resembles *Pteropus*, but the lower incisors are 1–1; its general colour is pale grayish to warm cinnamon above, with a white shoulder patch, light cinnamon under parts and a whitish or creamy mantle. The dog-faced bats (*Rousettus*), found throughout Africa and east to the Solomon Islands, have a short tail, the occiput of the skull is not tubular and the muzzle is shorter and coarser than that of *Pteropus*; in colour they are generally dark dull brown. The yellow fruit bat (*Eidolon*) occurs in Africa, from Southern Arabia and the Sudan to Namaqualand; it differs from other fruit bats in having a bony external ear tube. *Boneia bidens* of Celebes combines characters of *Pteropus* and *Rousettus*, having a tail, tubular occiput of the skull, but its incisors are $\frac{1-1}{2-2}$. The spinal-winged bat (*Dobsonia*) is found from Celebes and Bali to the Solomon Islands and Queensland; its wings are attached to the mid-line of the back rather than to the sides of the body and the index finger of the wing has no claw; in colour the various species are dark brown, usually with an olive cast, lighter on the underparts; the muzzle is heavy, shorter than in *Pteropus*, and the cheek teeth are heavy and crowded.

The epomorphorine tribe contains only African species. It is characterized by the brain case being flattened posteriorly (the alveolar line produced posteriorly passes below the occipital condyle or through its lower part); the muzzle is generally long but may be quite short; the upper cheek teeth are three or four on each side; there are whitish hair tufts before, and usually behind, the ear. *Plerotes*, known only from Angola, has narrow, weak cheek teeth, four in number above; the occiput of the skull is deflected more than typical of this group, and in coloration it is a dull fawn. The epaulet bats (*Epomophorus*) vary from small short-faced species to larger, long-faced types. They are fawn-coloured; the males have erectile whitish or yellowish shoulder pouches, from which the species received its common name. The hammer-headed bat (*Hypsignathus*) of the Congo and West Africa has an enormous muzzle, especially the adult males, swollen, pendulous lips and extensive cheek pouches; it is grayish-brown in colour. The males emit loud cries during the night, frequenting mangroves and palms along the river. *Casinycteris* of the Cameroons is a short-faced, broad-headed species, differing from all its relatives by the reduced palate, which ends shortly behind the last molar; it is fawn-coloured, with a white blaze on the face.

The short-faced fruit bats of India and the Malay region, east to the Molucca Islands, Timor and the Philippines, form the third, or cynopterine, tribe. They have the occipital region on the same plane as the upper alveolar line. *Cynopterus* occurs throughout the range of the group, including about a dozen species; a small tail is present; the lower incisors are 2–2, while the cheek teeth are $\frac{4-4}{5-5}$. *Sphaerias* of Burma is like *Cynopterus* but the calcar or spur, which usually supports the interfemoral membrane, is absent, as is also the tail. *Balionycteris* has spotted wings, the tail is absent and the cheek teeth are $\frac{5-5}{5-5}$; it occurs in Borneo. *Ptenochirus* has lower incisors 1–1, cheek teeth $\frac{4-4}{5-5}$, a short tail or none. The typical species occurs in the Philippines; related forms are found on the Malay peninsula, Borneo and Sumatra. The flying foxes and their relatives feed on many fruits, such as figs, guavas, bananas, dates and others. Flowers and their buds are frequently taken and some species have been known to gnaw bark of young trees. In the tropics some fruit or flowers are almost always available.



FROM DOBSON, "PROCEEDINGS OF THE ZOOLOGICAL SOCIETY"

FIG. 5.—TUBE-NOSED FRUIT BAT, NYCTIMENE

The subfamily Nyctimeninae includes two genera of tube-nosed fruit bats. They are short-faced, with their nostrils drawn out into tubes; their lower canines are in contact, the lower incisors being absent; and in the skull the premaxillary bones are strongly united. The tail is about as long as the lower leg. The wings and ears are usually yellowish spotted. *Paranyctimene* has sharp-cusped cheek teeth, while those teeth in *Nyctimene* are almost as blunt as in most fruit bats. Both of these may feed on insects rather extensively, in addition to fruit.

The subfamily Harpyionycterinae contains only a single genus, *Harpyionycteris*. Like *Nyctimene*, it has the premaxillary bones broadly fused; the canines slant forward, crossing when the jaws are closed, the lower incisors are usually absent. The cheek teeth each show five or six sharp cusps. The skull is like that of the pteropodine fruit bats, with a long face. The harpy fruit bat is chocolate brown in colour, small in size and the tail is absent. It is known only from the Philippine Islands and Celebes.

The subfamily Macroglossinae includes a number of small, long-faced fruit bats, generally less than 5 in. in head and body length. The long, narrow tongue is free for its anterior two-thirds, protrusile and armed with recurved filiform papillae. Their cheek teeth are narrow, incisors greatly reduced in size, the mandibular symphysis is long and the brain case strongly deflected. They feed on soft fruits, the nectar and pollen of flowers, probably also on insects found in them. Bats of this group are found from India to the Fiji Islands and Australia, while one

form occurs in West Africa. Two sections of Macroglossinae have been distinguished. The macroglossine tribe, with a narrow ascending process of the premaxillary bone, contains three genera. *Eonycteris,* characterized by relatively large cheek teeth ($\frac{5}{6}$ or $\frac{5}{5}$ on either side), a short tail and the index finger without a claw, is found from Burma to the Philippines and Celebes. *Megaloglossus,* characterized by bilobed lower incisors, no tail, and males with pale neck-ruffs, has an African distribution from Liberia to the Belgian Congo. *Macroglossus* occurs from India to the Solomon Islands and northern Australia; cranially the brain case is strongly deflected, the infraorbital canal generally long; the index finger is clawed and there is no tail. The notopterine tribe, the skull with the ascending process of the premaxilla broad, contains three genera. *Melonycteris* of New Guinea and the Bismarck archipelago is golden brown in colour above, with dark under parts and small white epaulettes in males; the index finger bears a claw; the tail is absent; the skull is almost semicircular in dorsal outline and the infraorbital canal is long. *Nesonycteris* of the Solomon Islands has under parts paler and duller than the russet-brown back; the index finger is clawless; there is one minute lower incisor on either side instead of two. The long-tailed flower bat (*Notopteris*), of New Caledonia, the Carolines, the New Hebrides and Fiji Islands, is the only fruit bat with a tail reaching to the heel; the wings take origin from the middle of the back; cranially it resembles *Melonycteris* and *Nesonycteris* but has only one upper and one lower incisor on each side.

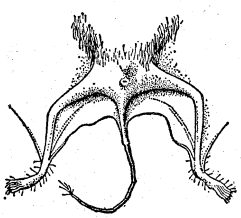
MICROCHIROPTERA

The second and larger suborder contains the insectivorous bats, most of which are of relatively small size. Their teeth are usually adapted for cutting up hard-bodied insects, the sharp cusps being arranged in W-pattern (fig. 2 B). The rim of the ear does not form a ring, as in the fruit bats. The angular process of the mandible is long and slender. The greater and lesser tubercles of the humerus are well developed and the former usually articulates with the scapula. The index finger never bears a claw and, except in a few species, lacks bony phalanges. As the suborder contains 600 or more different forms, it will be possible only to outline the various families and subfamilies, with special mention of some of the more important types.

The Microchiroptera may be divided into four superfamily groups, including 15 recent families.

(1) Superfamily Emballonuroidea is characterized by the premaxillaries being generally free, the ascending process the most important part. The greater tubercle of the humerus is small; only in the Noctilionidae does it articulate to a small degree with the scapula. The third digit bears two well developed phalanges. The teeth are normal.

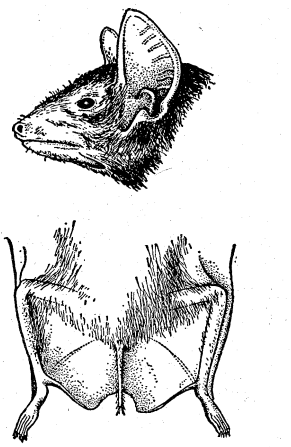
Family Rhinopomidae includes only the genus *Rhinopoma,* the mouse-tailed bat, found from Egypt to Burma and Sumatra. The interfemoral membrane is small, while the tail is slender and extremely long. The muzzle is broad, with a poorly developed nose-leaf; the ears are long and the index finger has two bony joints. The skull has a short rostrum, the dorsal surface of which exhibits a depression; there are no postorbital processes.



FROM ALLEN, LANG AND CHAPIN IN "BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY"

FIG. 6.—TAIL OF THE MOUSE-TAILED BAT (RHINOPOMA)

Family Emballonuridae, the sheath-tailed bats. The tail projects through the interfemoral membrane on the upper side. The basal phalanx of the third finger folds back on the upper side of the metacarpal bone when the wing is folded. The face is pointed, the nostrils project in front of the lips and there is no nose-leaf. The skull shows postorbital processes and the premaxillary bones are independent, without palatal processes. In subfamily Emballonurinae the postorbital processes are long and curved, the clavicle or collarbone is normal (its greatest breadth less than a quarter of its length). Bats of this group in the old world: *Emballonura,* with incisors $\frac{2-2}{3-3}$ and of small size, is found in Madagascar, the Malay region and eastward to Samoa; *Taphozous,* the tomb bats, has incisors $\frac{1-1}{2-2}$, a deep depression in the forehead of the skull, often a glandular throat-sac—bats of this genus are medium-sized or large and occur from Africa and southern Asia to the Philippines and Australia; *Coleura,* of eastern Africa and the Seychelle Islands, resembles *Emballonura* but has one upper incisor on each side. The sheath-tailed bats of the new world tropics (*Saccopteryx* and allies) have antebrachial pouches on the wings, the upper incisors are 1–1 or absent, and they are small or medium-sized species. *Rhynchiscus* of the same region lacks the wing pouch and has a long muzzle, although the rostrum of the skull is short. Subfamily Diclidurinae is characterized by the short and straight postorbital processes of the skull and a greatly expanded collarbone (its breadth more than one-third of the length). The interfemoral membrane is glandular. *Diclidurus,* the white bat, is widely distributed in tropical America. *Drepanonycteris* has whitish head, shoulders and underparts, but the back becomes brownish.



FROM ALLEN, LANG AND CHAPIN IN "BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY"

FIG. 7.—A. HEAD OF SHEATH-TAILED BAT (TAPHOZOUS); B. TAIL AND INTERFEMORAL MEMBRANE

Family Noctilionidae, the hare-lipped bats of tropical America and the West Indies, have a curiously folded upper lip, the middle forming an inverted V. The second finger has a rudimentary phalanx and the terminal phalanges of the third and fourth fingers fold under when at rest. The hind feet and claws are large and the ears long and pointed. There are cheek pouches but no nose-leaf. The incisors are $\frac{2-2}{1-1}$; both nasal and palatal processes of the premaxillaries are developed and these bones unite with the maxillaries in adults. The shoulder joint is strengthened by a small articulation of the greater tubercle of the humerus with the scapula. The hip-bones are solidly attached to the spinal column, the ischia fused together and with the under side of the sacrum, and the symphysis pubis is absent in females. These large or medium-sized bats feed chiefly on fish, which they catch with their long feet. Two genera, *Noctilio* and *Dirias,* are distinguished, the latter by minor dental characters and shorter legs and feet.

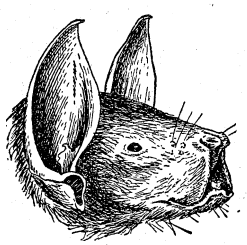


FIG. 8.—HARE-LIPPED BAT (NOCTILIO)

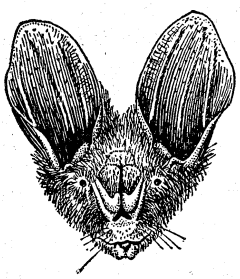
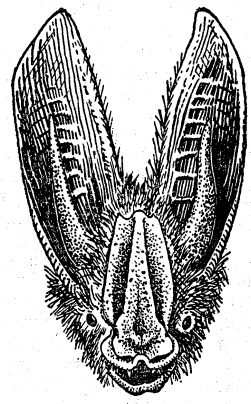


FIG. 9.—SLIT-FACED BAT (NYCTERIS)

(2) Superfamily Rhinolophoidea contains bats characterized by degenerate premaxillary bones, without nasal processes, and often partly or wholly cartilaginous. The nostrils open in a complicated nose-leaf or margined by cutaneous outgrowths forming a deep longitudinal groove. The ears are large and the third finger bears only two phalanges.

Family Nycteridae, the slit-faced bats, are so called from a deep slit down the front of the face, into which the nostrils open. The edges of this are swollen but do not form a nose-leaf. The

tail is long, included in the interfemoral membrane to the tip. The ear is large, with a simple tragus. The skull has poorly developed postorbital processes on the sides of an extensive frontal basin; the premaxillaries are represented only by their palatal portions. The humerus exhibits a poorly developed greater tubercle which does not articulate with the scapula. Only the single genus *Nycteris* is extant, found throughout Africa except for the northwest, and from Borneo and Java to Celebes and Timor.



FROM ALLEN, LANG AND CHAPIN, "BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY"

FIG. 10.—FALSE VAMPIRE (LAVIA FRONS)

Family Megadermidae, the false vampires, are distributed from India and southern China to the Philippine Islands and Java, and in Australia and tropical Africa. The muzzle bears a nose-leaf; the tragus of the ear is large and bifid and the tail is short. The premaxillaries are almost completely cartilaginous and there are no upper incisors. *Megaderma* (including *Lyroderma* of many authors) ranges from southern Asia to Java and the Philippines; it is distinguished by having $\frac{5-5}{5-5}$ cheek teeth and only slightly concave frontal region. *Macroderma,* the Australian false vampire, is one of the largest of the insectivorous bats, the head and body length 4.92–5.11 in. It is pale grayish green, almost whitish in colour and has 4–4 upper cheek teeth and conspicuously concave frontal part of the skull. *Lavia* (including *Cardioderma* of some authors) of the savanna country of Africa, agrees with *Macroderma* in dental formula and cranially. In colour these bats are bright greenish gray.

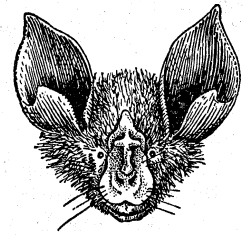


FIG. 11.—HORSESHOE BAT (RHINOLOPHUS)

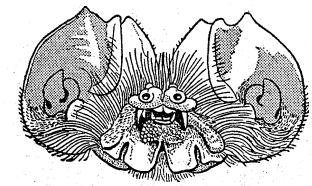
Family Rhinolophidae, the horseshoe and leaf-nosed bats, inhabits the tropical and temperate parts of the old world. The ears are large and lack a tragus and a complicated nose-leaf is developed. The tail is generally shorter than the hind legs. The rostrum of the skull is short, the nasal cavities inflated, and the premaxillaries are partly cartilaginous, the only ossified parts being a palatal strap bearing the small incisors. The greater tubercle of the humerus is large, articulating with the shoulder blade, and the first ribs, last cervical and first thoracic vertebrae tend to fuse with each other and the presternum to form a broad bony ring. The pelvic girdle is weak, the dorsal and ventral margins of the hipbone are almost parallel, the obturator foramen small. Two subfamilies may be recognized: the Rhinolophinae, with three joints in the second to fifth toes, the nose-leaf pointed above and broad below; the Hipposiderinae, with squarish nose-leaf, the toes with only two phalanges, the basal joint and the one bearing a claw. Subfamily Rhinolophinae, the horseshoe bats, contains only two genera. *Rhinolophus* is found throughout the tropical and temperate regions of the old world, from England and Japan to South Africa and Australia. Almost 100 species are recognized, ranging from small to medium in size (up to about 3.34 in. head and body length). *Chilophyla,* found only in the Philippines, has a broad, poorly differentiated horseshoe, the ears large and rounded. The thumb has a long metacarpal included in the antebrachial membrane, which forms a pouch. This rare



FROM ALLEN, LANG AND CHAPIN, "BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY"

FIG. 12.—LEAF-NOSED BAT (HIPPOSIDEROS CYCLOPS)

bat is dull fawn colour, with long soft hair. Subfamily Hipposiderinae, the leaf-nosed bats, restricted to the tropics or warmer regions, are found throughout Africa and southern Asia, east to Australia and the Solomons. In addition to the characters given above, the thoracic ring is more extensive than in the Rhinolophinae, the hipbone contains a secondary pre-acetabular foramen and the lumbar vertebrae tend to fuse. The typical genus, *Hipposideros,* has a range coextensive with that of the subfamily. Some species are large, *H. gigas* being as much as 4.92 in., while others vary from 1.57 in. to 3.46 in. head and body length. Many species are represented by bright red varieties. One grizzled brown species of Africa, *H. cyclops,* has a curious eversible pouch on the forehead, containing stiff whitish hairs. Other genera differ in precise dental formula and minor cranial characters. *Anthops* of the Solomon Islands has an extremely short tail and a rosette-like nose-leaf covering the face; at the top of this there are three hemispherical bodies, the rounded surfaces directed forward.



FROM DOBSON, "CATALOGUE OF THE CHIROPTERA" (BRITISH MUSEUM)

FIG. 13.—CHIN-LEAF BAT, MORMOOPS BLAINVILLII

(3) Superfamily Phyllostomatoidea is characterized by complete premaxillary bones in the skull, fused with each other and the maxillaries, and there is no postorbital process. The ears are moderately large, with a tragus. The third finger has three bony joints beyond the metacarpal, while the index finger has one phalanx. Many species have a nose-leaf. The shoulder joint includes both the head of the humerus and the greater tubercle (except in the Chilonycterinae).

Family Phyllostomatidae have well developed molar teeth, adapted for crushing insects or fruit. It is restricted to tropical and subtropical America. Subfamily Chilonycterinae contains three genera, differing from their relatives in having a primitive shoulder joint in which the humerus takes no part. The muzzle does not bear a nose-leaf but the lower lip is decorated with platelike outgrowths of skin. The tail membrane is large, supported in part by a long calcar or "spur." Two genera are noteworthy: *Pteronotus,* with wings attached along the mid-dorsal line, and *Mormoops,* with extremely shortened head, highly elevated brain case and extraordinary development of the cutaneous outgrowths on the chin (fig. 13). Subfamily Phyllostomatinae contains bats with a nose-leaf, usually shaped like a spearhead, on the muzzle. The greater tubercle of the humerus forms a secondary shoulder joint as it does in the following groups of this family. The molars have cusps arranged in the normal W-pattern. The best known genera are: *Phyllostomus,* the spear-nosed bat, represented by several species, 2.95 in. to 4.33 in. in head-body length and heavily built, with a well developed nose-leaf (fig. 14), short tail and incisors $\frac{2-2}{2-2}$; *Vampyrus,* the largest American bat, has a wing spread of about 27.55 in. and a head-body length of about 5.51 in., and *Macrotus* with large oval ears, head and body about 3.93 in. in length, is found as far north as California. The first two feed on other bats, small mammals and birds, in addition to fruit and insects, and are confined to tropical America and the West Indies. Subfamily Glossophaginae includes the long-nosed flower bats, adapted for feeding on nectar and pollen by their long brush-tipped tongue. In the skull, the zygomatic arch is slender or incomplete. The cheek teeth are long and narrow but show the W-pattern indistinctly, and the lower incisors are rudimentary. The nose-leaf is well developed though simple, and the ears small and separate. Subfamily Carolliinae is characterized cranially by incomplete zygomatic arch and cheek teeth simplified from the normal W-pattern to form cutting blades, the third molar patternless or with two low cusps. These bats feed on fruit, especially bananas, and are often very common. Subfamily Sturnirinae contains a single tailless, fruit-eating species, *Sturnira lilium,* with broad cheek teeth, the crowns of which have a longitudinal groove or valley laterally margined by two cusps. The muzzle is broad, with a normal nose-leaf. The males of this species have tufts of deep red stiff hair on the shoulders. Subfamily Stenoderminae includes a number of genera, short-faced and with a high brain case for the most part, the nose-leaf usually present, although sometimes rudimentary or absent; the tail is generally missing. The molar teeth are broad and short, the lateral cusps well developed, forming a cutting edge, a smaller medial cusp separated from these by a wide concavity, the enamel of which is often wrinkled. One of the best known genera is *Artibeus,* one form of which rarely reaches southern Florida. These bats are often large (up to 4.13 in. head and body length), marked by white lines on the head. *Uroderma* has similar head markings but in addition has a

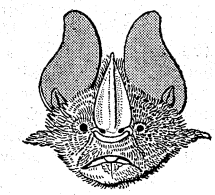
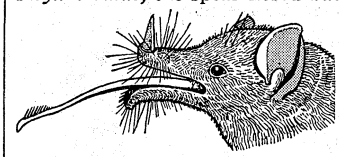


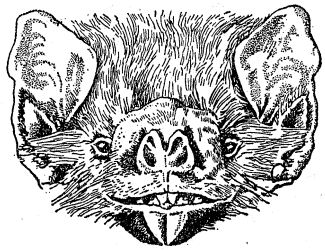
FIG. 14.—JAVELIN BAT (PHYLLOSTOMUS)



FROM DOBSON, "CATALOGUE OF THE CHIROPTERA" (BRITISH MUSEUM)

FIG. 15.—LONG-TONGUED FLOWER BAT (CHOERONYCTERIS)

white stripe extending from the shoulders to the hind quarters. *Centurio,* the centurion bat, lacks a nose-leaf but the skin of the entire face is folded in grotesque fashion. Subfamily Phyllonycterinae resembles the Glossophaginae externally, with long rostrum, extensile tongue, armed with bristle-like papillae at the tip. The zygomatic arch is likewise incomplete. The upper molars, however, are triangular in crown view, without distinct cusps, most of the crown surface occupied by a groove. Such teeth could be best derived from the stenodermine or sturnirine pattern. The habits of this group are undoubtedly like those of the Glossophaginae. They are confined to the Bahama Islands and Greater Antilles.

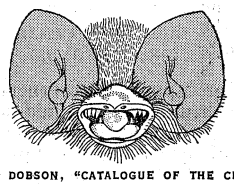


BY COURTESY OF ANTHONY, "NATURAL HISTORY"

FIG. 16.—VAMPIRE BAT (DESMODUS)

Family Desmodontidae, the vampire bats, is restricted to the warmer regions of America north to southern Mexico. They agree with the Phyllostomatidae in most characters of the wing and limb girdles. The skin around the nostrils is folded, forming a poorly developed nose-leaf. The fibula is large, reaching the head of the tibia, and the teeth are specialized for cutting, being narrow blades without any crushing surface. The cheek teeth are reduced and of little function. The stomach is reduced to a long slender tube, folded upon itself. Three genera are recognized, of which *Desmodus* is the best known, *Diaemus* and *Diphylla* being extremely rare. These bats feed on blood, apparently being unable to take any other food. (*See* VAMPIRE.)

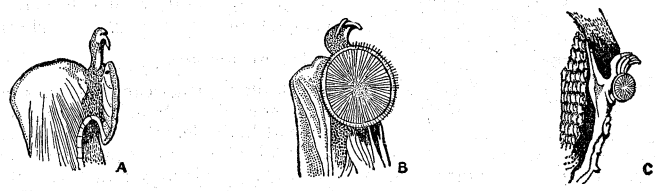
(4) Superfamily Vespertilionoidea includes the typical bats, the free-tailed bats and several small families. In this group the premaxillaries are complete, although often separated by a gap, and are fused with the surrounding bones. The greater tubercle of the humerus articulates in a secondary joint with the scapula. The ears are provided with a tragus, although it may be small. Except for the Australian long-eared bat, *Nyctophilus,* the muzzle does not bear a nose-leaf. The molars show a well-marked W-pattern.



FROM DOBSON, "CATALOGUE OF THE CHIROPTERA," COURTESY OF THE BRITISH MUSEUM

FIG. 17.—LONG-LEGGED BAT (CHILONATALUS)

Family Natalidae, the long-legged bats, includes several delicately built genera from the American tropics and subtropics. In all but one genus (*Nyctiellus*) the ears are funnel-shaped. The muzzle is long and relatively broad. The lumbar vertebrae are fused together, except for the last two, the presternum large and strong, with a well developed backward slanting keel. The third finger has two phalanges. The brain case is domelike, rising high above the rostrum.



AFTER DOBSON IN "THE PROCEEDINGS OF ZOOL. SOC." BY COURTESY OF THE COUNCIL

FIG. 18.—SUCTIONAL DISKS IN THYROPTERA

(A) Side, (B) concave surface of thumb disk, (C) foot, with disk and calcar

Family Furipteridae is restricted to the tropical parts of South America. The bats of this group resemble the preceding but the thumb is vestigial, included in the wing membrane to the base of the functionless claw. The premaxillary bones have a poorly developed palatal branch and are widely separated from each other. The two genera recognized, *Furipterus* and *Amorphochilus,* both have high-crowned skulls.

Family Thyropteridae, containing only a single genus, is restricted to tropical America, north as far as Honduras. The thumb and the sole of the foot (fig. 18) bear sucking-disks and the former has also a well developed claw. The lumbar vertebrae are independent. The dental formula on either side agrees with the Natalidae (incisors $\frac{2}{3}$, canines $\frac{1}{1}$, premolars $\frac{3}{3}$, molars $\frac{3}{3}=38$) and contains one more upper premolar than in the Furipteridae.

Family Myzapodidae contains only the sucker-footed bat of Madagascar related to the Natalidae and Thyropteridae. The index finger has a cartilaginous rod in addition to the metacarpal, probably representing the phalanges, while the third finger exhibits three bony phalanges. The thumb and sole of the foot bear adhesive disks; the toes have only two phalanges. The tragus is fused with the ear conch on the anterior side, and the ear opening is partly closed by a mushroomlike process. Cranially the premaxillary bones are complete, surrounding the incisive foramen. The teeth number 38, including incisors $\frac{2}{3}$, canines $\frac{1}{1}$, premolars $\frac{3}{3}$ and molars $\frac{3}{3}$ on each side.

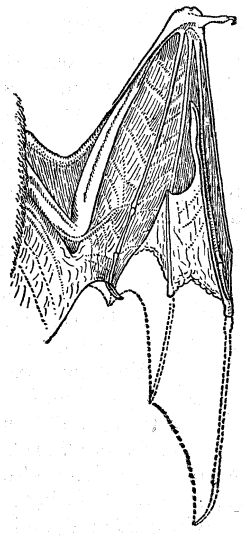


FROM ALLEN, "BATS" (HARVARD UNIVERSITY PRESS)

FIG. 19.—MOUSE-EARED BAT (MYOTIS LUCIFUGUS) IN FLIGHT

Family Vespertilionidae contains the typical insectivorous bats and is almost world-wide in distribution. The muzzle and lips are simple; except for one subfamily (Nyctophilinae) there is no nose-leaf and the ears are separate. The long tail extends to the edge of the broad interfemoral membrane and rarely projects more than one vertebral joint beyond it. The two incisors on each side of the upper jaw are separated by a considerable gap. The secondary shoulder joint is well developed, the greater tubercle projecting well above the head and articulating with a large facet on the shoulder blade. The ulna is usually fused with the proximal end of the radius, the shaft of the ulna reduced to a poorly ossified thread. The family is divided into six subfamily groups.

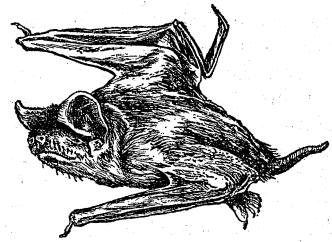
Subfamily Vespertilioninae contains about 20 genera and is as widely distributed as the family, being found on the continents to the limits of tree growth and on all but a few mid-oceanic islands. The best known genera are: the mouse-eared bats (*Myotis*), with about 75 species, found on all the continents, characterized by $\frac{6-6}{6-6}$ cheek teeth; the pipistrelles (*Pipistrellus*), with nearly as wide a range and almost as many species, have cheek teeth $\frac{5-5}{5-5}$, incisors $\frac{2-2}{3-3}$, and are usually smaller, only rarely more than 2.75 in. head and body length; the serotines and brown bats (*Eptesicus*), also widely distributed and represented by numerous species, have $\frac{4-4}{5-5}$ cheek teeth; the long-eared bats (*Plecotus*) are widely distributed in the northern hemisphere and have ears almost as long as their bodies. Numerous other bats belong here.



FROM ALLEN, LANG AND CHAPIN IN "BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY"

FIG. 20.—WING OF BENT-WINGED BAT (MINIOPTERUS)

Subfamily Miniopterinae. The bent-winged or long-fingered bats, represented by a single genus (*Miniopterus*), occur in southern Europe, Africa, Asia and the Pacific islands east to the Loyalties. The first phalanx of the third finger is short, only about a third as long as the second phalanx; this second phalanx and the equivalent joint of the fourth finger are folded back on the under side of the metacarpals when the bat rests. The crown of the skull is domelike and high and the cheek teeth are $\frac{5-5}{6-6}$. Long-fingered bats are usually small, with large wings.



FROM ALLEN, LANG AND CHAPIN IN "BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY"

FIG. 21.—FREE-TAILED BAT (TADARIDA)

Subfamily Murininae. The tube-nosed insectivorous bats are found in southern Asia and the Malaysian islands, east to Java and north to Japan. The nostrils form elongate tubes much like those of the fruit bat *Nyctimene.* The first upper premolar is not very different from the second in pattern, although smaller. Two genera are included here, one (*Harpiocephalus*) characterized by the V-pattern of the first two upper molars, unlike the more normal W-pattern of *Murina.*

Subfamily Kerivoulinae. The trumpet-eared bats are confined to the tropical and subtropical regions of the old world, east as far as the Solomon Islands. The well developed ears are funnel-shaped, with long slender tragi. The sternum differs from that of other bats by its shortness, less than twice as long as the breadth of the presternum, and only four or five ribs articulate with it. The skull is

high-crowned and the teeth number 38 (incisors $\frac{2}{3}$, canines $\frac{1}{1}$, premolars $\frac{3}{3}$, molars $\frac{3}{3}$). Three genera are known: one (*Anamygdon*) is confined to the Solomons; *Phoniscus,* with four-lobed lower incisors, occurs from the Malay peninsula and Sumatra to New Guinea; *Kerivoula,* with three-cusped lower incisors, is widely distributed in the warmer parts of the old world.

Subfamily Nyctophilinae contains two genera confined to Australia and New Guinea, and one found in North America. The muzzle is truncate, the nostrils opening beneath a horseshoelike ridge or small nose-leaf. *Antrozous,* of western North America from Texas to the Pacific and from Oregon to central Mexico, has long ears and incisors $\frac{1-1}{2-2}$. *Nyctophilus,* the long-eared bat of Australia and New Guinea, has incisors $\frac{1-1}{3-3}$, and there is a small nose-leaf.

Subfamily Tomopeatinae includes only a single genus, *Tomopeas,* found in Peru. The ear resembles that of the Molossidae, without anterior basal lobe and the tragus short and blunt. The upper lip is widely spreading but not heavily wrinkled. The seventh cervical vertebra is fused with the first dorsal, as in the free-tailed bats. Externally *Tomopeas* resembles a small pipistrelle.

Family Mystacinidae includes only the New Zealand bat, one of two species found in New Zealand. The feet are short and broad, the claws bearing accessory talons at the base. The fibula is complete and relatively large, forming with the tibia a stout lower leg. The tail projects from near the middle of the upper surface of the interfemoral membrane. The third finger bears three bony phalanges, the first of which is bent back on the upper surface of the metacarpal when at rest. In the vespertilionine skull, the premaxillary bones are complete, isolating two small incisive foramina.

Family Molossidae contains the mastiff, or free-tailed bats. The group is found in the warmer parts of both hemispheres, north to southern Europe and Asia, east to New Guinea, Australia and Norfolk Island; in America, north to the central United States and throughout the West Indies. In these bats the double articulation of the shoulder joint is perfected. The wing is long and narrow, the fifth finger much shortened, and the membranes thick and leathery. The tail projects beyond the interfemoral membrane, which can be contracted or expanded along the tail, somewhat like an awning. The ears are frequently joined across the forehead, the tragus much reduced. The muzzle is obliquely truncate, the upper lip broad and wrinkled, usually sprinkled with short spoon-tipped hairs. The lower leg is stout and contains a complete fibula, relatively strong and bowed out. Cranially, the premaxillaries are either united medially, enclosing the small incisive foramina, or are separated by a narrow space. About 12 genera are recognized. *Cheiromeles,* containing a single species, *C. torquatus,* from the Malay peninsula and the islands, east to Java and north to Palawan, is one of the strangest appearing bats, with long pig-like snout, widely separated ears, almost naked, wrinkled skin and large opposable first toe. A large pouch under each wing may serve to carry the young. This bat is one of the largest of the insectivorous group (head and body 5.31 in., tail 1.77 in. and forearm about 3.34 in. *Tadarida* has a range coextensive with that of the family, being found in the tropics and warm parts of the old and new world. The ears are large and rounded, arising from the middle of the head or joined by a narrow ridge. The fur covering the body is extremely fine and oily and males of many species have erectile crests on the forehead. Most species have the premaxillaries incomplete, the upper incisors separated by a space, but all gradations exist between this condition and complete premaxillae, with the upper incisors almost in contact. The upper cheek-teeth are 5-5 in number, the last molar often narrow, with a simplified V-pattern. Several species found in Malaysia, central Africa and the West Indies have elongate skulls and very large ears. *Myopterus,* an African genus, has transparent flesh-coloured wings and creamy white under parts. The ears in this bat are pointed and more erect than is usually the case in the Molossidae. The upper lip is not wrinkled; in front it is covered with relatively large "spoon-hairs." The upper incisor teeth are strongly in contact with each other and with the canine; the cheek-teeth are $\frac{4}{5}$ on each side. The skull is long and low, with sagittal crest poorly marked. *Molossops,* represented by several South American species, has procumbent upper incisors and broad low skull with large antorbital ridge but weak sagittal crest. The premaxillaries are complete, enclosing the small incisive foramina. The ears are rounded and short. *Eumops,* with numerous species, is found from southwestern United States to Argentina. They vary in size from large (4.43 in. head and body length) to medium (3.54 in.). The upper incisors are large, closely pressed together and procumbent, the skull is long and low with poorly developed sagittal crest. The cheek-teeth are generally $\frac{5}{5}$ on each side but the first upper premolar is sometimes absent. The ears are large, joined across the forehead, rounded or somewhat squarish and extending beyond the muzzle. *Molossus* is generally small, with short, rounded skull in which the sagittal crest is well developed. The first upper premolar is absent or a mere vestige, and the last upper molar is narrow, with a V-shaped crest. The other cheek-teeth are massive.

EXTINCT BATS

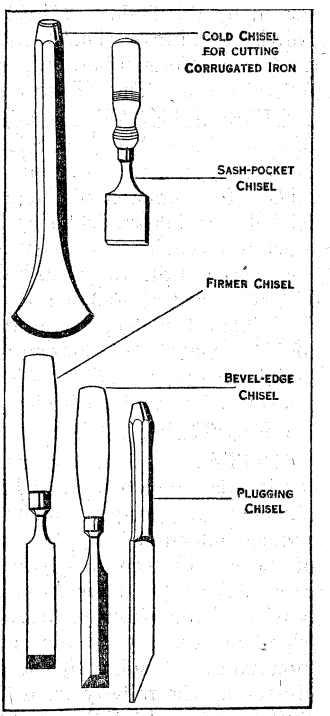
The frail skeletons of bats are rarely preserved as fossils but several deposits have yielded extremely fine specimens. The oldest forms come from the Eocene and even then showed most of their present-day structure; some were sufficiently different to be referred to separate families. Others were members of the Rhinolophidae. In a little later deposit representatives of the Megadermidae, Emballonuridae, Vespertilionidae and Molossidae were found. The first known pteropodid comes from the Oligocene of Italy. By the Pliocene most bat fossils can be referred to existing genera but even late Pleistocene deposits contain a few extinct genera and numerous extinct species.

BIBLIOGRAPHY.—G. E. Dobson, *Catalogue of the Chiroptera* (British Museum, Natural History, 1878); K. Andersen, *Catalogue of the Chiroptera,* vol. i; *Megachiroptera* (British Museum, Natural History, 1912); G. S. Miller, Jr., "Families and Genera of Bats," *U.S. National Museum, Bull. 57* (1907); G. M. Allen, *Bats* (1940); G. G. Simpson, *Bull. Amer. Mus. Nat. Hist.,* vol. 85, pp. 54–61 (1945).

(J. E. HL.)

CHIRU, a graceful Tibetan antelope (*Pantholops hodgsoni*), of which the bucks are armed with long, slender and heavily ridged horns of a peculiar type. Chiru are very wary and difficult to approach; they are generally found in small parties. They inhabit the desolate plateau of Tibet, at elevations of between 13,000 and 18,000 ft., and have a thick coat, formed of close woolly hair of a gray-fawn colour. The most peculiar feature about the chiru is its swollen, puffy nose, probably connected with breathing a rarefied atmosphere. The chiru is allied to the saiga (*q.v.*).

CHIRURGEON, one whose profession it is to cure disease by operating with the hand. The word in its original form is now obsolete. It derives from the Mid. Eng. *cirurgien* or *sirurgien,* through the Fr. from the Gr. words meaning *hand* and *work;* from the early form is derived the modern word "surgeon." "Chirurgeon" is a 16th century reversion to the Greek origin. (*See* SURGERY.)



CHISELS IN COMMON USE FOR CUTTING METAL, STONE OR WOOD USED IN CARPENTRY AND OTHER TRADES

CHISEL, a sharp-edged tool for cutting metal, wood or stone. There are numerous varieties of chisels used in different trades; the carpenter's chisel is wooden-handled with a straight edge, transverse to the axis and bevelled on one side; stone masons' chisels are bevelled on both sides, and others have oblique concave or convex edges. A chisel with a semicircular blade is called a "gouge." The tool is worked either by hand-pressure or by blows from a hammer or mallet. The "cold chisel" has a steel edge, highly tempered to cut unheated metal. The derivation is from O.Fr. *cisel,* modern *ciseau,* late Lat. *cisellum,* a cutting tool, from *caedere,* to cut. (*See* TOOL.)

CHISHOLM, HUGH (1866–1924), editor of the *Encyclopædia Britannica,* was born in London on Feb. 22, 1866. He was of Scottish descent, the son of Henry Chisholm, who became warden of the standards in the Board of Trade. Educated at Felsted school and Corpus Christi college, Oxford, of which he was a scholar, he graduated in 1888 with a first class in *literae humaniores.* He then read for the bar, being called at the Middle Temple in 1892, but occupied himself also with occasional journalism and finally adopted that profession. From 1892 to 1897 he was assistant editor, and from 1897 to the end of 1899 editor, of the *St. James's Gazette,* and during these years he also contributed numerous articles on political, financial and literary subjects to the weekly journals and monthly reviews, becoming known as a literary critic and Conservative publicist.

On resigning the editorship of the *St. James's,* he became a

leader writer for *The Standard,* and later, in 1900, was invited to join *The Times,* under whose management he acted as the responsible co-editor, with Sir Donald Mackenzie Wallace and President A. T. Hadley of Yale university, of the new volumes, constituting the tenth edition (1902), of the *Encyclopædia Britannica,* becoming in 1903 editor-in-chief of the 11th edition.

Rejoining *The Times* in 1913 as day editor, he became financial editor at the end of that year, and occupied this responsible position all through the momentous period of World War I, resigning his connection with *The Times* in March 1920, in order to reassume the editorship of the *Encyclopædia Britannica* and to organize the publication of the new volumes constituting the 12th edition. In 1893 Chisholm married E. Beatrix Harrison, of Ardkeen, County Down, Ireland, and had three sons. He died in London on Sept. 29, 1924.

CHISHOLM, a mining village of St. Louis county, Minnesota, U.S.A., on the Mesabi iron range, 75 mi. N.W. of Duluth. It is served by the Duluth, Missabe and Iron Range and the Great Northern railways. The population was 9,039 in 1920, of whom 3,412 were foreign-born white, and was 7,487 in 1940 by the federal census. The village was settled about 1901.

CHISLEHURST, a parish and, with Sidcup, an urban district of Kent, England, $11\frac{1}{4}$ mi. S.E. of London, by the S.R. Pop. (est. 1938) 61,750. Area 14 sq.mi. It is 300 ft. above sea level in the midst of a common of furze and heather. The church of St. Nicholas is Perpendicular with Early English portions, though much restored. The mortuary chapel attached to the Roman Catholic church of St. Mary was built to receive the body of Napoleon III, who died at Camden Place in 1873. This house was built by William Camden, the antiquary, in 1609. It was the residence of Napoleon III, of the empress Eugénie and of the prince imperial. In 1927 the National Trust secured 88 ac. of Pettswood as a memorial to William Willett, founder of "summer time."

CHISWICK: *see* BRENTFORD AND CHISWICK.

CHITA, a region, town and river in the Far Eastern area of the Russian Soviet Federated Socialist Republic. The area of the region is 277,992 sq.mi. and its population (1939) 1,159,478, urban 510,900 and rural 648,578. It consists of the southwestern tongue of the Far Eastern area lying between Mongolia and the Buriat Mongol A.S.S.R., and is thus a plateau area, with the southwestern portion of the Yablonoi mountains rising above the plateau. An island of territory on the southeastern slopes of the Yablonoi mountains, extending to the left bank of the Onon river, and crossed by the railway from Chita to Manchuria, belongs to the Buriat Mongol A.S.S.R. The subalpine conditions and the extreme continental character of the climate are unfavourable to agriculture except along the valleys of the Shilka and its tributaries, the Ingoda and Onon. Rye is the main crop, though oats, wheat, buckwheat, barley, grass and potatoes are also grown. Herding of horses, cattle, sheep and goats is, however, more important than cultivation, and only .9% of the region is ploughed land. But the essential wealth of the region is in its forests and minerals. Timber and fur (especially fox and squirrel) are exported, the latter being sent to the Irbit and Gorky fairs. The mineral wealth of the region is very great, gold is produced in quantity. Brown coal is mined, and used mainly for the railway and for the town of Chita, and iron ore is mined in quantity. It is almost the only area in U.S.S.R. where wolfram, bismuth and molybdenum are found. There are tin mines near the Onon river and precious stones, *e.g.,* crystal, topaz, aquamarine, amethyst, tourmaline and beryls occur. Mining in the area ceased during the civil war following the 1917 revolution, but most of the mines were working again after 1925. Much of the rolling stock of the railway was destroyed in this period and great damage done to the permanent way, and this hampered the reorganization of the mining industry. Manufactures are little developed, the chief being metal goods and leather. A few electric stations exist. The district is noted for contraband trade with Manchuria and Mongolia.

The town of Chita, lat. 52° N., long. 113° 25′ E. pop. (1939) 102,555, is on the Chita river above its confluence with the Ingoda. With the coming of the Trans-Siberian railway and the increasing exploitation of the mineral, timber and fur wealth of the region, the population and importance of the town developed. Its industries include iron founding, fur and leather dressing, soap boiling, chemical works and boxmaking. The Russian Geographical society has a museum in the town. The Dekabrists, exiled after the Dec. 1825 plot, by their improvements in draining and levelling, converted Chita from a village to a prosperous settlement.

CHITALDROOG, a district and town in the native state of Mysore, India. The district has an area of 4,022 sq.mi. and a population (1931) of 656,569. The rainfall is low, and the Vedavati or Hagari river, in whose valley the town lies, is mostly dry in the hot season. Several parallel chains of hills, reaching an extreme height of 3,800 ft., cross the district; otherwise it is a plain. The chief crops are cotton and rice, and manganese is worked. The west of the district is served by the Madras and Southern Mahratta railway. The largest town in the district is Davangere with cotton factories and a trade in cotton and grain. The town of Chitaldroog, which is the district headquarters (pop. 1931, 10,732) has a considerable trade in cotton. It possesses massive fortifications erected under Hyder Ali and Tippoo Sahib toward the close of the 18th century; and near it on the west are remains of a city of the 2nd century A.D. It is the terminus of a railway from Chikjajur.

CHITARRONE: *see* LUTE; THEORBO.

CHITIMACHA, a tribe of American Indians living on the shores of Grand lake and the banks of Grand river in Louisiana at the time the French settled that region. The Chitimachan linguistic group included three tribes: the Chitimacha, Washa and Chawasha. The name comes from the Choctaw: *chuti,* cooking pot, *masha,* they possess (they have cooking vessels). They called themselves *Pantchpinunukansh,* "men altogether red," a designation apparently made after the coming of the whites. War with the French over the murder of the missionary St. Cosme in 1706 was concluded by presentation of the head of the murderer. They were strict monogamists, and women evidently had authority in their government. What remains of the tribe is scattered.

CHITON, a genus of Amphineura (*q.v.*). (*See* also MOLLUSCA.)

CHITRAL, a native state in the North-West Frontier Province of India. The State of Chitral (*see* also HINDU KUSH) is somewhat larger than Wales, and supports a population of about 35,000 rough, hardy hillmen. Both the state and its capital are called Chitral, the latter being situated about 47 mi. from the main watershed of the range of the Hindu Kush, which divides the waters flowing down to India from those which take their way into the Oxus. The state is important because of its situation at the extremity of the country over which the government of India exerts its influence, and for some years before 1895 it had been the object of the policy of the government of India to secure an effective guardianship over its northern passes. This policy resulted in a British agency being established at Gilgit (Kashmir territory). Chitral can be reached either by the long circuitous route from Gilgit, involving 200 mi. of hill roads and the passage of the Shandur pass (12,250 ft.), or (more directly) from the Peshawar frontier at Malakand by 100 mi. of route through the independent territories of Swat and Bajour, involving the passage of the Lowarai (10,450 ft.). It is held by a small force as a British outpost.

The district of Chitral is called Kashgar by the people of the country. It was under Chinese domination in the middle of the 18th century, and was a Buddhist centre of some importance in the early centuries of our era. The aboriginal population is probably to be recognized in the people called Kho (speaking a language called Khowar), who form the majority of its inhabitants. Upon the Kho a people called Ronas, who form the chief caste and fighting race of the Chitral districts, have been superimposed; they came originally from the north, but have adopted the language and fashions of the conquered Chitrali. (X.)

The Siege of Chitral.—The town of Chitral is chiefly famous for a siege which it sustained in the spring of 1895. Owing to complications arising from the demarcation of the boundary of Afghanistan which was being carried out at that time, and the ambitious projects of Umra Khan, chief of Jandol, who was a

tool in the hands of Sher Afzul, a political refugee from Chitral supported by the amir at Kabul, the mehtar (or ruler) of Chitral was murdered, and a small British and Sikh garrison subsequently besieged in the fort. A large force of Afghan troops was at that time in the Chitral river valley to the south of Chitral, nominally holding the Kafirs in check during the progress of boundary demarcation. It is considered probable that some of them assisted the Chitralis in the siege. The position of the political agent Dr. Robertson (afterward Sir George Robertson) and his military force of 543 men (of whom 137 were noncombatants) was at one time critical. Two forces were organized for the relief. One was under Sir R. Low, with 15,000 men, who advanced by way of the Malakand pass, the Swat river and Dir. The other, which was the first to reach Chitral, was under Colonel Kelly, commanding the 32nd Pioneers, who was placed in command of all the troops in the Gilgit district, numbering about 600 all told, with two guns, and instructed to advance by the Shandur pass and Mastuj. This force encountered great difficulties owing to the deep snow on the pass (12,230 ft. high), but it defeated the Chitrali force opposed to it and relieved Chitral on April 20, the siege having begun on March 4. Sher Afzul, who had joined Umra Khan, surrendered, and eventually Chitral was restored to British political control as a dependency of Kashmir. (T. H. H.)

CHITTAGONG, town and port of British India, giving its name to a district and division of Bengal. It is situated on the right bank of the Karnaphuli river, about 12 mi. from its mouth. It is the terminus of the Assam-Bengal railway and a port of call for the Clan line of steamers. The municipal area covers about 9 sq.mi.; pop. (1941) 92,301. Tea is brought from Assam for export to Europe; mineral oil comes in bulk from Burma, is put into tins here and distributed by rail; other exports are jute, raw cotton, rice and hides.

The district of Chittagong occupies a strip of coast and hills between the Bay of Bengal and the mountains. Its area is 2,569 sq.mi.; in 1941 the population was 2,153,296. A few unimportant ranges rise within the northeastern portion, the highest hill being the sacred Sitakund, 1,155 ft. high. The principal rivers are the Karnaphuli, on which Chittagong town is situated, navigable by sea-going ships as far as Chittagong port, the Halda and the Sangu. The wild animals include tigers, elephants, leopards and deer. The northern portion of the district is traversed by the Assam-Bengal railway. Tea cultivation is moderately successful; there were 21 gardens with an output of 1,250,000 lb. in 1921. Chittagong was a famous seaport known to the Portuguese as Porto Grande, and described by de Barros in 1552 as "the most famous and wealthy city of the kingdom of Bengal"; it has been generally identified with the City of Bengala mentioned by Portuguese and other writers. Conquered by the Mohammedans in the 14th century, it passed under the rule of the Arakanese in the next century. The piratical raids of the Arakanese and their Portuguese mercenaries led to the despatch of a strong force by Shaista Khan, the Mughal Nawab of Bengal, which in 1666 captured the town and occupied the district. The Portuguese also had a settlement at Dianga, where 600 of them were massacred by the Arakanese in 1607. Chittagong was ceded to the East India company by Nawab Mir Kasim Ali in 1760.

The Chittagong Hill Tracts is an independent district occupying the hill country between Chittagong proper and the Lushai hills. The highest point is 4,034 ft. above sea level. Its area covers 5,007 sq.mi.; pop. (1941) 247,053. The inhabitants are either descendants of Arakanese or aboriginal tribes, such as Maghs, Tipperas and Chakmas: seven-tenths are Buddhists. The Hill Tracts are grouped in three circles, each under a chief, who is responsible for the collection of revenue and the internal management of the villages. The headquarters are at Rangamati, which was wrecked by a cyclone in Oct. 1897.

The division of Chittagong lies at the northeast corner of the Bay of Bengal, extending northward along the left bank of the Meghna. It consists of the districts of Chittagong, the Hill Tracts, Noakhali and Tippera. Its area covers 11,765 sq.mi.; the population in 1941 was 8,477,890.

CHITTOOR, a town and district of the Madras Presidency, British India. The district, which has an area of 5,951 sq.mi. and a population (1941) of 1,632,395, was formed in recent years from the northern part of North Arcot. It is in great part hilly, being traversed by spurs of the Eastern Ghats radiating east and south. The surface in the hill-country is rocky, save for patches of stunted jungle, but the narrow valleys between the hills are fertile, and the hills themselves are highly mineralized, showing copper and iron especially. The chief crops are rice, millet and oil-seeds. Chittoor (pop. 1941, 27,835) is the chief town, with a station on the Madras and South Mahratta railway, 100 mi. by road from Madras. It contains a native college, mission training school, a hospital and a sanatorium. There is a trade in granite, a distillery and a tannery, but Chittoor is not an important centre. Hyder Ali died here in 1782.

CHITTY, SIR JOSEPH WILLIAM (1828–1899), English judge, was born in London. He was the second son of Thomas Chitty, a celebrated special pleader and writer of legal text-books. Joseph Chitty was educated at Eton and Balliol college, Oxford, and elected to a fellowship at Exeter college. He became a member of Lincoln's Inn in 1851, was called to the bar in 1856, and made a queen's counsel in 1874, electing to practise in the court of the Master of the Rolls, Sir George Jessel, before whom he was very successful. In 1880 he entered the house of commons as Liberal member for Oxford (city); in 1881, however, he was selected to fill the vacancy in the chancery division caused by the elevation of the master of the rolls to the court of appeal by the Judicature Act. In 1897 he was promoted to the court of appeal.

See E. Manson, *Builders of our Law* (1904).

CHIUSI, a town of Tuscany, Italy, province of Siena, 55 mi. S.E. by rail from the town of Siena, and 26 mi. N.N.W. of Orvieto by the main line from Rome to Florence. Pop. (1936) 2,534 (town), 8,043 (commune). The ancient name was Clusium (*q.v.*). It is on a hill 1,305 ft. above sea level, and is surrounded by mediaeval walls, in which, in places, fragments of the Etruscan wall are incorporated. The cathedral of S. Secondiano is a basilica with eighteen ancient marble columns. It has fine choir books from Monte Oliveto Maggiore (*see* ASCIANO). Chiusi was devastated by malaria in the middle ages (*see* CHIANA). Nine miles by road to the northwest are the baths of Chianciano.

CHIVALRY, the knightly class of feudal times. (*See* KNIGHTHOOD AND CHIVALRY.) The primary sense in the middle ages is "knights" or "fully armed and mounted fighting men." Thence the term came to mean that gallantry and honour expected of knights. Lastly, the word came to be used in its general sense of "courtesy." In English law chivalry meant the tenure of land by knights' service. The *Court of Chivalry* was a court instituted by Edward III, of which the lord high constable and earl marshal of England were joint judges, having summary criminal jurisdiction as regards all offences of knights, and generally as to military matters. When the earl marshal alone presided it was a court of honour deciding as to precedence, coats of arms, etc. This court sat for the last time in 1737. The heraldic side of its duties is now vested in the earl marshal as head of the Heralds' college.

CHIVASSO, a town and episcopal see of Piedmont, Italy, province of Turin, 18 mi. N.E. by rail from that town, 600 ft. above sea level. Pop. (1936) 6,002 (town); 11,590 (commune). It is on the left bank of the Po, near the influx of the Orco. The cathedral (15th century) has a fine façade, with statues in terracotta. A tower remains of the old castle of the marquesses of Monferrato, who possessed the town from 1164 to 1435. It was an important fortress in the middle ages and until the French dismantled it (1804). Chivasso is the junction of branches for Aosta, Asti, and Casale Monferrato.

CHIVES (*Allium Schoenoprasum*), hardy perennial plant, with small narrow bulbs tufted on short root-stocks and long cylindrical hollow leaves. It is found in the north of England and in Cornwall, growing in rocky pastures throughout temperate and northern and in the mountain districts of southern Europe and in Asiatic Russia. It is cultivated for its leaves, which are used in salads and soups as a substitute for young onions; it will grow in any good soil.

CHLOPICKI, GREGORZ JOZEF (1772–1854), Polish general, was born in Podolia. In 1787 he enlisted in the Polish army and fought in the campaigns of 1792–94. He served with the new Italian legion at the storming of Peschiera, at Modena, Busano, Casabianca and Ponto, and in 1807 commanded the first Vistula regiment. In Spain he obtained the Legion of Honour for his heroism at Epila and the storming of Saragossa. Chlopicki accompanied the Grande Armée into Russia (1812). On the reconstruction of the Polish army in 1813 he was made a general of a division, afterwards joining the Russian army with the rank of general officer. He held aloof at first from the Polish national rising of 1830, but at the request of his countrymen he accepted the dictatorship on Dec. 5, 1830. Lacking faith in the success of the movement, he clung to the hope of negotiation with Russia and acted purely on the defensive. On Jan. 17, 1831, he resigned and became a private, until he was forced to retire into private life owing to serious wounds received at Olszyna.

See Josef Maczynski, *Life and Death of Joseph Chlopicki* (Pol.) (Cracow, 1858); Ignacy Pradzynski, *The Four Last Polish Commanders* (Pol.) (Posen, 1865).

CHLORAL or **TRICHLOROACETALDEHYDE,** first prepared by J. von Liebig in 1832, is a heavy, oily and colourless liquid, of specific gravity 1·541 at 0°C, boiling point 97·7°C and the formula $CCl_3{\cdot}CHO$. It has a greasy, somewhat bitter taste, and gives off a vapour at ordinary temperature which has a pungent odour and an irritating effect on the eyes. The word *chloral* is derived from the first syllables of *chlorine* and *alcohol,* the names of the substances employed for its preparation. Chloral is soluble in alcohol and ether, in less than its own weight of water, and in four times its weight of chloroform. It deliquesces in the air, and is converted by water into a hydrate, with evolution of heat; it combines with alcohols and mercaptans. With an alkali, chloral gives chloroform (*q.v.*) and a formate; oxidizing agents give trichloroacetic acid, $CCl_3{\cdot}CO_2H$. When kept for some days, as also when placed in contact with sulphuric acid or a very small quantity of water, chloral undergoes spontaneous change into the polymeride metachloral $(C_2Cl_3OH)_3$, a white substance slowly volatile in the air, and reconverted into chloral without melting at 180°C.

Chloral is prepared by passing dry chlorine into cooled absolute alcohol; towards the end of the operation the liquid is heated nearly to boiling. The alcohol is converted finally into a syrupy fluid, from which chloral is procured by treatment with sulphuric acid (P. Fritsch, 1894). The crude chloral is distilled over lime, and is purified by further treatment with sulphuric acid, and by redistillation. A mixture of starch or sugar with manganese peroxide and hydrochloric acid may be employed instead of alcohol and chlorine (A. Staedeler, 1847).

Chloral hydrate, $CCl_3{\cdot}CH(OH)_2$, forms oblique rhombic prisms, perfectly transparent and only slightly odorous. The melting point of pure chloral hydrate is 57°, the boiling point 96–98°C. When heated with sulphuric acid it is converted into anhydrous chloral and *chloralide,* $C_5H_2Cl_6O_3$. When mixed with water, chloral hydrate causes a considerable degree of cold; and, as with camphor, small fragments of it placed on the surface of water exhibit gyratory movements. Chloral hydrate does not restore the colour to a solution of fuchsine decolorized by sulphurous acid; this absence of aldehydic property indicates that the water present is combined in the molecular condition. Chloral may be estimated by distilling the hydrate with milk of lime and measuring the volume of chloroform produced, or by hydrolysis with a known volume of standard alkali and back titration with standard acid. Chloral hydrate has the property of checking the decomposition of many albuminous substances, such as milk and meat; and a mixture with glycerin, according to J. Personne, is suitable for the preservation of anatomical preparations.

Pharmacology and Therapeutics.—The alkaline hydrolysis (*q.v.*) of chloral hydrate, with production of chloroform and formates, led Liebreich to the conjecture that a similar decomposition might be produced in the blood; and hence his introduction of the drug in 1869, as an anaesthetic and hypnotic. It is now known, however, that the drug circulates in the blood unchanged, and is excreted as urochloralic acid. The dose is often given in the form of the pharmacopoeial *Syrupus Chloral,* which contains ten grains of chloral hydrate to the fluid drachm. In large doses chloral hydrate is a depressant to the circulation and the respiration, and also lowers the temperature. In the above dosage the drug is a powerful and safe hypnotic, acting directly on the brain, and producing no preliminary stage of excitement. About 20 minutes after taking such a dose, the patient falls into a refreshing sleep which, lasting several hours, is not distinguishable from natural sleep and is without disagreeable after-symptoms. Chloral hydrate rapidly induces a depression of the anterior horns of grey matter in the spinal cord, and as strychnine poisoning is accompanied by violent stimulation of these areas, chloral hydrate is a valuable antidote in such cases. It should not be hypodermically injected. Its disadvantages are that it is powerless when there is pain, resembling in this feature nearly all hypnotics except opium (morphine) and hyoscin. Its action on the spinal cord has been employed with success in cases of tetanus, whooping-cough, urinary incontinence and strychnine poisoning. In the latter case 20 grains in "normal saline" solution may be directly injected into a subcutaneous vein, but not into the subcutaneous tissues.

Toxicology.—In cases of acute poisoning by chloral hydrate, the symptoms may be summarized as those of profound coma. The treatment is to give a stimulant emetic such as mustard; to keep up the temperature by hot bottles, etc.; to prevent or disturb the patient's morbid sleep by the injection of hot strong coffee into the rectum, and by shouting, flipping with towels, etc.; to use artificial respiration in extreme cases. Strychnine injections are much less likely to save life after poisoning by chloral hydrate, than chloral hydrate is to save life in poisoning by strychnine.

Habitual use of chloral as a drug results in chronic poisoning. The victim is usually excited, loquacious, easily fatigued and suffers from attacks of readily induced syncope. The patient may succumb to a dose only slightly larger than usual. There is no specific remedy; the patient must be persuaded to put himself under restraint, and the drug must be stopped at once and entirely.

CHLORATES, the metallic salts of chloric acid; they are all solids, soluble in water, the least soluble being the potassium salt. They may be prepared by dissolving or suspending a metallic oxide or hydroxide in water, saturating the hot solution with chlorine; by double decomposition; or by neutralizing a solution of chloric acid by a metallic oxide, hydroxide or carbonate. They are all decomposed on heating, with evolution of oxygen; and in contact with concentrated sulphuric acid with liberation of chlorine peroxide. The most important is potassium chlorate, $KClO_3$, which was obtained in 1786 by C. L. Berthollet by the action of chlorine on caustic potash, and this method was at first used for its manufacture. The modern process consists in the electrolysis of a hot solution of potassium chloride, or, preferably, the formation of sodium chlorate by the electrolytic method and its subsequent decomposition by potassium chloride. (*See* ALKALI MANUFACTURE.) Potassium chlorate crystallizes in large white tablets, of a bright lustre. It melts without decomposition, and begins to give off oxygen at about 370°C. By very careful regulation this decomposition can be made to yield the perchlorate, $KClO_4$. The decomposition is rendered more easy and regular by mixing the salt with powdered manganese dioxide. The salt finds application in the preparation of oxygen as an oxidizing agent in the laboratory, with concentrated hydrochloric acid in the laboratory production of chlorine, in the manufacture of matches, for pyrotechnic purposes, and in medicine. If crystals of potassium chlorate are rubbed together in the dark, they become faintly luminous; this phenomenon is known as "triboluminescence." Sodium chlorate, $NaClO_3$, is prepared by the electrolytic process; by passing chlorine into milk of lime and decomposing the calcium chlorate formed by sodium sulphate; or by the action of chlorine on sodium carbonate at low temperature (not above 35°C.). It is much more soluble in water than the potassium salt. Its crystal structure resembles that of calcite; sodium atoms occur at alternate corners of a rhombohedron, and the other corners are occupied by chlorine atoms each surrounded by three co-planar oxygen atoms.

Potassium chlorate is very valuable in medicine. Given in large

doses it causes rapid and characteristic poisoning, with alterations in the blood and rapid degeneration of nearly all the internal organs; but in small doses—5 to 15 grains—it partly undergoes reduction in the blood and tissues, the chloride being formed and oxygen being supplied to the body cells in nascent form. Its special uses are in ulceration of the mouth or tongue (*ulcerative stomatitis*), tonsillitis and pharyngitis. For these conditions it is administered in the form of a lozenge, but may also be swallowed in solution, as it is excreted by the saliva and so reaches the diseased surface. Its remarkable efficacy in healing ulcers of the mouth—for which it is the specific—has been ascribed to the production of chloric acid, which, being an extremely powerful antiseptic, kills the bacteria to which the ulcers are due.

CHLORINE, a gaseous chemical element of the halogen group, taking its name from the colour, greenish-yellow (Gr. χλωρός); symbol Cl, atomic number 17, atomic weight 35·457, isotopes 35, 37. It was discovered in 1774 by Scheele, who called it *dephlogisticated muriatic acid;* about 1785, C. L. Berthollet, regarding it as being a compound of hydrochloric acid and oxygen, termed it *oxygenized muriatic acid.* This view was generally held until about 1810–11, when Sir H. Davy showed definitely that it was an element, and gave it the name which it now bears.

Chlorine is never found in nature in the uncombined condition, but in combination with the alkali metals it occurs widely distributed in the form of rock-salt (sodium chloride); as sylvine and carnallite, at Stassfürt; and to a smaller extent in various other minerals such as matlockite and horn-mercury. In the form of alkaline chlorides it is found in sea-water and various spring waters, and in the tissues of animals and plants; while, as hydrochloric acid it is found in volcanic gases.

The preparation of chlorine on the small scale depends on the oxidation of hydrochloric acid; the usual oxidizing agent is manganese dioxide, which, when heated with concentrated hydrochloric acid, forms manganese chloride, water and chlorine:—$MnO_2+4HCl=MnCl_2+2H_2O+Cl_2$. The manganese dioxide may be replaced by various other substances, such as red lead, lead dioxide, potassium bichromate, and potassium permanganate. Instead of heating hydrochloric acid with manganese dioxide, use is frequently made of a mixture of common salt and manganese dioxide, to which concentrated sulphuric acid is added and the mixture is then heated:—$MnO_2+2NaCl+3H_2SO_4=MnSO_4+2NaHSO_4+2H_2O+Cl_2$. (For electrolytic and other industrial methods of preparation, *see* below, *In Industry.*)

Chlorine is a gas of a greenish-yellow colour, and possesses a characteristic unpleasant and suffocating smell. It can be liquefied at −34°C under atmospheric pressure, and at −102°C it solidifies and crystallizes. Its specific heat at constant pressure is 0·1155, and at constant volume 0·08731, and its refractive index 1·000772, whilst in the liquid condition the refractive index is 1·367. The density is 2·4885 (air=1). Its critical temperature is 146°C and its critical pressure 93·5 atm.; it is not appreciably dissociated at 1500°C, but at 2350°C 50% of the molecules are broken down to atoms. Liquid and solid chlorine are both yellow in colour. The gas must be collected either by downward displacement, since it is soluble in water and also attacks mercury; or over a saturated salt solution, in which it is only slightly soluble. At ordinary temperatures it unites directly with many other elements; thus with hydrogen, combination takes place in direct sunlight with explosive violence; arsenic, antimony, thin copper foil and phosphorus take fire in an atmosphere of chlorine, forming the corresponding chlorides. Many compounds containing hydrogen are readily decomposed by the gas; for example, a piece of paper dipped in turpentine inflames in an atmosphere of chlorine, producing hydrochloric acid and a copious deposit of soot; a lighted taper burns in chlorine with a dull smoky flame. The solution of chlorine in water, when freshly prepared, possesses a yellow colour, but on keeping becomes colourless, on account of its decomposition into hydrochloric acid and oxygen. It is on this property that its bleaching and disinfecting power depends (*see* BLEACHING). Water saturated with chlorine at 0°C deposits crystals of a hydrate $Cl_2{\cdot}8H_2O$, which is readily decomposed at a higher temperature into its constituents. Chlorine hydrate has an historical importance, as by sealing it up in a bent tube, and heating the end containing the hydrate, whilst the other limb of the tube was enclosed in a freezing mixture, M. Faraday was able to obtain liquid chlorine.

Chlorine finds an extensive use in organic chemistry as a substituting and oxidizing agent, as well as for the preparation of addition compounds. For purposes of substitution, the free element, as a rule, only works slowly on saturated compounds, but the reaction may be accelerated by the action of sunlight or on warming, or by using a "carrier." In these latter cases the reaction may proceed in different directions; thus, with the aromatic hydrocarbons, chlorine in the cold or in the presence of a carrier substitutes in the benzene nucleus, but in the presence of sunlight or on warming, substitution takes place in the side chain. Iodine, antimony trichloride, molybdenum pentachloride, ferric chloride, ferric oxide, antimony, tin, stannic oxide and ferrous sulphate have all been used as chlorine carriers.

Hydrochloric Acid.—Chlorine combines with hydrogen to form hydrochloric acid, HCl, the only known compound of these two elements. The acid itself was first obtained by J. R. Glauber in about 1648, but J. Priestley in 1772 was the first to isolate it in the gaseous condition, and Sir H. Davy in 1810 showed that it contained hydrogen and chlorine only, as up to that time it was considered to contain oxygen. It may be prepared by the direct union of its constituents, and with the displacement of the Leblanc soda process by the ammonia-soda and electrolytic-soda processes the production of synthetic hydrochloric acid has acquired industrial importance. On the large scale and also for the preparation of small quantities it is made by the decomposition of salt by means of concentrated sulphuric acid, $NaCl+H_2SO_4=NaHSO_4+HCl$. (*See* ALKALI MANUFACTURE.) The commercial acid is usually yellow in colour and contains many impurities, such as traces of arsenic, sulphuric acid, chlorine, ferric chloride and sulphurous acid.

It is a colourless gas, which can be condensed by cold and pressure to a liquid boiling at −83·7°C, and can also be solidified, the solid melting at −112·5°C. Its critical temperature is 52·3°C, and its critical pressure is 86 atmospheres. The gas fumes strongly in moist air, and it is rapidly dissolved by water, one volume of water at 0°C absorbing 503 volumes of the gas. The gas does not obey Henry's law, that is, its solubility in water is not proportional to its pressure. It is one of the "strong" acids, being ionized to the extent of about 91·4% in decinormal solution according to conductivity and cryoscopic methods (*see* SOLUTIONS). The strongest aqueous solution of hydrochloric acid at 15°C contains 42·9% of the acid, and has a specific gravity of 1·212. On being boiled at ordinary pressure, solutions stronger than 20·24% lose HCl, and weaker solutions lose water until a mixture of this composition is obtained; this boils constantly at 110° and has a specific gravity of 1·10, but it is not a definite hydrate because its composition is slightly different if it is produced by evaporation at higher or lower pressures. Perfectly dry hydrochloric acid gas has no action on metals, but in aqueous solution it dissolves many of them with evolution of hydrogen and formation of chlorides.

Chlorides.—The salts of hydrochloric acid, known as *chlorides,* can, in most cases, be prepared by dissolving either the metal, its hydroxide, oxide, or carbonate in the acid; or by heating the metal in a current of chlorine, or by precipitation. The majority of the metallic chlorides are solids (stannic chloride, titanic chloride and antimony pentachloride are liquids) which readily volatilize on heating. Many are readily soluble in water, the chief exceptions being silver chloride, mercurous chloride, cuprous chloride and palladious chloride which are insoluble in water, and thallous chloride and lead chloride which are only slightly soluble in cold water, but are readily soluble in hot water. Bismuth and antimony chlorides are decomposed by water with production of oxychlorides, whilst titanium tetrachloride yields titanic acid under the same conditions. All the metallic chlorides, with the exception of those of the alkali and alkaline earth metals, are reduced either to the metallic condition or to that of a lower chloride on heating in a current of hydrogen; most are decomposed by concentrated sulphuric acid. They can be distinguished from the corresponding bromides and iodides by the fact that on distillation with a mix-

ture of potassium bichromate and concentrated sulphuric acid they yield chromium oxychloride, whereas bromides and iodides by the same treatment give bromine and iodine respectively. Some metallic chlorides readily form double chlorides, the most important of these double salts being the platinichlorides (chloroplatinates) of the alkali metals. The chlorides of the non-metallic elements are usually volatile fuming liquids of low boiling-point, which can be distilled without decomposition and are decomposed by water. Hydrochloric acid and its metallic salts can be recognized by the formation of insoluble silver chloride, on adding silver nitrate to their nitric acid solution, and also by the formation of chromium oxychloride (*see* above). Chlorides can be estimated quantitatively by conversion into silver chloride, or if in the form of alkaline chlorides (in the absence of other metals, and of any free acids) by titration with standard silver nitrate solution, using potassium chromate as an indicator (*q.v.*).

Oxides.—Chlorine and oxygen do not combine directly, but compounds can be obtained indirectly. Three oxides are known: chlorine monoxide, Cl_2O, chlorine peroxide, ClO_2, and chlorine heptoxide, Cl_2O_7.

Chlorine monoxide results on passing chlorine over dry precipitated mercuric oxide at 0°C. It is a pale yellow gas which can be condensed, on cooling, to a dark-coloured liquid boiling at 19°C. It is extremely unstable, decomposing with extreme violence on the slightest shock or disturbance, or on exposure to sunlight. It is readily soluble in water, with which it combines to form hypochlorous acid. Sulphur, phosphorus, carbon compounds, and the alkali metals react violently with the gas, taking fire with explosive decomposition.

Chlorine peroxide was first obtained by Sir H. Davy in 1815 by the action of concentrated sulphuric acid on potassium chlorate: $3KClO_3+2H_2SO_4=KClO_4+2KHSO_4+H_2O+ClO_2$. A mixture of chlorine peroxide and chlorine (which Davy called "euchlorine") is obtained by the action of hydrochloric acid on potassium chlorate, and similarly, on warming a mixture of potassium chlorate and oxalic acid to 70°C on the water bath, a mixture of chlorine peroxide and carbon dioxide is obtained. Chlorine peroxide must be collected by displacement, as it is soluble in water and readily attacks mercury. It is a heavy gas of a deep yellow colour and possesses an unpleasant smell. It can be liquefied, the liquid boiling at 9·9°C, and on further cooling it solidifies to orange crystals at −79°C. It is highly explosive, being resolved into its constituents by influence of light, by warming, or by shock. It is a very powerful oxidant; a mixture of potassium chlorate and sugar spontaneously inflames when touched with a drop of concentrated sulphuric acid or even on rubbing, the chlorine peroxide liberated setting fire to the sugar, which goes on burning.

Chlorine heptoxide was obtained by A. Michael (1900, 1901) by slowly adding perchloric acid to phosphoric oxide below −10°C; the mixture is allowed to stand for a day and then gently warmed, when the oxide distils over as a colourless very volatile oil of boiling-point 82°C. It turns to a greenish-yellow colour in two or three days and gives off a greenish gas; it explodes violently on percussion or in contact with a flame, and is gradually converted into perchloric acid by the action of water. On the addition of iodine to this oxide, chlorine is liberated and a white substance is produced, which decomposes, on heating to 380°C, into iodine and oxygen; bromine is without action.

Oxy-acids.—Several oxy-acids of chlorine are known, namely, hypochlorous acid, HClO, chlorous acid, $HClO_2$, chloric acid, $HClO_3$, and perchloric acid, $HClO_4$. Hypochlorous acid is formed when chlorine monoxide dissolves in water, and can be prepared (in dilute solution) by passing chlorine through water containing precipitated mercuric oxide in suspension, or best by passing carbon dioxide through a suspension of bleaching powder in water. Precipitated calcium carbonate may be used in place of the mercuric oxide, or a hypochlorite may be decomposed by a dilute mineral acid and the resulting solution distilled under diminished pressure. For this purpose a filtered solution of bleaching-powder and a very dilute solution of nitric acid may be employed. The acid is only known in aqueous solution, and only dilute solutions can be distilled without decomposition. The solution has a pale yellow colour, and is a strong oxidizing and bleaching agent; it is readily decomposed by hydrochloric acid, with evolution of oxygen. The salts of this acid are known as hypochlorites, and like the acid itself are very unstable, so that it is almost impossible to obtain them pure. A solution of sodium hypochlorite (*Eau de Javelle*), which can be prepared by passing chlorine into a cold aqueous solution of caustic soda, has been extensively used for bleaching purposes. One of the most important derivatives of hypochlorous acid is bleaching powder. Sodium hypochlorite can be prepared by the electrolysis of brine solution in the presence of carbon electrodes, having no diaphragm in the electrolytic cell, and mixing the anode and cathode products by agitating the liquid. The temperature should be kept at about 15°C, and the concentration of the hypochlorite produced must not be allowed to become too great, in order to prevent reduction taking place at the cathode. Its solutions are used in preservatives and antiseptics, but on keeping or warming they decompose to chloride and chlorate.

Chlorous acid has been prepared in solution by adding sulphuric acid in theoretical proportion to a solution of the barium salt; its solutions readily decompose to hypochlorous and chloric acids. The sodium salt is prepared by the action of sodium peroxide on a solution of chlorine peroxide: $2ClO_2+Na_2O_2=2NaClO_2+O_2$. The silver and lead salts are unstable, being decomposed with explosive violence at 100°C. On adding a caustic alkali solution to one of chlorine peroxide, a mixture of a chlorite and a chlorate is obtained.

Chloric acid was discovered in 1786 by C. L. Berthollet, and is best prepared by decomposing barium chlorate with the calculated amount of dilute sulphuric acid. The aqueous solution can be concentrated *in vacuo* over sulphuric acid until it contains 40% of chloric acid. Further concentration leads to decomposition, with evolution of oxygen and formation of perchloric acid. The concentrated solution is a powerful oxidizing agent; organic matter being oxidized so rapidly that it frequently inflames. Hydrochloric acid, sulphuretted hydrogen and sulphurous acid are rapidly oxidized by chloric acid. The salts of this acid are known as chlorates (*q.v.*).

Perchloric acid is best prepared by distilling potassium perchlorate with concentrated sulphuric acid under diminished pressure. Perchloric acid distils over at first, but if the distillation be continued a white crystalline mass of hydrated perchloric acid, $HClO_4{\cdot}H_2O$, passes over; this is due to the decomposition of some of the acid into water and lower oxides of chlorine, the water produced then combining with the pure acid to produce the hydrated form (H. E. Roscoe). This solid, on redistillation, gives the pure acid, which is a liquid boiling at 39°C (under a pressure of 56mm.), melting at −112°C, and of specific gravity $1{\cdot}764\left\{\frac{22°}{4}\right\}$. The crystalline hydrate melts at 50°C. A constant-boiling solution (b.p. 203°C under 760mm. pressure) of 71·6% content results as in the case of hydrochloric acid (*see* above). The pure acid decomposes slowly on standing, but is stable in dilute aqueous solution. It is a very powerful oxidizing agent; wood and paper in contact with the acid inflame with explosive violence. In contact with the skin it produces painful wounds. It may be distinguished from chloric acid by the fact that it does not give chlorine peroxide when treated with concentrated sulphuric acid, and that it is not reduced by sulphurous acid. The salts of the acid are known as the *perchlorates,* and are all soluble in water; the potassium and rubidium salts, however, are only soluble to a slight extent, and methods for the estimation of these metals are based on this fact. Potassium perchlorate, $KClO_4$, can be obtained by carefully heating the chlorate until it first melts and then nearly all solidifies again. The fused mass is then extracted with water to remove potassium chloride, and warmed with hydrochloric acid to remove unaltered chlorate, and finally extracted with water again, when a residue of practically pure perchlorate is obtained. The alkaline perchlorates are isomorphous with the corresponding permanganates.

IN INDUSTRY

As an industrial product of increasing importance chlorine is closely connected with alkali and the manufacturing industries

are, in practice, combined. It has been pointed out in another article (*see* ALKALI MANUFACTURE) that the manufacture of chlorine has undergone a complete revolution. During the ascendancy of the Le Blanc soda process, it was necessary to produce chlorine in order to reduce the great surplus of unwanted hydrochloric acid, which served as the raw material. Nowadays the reverse is the case, and the production of caustic soda, by the

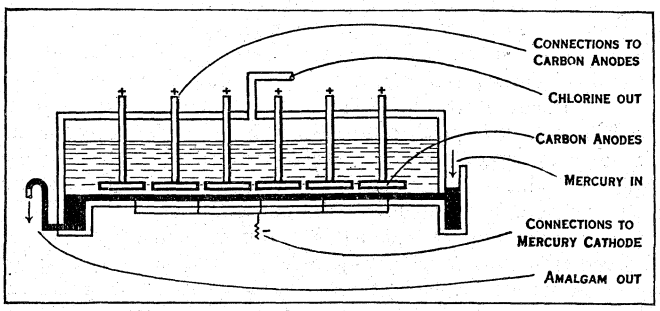


FIG. 1.—PRINCIPLES OF A MERCURY CELL

Mercury enters the cell at one end, propelled by a mechanical device. Brine flows through the cell in the same direction as the mercury (entrance and exit not shown). The mercury-sodium amalgam formed by the electrolysis leaves the cell and travels to a separate chamber in which it is brought into contact with water. After extraction of the sodium, the mercury returns to the cell and repeats the cycle

electrolytic process, is limited by the extent to which the accompanying chlorine can be utilized.

Chemically speaking, chlorine can be produced in several ways; *i.e.*, from hydrochloric acid with the aid of "oxidizing" agents; from salt by the action of sulphuric acid and an oxidizing agent combined; or by the so-called "electrolytic method," in which an electric current is passed through a solution of common salt in water. The two former methods are now obsolete; the Deacon and Weldon processes were examples of the oxidation of hydrochloric acid, and ceased to be operated when the Le Blanc soda process was finally superseded by Solvay's ammonia-soda method. The electrolytic process is the source of all the chlorine now produced on the large scale. The action of the electric current on brine is to produce chlorine gas, hydrogen gas and a solution of caustic soda simultaneously. The caustic soda is concentrated and solidified; the hydrogen is either allowed to go to waste or is used for the synthesis of ammonia (with nitrogen) or of hydrochloric acid (with chlorine); the chlorine gas is piped off and utilized for making either liquid chlorine, in which there is now a large trade; bleaching powder; hydrochloric acid; calcium and sodium hypochlorites; sulphur-chlorine compounds; chlorinated organic compounds; or metallic chlorides.

The raw materials of the industry are salt and coal; the former as the actual source of the chlorine, and the latter to provide the energy for removing it from its combination with the sodium. The industry therefore tends to concentrate in districts where brine is available, and where cheap energy exists, either as coal or water-power. Where water-power is to be had it may prove economical to site the works there and bring salt from a distance. In general, and as in the case of alkali, the chlorine industry is one in which it is cheaper to build the plant close to the raw materials rather than close to the markets in which the products are to be sold.

England, Germany and North America are the chief producing countries, and Italy is developing rapidly. In the two former countries the industry has long been well-established, but in Canada and the United States, with their great deposits of salt, and unrivalled sources of cheap water-power, it is comparatively of recent development; it has nevertheless already reached such dimensions that practically the whole of the requirements of these countries can now be satisfied without imports. Of recent years Italy also has gone ahead in this matter, largely owing to the rise of the artificial silk industry there; this requires large quantities of caustic soda which, taken together with a well-organized system of water-power, provides a good basis for electrolytic chlorine-soda manufacture.

England and Germany are the chief exporting countries. The total production of chlorine and chlorine compounds amounts to 300,000 tons per annum. The largest chlorine manufacturing plant in 1928 was situated at South Charleston, W.Va., with a capacity of one hundred tons per day.

Manufacture of Chlorine.—The electrolytic process is nowadays the only source of chlorine on a large scale. It is nevertheless of interest, both from a historical as well as a chemical point of view, to give some account of the older methods.

K. W. Scheele, who discovered chlorine in 1774, made use of manganese dioxide, in the form of the natural mineral pyrolusite, to oxidize hydrochloric acid:—

$$MnO_2 + 4HCl = MnCl_2 + Cl_2 + 2H_2O$$

(manganese dioxide) (hydrochloric acid) (manganese dichloride) (chlorine) (water)

This reaction must be promoted by heating the mixture, although even then only a part of the hydrochloric acid is oxidized. Owing to strongly corrosive action of both hydrochloric acid and moist chlorine, no metal could be employed in the construction of vessels, which were made of stone slabs. The process was very costly, as much of the acid and all the manganese was wasted, and the waste liquor from the vessels was of a most noxious kind.

The chemistry of the process is not quite so simple as the foregoing description indicates, but sufficient has been said to give a general outline of it. Of the hydrochloric acid originally employed only some 35% is actually converted to chlorine, the remainder being lost as calcium chloride.

The second well-known process, due to Henry Deacon working from 1868 onwards, is also based on the oxidation of hydrochloric acid, but using atmospheric air in place of manganese dioxide. Deacon worked on the direct reaction

$$4HCl + O_2 = 2H_2O + 2Cl_2$$

(oxygen)

This reaction is under ordinary circumstances so slow as to be quite useless for practical purposes. If, however, a "catalyst" is employed at the proper temperature, the process proceeds at a very much greater rate, and can even be carried out as a continuous operation. The catalyst that Deacon used was cupric chloride: if pieces of porous clay be soaked in a solution of this salt, dried, and heated to about 450° C. and the temperature maintained there or slightly higher, they are found to have the property of producing chlorine and water continuously from a stream of mixed hydrochloric acid gas and air passed over them. On a large scale about 60% of the acid can thus be decomposed. The air-acid mixture was taken directly from the pan in which salt cake (*see* ALKALI MANUFACTURE) had been prepared, after cooling to condense out water and reheating to the temperature necessary for the catalytic reaction.

The Electrolytic Method.—The Deacon process made cheaper chlorine than the Weldon process: but it is evident that in both cases the plant was complicated, costly and difficult to manipulate. The contrast between these older methods and the modern electrolytic process is very marked.

The various types of plant employed nowadays all depend upon the decomposition of the molecules of salt by means of the applied energy of the electric current. Faraday discovered that equal quantities of electric energy will liberate elements from their compounds in amounts proportional to their equivalent weights: for example, 23 grams of sodium, 35·5 grams of chlorine, 107 grams of silver, 31·5 grams of copper, are all set free from solutions of their salts, or from the fused salts, under appropriate conditions by the same quantity of electric energy, viz., 96,540 coulombs. The degree to which this decomposition is brought about is a function solely of the amount of electric energy applied, and does not depend on the voltage, or electrical pressure. At the same time, owing to considerations which cannot be enlarged upon here, it is found that a certain minimum voltage is required before actual liberation of the elements takes place; the voltage actually used in practice depends upon the type of "cell" in which the electrolysis is conducted, and may vary from 3·5 to 7 volts.

A very large number of cells have been devised to work this process; but, neglecting the Acker process, which used fused sodium chloride, only three principal types are now in use; viz.,

the mercury cell, the diaphragm cell and the "belljar" cell.

In each of these types a solution of sodium chloride (brine) is used; the points at which the electric current is introduced into the solution are called respectively the "anode" and "cathode."

The mercury cell (fig. 1) has the form of a rectangular horizontal box; saturated brine, *i.e.*, brine containing as much salt as possible, is fed into the cell at one end and overflows in the partially spent condition at the other. Into this brine dip anodes of graphitic carbon; on the bottom of the cell is a layer of mercury which forms the cathode. The action of the current liberates chlorine upon the graphite anodes in the form of a gas, which is conveyed away by pipes for subsequent use; at the cathode sodium is deposited and at once forms an amalgam with the mercury. This amalgam is caused to flow into another compartment, where it is brought into contact with water, the effect of which is to extract the sodium with formation of a dilute solution of caustic soda and hydrogen gas; the disposal of the latter has already been touched upon. After the removal of the sodium the mercury returns to the first compartment. This type of cell, which is now largely employed, was devised by Castner in the United States, and by Kellner in Austria. In the original form the movement of the mercury was occasioned by rocking the cell on a pivot; in more modern plant the mercury is propelled by mechanical means, the cell itself being stationary. The alkali thus produced is of high purity, and the "current efficiency" or yield per unit of current good; but the plant is expensive to erect and the mercury costly.

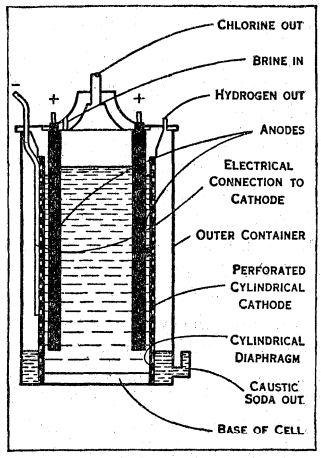


FIG. 2.—DIAGRAM OF A CYLINDRICAL DIAPHRAGM CELL
The sodium set free at the perforated cathode reacts with the brine, which percolates through it, forming caustic soda and hydrogen gas. The chlorine is set free at the carbon anodes

The diaphragm type of cell (fig. 2) uses no mercury which can be moved from one compartment to another, and it is therefore necessary to provide some means whereby the sodium and the chlorine may be collected separately.

To effect this, the cell, which, in the form chosen for description here, takes the shape of a cylinder on end, is divided into two annular compartments by a ring or diaphragm of asbestos fibre, supported by a perforated metal sheet or wire screen on the outer side. This iron gauze forms the cathode at which the sodium separates. The anode is formed by graphitic carbon sticks suspended from the top of the cell and hanging vertically in the inner compartment of the cell. This compartment is fed with purified brine. Purification of the brine from the calcium and magnesium compounds, which occur naturally in it, is necessary on account of the subsequent blocking and deterioration of the asbestos diaphragm which would otherwise occur: the purification is carried out by precipitating the calcium as carbonate and the magnesium as hydroxide by treatment with sodium carbonate and caustic soda. As the asbestos diaphragm is permeable to liquid some brine runs through it, so that the metal sheet on the outside is continually wet. On passing the current through the cell, chlorine is liberated at the anode as in the mercury cell, and sodium momentarily at the metal cathode, where it at once reacts with the water of the brine which has soaked through the asbestos, and forms a solution of caustic soda, with simultaneous evolution of hydrogen gas. The liquor thus formed contains a large proportion of undecomposed salt, which is recovered in solid form during the subsequent evaporation for the production of solid caustic soda. Not only does this cause some complication in the method adopted for evaporation, but the resulting caustic soda cannot be obtained free from salt, and contains usually about 2% of it.

In the Belljar type (fig. 3) the anode is surrounded by an inverted bell of material, which does not conduct electricity, placed in a tank in which the cathode is suspended. Brine is fed into the interior of the bell and the chlorine there produced is piped off as before. The caustic soda formed at the cathode sinks, by virtue of its greater density, through the brine and is drawn off through a pipe. The liquor produced is similar to that formed in the diaphragm process.

Various modifications and combinations of these main types of cell exist. The bulk of the electrolytic chlorine produced to-day is made in the mercury and diaphragm cells, the relative advantages of which are as follows: In the mercury cell the preliminary treatment of the brine is much cheaper; the liquid produced in the cell is much more concentrated, and it contains no salt, so that evaporation is a straight-forward operation. In the diaphragm cell the capital cost of the installation is less, as no expensive mercury is required; the consumption of electric energy is less per unit of product, and salt of high purity can be produced as a by-product if required. The choice of process for any given purpose depends, therefore, on a variety of considerations, and must be made on the merits of each individual case.

Liquid Chlorine.—The chlorine from the cell is now usually liquefied by subjecting it to refrigeration with, or without, pressure, and is packed in steel cylinders or tank waggons. Before this can be done, however, it is necessary to dry it thoroughly; this is accomplished by bringing it into contact with concentrated sulphuric acid. Chlorine that contains moisture has the property of attacking metals; chlorine in the absence of water does not do this, and can therefore be packed safely in steel vessels, provided that the latter are strong enough to withstand the pressure necessary to keep the chlorine in the liquid condition under all conditions of atmospheric temperature which are likely to be met with. This liquid chlorine is the form in which the element is now most largely employed.

USES OF CHLORINE

In the days of the Weldon and Deacon processes the principal outlet for chlorine was in the manufacture of bleaching powder (*q.v.*). Although a very considerable quantity of this is now produced, its place has been taken to a great extent by liquid chlorine itself. Chlorine has an immediate and disastrous effect on all forms of low organic life, and is therefore an ideal disinfectant. The quantity required, for example, to sterilize potable water, or swimming pools, completely is extremely minute and, when

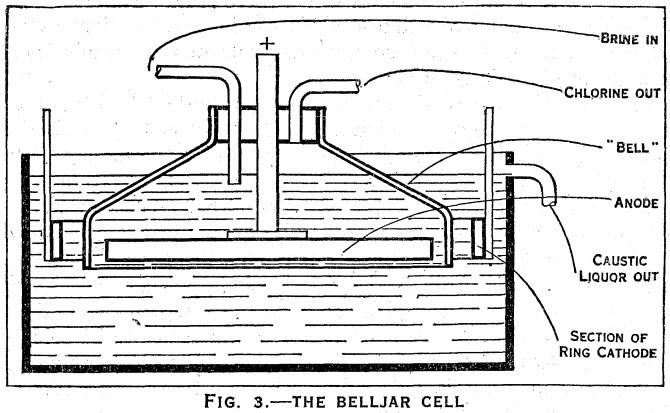


FIG. 3.—THE BELLJAR CELL
The anode is here separated from the cathode by an inverted bell non-conductive of electricity. Brine enters the interior of the bell and the chlorine produced is piped off

the treatment is properly carried out, no taste can be detected. Over 75% of the drinking water of North America is sterilized with chlorine. The death rate from typhoid has dropped from 28 per 100,000 in 1908 to less than five per 100,000 in 1927, and much of this improvement can be traced to the use of chlorine. This, and the application to sewage, is daily finding more extended use. Chlorine in the form of hypochlorite is the potent ingredient of the familiar Carrel-Dakin solution and other types of germicides. It is frequently found that metal surfaces, such as condenser tubes, which are in constant contact with water, de-

velop considerable growths of algae and similar vegetable matter, which impair the efficiency of the apparatus. These growths can be entirely inhibited by the addition of very small quantities of chlorine to the water, and the efficiency of the plant restored to the normal.

The biggest outlet for chlorine is the pulp and paper trade. As is well-known, modern newsprint and paper of the inferior sorts

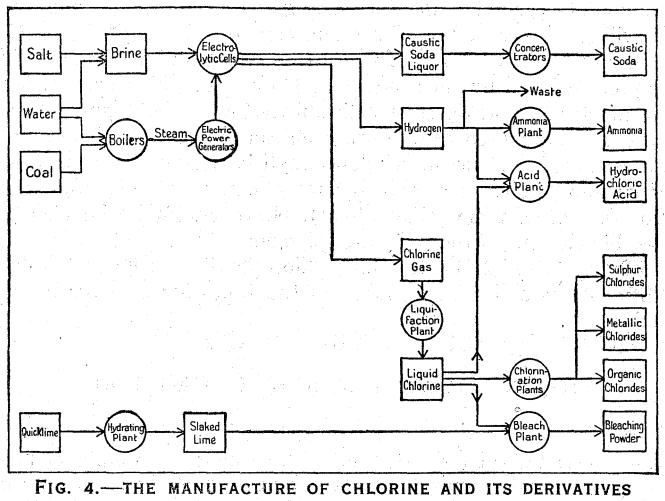


FIG. 4.—THE MANUFACTURE OF CHLORINE AND ITS DERIVATIVES
The diagram shows, from left to right, the manufacture of chlorine from salt, water, and coal, the principal industrial compounds formed, and the commercial utilization of the by-products

generally are made from wood which has been shredded and beaten to a pulp. This requires bleaching before it can be used as paper; and to this is due the rise of the chlorine industry in North America. Bleaching powder (*q.v.*) was at one time extensively used for this purpose, and is still to some extent; but in Canada and the United States the change over to chlorine itself is very marked, and the same tendency is showing itself to an increasing degree in Europe.

In the manufacture of artificial silk large quantities of chlorine are involved. In the viscose process the source of cellulose is, generally, wood pulp which, as mentioned above, is bleached by chlorine. Caustic soda is also used and the pure product of the mercury cell is much preferred. In the acetate process liquid chlorine and sulphur-chlorine compounds are required. The rise of the artificial silk trade has, therefore, been very beneficial to the industry in general.

Sodium and calcium hypochlorites, prepared by action of chlorine on caustic soda and lime respectively, are also used as bleaching agents.

Both liquid chlorine and bleaching powder are used in large amounts in the refining of crude natural oils.

The organic chemical industry provides an important outlet for chlorine in the manufacture of dyestuffs, insecticides, fire-extinguishing liquids, grease-removers, solvents of different kinds, anaesthetics (chloroform), and various intermediate compounds used in comparatively small quantities throughout the chemical industry. Chlorine is widely used in bleaching flour.

In metallurgy chlorine has been used for the extraction of metals from their ores.

Even from the above abbreviated description of the industry, it will readily be seen that chlorine, like so many other raw materials of the modern world, is one of those products which, without being obtrusive, and, in fact, without being known even by name to the vast majority of people, yet has a profound influence on our daily life. Newspapers, clothes, medicines, colours, sanitation and petrol, for example, are matters of concern to everyone, and all consume chlorine or its derivatives at some stage. In 1774, when first discovered by Scheele, it was a chemical curiosity masquerading under the name of "dephlogisticated marine acid air"; it is now a necessity.

BIBLIOGRAPHY.—F. Foerster, *Elektrochemie wässeriger Lösungen* (1905); R. Lucion, *Die Elecktrolytischen Alkalichloridzerlegung mit flüssigen Metallkathoden* (1906); A. Brochet, *La Soude Electrolytique* (1909); J. Billiter, *Die elektrochemischen Verfahren der chemischen Grossindustrie* (2nd vol. 1911); A. J. Hale, *The Applications of Electrolysis in Chemical Industry* (1918); G. Martin and G. W. Clough, *Chlorine and Chlorine Products* (1918); T. E. Thorpe, *Dictionary of Applied Chemistry* (revised ed. 1921); A. J. Allmand, *The Principles of Applied Electro-Chemistry* (2nd ed. 1924); J. R. Partington, *The Alkali Industry* (1925). (A. E. H.)

CHLORITE, a group of green micaceous minerals which are hydrous silicates of aluminium, magnesium and ferrous iron. The name was given by A. G. Werner in 1798, from χλωρῖτις, "a green stone." Several species and many rather ill-defined varieties have been described, but they are difficult to recognize. Like the micas, the chlorites (or "hydromicas") are monoclinic in crystallization and have a perfect cleavage parallel to the flat face of the scales and plates. The cleavage is, however, not quite so prominent as in the micas, and the cleavage flakes though pliable are not elastic. The chlorites usually occur as soft (H.=2–3) scaly aggregates of a dark-green colour. They vary in specific gravity between 2·6 and 3·0, according to the amount of iron present. Well-developed crystals are met with only in the species clinochlore and penninite; those of the former are six-sided plates and are optically biaxial, whilst those of the latter have the form of acute rhombohedra and are usually optically uniaxial. The species prochlorite and corundophilite also occur as more or less distinct six-sided plates. These four better crystallized species were grouped together by G. Tschermak as orthochlorites, the finely scaly and indistinctly fibrous forms being grouped by the same author as leptochlorites.

Chemically, the chlorites are distinguished from the micas by the presence of a considerable amount of water (about 13%) and by not containing alkalis; from the soft, scaly, mineral talc they differ in containing aluminium (about 20%) as an essential constituent. The magnesia (up to 36%) is often in part replaced by ferrous oxide (up to 30%), and the alumina to a lesser extent by ferric oxide; alumina may also be partly replaced by chromic oxide, as in the rose-red varieties kämmererite and kotschubeite.

The chlorites usually occur as alteration products of other minerals, such as pyroxene, amphibole, biotite, garnet, etc., often occurring as pseudomorphs after these, or as earthy material filling cavities in igneous rocks composed of these minerals. Many altered igneous rocks owe their green colour to the presence of secondary chlorite. Chlorite is also an important constituent of many schistose rocks and phyllites, and of chlorite-schist it is the only essential constituent. (L. J. S.)

CHLOROFORM, a valuable anaesthetic first prepared by J. v. Liebig and E. Soubeiran (1831). It is a colourless liquid (trichloromethane, $CHCl_3$), possessing an agreeable smell and a pleasant taste. It may be prepared by the action of bleaching powder on many carbon compounds, but preferably ethyl alcohol and acetone, by heating trichloroacetic acid with ammonia or by alkaline hydrolysis of chloral (*q.v.*). In the preparation of chloroform by the action of bleaching powder on ethyl alcohol it is probable that the alcohol is first oxidized to acetaldehyde, which is subsequently chlorinated and then decomposed. Chloroform solidifies in the cold and then melts at −62° C.; it boils at 61·2° C., and has a specific gravity 1·52637 (0° C./4° C.) (T. E. Thorpe). It is an exceedingly good solvent, especially for fats, alkaloids and iodine. It is not inflammable. Chromic acid or exposure to light converts it into phosgene (carbonyl chloride, $COCl_2$). It reacts with sodium ethylate to form orthoformic ester, $CH(OC_2H_5)_3$. When digested with phenols and caustic soda it forms hydroxyaldehydes (K. Reimer); and when heated with alcoholic potash it is converted into potassium formate.

Chloroform may be readily detected by the production of an *iso*nitrile when it is heated with alcoholic potash and a primary amine; thus with aniline the nauseating odour of phenyl *iso*cyanide is produced. For the use of chloroform as an anaesthetic, *see* ANAESTHESIA AND ANAESTHETICS.

Chloroform may be given internally in doses of from one to five drops. The *British Pharmacopoeia* contains a watery solution —the *Aqua Chloroformi*—which is useful in disguising the taste of nauseous drugs; a liniment which consists of equal parts of camphor liniment and chloroform, and is a useful counter-irritant;

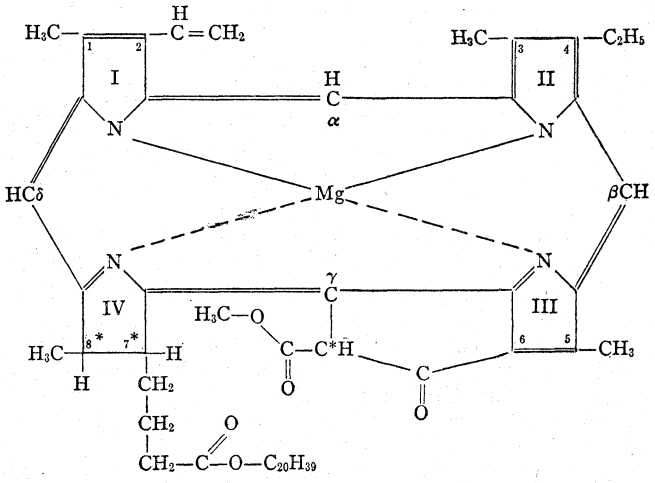
the *Spiritus Chloroformi* (erroneously known as "chloric ether"), which is a useful anodyne in doses of from five to forty drops; and the *Tinctura Chloroformi et Morphinae Composita,* which is the equivalent of a proprietary drug called chlorodyne. This tincture contains chloroform, morphine and prussic acid, and must be used with the greatest care.

Externally chloroform is an antiseptic, a local anaesthetic if allowed to evaporate, and a rubefacient, causing the vessels of the skin to dilate, if rubbed in. Its action on the stomach is practically identical with that of alcohol (*q.v.*), though in very much smaller doses. Chloroform is also used as a counter-irritant; as a local anaesthetic for toothache due to caries; an antispasmodic in tetanus and hydrophobia; and as the best and most immediate and effective antidote in cases of strychnine poisoning.

BIBLIOGRAPHY.—W. H. Martindale and W. W. Westcott, *The Extra Pharmacopoeia* (1924); W. E. Dinn, *Manual of Pharmacology* (1925).

CHLOROPHYLL, CHEMISTRY OF. The green colour of leaves is due to the presence of chlorophyll, which is necessary for photosynthesis in plants (transformation of the raw materials CO_2 and H_2O into organic compounds of a carbohydrate nature). Yellow carotenoid pigments occur with chlorophyll in the chloroplast bodies within the leaf. They are principally either hydrocarbons with the formula $C_{40}H_{56}$ (carotenes) or oxidized derivatives such as the alcoholic compounds, $C_{40}H_{56}O_2$ known as carotenols (also called xanthophylls). Other modifications of these yellow pigments exist in various plant and animal sources.

Most higher plants contain two modifications of chlorophyll, known as components *a* and *b*. The chemical structure of chlorophyll *a* follows:



(according to H. Fischer, 1939)

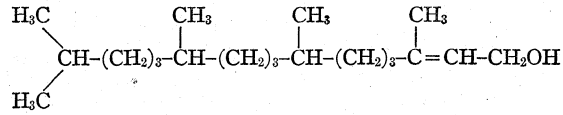
The carbons with asterisks are asymmetric and are responsible for the optical activity of chlorophyll. $[\alpha]^{25°}_{7200A} = -262°$ for *a*, and $-267°$ for *b*.

Component *b* differs from chlorophyll *a* in that the methyl ($-CH_3$) group on ring II is substituted by an aldehyde group ($-\overset{\overset{O}{\parallel}}{C}-H$). The empirical formulae of chlorophylls *a* and *b* are thus $C_{55}H_{72}O_5N_4Mg$ and $C_{55}H_{70}O_6N_4Mg$ respectively.

The central large porphin nucleus consists of 4 pyrrole groups (I to IV), linked together by methine bridges (α to δ). The nitrogen atoms are linked together by the magnesium. This skeletal structure and the composition of the principal additional groups of chlorophyll were demonstrated by the chemical work of R. Willstätter, A. Stoll, and coworkers. The positions of the H atoms were shown by H. Fischer to be on carbons 7 and 8 of ring IV rather than on carbons 5 and 6 of ring III (1939). His work also definitely placed the carbonyl group of component *b* on ring II. The location of the phytyl group on the propionic acid side chain of ring IV was established by J. B. Conant and coworkers (1931). The vinyl group on carbon 2, ring I, readily adds HI, followed by hydrolysis and spontaneous dehydrogenation to produce a ketone group.

The Mg linkage in chlorophyll is unique. Our incomplete knowledge of this linkage is indicated by the dotted lines drawn to represent bonds from Mg to N. Mg is easily replaced by H when chlorophyll is exposed to acidic conditions. This is of importance in the extraction of chlorophyll as well as in the canning of vegetables. In processing green vegetables an increase of acidity may cause loss of Mg and consequent loss of the desirable green colour, since the metal-free compound is brown. Mg may be replaced by such metals as Cu or Zn, which compounds are much more stable than chlorophyll toward light and oxidation. They are used as colouring agents in candles, soaps, and waxes. The ring structure of chlorophyll is closely related to that of haemin (which is combined with globin in haemoglobin, the red pigment of mammalian blood). However, Fe is the central metallic element of the red blood pigment.

Phytol, ($C_{20}H_{39}OH$), to which chlorophyll owes its high solubility in fats and fat solvents, has the following structural formula:



The phytyl radical ($-C_{20}H_{39}$) is a constituent of vitamin E (α-tocopherol) and vitamin K_1. Chlorophyll does not crystallize until the phytyl group is removed by hydrolysis. Simpler derivatives yield excellent crystalline preparations. Solid chlorophyll is a very dark, waxy, amorphous material with a bluish or greenish tinge, depending upon the physical condition of the surface.

Treatment of chlorophyll with alkali hydrolyzes the methyl and phytyl ester groups to the corresponding alcohols, leaving water-soluble salts. At low temperatures of saponification chlorophyllins result, and at high temperatures another series of compounds results, known as iso-chlorophyllins. They may be further decomposed by treatment with acids and heat.

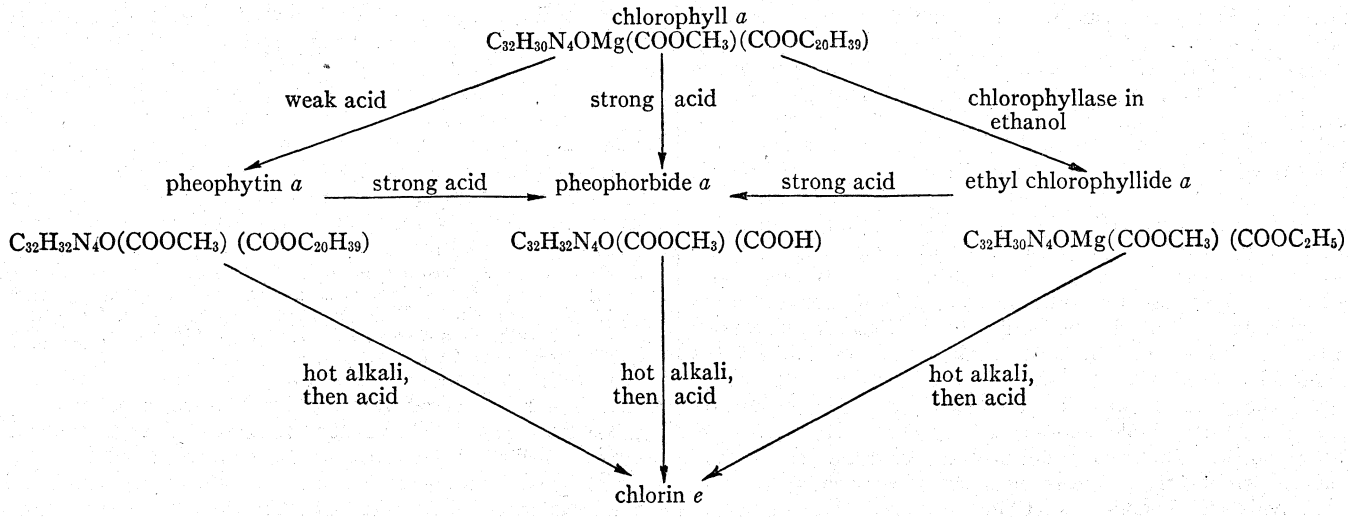
In many leaves an enzyme chlorophyllase is found which acts in alcohol, acetone or water (under certain conditions) to hydrolyze the phytyl group, replacing it with the alcohol group from the alcoholic solvent or by H in the case of acetone or water media. The corresponding chlorophyllides are thus formed when such leaves are allowed to stand at the proper temperature, steeped in the proper concentration of the solvent. C. Weast and G. Mackinney studied this reaction under a variety of conditions (1940). In the case of spinach the chlorophyllase content varies with the season and with the variety, being most active in early spring. Under favourable conditions for enzyme activity, 20 min. in hot water may hydrolyze most of the chlorophyll. This is of practical importance in the blanching and canning of vegetables. Some vegetables apparently have no chlorophyllase.

Porphyrins possess the skeletal porphin ring structure of chlorophyll and have various groups attached to carbons 1 to 8, but no metallic element. Many porphyrins have been derived from chlorophyll and haemoglobin (J. B. Conant, H. Fischer, P. Rothemund) and some have been synthesized. Chlorophyll has not been completely synthesized in the laboratory, although many steps in its synthesis have been successful. The phytyl group can be introduced into pheophorbide and Mg can be introduced into pheophytin by use of the Grignard reaction.

Chlorophyll solutions undergo certain changes on standing, particularly in alcoholic solution. Such old solutions no longer give the "phase test," a transient colouration best shown by the addition of concentrated alkali to ether solutions. This change is called allomerization. Component *a* gives a yellow phase, *b* a red phase, after which (5–10 min.) the original colour is restored and the chlorophyll has become water-soluble because of salt formation. Conant, *et al.* (1931) showed that allomerization consists of a slow oxidation, two equivalents of oxygen being absorbed per mole of chlorophyll.

Certain chlorophyll derivatives also give the phase test and may be allomerized.

A summary of some of the above reactions follows:



E. Rabinowitch and J. Weiss (1937) reported that both chlorophyll components and the ethyl chlorophyllides turn yellow when Fe^{+++} is added to their alcoholic or acetone solutions. Other oxidizing agents such as I_2, Cu^{++}, and Ce^{++++} are also effective. On standing the original colour is regenerated, because of slow oxidation of the alcohol; it may be regenerated also by the addition of Fe^{++}. The absorption band in the red region was most affected and the fluorescence characteristic of chlorophyll solutions disappeared. Earlier methods of chlorophyll purification, as developed by Willstätter, *et al.* (1906–14), consisted principally of partitions between immiscible solvents and filtrations of precipitated chlorophyll. Later the products obtained in this way were shown to be partially impure, and numerous adsorption methods have been developed to supplement his procedures. Careful measurement of the absorption spectrum and suitable chromatographic technique have been found to be the most delicate tests for purity. Such methods have led to quantitative spectroscopic standards of purity for the two components *a* and *b*. Those most active in this development were Mackinney (1940–42), A. Winterstein and G. Stein (1934) and F. P. Zscheile (1934–43). Spectroscopic methods of analysis for components *a* and *b* separately are now available, without the necessity for separation from the yellow carotenoid pigments.

Spectroscopic data indicate that chlorophyll solutions are quite sensitive to light. The reversible bleaching of chlorophyll solutions by light has been studied in some detail by R. Livingston (1941). This bleaching is inhibited by oxygen. In hay making, direct sunlight causes rapid and complete decomposition of chlorophyll.

Spectroscopic tests, which can be made very delicate, indicate appreciable decomposition during evaporation of a solution to dryness under certain conditions or by adsorption on certain surfaces (F. P. Zscheile and C. L. Comar, 1941). This makes the preparation of reliable spectroscopic standards in a solid form very difficult until these factors are better understood. Powdered sucrose, magnesium citrate and inulin have been found better adsorbents than talc or calcium carbonate from the viewpoint of chlorophyll stability.

The colours of chlorophyll *a* and *b* solutions are most strikingly different in ethereal solutions. Component *a* is a rich, pure blue, while component *b* is a true green. Absorption of light is highest in the blue and red regions of the spectrum. The colour is intimately associated with the long system of conjugated double bonds in the chlorophyll molecule and with the metallic linkages. Profound colour changes accompany certain of the chemical reactions discussed above. The spectra of chlorophyll solutions in numerous solvents have been studied by D. G. Harris and F. P. Zscheile (1943).

When irradiated, chlorophyll solutions fluoresce a brilliant red. The fluorescence spectrum consists of two bands, one in the red and another, of lesser magnitude, in the near infrared region. This subject has been studied by Ch. Dhéré and O. Biermacher (1914–36) and by Zscheile and Harris (1943). Colloidal suspensions of chlorophyll may be formed by rapid addition of an acetone solution to large volumes of water. Such preparations show no visible fluorescence. Relations between fluorescence of chlorophyll in leaves and photosynthesis under various conditions have been extensively studied by J. Franck and coworkers (1935–42), H. Kautsky (1932–37), E. D. McAlister (1937–41), E. C. Wassink, *et al.* (1937–39).

H. H. Strain and W. M. Manning reported (1942) the isomerization of both components to isomers which were separable from the parent substances by adsorption on sucrose, although their properties are not greatly different. Extraction at low temperatures minimizes the extent of isomerization during the extraction procedures.

The details of the organization of the fat-soluble pigments in the chloroplast are essentially unknown. Colloidal systems are undoubtedly involved and considerable evidence indicates a union between protein and chlorophyll, the latter as the prosthetic group. E. Smith suggested (1941), on the basis of chlorophyll and protein analyses, a complex of 3 molecules of chlorophyll *a* and 1 molecule of *b* combined with each Svedburg unit of protein with a molecular weight of 17,500. Lecithins and fats are probably involved in the chlorophyll complex also. Certain data indicate that carotenoids (H. J. Dutton and W. M. Manning, 1941), as well as other pigments (R. Emerson and C. M. Lewis, 1942), may play a significant role in photosynthesis, at least in certain plants. Some algae (blue-green types) contain little or none of the *b* component. Certain brown algae and diatoms contain a green pigment (chlorofucine) with properties that indicate its close chemical relationship to the better-known chlorophylls *a* and *b* (Strain and Manning, 1942).

Another pigment, bacteriochlorophyll, is found in certain photosynthetic bacteria such as the purple sulphur bacteria. Its structure is identical with that of chlorophyll *a* except that an acetyl group $(-\overset{\overset{O}{\|}}{C}-CH_3)$ replaces the vinyl group on carbon 2, ring I. Fischer's work indicates that bacteriochlorophyll contains 2 more hydrogens than chlorophyll *a*. Their exact positions have not been established. The purple bacteria apparently possess only the one chlorophyll component. It is extremely unstable, especially to light. It exhibits high absorption in the infrared and most of its fluorescence is in this region also. C. S. French (1940) and others have studied aqueous extracts of photosynthetic bacteria, which contain a water-soluble protein to which bacteriochlorophyll and carotenoids are attached. (F. P. Z.)

CHLOROPICRIN, product of the distillation of bleaching powder with many nitro-compounds (*e.g.*, picric acid, nitromethane), may be prepared also by the action of concentrated nitric acid on chloral or chloroform, or by the action of aqua regia (*q.v.*) upon almost any organic substance. The most common method of preparation (A. W. von Hofmann, 1866) consists of adding a solution (saturated at 30° C.) of one part of picric acid to a paste of ten parts of bleaching powder and water. A violent reaction occurs and chloropicrin (nitrochloroform, trichloronitromethane), $NO_2.CCl_3$, distils over, generally without external heating. It is a colourless liquid of boiling-point 112° C., and of specific gravity 1.692. It is almost insoluble in water but is readily soluble in alcohol; it has a sharp smell, and its vapour powerfully affects the eyes. Chloropicrin has been employed in chemical warfare (*q.v.*) as a lachrymatory, irritant and lethal agent. High concentrations of this chemical cause fatal lung in-

juries and death may ensue from exposure to its action even at low concentrations.

CHLOROPLAST, the botanical name for that structure in the plant cell which carries the green pigment, chlorophyll (*q.v.*). (*See* LEAF; PLANTS AND PLANT SCIENCE.)

CHLOROSIS, the botanical term for loss of colour in a plant-organ, a sign of disease; also in medicine, a form of anaemia (*q.v.*).

CHMIELNICKI, BOGDAN (*c.* 1593–1657), hetman of the Cossacks, but a Pole by descent, was born near Chigirin in the Ukraine. After serving with the Cossacks in the Ukraine campaign in 1646, against the Turks, he suffered Polish persecution as a royalist and a Cossack, and he fled to the Cossack settlements on the Lower Dnieper. On April 11, 1648, at an assembly of the Zaporozhians (*see* POLAND: *History*), he declared his intention of fighting the Poles and was elected *ataman.* As a result of his victories at Zheltnaya Vodui and Kruta Balka in May the serfs rose. Throughout the Ukraine the Polish gentry and the Jesuits were hunted down and slain. The rebels swarmed over the palatinates of Volhynia and Podolia, and Chmielnicki routed the Poles at Pildawa (Sept. 23). In June 1649 he entered Kiev, where he permitted the committal of atrocities on the Jews and Roman Catholics. His extravagant demands at the peace congress at Pereyaslavl led to the renewal of war, which was ended by the compact of Zborow. Chmielnicki was recognized as a semi-independent prince of the Ukraine. His attempt to carve a principality for his son out of Moldavia led to the third outbreak of war in 1651. At Beresteczko (July 1, 1651) Chmielnicki was defeated. In 1652 he sent an embassy to the Tsar asking for Russia's alliance, and in 1654 took an oath of allegiance to him. All hope of an independent Cossack state was thus at an end. Chmielnicki died on Aug. 7, 1657.

See P. Kulish, *On the Defection of Malo-Russia from Poland* (Rus.) (Moscow, 1890); S. M. Solovev, *History of Russia,* vol. x. (Rus.) (Moscow, 1857, etc.); R. N. Bain, *The First Romanovs,* ch. iii.–iv. (1905).

CHOATE, JOSEPH HODGES (1832–1917), U.S. lawyer and diplomat, was born at Salem, Mass., on Jan. 24, 1832. He was the son of Dr. George Choate, a physician of considerable note. He was admitted to the bar in 1855 and in 1856 began practice in New York city. Choate was associated with many of the most famous litigations in American legal history, including the Tilden, A. T. Stewart and Stanford will cases, the Kansas prohibition cases, the Chinese exclusion cases, the Maynard election returns case and the income tax suit. In 1871 he became a member of the "Committee of Seventy" in New York city, which was instrumental in breaking up the "Tweed Ring." His greatest reputation was won, perhaps, in cross-examination. In politics he allied himself with the Republican party on its organization, being a frequent speaker in presidential campaigns, beginning with that of 1856. He never held political office but he was ambassador to Great Britain from 1899 to 1905. In England he won great personal popularity, and accomplished much in fostering the good relations of the two great English-speaking powers. He was one of the representatives of the U.S. at the second peace congress at The Hague in 1907. Upon the outbreak of World War I he ardently supported the British and Allied cause and severely criticized President Wilson's hesitation to recommend America's immediate co-operation, but shortly before his death retracted his criticism. He died in New York on May 14, 1917. Among his last works were *Abraham Lincoln and Other Addresses in England* (1910) and *American Addresses* (1911).

See *The Choate Story Book* (1903); T. G. Strong, *Joseph Choate, New Englander, New Yorker, Lawyer, Ambassador* (1917); *Joseph Choate, a Great Ambassador* (1918); Edward Sandford Martin, *The Life of Joseph H. Choate* (1920); *Arguments and Addresses of Joseph Hodges Choate,* edit. Frederick C. Hicks (1926).

CHOATE, RUFUS (1799–1859), U.S. lawyer and orator, was born at Ipswich (Mass.) on Oct. 1, 1799. He graduated at Dartmouth college in 1819 and spent a year in the law school of Harvard university. He was admitted to the Massachusetts bar in 1823 and practised for five years, during which time he served in the Massachusetts house of representatives (1825–26) and in the state senate (1827). In 1830 he was elected to congress as a Whig from the Salem district, and in 1832 was re-elected. In 1841 he succeeded Daniel Webster in the U.S. Senate, where he made a series of brilliant speeches on the tariff, the Oregon boundary, in favour of the Fiscal Bank act, and in opposition to the annexation of Texas. On Webster's reelection to the senate, Choate resumed (1845) his law practice, which no amount of urging could ever persuade him to abandon for public office, save for a short term as attorney general of Massachusetts in 1853–54. He died July 13, 1859, at Halifax, Nova Scotia, while he was en route to Europe.

His *Works* (edited with a memoir by S. G. Brown) were published in 2 vol. in 1862. The *Memoir* was afterwards published separately (1870). *See* also E. G. Parker's *Reminiscences of Rufus Choate* (1860); E. P. Whipple's *Some Recollections of Rufus Choate* (1879); and the *Albany Law Review* (1877–78).

CHOBE, a large western affluent of the middle Zambezi (*q.v.*). The river was discovered by David Livingstone in 1851, and to him was known as the Chobe. It is also called the Linyante and the Kwando, the last name being that commonly used.

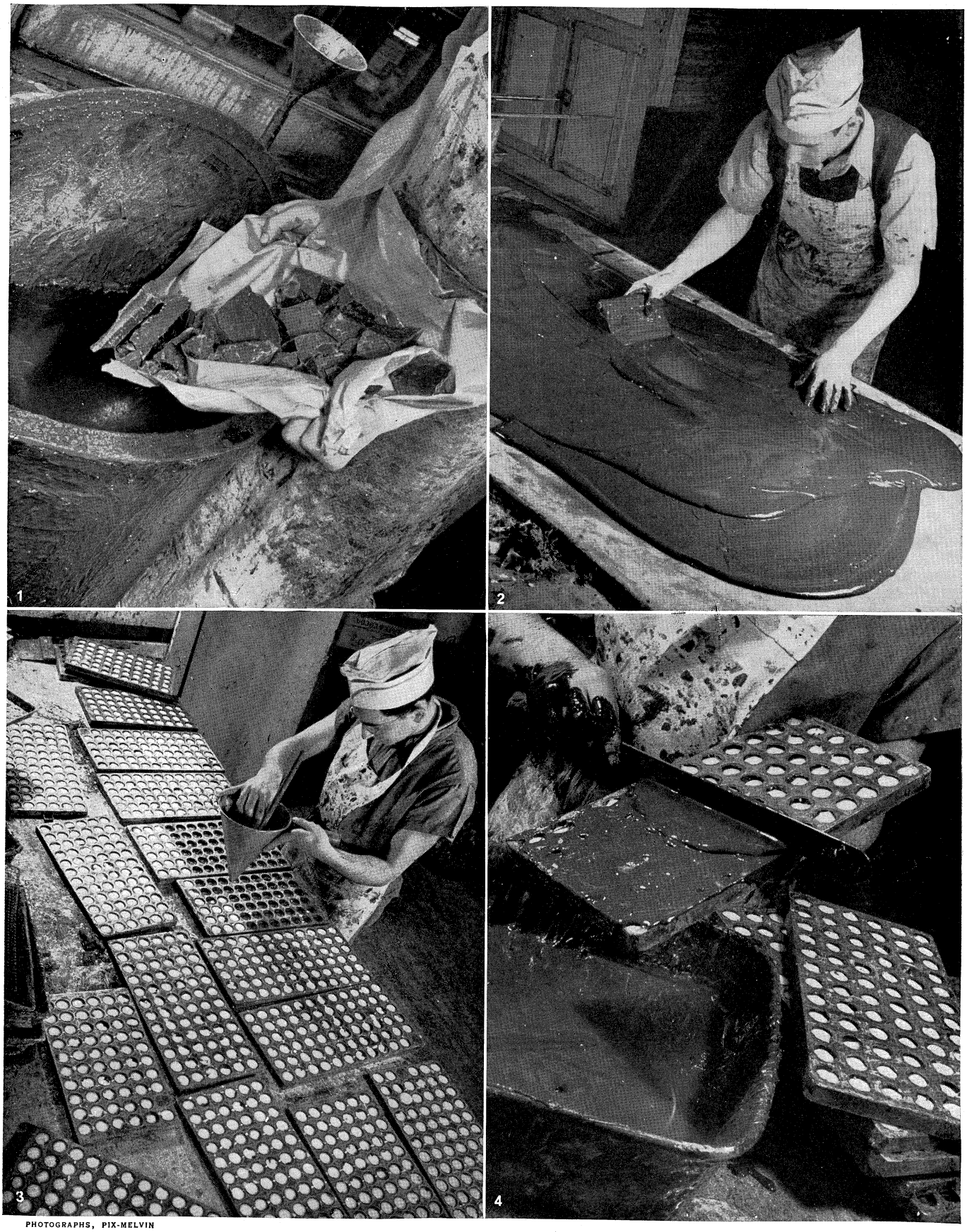
CHOCOAN, an independent linguistic stock of South American Indians, so called from the Chocos, who are the best known of its tribes. At the time of the first appearance of Europeans the Chocoan tribes seem to have held a large region in northwestern Colombia and southeastern Panamá. They were one of the few South American peoples who lived in pile dwellings. The Chocoan tribes were skilful canoemen, having large canoes which they used in trade. Andagoya in 1522 heard the first rumours of the Inca empire from the coastal tribes of this stock, and from a district called Biru near the mouth of the San Juan the name Peru is supposed to have been derived. The Chocoan tribes survive today in considerable numbers but are very little known. They were described at the period of the conquest as a warlike people, living mainly by hunting and fishing and on wild vegetable products. They had an abundance of gold, which they traded with the Chibchan (*q.v.*) tribes to the east. They used poisoned arrows and also the blow-gun, which was of the two-piece type. They wore little or no clothing and lived communally in large houses of thatch, set on very high piles or sometimes in trees.

See P. Simon, *Noticias historiales de las Conquistas de Tierra Firme en las Indias Occidentales* (Bogota, 1882); W. Lehmann, *Zentral Amerika* (Berlin, 1920).

CHOCOLATE, a preparation of the cacao bean and sugar, usually flavoured, and either used as a food or mixed with hot water and milk as a drink. It is also widely used to flavour other types of food such as ice cream, bakery products and candy. Cocoa and chocolate for eating are comparatively modern preparations, whereas drinking chocolate, of a sort, has been known to Europeans since the discovery of America. The original of the modern chocolate was *chocolatl,* a frothy beverage taken cold and held in high esteem in Mexico by the Aztecs. As *chocolatl* apparently consisted simply of the roasted and ground cacao bean flavoured with peppers and other spices, it was both bitter and pungent. The Spaniards greatly improved it by adding sugar and guarded the secret of its preparation for nearly a century, when it became known in Italy, Germany and France. In 1657 a Frenchman opened a shop in London, at which solid chocolate for making the beverage could be purchased at 10*s.* to 15*s.* a pound. At this price, only the wealthy could afford to drink it; hence the appearance in London, Amsterdam and other European capitals of the fashionable chocolate houses, some of which developed later into famous clubs. About 1700 the English improved chocolate by the addition of milk. The reduction of the cost of the beverage was hampered in Great Britain by the imposition of high import duties on the raw cacao bean, and it was not until 1853, when Gladstone lowered the duty to a uniform rate of 1*d.* a lb., that chocolate became popular.

Cakes of chocolate are still the accepted material in France from which to prepare a cacao beverage, but elsewhere cocoa powder has for many years been more generally used. While the use of chocolate for drinking has declined, the amount of chocolate eaten has greatly increased.

Method of Manufacture.—In the manufacture of chocolate, cocoa beans are first cleaned to remove stones, dirt and other foreign matter and then roasted. The roasting process develops

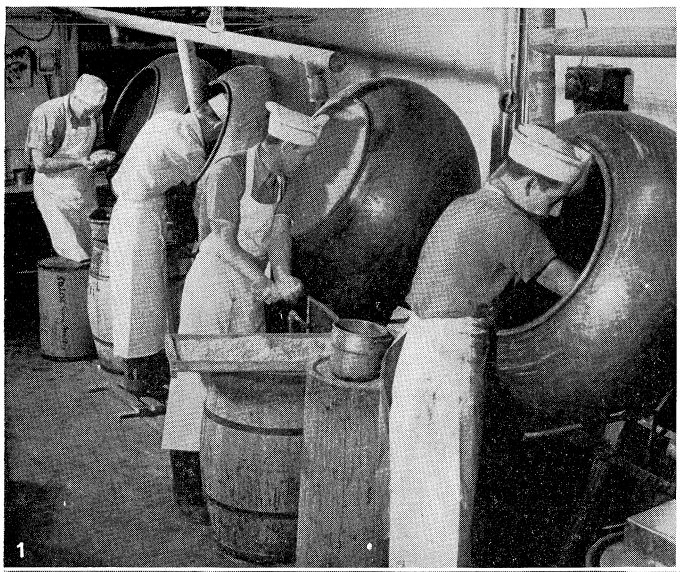


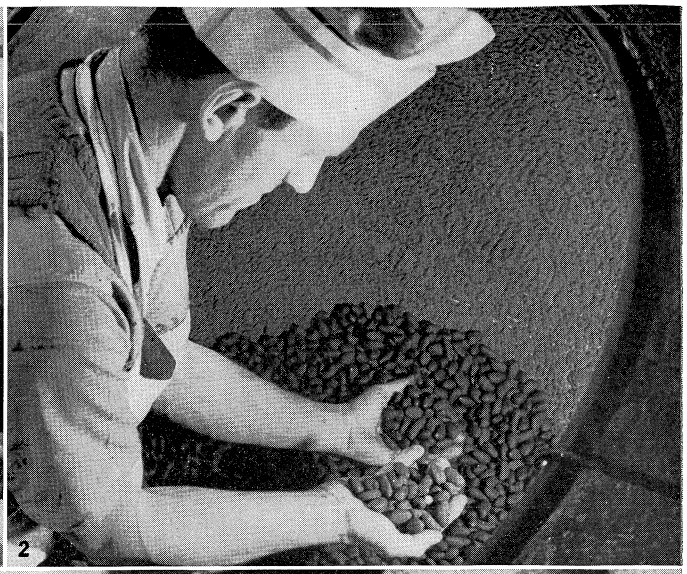
PHOTOGRAPHS, PIX-MELVIN

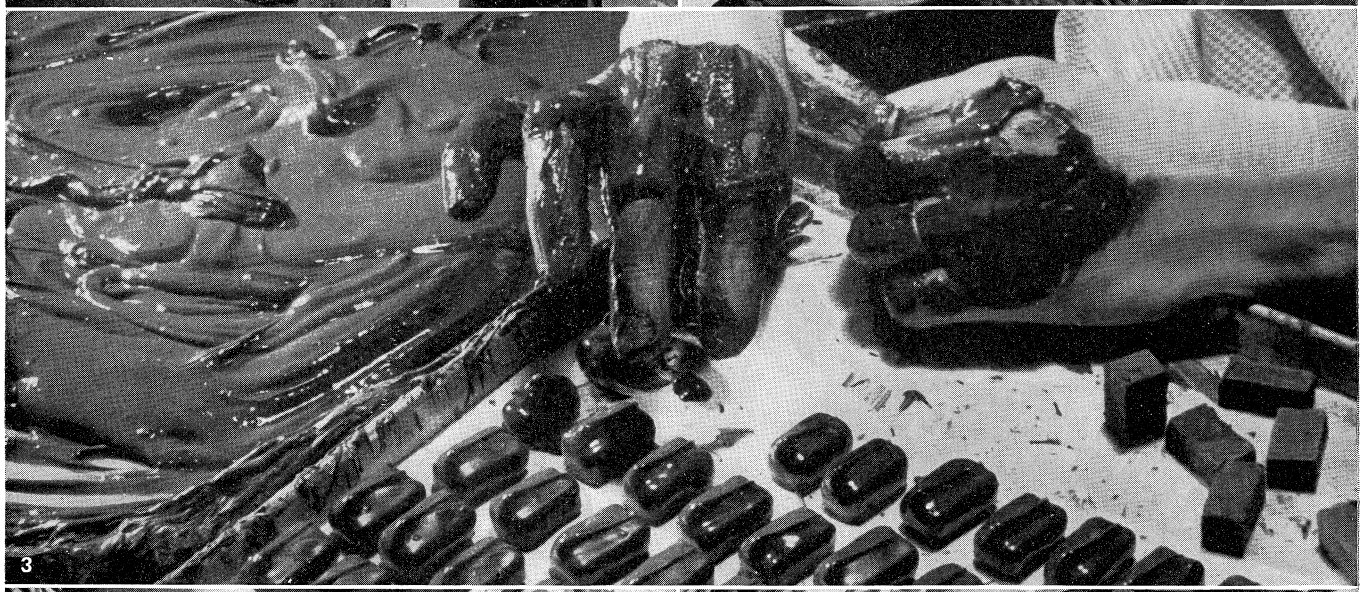
MANUFACTURE OF CHOCOLATE CANDY

1. Placing solid blocks of chocolate into a melter, where they are heated to liquid form
2. After melting, the chocolate is poured onto a marble slab for cooling and working
3. Making chocolate-covered creams. The cream fillings are first poured into moulds
4. The entire tray of moulds filled with the cream centres is covered with liquid chocolate, then allowed to harden

CHOCOLATE











PHOTOGRAPHS, PIX-MELVIN

MAKING VARIOUS KINDS OF CANDIES

1. Revolving pens in which nut fillings of candies are covered with an equal distribution of chocolate
2. Workman inspecting finished chocolate-covered almonds in a revolving pen
3. Hand-dipping centres in liquid chocolate
4. Wrapping pieces of candy in tin foil
5. Packing candy in boxes

flavour, colour and serves to loosen the kernel or nib from the shell. Beans are then cracked and the shell is removed by a winnowing process. The nibs are generally ground through stone mills. During the grinding the heat of friction melts the cocoa butter present, and the resulting product comes from the mills in liquid form. It is known in the trade as "chocolate liquor." This liquor can then be cooled and moulded into cakes for use in other branches of the food industry or can be given further processing to prepare sweet chocolate, milk chocolate or cocoa powder. The U.S. standard for chocolate liquor calls for a minimum of 50% fat and a maximum of 8% ash, and 7% crude fibre on a fat and moisture-free basis. The ash and fibre limits are intended to prevent adulteration with shells.

In the manufacture of sweet chocolate, granulated or pulverized sugar is mixed with the chocolate liquor and the resulting paste is ground by passing it over steel roll refiners. As the addition of sugar reduces the over-all fat content, additional cocoa butter must be supplied to the mix to maintain sufficient fat to permit further processing and moulding. A typical sweet chocolate contains 42% chocolate liquor, 42% sugar and 16% added cocoa butter. The finer qualities of sweet chocolate are further processed to improve and develop their flavour in machines known as "Conges." This processing may take up to 96 hours. After the processing, the sweet chocolate is cooled and moulded into cakes for use by the candy industry as a coating for centres or it may be cast directly into small bars suitable for eating.

Milk chocolate is sweet chocolate in which the flavour has been modified by the addition of whole milk solids. The U.S. standard calls for a minimum of 12% whole milk solids, but most good quality chocolates may contain as much as 20 to 22% whole milk solids.

The cocoa butter required for the manufacture of sweet chocolate is obtained by pressing chocolate liquor.

Sweet chocolate in block form is recognized as a compact and valuable foodstuff. Blocks or bars are sold plain and in combination with nuts and fruits. During World War II, the high food value of chocolate was recognized through its use by the armies as an emergency ration, and at sea as a lifeboat ration. It is unique among foods because of its high calorific value combined with small bulk.

Because of shipping shortages in World War II, it was rationed in Great Britain and the United States. The method employed in the U.S. was to limit the quantity which manufacturers could grind to a fraction of the amount which the same manufacturer had ground in 1941. This fraction was changed from time to time as was found necessary to maintain a reserve stock of cocoa beans in the U.S.

Chocolates or Chocolate-covered Confectionery.—Chocolate is used for covering all manner of confections. It is prepared by the methods outlined above, but more cocoa butter is added to make it flow readily. The best work is done by hand: the vanilla crême, caramel or other confection is laid on a fork and dipped beneath the molten chocolate and then turned on to a sheet of paper. A mechanical coverer or "enrober" invented in 1903 is much used; in this machine the crêmes move on a woven wire band through a cascade of liquid chocolate.

Production of Chocolate and Cocoa Trades.—According to the United States biennial census of manufactures of 1940 the total values of products of manufactures of chocolate and cocoa was $99,018,203. Of this amount, $39,516,767 represented the value of 216,821,762 lb. of chocolate (not including chocolate coatings); $32,194,541 the value of 339,530,664 lb. of chocolate coatings; $13,199,965 the value of 153,440,919 lb. of powdered cocoa; $6,880,433 the value of 57,205,043 lb. of cocoa butter; and $1,159,041 the value of other products, chiefly chocolate and cocoa specialties. In the 39 reporting establishments there were 6,464 wage earners, who received $7,711,129 in wages. During the calendar year ending Dec. 31, 1939, the United States imported 545,010,374 lb. of raw cocoa, valued at $28,547,394; of prepared cocoa (not including confectionery), 3,587,000 lb., valued at $432,000. The United Kingdom imported 147,298 tons of raw cocoa valued at $16,076,714 in 1938, of which 78,130 tons were retained for home consumption. For the general facts of the industry, see COCOA, INDUSTRY AND TRADE; CONFECTIONERY MANUFACTURE.

BIBLIOGRAPHY.—*See* for cacao cultivation: J. H. Hart, *Cacao* (1911) and C. J. J. van Hall, *Cocoa* (1914). For chemistry and manufacture *see:* R. Whymper, *Cocoa and Chocolate* (1921). A popular work on cultivation and manufacture is A. W. Knapp, *Cocoa and Chocolate* (1920). On pp. 191–203 is a full bibliography.

(A. W. KN.; X.)

CHOCTAW, a prominent tribe in southern Mississippi, of Muskogi stock (*see* MUSKOGIAN INDIANS). Their name is apparently a corruption of the Spanish *chato,* flattened, which referred to their practice of flattening the heads of male infants. They farmed intensively. The Choctaws were allies of the French, enemies of the British and of most of the Muskogians. In the later 18th century they began drifting west of the Mississippi, and about 1832 the majority moved to what is now eastern Oklahoma, where they remained self-governing and semi-civilized until their absorption into American citizenship in 1906. They number about 17,500 exclusive of Negro freedmen included in the "nation," but include many of mixed blood; the original population seems to have been only slightly larger.

CHODKIEWICZ, JAN KAROL (1560–1621), Polish general. In 1599 he was appointed *starosta* of Samogitia, and in 1600 acting commander-in-chief of Lithuania. In the war against Sweden for the possession of Livonia he repulsed the duke of Sudermania, afterwards Charles IX, from Riga, and in 1604 captured Dorpat. At Kirkholm (Aug. 27, 1605) he annihilated a large Swedish army; but he was hampered always by the Polish diet which denied him adequate supplies, and after helping to defeat the rebels in Poland and to relieve Riga when the Swedes again invaded Livonia, he was sent against Moscow with an army which mutinied for lack of pay and was compelled to retreat to Smolensk. On being reinforced by Prince Wladislaus, however, he took the fortress of Drohobu in 1617, and on the conclusion of the Muscovite war by the treaty of Deulina he was sent to defend the southern frontier against the Turks. He died on Sept. 24, 1621, after forcing the Ottoman army to raise the siege of Khotin.

See Adam Stanislaw Naruszewicz, *Life of J. K. Chodkiewicz* (Pol.) 4th ed. (Cracow, 1857–58); Lukasz Golebiowski, *The Moral Side of J. K. Chodkiewicz as indicated by his Letters* (Pol.) (Warsaw, 1854).

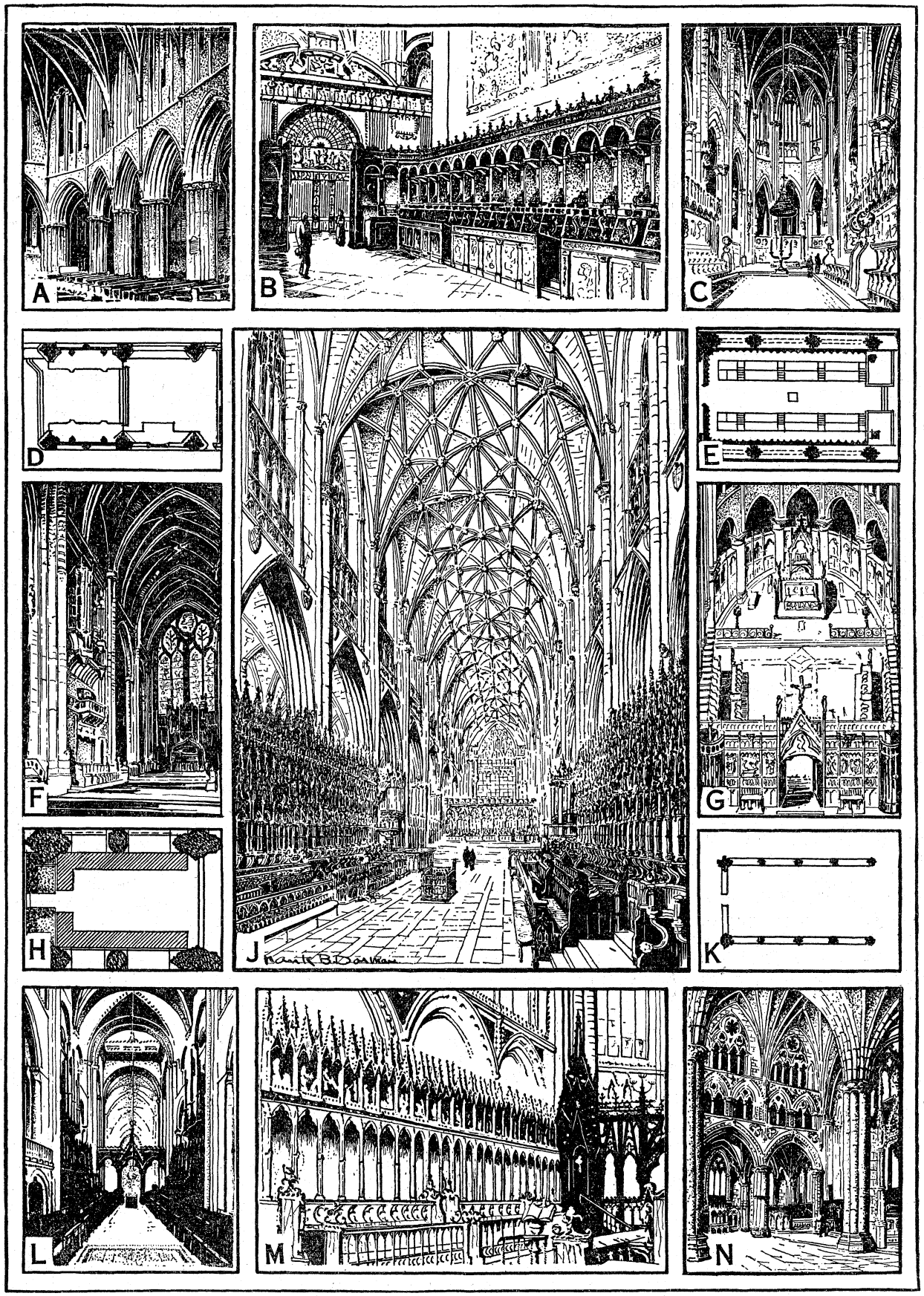
CHODOWIECKI, DANIEL NICOLAS (1726–1801), German genre painter and engraver of Polish descent, was born at Danzig on Oct. 13, 1726, and died at Berlin on Feb. 7, 1801. He began engraving in 1758. After designing and engraving several subjects from the story of the Seven Years' War, Chodowiecki produced the famous "History of the Life of Jesus Christ," a set of admirably painted miniatures, which made him popular at once. Few books were published in Prussia for some years without plate or vignette by Chodowiecki. The catalogue of his works (Berlin, 1814) includes over 3,000 items, the most famous being the picture of "Jean Calas and his Family." He became director of the Berlin Academy in 1797. The title of the German Hogarth was disclaimed by Chodowiecki himself. He actually had only one point in common with Hogarth—the practice of representing actual life and manners.

See Von Oettingen, *Daniel Chodowiecki* (1895).

CHOERILUS. (1) An Athenian tragic poet, who exhibited plays as early as 524 B.C. He was said to have competed with Aeschylus, Pratinas, and even Sophocles. According to F. G. Welcker, however, the rival of Sophocles was a son of Choerilus, who bore the same name. Suidas states that Choerilus wrote 150 tragedies and gained the prize 13 times. His works are all lost; only Pausanias (i, 14) mentions a play by him entitled *Alope.* Choerilus was also said to have introduced considerable improvements in theatrical masks and costumes.

See A. Nauck, *Tragicorum Graecorum Fragmenta* (1889); F. G. Welcker, *Die griechischen Tragödien,* pp. 18, 892.

(2) An epic poet of Samos who flourished at the end of the 5th century B.C. After the fall of Athens he settled at the court of Archelaus, king of Macedonia, where he was the associate of Agathon, Melanippides and Plato, the comic poet. The only work that can with certainty be attributed to him is the Περσηίς or Περσικά, a history of the struggle of the Greeks against Persia. The treatment of contemporary events was a new departure in epic; he apologizes in the introductory verses (preserved in the scholiast on Aristotle, *Rhetoric,* iii, 14). The *Perseis* was at first successful, but later critics reversed this favourable judgment. Aristotle (*Topica,* viii, I) calls Choerilus's comparisons farfetched and obscure, and the Alexandrians displaced him by Anti-



A, PERSHORE ABBEY, ENGLISH DECORATED GOTHIC (14TH CENTURY); B, THE CERTOSA, PAVIA, ITALIAN RENAISSANCE; C, HALBERSTADT CATHEDRAL, GERMAN GOTHIC (14TH–15TH CENTURIES). D, F, CHOIR, LIVERPOOL CATHEDRAL, MODERN ENGLISH GOTHIC; E, J, CHOIR, YORK CATHEDRAL, ENGLISH DECORATED GOTHIC (14TH CENTURY); G, RESTORATION OF 13TH CENTURY STATE OF THE CHOIR OF NOTRE DAME, PARIS, FRENCH GOTHIC; H, L, CHOIR OF DURHAM CATHEDRAL, ENGLISH ROMANESQUE AND GOTHIC (STALLS, 17TH CENTURY; SCREEN, 19TH CENTURY). K, CHOIR, LINCOLN CATHEDRAL, EARLY ENGLISH GOTHIC (12TH–13TH CENTURIES); M, CHOIR STALLS, ELY CATHEDRAL, ENGLISH DECORATED GOTHIC (14TH CENTURY); N, RETRO CHOIR ("ANGELS CHOIR") LINCOLN CATHEDRAL (13TH CENT.)

machus in the canon of epic poets.

G. Kinkel, *Epicorum Graecorum Frag.* i. (1877); for another view of his relations with Herodotus *see* Müder in *Klio* (1907), 29–44.

(3) An epic poet of Iasus in Caria, who lived in the 4th century B.C. He accompanied Alexander the Great on his campaigns as court-poet. He is well known from the passages in Horace (*Epistles,* ii. 1, 232; *Ars Poëtica,* 357), according to which he received a piece of gold for every good verse he wrote in honour of the deeds of his master.

See G. Kinkel, *Epicorum Graecorum Fragmenta,* i. (1877); A. F. Näke, *De Choerili Samii Aetate Vita et Poësi aliisque Choerilis* (1817), where the above poets are carefully distinguished; and the articles in Pauly-Wissowa's *Realencyklopädie,* iii. 2 (1899).

CHOEROBOSCUS, GEORGIUS, also called CHARTOPHYLAX (*c.* A.D. 60), deacon and professor at the oecumenical school at Constantinople. A course of his lectures on grammar has come down to us in the shape of notes taken by his pupils. He drew from the best authorities—Apollonius Dyscolus, Herodian, Orion, Theodosius of Alexandria. These lectures were much used by Constantine Lascaris in his Greek grammar and by Urban of Belluno (end of 15th century). Other works: commentary on the canons of Theodosius on declension and conjugation, which is extant; a treatise on orthography, of which a fragment (on quantity) has been preserved; a tract on prosody; commentaries on Hephaestion and Dionysius Thrax; and grammatical notes on the Psalms.

BIBLIOGRAPHY.—*See* A. Hilgard, *Grammatici Graeci,* iv. (1889–94), containing the text of the commentary on Theodosius and a full account of the life and writings of Choeroboscus; L. Kohn in Pauly-Wissowa's *Realencyklopädie,* iii. 2 (1889); C. Krumbacher, *Geschichte der byzantinischen Literatur* (1897); Reitzenstein, *Etymologika,* 190, n. 4.

CHOIR, the body of singers who perform the musical portion of the service in a church, or the place set apart for them (O.F. *cuer* from Lat. *chorus,* Fr. *choeur*). Any organized body of singers performing full part choral works or oratorios is also called a choir. The word was originally applied to all the clergy taking part in services of the church.

In English cathedrals the choir is composed of men (vicars-choral or lay clerks) and boys (choristers). They are divided into two sets, sitting on the north and south side of the chancel respectively, called *cantoris* and *decani* from being on the same side as the *cantor* (precentor) or the *decanus* (dean). Surpliced choirs of women have occasionally been introduced, notably in the United States and the British colonies, but the practice has no warrant of traditional usage. (*See* VESTMENTS.) In England at the Reformation the choir services (Mattins, Evensong) replaced the Mass as the principal popular services, and, in general, only the choir vestments were retained in use. In the English cathedrals the members of the choir often retain privileges reminiscent of an earlier definite ecclesiastical status.

In architecture, (1) any part of a church intended for choir use, and (2), more commonly, the eastern end of a church, almost synonymous with chancel (*q.v.*). In developed churches of the middle ages, the choir is just to the west of the altar rail, usually between that and the crossing, although in some churches of England and Spain the space extends well into the nave (*q.v.*). In some modern churches members of the choir are placed in a western gallery; in Non-conformist churches they are frequently placed over and behind the pulpit. The choir stalls of Gothic churches such as Amiens, Exeter, Lincoln are works of great richness. In the illustration, Figure A. is from Gardner, *A Guide to English Gothic Architecture,* permission of the Cambridge University Press; C. and N. are by permission from Sir Banister Fletcher, *History of Architecture on the Comparative Method,* 8th ed. 1928 (Batsford); F. from Atkinson and Bagenal, *Theory and Elements of Architecture,* permission of Benn & Co.; L. from Greenwell, *Durham Cathedral,* permission of Andrews & Co. (*See* also CHORAL SINGING; FESTIVALS, MUSICAL.)

CHOISEUL, CÉSAR, DUC DE (1598–1675), French marshal and diplomatist, known for the best part of his life as the marshal du Plessis-Praslin, came of the old French family of Choiseul, which arose in the valley of the Upper Marne in the 10th century. Entering the army he took part in the siege of La Rochelle, assisted to defend the island of Ré against the duke of Buckingham, and accompanied the French forces to Italy in 1629. In 1630 he was appointed ambassador at the court of the duke of Savoy, and was engaged in diplomatic and administrative work in Italy till 1635, when war was declared between France and Spain. Plessis-Praslin distinguished himself in the Italian campaign which followed, and after further service in Italy he was made a marshal of France (1645). During the first War of the Fronde he assisted Condé in the brief siege of Paris; and in the second war, remaining loyal to the queen-regent and the court party, he defeated Turenne and the allied Spaniards and rebels at Rethel (or Blanc-Champ) in 1650. He became minister of state in 1652, and in November 1665 was created duc de Choiseul. He was concerned in some of the negotiations between Louis and Charles II. of England which led to the Treaty of Dover, and died in Paris on Dec. 23, 1675.

CHOISEUL, ÉTIENNE FRANÇOIS, DUC DE (1719–1785), French statesman, was the eldest son of François Joseph de Choiseul, marquis de Stainville (1700–1770), and bore in early life the title of comte de Stainville. Born on June 28, 1719, he entered the army, and during the War of the Austrian Succession served in Bohemia in 1741 and in Italy, where he distinguished himself at the battle of Coni, in 1744. From 1745 until 1748 he was with the army in the Low Countries, being present at the sieges of Mons, Charleroi, and Maestricht. He acquired a large fortune by his marriage in 1750 with a daughter of the marquis de Châtel.

Choiseul gained the favour of Madame de Pompadour, and was given the appointment of ambassador to Rome in 1753, where he was entrusted with the negotiations concerning the disturbances called forth by the bull *Unigenitus.* In 1757 his patroness obtained his transfer to Vienna, where he was instructed to cement the new alliance between France and Austria. He then replaced Antoine Louis Rouillé (1689–1761) as minister for foreign affairs, and therefore had the direction of French foreign policy during the Seven Years' War. At this time he was made a peer of France and created duc de Choiseul. Although from 1761 until 1766 his cousin César, duc de Choiseul-Praslin, was minister for foreign affairs, yet Choiseul continued to control the policy of France until 1770, and during this period held most of the other important offices of state. As the author of the "Family Compact" he sought to retrieve by an alliance with the Bourbon house of Spain the disastrous results of the alliance with Austria, but his action came too late. He reformed both the army and navy, and although too late to prevent the loss of Canada and India, he developed French colonies in the Antilles and San Domingo, and added Corsica and Lorraine to the crown of France. His management of home affairs in general satisfied the *philosophes.* He allowed the publication of the *Encyclopédie* and procured the banishment of the Jesuits and the temporary abolition of the order by Pope Clement XIV.

Choiseul's fall was caused by his action towards the Jesuits, and by his support of their opponent La Chalotais, and of the provincial parlements. After the death of Madame de Pompadour in 1764, his enemies, led by Madame du Barry and the chancellor Maupeou, were too strong for him, and in 1770 he was ordered to retire to his estate at Chanteloupe. Greatly to his disappointment Louis XVI. did not restore him to his former position, although the king recalled him to Paris in 1774, where he died on May 8, 1785.

BIBLIOGRAPHY.—P. Calmettes, *Choiseul et Voltaire* (1902); G. Mangras, *Le duc et la duchesse de Choiseul* (1902) and *La disgrace du duc et de la duchesse de Choiseul* (1903); *Memoires du duc de Choiseul,* ed. F. Calmettes (1904); A. Bourguet, *Le duc de Choiseul et l'alliance espagnal* (1906) and *Études sur la politique étrangère du duc de Choiseul* (1907). *See* also *Cambridge Modern History,* Bk. vi.

CHOISY, FRANÇOIS TIMOLEON, ABBÉ DE (1644–1724), French author, was born in Paris on Aug. 16, 1644, and died in Paris on Oct. 2, 1724. His father was attached to the household of the duke of Orleans, and the lad became famous in court circles for his extravagance, his adoption of female dress and his numberless intrigues. He had been made an abbé in his childhood,

and poverty drove him to live on his benefice at Sainte-Seine in Burgundy, where he found a kindred spirit in Bussy-Rabutin. He visited Rome in the suite of the cardinal de Bouillon in 1676, and shortly afterwards a serious illness brought about a sudden conversion. In 1685 he accompanied the chevalier de Chaumont on a mission to Siam. He was ordained priest, and received various ecclesiastical preferments. He wrote voluminous historical works, but is remembered by his gossiping *Mémoires* (1737), which contain remarkably exact portraits of his contemporaries, although he has otherwise small pretensions to historical accuracy.

The *Mémoires* passed through many editions, and were edited in 1888 by M. de Lescure. Some admirable letters of Choisy are included in the correspondence of Bussy-Rabutin. Choisy is said to have burnt some of his indiscreet revelations, but left a considerable quantity of unpublished ms. Part of this material, giving an account of his adventures as a woman, was surreptitiously used in an anonymous *Histoire de madame la comtesse de Barres* (Antwerp, 1735), and again with much editing in the *Vie de M. l'abbé de Choisy* (Lausanne and Geneva, 1742), ascribed by Paul Lacroix to Lenglet Dufresnoy; the text was finally edited (1870) by Lacroix as *Aventures de l'abbé de Choisy*. *See* also Sainte-Beuve, *Causeries du lundi*, vol. iii.

CHOKE BORE, the bore of a gun narrowed at the muzzle to concentrate the shot.

CHOKE-DAMP, also known as "black-damp" and "stythe," is a mixture of carbon dioxide and nitrogen, pure choke-damp according to Dr. J. Haldane, containing about 13% of the former and 87% of the latter; but probably the relative proportions are variable. Choke-damp, which in this connection is more frequently known as "stythe," is found in old, abandoned, or worked portions of the mines—especially wet mines—where the ventilation is stagnant, and on the occasion of a fall in the atmospheric pressure emerges from the "wastes" ("goaves") and makes its appearance in the workings, and, being heavier than air, lies along the floor of the mine gradually ascending as it increases in volume.

Choke-damp is the result of the absorption of the oxygen in the air by the coal substance in the mine and the formation of carbon dioxide in the process; it is also produced by the decay of timber, the breathing of men and animals, the burning of lamps and candles, and the firing of explosives. Spontaneous combustion, or self-heating of coal, which is a characteristic of some coal mines, is merely the rapid absorption of oxygen by the coal, which produces carbon dioxide and carbon monoxide in the process.

Carbon monoxide is known to miners as "white-damp" but is present only in minute quantities in the mine. It is the result of incomplete combustion, may be caused by the exploding of gunpowder and other explosives, and is always present in the "after-damp" resulting from an explosion of fire-damp or of coal dust.

Whereas carbon dioxide, if present in sufficient quantity, extinguishes light and life mainly by suffocation, carbon monoxide, if present in the air to an extent greater than 1%, can be detected by a cap on the ordinary flame of a safety lamp. It is a virulent poison, its destructive effect being due to its action on the haemoglobin of the blood with which it chemically combines, robbing the body of its oxygen. But haemoglobin when saturated with carbon-monoxide cannot take up oxygen. An atmosphere containing as low as 0·2% of the dangerous gas will cause in time complete helplessness and loss of consciousness. An analysis of after-damp made by Dr. Bedson after the Usworth explosion (County Durham) in 1885 showed it to contain—

	%
Carbon dioxide (CO_2)	4·54
Carbon monoxide (CO)	2·48
Methane (CH_4 the chief constituent of fire-damp)	8·68
Oxygen	7·23
Nitrogen	76·80

Analyses of after-damp by Mr. W. I. Orsman in 1892 showed it to be composed of—

	%
Oxygen	3·9
Nitrogen	75·9
Carbon dioxide	12·1
Carbon monoxide	8·1

The bodies of persons killed by after-damp in which carbon monoxide was the fatal agent, present a pink and healthy look due entirely to its coloration effect, and *rigor mortis* is not present.

(R. R.)

CHOKING, the obstruction of a passage. In animals choking is an obstruction of the windpipe (*see* TRACHEA) and may lead to suffocation (*see* TRACHEOTOMY). In electricity, a *choking coil* is designed so that it will pass alternating currents of low but not of high frequencies (*see* RADIO RECEIVER).

In internal combustion engines (*q.v.*) a *choke-tube* is a constriction in a pipe, which increases the velocity of the fluid in its neighbourhood and thus reduces the pressure (*see* HYDROMECHANICS: *Hydrodynamics*); this results in the liquid from the carburettor being sucked into the tube.

CHOLERA, the name formerly given to two distinct diseases, acute infective enteritis and Asiatic cholera but now restricted to Asiatic cholera alone. Although essentially different in causation and pathological relationships, these two diseases may in individual cases present many symptoms of resemblance.

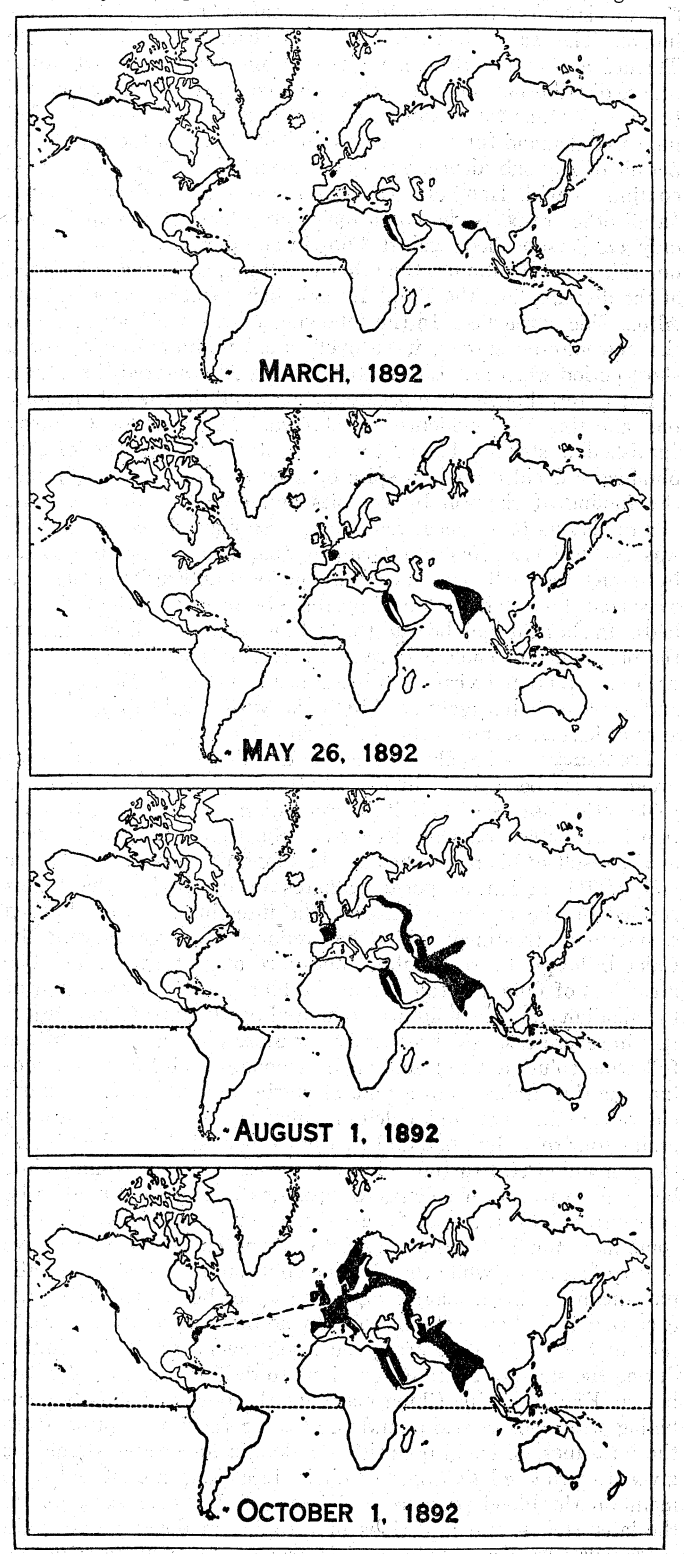
Acute Infective Enteritis (synonyms, *cholera nostras, simple cholera, Cholera Europaea, British Cholera, Summer* or *Autumnal Cholera*) is the cholera of old medical writers. Its occurrence in an epidemic form was noticed in the 16th century. The chief symptoms in well-marked cases are vomiting and purging occurring either together or alternately. The seizure is usually sudden and violent. The diarrhoea is attended with severe griping abdominal pain, while cramps affecting the legs or arms greatly intensify the suffering. In unfavourable cases, particularly where the disorder is epidemic, death may result within 48 hours. Generally, however, the attack is arrested and recovery soon follows, although irritability of alimentary canal may remain for some time, rendering necessary the utmost care in diet. Attacks of this kind are frequent in summer and autumn in almost all countries. Occasionally the disorder prevails so extensively as to constitute an epidemic. The exciting cause conveyed by food or water is bacterial, *B. Enteritidis* (Gaertner) or an allied form being responsible for the majority of cases. The symptoms are those of toxic poisoning and collapse from loss of fluid. Hence the resemblance to Asiatic cholera.

Treatment.—Vomiting and diarrhoea are natural means whereby the harmful material is ejected, but if excessive must be controlled by opiates. Ice and effervescing drinks quench thirst and subdue sickness. Counter-irritation by mustard or turpentine over the abdomen is of use, as is friction with the hands where cramps are present. Food should be whey or albumin water. In young children reliance is placed on chalk and starch enemata; opium is dangerous.

Asiatic Cholera (synonyms, *Malignant Cholera, Indian Cholera, Epidemic Cholera, Algide Cholera*) is one of the most severe and fatal diseases. Three stages are usually described but often they cannot be distinguished. The first stage is characterized by mild and painless diarrhoea. This generally lasts for two or three days, and then may gradually subside or pass into the more severe phenomena characteristic of the second stage, or may itself prove fatal. This stage may pass unnoticed.

The second stage is that of collapse or the algide or asphyxial stage. Not infrequently this stage is the first to manifest itself. Often it starts suddenly in the night with diarrhoea of the most violent character, the matters discharged being whey-like ("rice-water" stools). They contain large quantities of disintegrated epithelium from the mucous membrane of the intestines. The discharge, which is at first unattended with pain, is soon succeeded by copious vomiting of matters similar to those passed from the bowels, accompanied by severe pain at the pit of the stomach, and intense thirst. The symptoms now advance with rapidity. Agonizing cramps of the legs, feet and abdominal muscles and signs of collapse supervene. The surface of the body becomes cold and blue or purple, the skin is dry and wrinkled, the features are pinched and the eyes deeply sunken, the pulse at the wrist is imperceptible, and the voice is reduced to a hoarse whisper. There is complete suppression of the urine. In this condition death often occurs in less than one day, but in epidemics cases are frequently observed where the collapse is so sudden and complete as to prove fatal in one or two hours even without any great

amount of previous purging or vomiting. In most instances the mental faculties are comparatively unaffected, although towards the end there is in general more or less apathy. Reaction, however, may take place, and this constitutes the third stage. It



MERCATOR PROJECTIONS OF THE WORLD SHOWING THE SPREAD OF CHOLERA IN THE EPIDEMIC OF 1892

consists in arrest of the alarming symptoms characterizing the second stage, and gradual but evident improvement in the patient's condition. The urine may remain suppressed for some time, and on returning is often albuminous. Even in this stage, however, the danger is not past, for fatal relapses sometimes occur or reaction may be so imperfect that death from exhaustion may occur two or three weeks from the commencement of the illness.

The bodies of persons dying of cholera remain long warm, and the temperature may even rise after death. Peculiar muscular contractions have been observed after death, so that the position of the limbs may become altered. The soft tissues are dry and hard, and the muscles dark brown. The blood is tarry in character. The upper portion of the small intestines is generally found distended with the rice-water discharges, the mucous membrane is swollen, and there is extensive loss of its epithelium. The kidneys are usually in a state of acute congestion.

The cause of Asiatic cholera is a micro-organism identified by Koch in 1883 (*see* PARASITIC DISEASES). For some years it was called the "comma bacillus," but it was subsequently found to be a vibrio, not a bacillus. Apparently there are many strains of the vibrio which differ widely in toxicity and other characters. Probably this explains the great variations in epidemics.

Cholera is endemic in the East from Bombay to southern China, but its chief home is British India. It principally affects the alluvial soil near the mouths of the great rivers, particularly the delta of the Ganges. Lower Bengal is pre-eminently the standing focus and centre of diffusion. In some years it is quiescent, though never absent; in others it passes its natural boundaries and is carried east, north and west, it may be to Europe or America. The micro-organism is carried chiefly by infected persons moving from place to place; but soiled clothes, rags and other articles that have come into contact with persons suffering from the disease may be the means of conveyance to a distance. There is no reason to suppose that it is air-borne, or that atmospheric influences have anything to do with its spread, except in so far as meteorological conditions may be favourable to the growth and activity of the micro-organisms. Beyond all doubt, the great culture ground of the vibrio is the human body, and the discharges from it are the great source of contagion. They may infect the ground, the water, or the immediate surroundings of the patient, the poison finding entrance into the bodies of the healthy by means of food and drink which have become contaminated in various ways, *e.g.* by flies. Of all the means of local dissemination, contaminated water is the most important, because it affects the greatest numbers, particularly in places with a public water-supply. All severe outbreaks of an explosive character are due to this cause. It is also possible that the cholera poison multiplies rapidly in water under favourable conditions, and that a reservoir, for instance, may form a sort of forcing-bed. But it would be a mistake to regard cholera as purely a water-borne disease, even locally. It may infect the soil in localities which have a perfectly pure water-supply, but have defective drainage or no drainage at all, and then it will be found more difficult to get rid of, though less formidable in its effects, than when the water alone is the source of mischief. In all these respects it has a great affinity to enteric fever. With regard to locality, no situation is secure against attack if the disease is introduced and the sanitary conditions are bad; but, speaking generally, low-lying places on alluvial soil near rivers are more liable than those standing high or on a rocky foundation. Of meteorological conditions it can only be said with certainty that a high temperature favours the development of cholera, though a low one does not prevent it. In temperate climates the summer months, and particularly August and September, are the season of its greatest activity.

Cholera spreads westwards from India by two routes—(1) by sea to the shores of the Red sea, Egypt and the Mediterranean; and (2) by land to northern India and Afghanistan, thence to Persia and central Asia, and so to Russia. In the great invasions of Europe during the 19th century it sometimes followed one route and sometimes the other. An Indian epidemic of 1817 reached Europe by way of Persia and Russia in 1830 and extended to America. Another of 1841 followed the same track and reached Europe and America in 1847. A third took place in the East in 1850 and entered Europe in 1853; this epidemic was specially severe throughout North and South America. Other epidemics visiting Europe occurred in 1866, 1869–74, 1883–87; these travelled by way of the Mediterranean. The epidemic of 1892–95 reverted to the overland route and travelled with unprecedented

rapidity. Within less than five months it travelled from the North-West provinces of India to St. Petersburg (Leningrad) and probably to Hamburg, and thence in a few days to England and the United States. During the period of 1910–25 cholera continued to be widely prevalent in India, and the recorded mortality exceeded 500,000 in both 1918 and 1919, when the disease was also epidemic in China, but, with the exception of moderate prevalence in eastern and southern Europe, including Italy in 1911, there has been little spread to Europe. Bengal maintains its unenviable reputation as the home of cholera.

Prevention.—The great invasion of 1892–95 was fruitful in lessons for the prevention of cholera. It proved that the one real and sufficient protection lies in a standing condition of good sanitation backed by an efficient and vigilant sanitary administration. The experience of Great Britain where the deaths per 10,000 living were less than 0·05 was a remarkable piece of evidence, but that of Berlin was perhaps even more striking, for Berlin lay in the centre of four fires, in direct and frequent communication with Hamburg, Russia, France and Austria, and without the advantage of a sea frontier. Cholera was repeatedly brought into Berlin, but never obtained a footing, and its successful repression was accomplished without any irksome interference with traffic or the ordinary business of life. The general success of Great Britain and Germany in keeping cholera in check by ordinary sanitary means completed the conversion of all enlightened nations to the policy laid down so far back as 1865 by Sir John Simon, and advocated by Great Britain at a series of international congresses—the policy of abandoning quarantine, which Great Britain did in 1873, and trusting to sanitary measures with medical inspection of persons arriving from infected places. This principle was formally adopted at the international conference held at Dresden in 1893, at which a convention was signed by the delegates of Germany, Austria, Belgium, France, Great Britain, Italy, Russia, Switzerland, Luxembourg, Montenegro and the Netherlands. Under this instrument the practice is broadly as follows, though the procedure varies a good deal in different countries: Ships arriving from infected ports are inspected, and if healthy are not detained, but bilge-water and drinking-water are evacuated, and persons landing may be placed under medical supervision without detention; infected ships are detained only for purposes of disinfection; persons suffering from cholera are removed to hospital; other persons landing from an infected ship are placed under medical observation, which may mean detention for five days from the last case; or, as in Great Britain, supervision in their own homes, for which purpose they give their names and places of destination before landing. All goods are freed from restriction, except rags and articles believed to be contaminated by cholera matters. By land, passengers from infected places are similarly inspected at the frontiers and their luggage "disinfected," only those found suffering from cholera can be detained. Each nation is pledged to notify the others of the existence within its own borders of a "focus" of cholera. The precise interpretation of the term is left to each government, and is treated in a rather elastic fashion by some, but it is generally understood to imply the occurrence of non-imported cases in such a manner as to point to the local presence of infection. The question of guarding Europe generally from the danger of diffusion by pilgrims through the Red sea was settled at another conference held in Paris in 1894. The provisions agreed on included the inspection of pilgrims at ports of departure, detention of infected or suspected persons, and supervision of pilgrim ships and of pilgrims proceeding overland to Mecca.

The substitution of the procedure above described for the old measures of quarantine and other still more drastic interferences with traffic presupposes the existence of a sanitary service and fairly good sanitary conditions if cholera is to be effectually prevented. No doubt if sanitation were perfect in any place or country, cholera, along with many other diseases, might there be ignored, but sanitation is not perfect anywhere, and therefore it requires to be supplemented by a system of notification with prompt segregation of the sick and destruction of infective material. Of general sanitary conditions the most important is unquestionably the water-supply. The classical example is Hamburg. The water-supply is obtained from the Elbe, which became infected by some means not ascertained. The drainage from the town also runs into the river, and the movement of the tide was sufficient to carry the sewage matter up above the water-intake. The water itself, which is no cleaner than that of the Thames at London Bridge, underwent no purification whatever before distribution. It passed through a couple of ponds, supposed to act as settling tanks, but owing to the growth of the town and increased demand for water it was pumped through too rapidly to permit of any subsidence. On the other hand, at Altona, which is continuous with Hamburg, the water was filtered through sand. In all other respects the conditions were identical, yet in Altona only 328 persons died, against 8,605 in Hamburg. In some streets one side lies in Hamburg, the other in Altona, and cholera stopped at the dividing line, the Hamburg side being full of cases and the Altona side untouched. In the following year, when Hamburg had the new filtered supply, it enjoyed equal immunity, save for a short period when raw Elbe water accidentally entered the mains.

But water, though the most important condition, is not the only one affecting the incidence of cholera. The case of Grimsby furnished a striking lesson to the contrary. Here the disease obtained a decided hold, in spite of a pure water-supply, through the fouling of the soil by cesspits and defective drainage. At Havre also its prevalence was due to a similar cause. Further, it was conclusively proved at Grimsby that cholera can be spread by sewage-fed shell-fish. Several of the local outbreaks in England were traced to the ingestion of oysters obtained from the Grimsby beds. In short, it may be said that all insanitary conditions favour the prevalence of cholera in some degree. Preventive inoculation with an attenuated virus was introduced by W. M. W. Haffkine, and has been extensively used in India, with considerable appearance of success so far as the statistical evidence goes.

Treatment.—Happily, during the decades 1905–25, important progress has been made in the treatment of cholera, which has robbed the disease of half its terrors when hospital accommodation is available. Leonard Rogers of the Indian medical service, as the result of his researches on the blood changes in the disease and of the action of permanganates in destroying the toxins formed by the cholera vibrios in the intestines, has established a system of treatment which has reduced the mortality in the Calcutta hospital cases to about one-third of its former rate. The great loss of fluid and salts from the blood, and the reduction of the alkalinity of that fluid are combated by the intravenous injection in severe cases of three to five or more pints at a time of the following solutions: (1) sodium bicarbonate grains 160 and sodium chloride grains 90 in a pint of sterile water, and (2) sodium chloride grains 120 and calcium chloride (as a cardiac tonic) grains four to a pint; one pint of the former alkaline solution and the remaining two to four pints of the second hypertonic saline being given whenever collapse occurs, or the blood is found to be concentrated by the specific gravity test; 20 to 30 pints being sometimes administered successfully in the course of a few days in very bad cases, while the alkaline solution is also given in half-pint quantities in enemata every two to four hours until the renal excretion is fully re-established. In addition two permanganate pills of two grains each are given orally every 15 to 30 minutes during the stage of acute evacuations to destroy the toxins in the bowel. Kaolin, or fine China clay, has the power of loosely combining with cholera toxins and preventing their absorption from the intestines, so equal quantities of kaolin and water should be given to drink *ad libitum*. Pituitrin injections are of value to maintain the blood pressure and increase the renal secretion in the later stages, and injections of atropine in doses 1/100 grain twice a day are also of value as first suggested by Lauder Brunton. As the cramps and other symptoms are immediately relieved by the saline injections, opium is unnecessary and should never be given in any stage of cholera, as it strongly predisposes to fatal suppression of urine.

By these methods the mortality in over 1,000 severe cases in the Calcutta cholera ward over a number of years past has been reduced from 60% to 20% and equally good results were obtained

in China in 1919. In the Bombay and Central Provinces the administration of large quantities of permanganate pills in outbreaks in villages remote from hospitals has reduced the death-rate one-half to one-third of that in untreated cases in the same epidemics, although the severest types require intravenous salines in addition if life is to be saved. The great paucity of skilled medical men in Indian villages alone prevents greater saving of life by these methods, and prevention, especially by good water supplies and greater sanitary control of cholera-spreading places of pilgrimage within the endemic areas of the disease in Lower Bengal and south-east Madras, together with the compulsory inoculation against cholera of all pilgrims before being allowed to return to their homes from cholera areas, should be generally adopted without further loss of time if this very serious cause of mortality in India is to be reduced, as it well might be, and Europe saved from further pandemics of cholera.

See *Local Government Board Reports, 1892–93–94–95;* Clemow, *The Cholera Epidemic of 1892 in the Russian Empire;* Wall, *Asiatic Cholera;* Notter, *Epidemiological Society's Transactions,* vol. xvii.; Emmerich and Gemünd, *München. med. Wochenschr.* (1904), pp. 1,086–1,157; Wherry, *Department of the Interior Bureau of Government Laboratories,* No. 19 (Oct., 1904, Manila); Wherry and M'Dill, *Ibid.* No. 31 (May, 1905, Manila).

CHOLET, a town of western France, capital of an arrondissement in the department of Maine-et-Loire, 33 mi. E.S.E. of Nantes. Pop. (1936) 21,636. Cholet stands on high ground on the right bank of the Maine, which is crossed by a 15th century bridge. Megalithic monuments are numerous in the neighbourhood. The town owes the rise of its prosperity to the settlement of weavers there by Edouard Colbert, count of Maulévrier, a brother of the great Colbert. It suffered severely in the War of La Vendée of 1793. A public garden occupies the site of the old castle. The town possesses a sub-prefecture, a tribunal of first instance, a chamber of commerce and a board of trade-arbitrators. There are granite quarries in the vicinity. The chief industries are the manufacture of linen and of preserved foods. Cholet is an important centre for the sale of fat cattle, sheep and pigs, for which Paris is the chief market.

CHOLON ("great market"), a town of French Indo-China, the largest commercial centre of Cochin-China, 3½ mi. S.W. of Saigon, with which it is united by railway, tramways, roads and canal. Cholon was founded by Chinese immigrants about 1780, and is situated on the *Arroyo Chinois* at the junction of the Lo-Gom and a canal. Its waterways are frequented by innumerable boats and lined in some places with native dwellings built on piles, in others by quays and houses built by the French, who have also carried out drainage schemes, installed electric lighting in the main streets and erected factories, schools, hospitals and administrative buildings. Its population is almost entirely Asiatic. In 1880 the population was 45,000; in 1936 it was about 145,000. Of these about half were Chinese, divided into congregations according to their place of origin. During the rice season the town is visited by a large floating population. Pre-1941 Cholon had a municipal council, composed of French, Annamese and Chinese traders. An administrator of native affairs, nominated by the governor, fills the office of mayor. The rice trade, almost monopolized by the Chinese, is the leading industry. Tanning, dyeing, copper-founding, glass, brick and pottery manufacture, stone working, timber-sawing and junk building are other industries.

CHOLONAN, a linguistic stock of South American Indians, so called from the Cholones, its most important tribe. The Cholonan Indians live in eastern Peru, between the eastern crest of the Andes and the upper Huallaga river, from the Monzon in the south to the Mayo in the north. Missions were established among them in the 17th century, so that they have now largely lost their original culture. They are sedentary agriculturists, and still retain the use of the blow-gun, widely distributed among the neighbouring tribes to the north and east. They live in cane-walled, thatched-roof houses, but, unlike their neighbours to the north and east, do not use the hammock for sleeping. They appear to have had elaborate puberty ceremonies for the young men.

See E. Poeppig, *Reise in Chile, Peru und auf dem Amazonenstrome,* etc. (Leipzig, 1835).

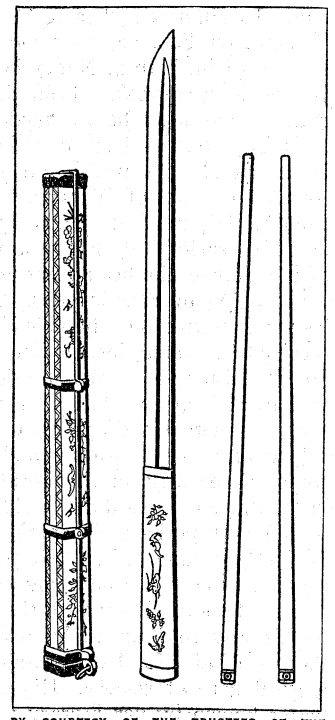
CHOLULA, an ancient town of Mexico, in the state and on the plateau of Puebla, eight miles by rail W. by N. of the city of that name, and situated about 6,912 ft. higher than sea level. Pop. (1940) 8,424. The Mexican national railway passes through Cholula, but the city's commercial and industrial standing is overshadowed by that of its larger, more modern neighbour. At the time of the Spanish conquest, Cholula—then known as Chololan—was a large and important town, consecrated to the worship of the god Quetzalcoatl, who had here one of the most imposing temples in Anahuac, built on the summit of a truncated pyramid, the largest of its kind in the world. This pyramid, constructed of sun-dried bricks and earth, 177ft. high, and covering an area of nearly 45ac., is the most conspicuous object in the town and was built probably as an imposing site for a temple. Nothing definite is known of its age and history, as the fanatical zeal of Cortés and his companions destroyed whatever historical data the temple may have contained. Cholula was visited by Cortés in 1519 during his eventful march inland to Montezuma's capital, Tenochtitlán, when he treacherously massacred its inhabitants and pillaged the city, pretending to distrust the hospitable inhabitants. Cortés estimated that the town then had 20,000 habitations, and its suburbs as many more, but this was undoubtedly a deliberate exaggeration. The Cholulans were of Nahuatl origin and were semi-independent, yielding only a nominal allegiance to Montezuma. They were a trading people, holding fairs, and exchanging their manufactures of textiles and pottery for other produce. The pyramid is believed to have been built by a people occupying this region before the Cholulans.

CHOPIN, FRÉDÉRIC FRANÇOIS (1810–1849), Polish musical composer and pianist, was born at Zelazowa-Wola, near Warsaw, on Feb. 22, 1810 (*not* Mar. 1, 1809). His father, of French origin, born at Nancy in 1770, had married a Polish lady, Justine Krzyzanowska. Frédéric was their third child. His first musical education he received from Adalbert Ziwny, a Czech musician, who is said to have been a passionate admirer of J. S. Bach. He also received a fair general education at the recently-founded Lyceum of Warsaw, where his father was professor of French. His musical genius opened to Chopin the best circles of Polish society, at that time unrivalled in Europe for its ease of intercourse, the beauty and grace of its women, and its liberal appreciation of artistic gifts. These early impressions were of lasting influence on Chopin's development. While at school he received thorough instruction in the theory of his art from Joseph Elsner, a learned musician and director of the conservatoire at Warsaw. When in 1829 he left his native town for Vienna, where his *début* as a pianist took place, he was in all respects a perfectly formed and developed artist. There is in his compositions little of that gradual progress which, for instance, in Beethoven, necessitates a classification of his works according to different periods. Chopin's individuality and his style were distinctly pronounced in that set of variations on "La ci darem" which excited the wondering enthusiasm of Robert Schumann. In 1831 he left Vienna with the intention of visiting London; but on his way to England he reached Paris and settled there for the rest of his life. Here again he soon became the favourite and musical hero of society. His connection with Mme. Dudevant, better known by her literary pseudonym of George Sand (*q.v*), is an important feature of Chopin's life. When in 1839 his health began to fail, George Sand went with him to Majorca, and it was mainly owing to her tender care that the composer recovered his health for a time. Chopin declared that the destruction of his relations with Mme. Dudevant in 1847 broke up his life. The association of these two artists has provoked a whole literature on the nature of their relations, of which the novelist's *Un Hiver à Majorque* was the beginning. The last ten years of Chopin's life were a continual struggle with the pulmonary disease to which he succumbed in Paris Oct. 17, 1849. The year before his death he visited England, where he was received with enthusiasm by his numerous admirers. Chopin died in the arms of his sister, who hastened from Poland to his death-bed. He was buried in the cemetery of Père Lachaise.

In looking through the list of Chopin's compositions, teeming

with mazurkas, valses, polonaises, and other forms of national dance music, one might hardly suppose that here one of the most melancholy natures revealed itself. This seeming paradox is explained by the type of Chopin's nationality, of which it has justly been said that its very dances are sadness intensified. Yet notwithstanding its strongly pronounced national characteristics, Chopin's music is always expressive of his individual feelings and sufferings in the highest possible degree. He is indeed the lyrical composer *par excellence,* and the intensity of his expression finds its equal in literature only in the songs of Heinrich Heine, to whom he has been so often likened. Such high-strung passion cannot be prolonged, and hence it was in works of small compass, such as the nocturne and the étude, that Chopin found the happiest expression of his genius. In compositions of larger scope he was out of his element, and even the beauty of his melodies and harmonies cannot wholly banish the impression of incongruity. Fortunately, he himself had an unerring sense of his own limitations, though there could be no greater mistake than to suppose that because he wrote in the smaller forms he was not, even so, one of the greatest of masters. Chopin's piano-playing was as exquisite as his music, and many accounts left by his contemporaries have testified to the irresistible fascination which he exercised by performances described as the last word in delicacy, subtlety and refinement.

It is well to sift the posthumous works from those published under Chopin's direction, for the last three mazurkas are the only things he did not keep back as misrepresenting him. On these principles his mature works are summed up in the 42 mazurkas (Opp. 6, 7, 17, 24, 30, 33, 41, 50, 56, 59, 63, and the beautiful contribution to the collection *Notre temps*); seven polonaises (Opp. 26, 40, 53, 61); 24 preludes (in all the major and minor keys), Op. 28, and the single larger prelude, Op. 45; 27 études (12 in Op. 10, 12 in Op. 25, and 3 written for the *Méthode des méthodes*); 18 nocturnes (Opp. 9, 15, 27, 32, 37, 48, 55, 62); 4 ballades, in forms of Chopin's own invention (Opp. 23, 38, 47, 52); 4 scherzos (Opp. 20, 31, 39, 54); 8 waltzes (Opp. 18, 34, 42, 64); and several pieces of various description, notably the great fantasia, Op. 49, and the impromptus, Opp. 29, 36, 51. The posthumous works number 35 pieces, besides a small volume of songs a few of which are of great interest.



BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

CHINESE CHOPSTICKS. TO THE LEFT IS A LONG, SLENDER KNIFE WITH ITS ENGRAVED CASE

The editions of Chopin's works by his pupil Mikuli and by Klindworth are full of valuable elucidation as to methods of performance, but unfortunately they do not distinguish the commentary from the text. The critical edition published by Breitkopf and Härtel, with all its mistakes, is absolutely necessary for students who wish to know what Chopin wished to put into the hands of players of independent judgment.

The Chopin literature is very extensive. The standard biography is the English work of Prof. F. Niecks (1888), while other leading works are those by Liszt, Karasowski and Huneker. *See* also W. H. Hadow, *Studies in Modern Music,* Henry Bidou, *Chopin* (1927) and G. Ashton Jonson's useful *Handbook to Chopin's Works.*

CHOPSTICKS, the "pidgin-English" name for the pair of small tapering sticks used by the Chinese in eating. (Chinese *kwai-tse* "the quick ones," "chop"-quick.) They are made of wood, bone, or ivory, somewhat longer and thinner than a lead-pencil. Held between the thumb and fingers, they are used to take up portions of food, cut up into small pieces. Many rules of etiquette govern the proper conduct of the chopsticks; laying them across the bowl is a sign that the guest wishes to leave the table; they are not used during a time of mourning, when food is eaten with the fingers; and various methods of handling them form a secret code of signalling.

CHORALE, a term in music used by English writers to indicate the hymn-tunes composed or adopted for use in church by the German reformers (Lat. *Choralis*). German writers, however, apply the terms "Choral" and "Chorale-geesang," as Luther himself would have applied them, to any solemn melody used in the church. It is thus the equivalent of canto fermo; and the German rhymed versions of the biblical and other ancient canticles, such as the Magnificat and the Te Deum, are set to curious corruptions of the corresponding Gregorian tunes, which adaptations the composers of classical German music called chorales with no more scruple than they applied the name to tunes of secular origin, German or foreign. The peculiarity of German chorale-music, however, is that its use, and consequently much of its invention, not only arose in connection with the Reformation, by which the liturgy of the church became "understanded of the people," but also that it belongs to a musical epoch in which symmetry of melody and rhythm was beginning to assume artistic importance. The growing sense of form shown by some of Luther's own tunes (*e.g., Vom Himmel hoch, da komm' ich her*) soon advanced, especially in the tunes of Crüger, beyond any that was shown by folk-music; and it provided a massive bulwark against the chaos that was threatening to swamp music on all sides at the beginning of the 17th century.

By Bach's time all the polyphonic instrumental and vocal art-forms of the 18th century were mature; and though he loved to derive the design as well as the details of a large movement from the shape of the chorale tune on which it was based, he became quite independent of any aid from symmetry in the tune as raw material. The chorus of his cantata "Jesus nun sei gepreiset" is one of the most perfectly designed and quite the longest of movements ever based upon a chorale-tune treated phrase by phrase. Yet the tune is one of the most intractable in the world, though its most unpromising portion is the basis of the most impressive feature in Bach's design (the slow middle section in triple time.)

In recent times the great development of interest in folk-music, and the discovery of the unique importance of Bach's work, have combined to tempt writers on music to over-estimate the distinctness of the art-forms based upon the German chorale. There is really nothing in these art-forms which is not continuous with the universal practice of writing counterpoint on a canto fermo. Thus Handel in his Italian and English works wrote no entire chorale movements, yet what is the passage in the "Hallelujah" chorus from "the kingdom of this world" to the end, but a treatment of the second part of the chorale "Wachet auf"? Again, to return to the 16th century, what are the hymns of Palestrina but figured chorales? In what way, except in the lack of symmetry in the Gregorian phrasing, do they differ from the contemporary setting by Orlando di Lasso, also a Roman Catholic, of the German chorale "Vater unser im Himmelreich"? In later times the use of German chorales, as in Mendelssohn's oratorios and organ-sonatas, has had rather the aspect of a revival than of a development; though the technique and spirit of Brahms's posthumous organ chorale-preludes is thoroughly modern and vital.

One of the most important, and practically the earliest collection of "Chorales" is that made by Luther and Johann Walther (1496–1570), the "Enchiridion," published in 1524. Next in importance we may place the Genevan Psalter (1st ed., Strasbourg, 1542, final edition 1562), which is now conclusively proved to be the work of Bourgeois. From this Sternhold and Hopkins borrowed extensively (1562). The psalter of C. Goudimel (Paris, 1565) is another among many prominent collections showing the steps towards congregational singing, *i.e.,* the restriction to "note-against-note" counterpoint (*sc.* plain harmony), and, in 12 cases,

the assigning of the melody to the treble instead of to the tenor. The first hymn-book in which this latter step was acted on throughout is Osiander's "Geistliche Lieder . . . also gesetzt, das ein christliche Gemein durchaus mitsingen kann" (1586). But many of the finest and most famous tunes are of much later origin than any such collections. Several (*e.g.*, "Ich freue mich in dir") cannot be traced before Bach, and were very probably composed by him. (D. F. T.)

CHORAL SINGING. In Great Britain choral singing, from 1913 to 1928, falls into three periods—the splendid activity which was checked by the World War, the struggles during that dark period, and the efforts since 1919 to find means of meeting the new situation. In the first period there was extraordinary vitality and much new impetus.

Some Notable Figures.—The old tradition of solid, square-toed choralism had been shaken to the roots by the personality of Dr. (now Sir) Henry Coward, the Sheffield chorus master. He had turned the big, heavy, unwieldy body of the provincial choral society into a living, sensitive, functioning organism, and his exploits had created a sensational interest in this form of art. Some of his disciples, no doubt, carried his ideas too far and lost sight of the end in exploiting the means. There were other notable workers in the field, with different aims, each contributing to the general good. Harry Evans, by his work in Wales and Liverpool, his keen personality and penetrating insight, made a great impression on the choral world. He was particularly successful in modern works for large choirs, exploiting vivid colouring. His comparatively early death in 1914 was a severe loss.

Two other choirs, also under men of outstanding personality, were beginning to attract attention. Both were breaking away from the lines traditionally followed by the average British choral society. In 1904 Charles Kennedy Scott, an able and versatile musician, founded in London the Oriana Madrigal Society, a small body originally intended to arouse interest in the English madrigal school. It eventually widened its scope and devoted much attention to modern British unaccompanied choral works, and in the period in question it was becoming firmly established in public notice. The choice of programmes struck out new lines and gave fresh ideas to choral conductors all over the world.

In Glasgow an amateur musician, Hugh S. Roberton, was attracting attention by the skilled singing of his Orpheus Choir, a body of about 120 singers, concentrating mostly on Scottish song arrangements and unaccompanied works on a small scale. Dr. E. C. Bairstow, organist of York Minster since 1913, was proving himself one of the most able choral conductors in the land, and a church musician who made the services at the Minster among the finest of the world.

The period being described was also remarkable for experiments in choral composition. The new technique acquired by large choral societies and the enormous strides made by choirs in touch with the competition festival movement opened up new possibilities to composers. The most daring experimentalist was Sir Granville Bantock, who wrote (1912–14) *Atalanta in Calydon* and *The Vanity of Vanities*. Entitled choral symphonies, they are divided into four movements on the lines of the traditional orchestral form, and are written for unaccompanied voices. The voices are disposed in 20 and 12 parts respectively, not with a view to polyphonic writing, but to obtain contrasts of colour on the lines of strings, wind and brass of the orchestra. Many highly original effects are obtained, and severe problems set for choir and trainer.

Recent Developments.—On the conclusion of the World War the task of reconstruction proved even greater than had been anticipated. Traditions had been broken and the formerly constant supply of tenors and basses was not and has not been recaptured. Subscribers who had supported institutions for many years as a duty did not resume their help. The war, too, had accelerated a change of taste which had gradually been coming about. Standard societies had always been able to rely upon the popular oratorios of Handel and Mendelssohn to crowd houses and fill coffers. *The Messiah* had paid many and many a deficit. But, generally speaking, this was no longer the case. Moreover, costs of halls, orchestra, printing and advertising, were all higher, and in addition there was the devastating entertainment tax. Consequently few societies could meet their expenses.

On the other side of the account, however, there was a new awakening of competition festivals, which, firmly established before the war, have attained an extraordinary vitality since. One great value of this movement is that it affords a *raison d'être* for the existence of every kind of society, except the larger bodies. Rural festivals bring into existence choirs in the smallest of villages, and the larger festivals stimulate the virtuosity of the leading bodies. Choirs connected with churches and chapels, women's institutes, guilds, boy scouts, all sorts of male, female and mixed organizations, are encouraged, improved and given a new outlook. In this way the problem of finding an audience for a concert and making ends meet may be avoided.

There has been a remarkable development of male voice choirs, mostly of working men, often connected with factories or works of various kinds, and these have, to a certain extent, thinned the male ranks of mixed choirs. A keen sense of sportsmanship and comradeship results in much more intensive work than is customary with mixed choirs. "Trade" bodies were willing to submit to 60 or 70 rehearsals of a single part song. A much higher standard of music is now obtained through the influence of these festivals. The singing of madrigals has received an immense impetus. Choral arrangements of folk songs and compositions by the best of our modern composers are being brought within the ken of many thousands of people. For some festivals choirs prepare choruses from an important work which is finally given by combined forces. In this way tiny rural villages know their Bach cantatas, and are even intimate with the B minor Mass and other large-scale compositions.

Another striking development of importance has been the growth of "works" choirs, some of which are very fine bodies. The Glasgow police and tramways choirs and the L.N.E.R. Musical Society are examples. One interesting fact is being disclosed by this activity. It was thought that the best choral singing was to be found only in Yorkshire, and that other parts of the country could not hope to rival that county. But the opinion of most adjudicators is that first-rate work can be produced anywhere. Without doubt the most robust voices come from this northern county, and in other parts of the country the current quality is less adapted to powerful and brilliant results, but a good conductor can produce superlatively good results from material existing in any district in the British Isles. Adjudicators of the widest experience have found astonishing results in places which were supposed to be unmusical. The general consensus of opinion among critics at the Leeds festival of 1925 was that although vocally the choir there was perhaps the finest in the world, technically it was inferior to many bodies in other parts of the country. This change of centre foreshadows a new era in choral singing.

Some Notable Choirs.—In London the Oriana Choir continues to do good work, forming a model for madrigal singing, and producing the latest works of modern British composers. In 1919 the Philharmonic Choir was formed in order that a large choral body might be affiliated with the Philharmonic Society. Kennedy Scott was appointed conductor, and he had proved as brilliant with a large choir as with a small one. Among the important works produced, in addition to classics, have been Bax's motets and the choral works of Delius. In particular, the performance of the *Mass of Life* in April 1925, reached a remarkable standard. London possesses, for the first time in its history, both a large and a small choir which can give performances unexcelled anywhere else in the kingdom. A junior philharmonic choir, composed of young women, is now in existence. Besides giving concerts of its own, it forms a source from which experienced singers can be drafted into the main body.

In Scotland.—The Glasgow Orpheus Choir has reached a state of popularity unprecedented in the history of choral singing, and maintains the level of its superlatively polished performances. It attracts crowded audiences in Glasgow, gives concerts all over Scotland, and makes annual raids into England. It has done

much to stimulate choral singing; its policy has been to afford opportunities for the training of conductors, and to give advice and assistance on the question of formation of new choirs. It is probably the first time that any choir has undertaken missionary work on such a large scale. A most successful tour was made in Canada and the United States of America, in the summer of 1926, and the reputation of British choral singing was brilliantly enhanced. In Manchester the Hallé Choir (chorus master, Mr. Dawber) has within late years won fresh honours at the concerts conducted by Sir Hamilton Harty.

Changes of Taste.—A significant feature in recent years has been the greatly increased interest in Bach. At the beginning of the century Bach was considered suitable for only the finest choirs, and especially cultured audiences. His cantatas were almost unknown in Britain. Now large and small societies produce his larger works frequently, and his church cantatas are being regularly performed. Reference may be made in this connection to an experiment, the founding of the Newcastle-upon-Tyne Bach Choir in 1915 to perform the works of the master, not with the wrong proportions of an orchestra of 50 and a choir of 300, but with forces approximating to those used in his day. The choir, after a period of experiment, was fixed at 40, ten to a line. The orchestra varies according to the work concerned; in some cases it is practically equal to the choir in numbers. Besides all the large works of Bach and the motets, about 80 of his cantatas have been given. A three days' Bach festival was given in London in Feb. 1921. British composers are also included in the scheme of work, over 60 having been represented. It gave in Newcastle cathedral in 1924 the first known complete performance of Byrd's recently discovered *Great Service,* and the Carnegie United Kingdom Trust sent the choir to give three performances of it in St. Margaret's, Westminster, London, in November of the same year. Several choirs have been formed on its lines, in Doncaster, Stockton, Leicester, Liverpool, and are helping to spread a knowledge of Bach unrivalled in any other country outside Germany if, indeed, that country is not now outdistanced in this direction by Great Britain. A Bach Cantata Club began operations in London in Feb. 1926, under the direction of C. K. Scott.

The Newcastle-upon-Tyne Bach Choir was invited to sing at the festival of the International Society for Contemporary Music, in Frankfurt-on-Main in July 1927, and afterwards made a short tour of German university towns, singing unaccompanied British music ranging from Byrd to Holst.

Advance in Technique.—It is impossible in a short article even to mention all the manifestations of choral singing throughout Great Britain. As a result of the competition festival movement, new conductors of merit are appearing everywhere. Works which, a few years ago, were looked upon as extremely difficult, for instance, Elgar's *Gerontius,* are now sung in many small towns. The work in question will receive 50 to 60 performances every winter. To take a single example, an isolated town like Kendal, with a population of 14,000, can produce such works as Holst's *Cloud Messenger* and Vaughan Williams' *Sea Symphony.*

At the same time the improved standard of choral singing has inspired a series of fine works by British composers. Vaughan Williams' unaccompanied *Mass,* and his oratorio, *Sancta Civitas,* Holst's *Hymn of Jesus* and first choral symphony, and a remarkable group of unaccompanied motets by Arnold Bax, are a tribute alike to the technical efficiency of choral bodies and to the vitality and high level of the great tradition of native compositions for choirs.

Community singing has been another development of the movement and was inaugurated in 1915 on the lines of successful gatherings in Australia. Meetings were organized at which folk, national, and simple classical songs were sung in unison, and easy rounds were rehearsed, the music being taught by pattern, so that no technical knowledge was demanded from the singers. This "caught on" in a remarkable way, and the movement promises to become a permanent feature of national life, closely allied with the folk dance revival. Notable leaders are Gibson Young (who was one of the prime movers in Australia), Geoffrey Shaw, Sir Richard Terry, and Sir Hugh Allen.

In the Dominions.—British choirs overseas bid fair to follow the good example of the Mother Country. Dr. Fricker, late of Leeds, is doing splendid work in Toronto. The Winnipeg Male Voice Choir, under Hugh Ross (since conductor of the Schola Cantorum in New York) impressed visiting adjudicators greatly. British adjudicators returning from recent competitive festival tours, report that choral activity may outdistance the Mother Country in a short time, and speak enthusiastically of a remarkable standard of performance. Possibly by virtue of its climate, Australia produces splendid women's voices, which rather overweigh the men's. South Africa is producing some astonishing results with native races, especially in schools, where early maturity enables fully fledged four-part singing to be cultivated. There is much choral activity in the main centres of that continent. (W. G. W.)

THE UNITED STATES

The early growth of choral music in the United States, as elsewhere, was associated with the Church. It was the Puritans of New England rather than the Dutch colonists of New York who were mainly responsible for the earliest developments, and this although the Pilgrim fathers brought to America a hatred of musical culture that is without parallel in history. Over a century of controversy was required, indeed, before the Church reluctantly accepted organized singing in "the new and ruleable way," which simply meant singing from the printed page rather than constantly repeating the traditional tunes from memory. Even late in the 18th century some localities still sang in "the usual way," which often consisted of the congregation's singing parts of two or three different tunes to one stanza of a hymn, or even singing different tunes at the same time. These melodies were sung so slowly that it was often necessary to take breath twice on one and the same tone or word-syllable.

In the face of such a handicap, it is surprising that early choral singing developed as rapidly as it did. But the acceptance of organized singing in the Church brought with it the advent of the singing school, with its psalm-tune teacher, and thereafter the choral society was a natural development. An early, but it must be admitted not too well authenticated, report describes a performance of the *Messiah* with organ accompaniment in the New York Trinity church as long ago as Jan. 9, 1770, less than 28 years after the original production of the work.

Early Organizations.—Probably the first stable organization of amateur singers in America was the Stoughton Musical Society, founded in Stoughton, Mass., by the first American composer, William Billings, in 1786. This antedates by five years the famous Berlin *Singakademie.* A rapid growth of similar choral societies followed, so that by 1812 the regularly established amateur choruses in America already outnumbered those of Germany, although the latter were doubtless vastly superior in quality. Of more lasting influence than the Stoughton Society was the Handel and Haydn Society, founded in Boston in 1815. This, while it lasted, became to America what the *Singakademie* of Berlin was to Continental Europe—the model for all similar organizations throughout its native country. It may be added that this society, whose present conductor is Thompson Stone, actually negotiated with Beethoven for a new choral work.

Henceforward, choral societies appeared in rapid succession. The short-lived Handel and Haydn Society of New York gave way to the New York Choral Society and the New York Sacred Music Society, both established in 1823, though the former only lasted a year. In 1844 the Musical Institute of New York was founded, but by 1850 it was saved only by an amalgamation of the three New York choral groups, the Vocal Society, the Sacred Music Society and the American Musical Institute, all combining to form the New York Harmonic Society. As a result of a controversy the short-lived Mendelssohn Society was formed in 1863, but nothing of a permanent nature was established until 1873, when Dr. Leopold Damrosch organized the New York Oratorio Society, which remains to-day as probably the foremost choral organization in the United States.

In recent years the Harvard and Radcliffe Glee clubs have taken part in notable choral performances with the Boston Symphony orchestra under Koussevitzky.

New York Oratorio Society.—Starting with a group numbering from 15 to 20, and giving its first concert with only 60 voices, Dr. Damrosch lived to direct such a festival as that of 1881 when he conducted a chorus of 1,200 and an orchestra of 250. At his death the work was continued by his son Walter and later, for a short period, by Frank Damrosch. Louis Koemmenich, a German conductor, did much for the development of the Oratorio Society. After 1921 the society was under the leadership of Albert Stoessel, who, in its annual Christmas production of the *Messiah,* and performances of other compositions of the great classical masters, as well as of modern works, had continued the traditions of the organization. In 1927 the society gave the first complete performance in New York of Bach's *B Minor Mass.* The Oratorio Society shares with the more recent Schola Cantorum of New York, founded by Kurt Schindler in 1909 (Hugh Ross, conductor), the responsibility of providing New York with choral music.

It was due largely to the singing schools of New England that choral culture found its way to other sections of the country. In the west, Cincinnati became a choral centre, developing around the German population who were responsible for the first American *Sängerfest* in 1849, just four years after such reunions had been introduced in Würzburg, Germany. Theodore Thomas was responsible for the first of the famous Cincinnati festivals, in 1873. With one exception they have taken place biennially since that time. The director in 1931, 1933, 1935, 1937 and 1939 was Eugene Goossens.

Of eastern choral festivals, two are of outstanding importance. The annual Worcester (Mass.) music festival was established in 1858 under the name of Musical Convention. In 1873 it became the Worcester County Musical Festival. The annual Bach festival at Bethlehem, Pa., is devoted to the works of the great master, and was responsible for the first complete American performance of the *B Minor Mass.* To-day the choral societies in the United States are almost innumerable; Philadelphia alone boasts over 60, and the number of such bodies throughout the whole country is being added to every year.

BIBLIOGRAPHY.—Elson, *The History of American Music;* Key, *International Music Year Book;* Krehbiel, *Choral Music in New York;* Mees, *Choirs and Choral Music;* Bauer, *Music Through the Ages.*

(A. STO.)

CHORAL SYMPHONY, a symphony including choral movements or numbers. Beethoven's ninth symphony, with vocal finale for four solo singers and chorus, is the most famous of all such works. Another is Mendelssohn's *Hymn of Praise.* Among more recent composers Mahler wrote several choral symphonies.

CHORAZIN and **BETHSAIDA.** Towns in the neighbourhood of Capernaum (Mth. xi., 21; Lk. x., 13). Since the 18th century the former has been identified with a ruined site *Khirbet Kerāzeh* about 2 m. N. of *Tell Hûm* (Capernaum). Amongst the ruins are the remains of a synagogue built of black basalt. Scholars are divided as to whether *one* Bethsaida is to be sought or *two.* Those who favour one generally locate it east of the Jordan at *Et-Tell* or *El-'Ardj* (either site answering the description of Bethsaida-Julias of Josephus, *Antiq.* xviii. 2. 1) or at *Mas 'adiyeh.* Those who would look for a separate "Bethsaida of Galilee" (John xii., 21) have advocated variously *Tell Hūm, 'Ain' et-Tābighah, Khirbet (Khān) Minyeh* or *'Ain et-Tīneh.* Now that *Tell Hūm* has been identified with Capernaum, the identification of *Khirbet Minyeh* with Bethsaida is being urged.

CHOREA: *see* ST. VITUS'S DANCE.

CHORIAMBIC VERSE or **CHORIAMBICS,** lyric verse based on the choriambus, a group of four syllables, – ∪ ∪ – (*i.e.,* choree or trochee+iamb). It is especially characteristic of Aeolic verse, as that of Alcaeus, Sappho, and their Latin imitator Horace, but is not confined to it. Regularly, one or more choriambi are preceded, or followed, or both, by other groups of syllables, as

– ∪∪ –|– ∪ ∪ – | – ∪ ∪ – | ∪ – – hoc dea ue|re Sybarim | cur properas | amando (Greater Sapphic).

– ∪ – ∪ | – ∪∪ – | ∪ – integer ui | tae sceleris | que purus (Sapphic hendecasyllable).

∪ ∪ – ∪ | – ∪∪ – | – ∪ ∪ – sic fra|tres Helenae | lucida si|dera (Lesser Asclepiad).

∪ ∪ – ∪ | – ∪∪ – | – ∪ ∪ – tu ne | quaesieris | scire nefas | quem mihi quem | tibi (Greater Asclepiad).

These and other varieties are arranged into various stanzas. These are essentially metres meant for song, not recitation, and are used to express emotion, serious or trivial. *See* GLYCONIC; SAPPHIC METRE.

Modern music often contains choriambi, but the few attempts at these in modern verse are mere *tours de force* as Gilbert Murray's:—

"an old | eagle, a | blind | eagle who | waits | hungry and | cold | and still."

CHORICIUS, of Gaza, Greek sophist and rhetorician, flourished in the time of Anastasius I. (A.D. 491–518). He was the pupil of Procopius of Gaza, who must be distinguished from Procopius of Caesarea, the historian. His declamations, often accompanied by commentaries, include, besides panegyrics, funeral orations, and stock themes, *Epithalamioi,* or wedding speeches. Choricius was also the author of so-called *Ekphraseis,* descriptions of works of art after the manner of Philostratus. His moral maxims were largely drawn upon by Macarius Chrysocephalas, metropolitan of Philadelphia (middle of the 14th century), in his *Rodonia* (rose-garden). A special feature of Choricius' style is the avoidance of hiatus, peculiar to what is called the school of Gaza.

Editions by J. F. Boissonade (1846, supplemented by C. Graux in *Revue de philologie,* 1877), and R. Förster (1882–94); *see* also C. Kirsten, "Quaestiones Choricianae" in *Breslauer philologische Abhandlungen,* vii. (1894); G. Pietsch, "De Choricio Patrocli declamationis auctore" in same publication (1910), and article by W. Schmid in Pauly-Wissowa's *Realencyklopädie,* iii. 2 (1899). On the Gaza school *see* K. Seitz, *Die Schule von Gaza* (Heidelberg, 1892).

CHORIN, AARON (1766–1844), Hungarian rabbi and pioneer of religious reform, born at Weisskirchen, Moravia, on Aug. 3, 1766, educated at Prague, and became rabbi at Arad in 1789. His *Emek ha Shaweh* (Vale of the Plain) of 1803 was declared heretical by the orthodox party, but he continued to favour such reforms as modification of the traditional laws, vernacular prayers, and the use of the organ. Chorin was also interested in the promotion of schools, seminaries, and professions among the Jews. He died on July 26, 1844.

See L. Low: *Gesammelte Schriften* vol. ii. (Szegedin, 1889).

CHORIZONTES ("separators"), the name given to the Alexandrian critics who denied the single authorship of the *Iliad* and *Odyssey,* and held that the latter poem was the work of a later poet. The most important of them were the grammarians Xeno and Hellanicus; Aristarchus was their chief opponent (*see* HOMER).

CHORLEY, a municipal borough, Chorley parliamentary division, North Lancashire, England, 22 mi. N.W. from Manchester, on the L.M.S.R. and the Leeds and Liverpool canal. Pop. (est. 1938) 30,140. Area, 6.7 sq.mi. The town is situated on the "fall-line" between a westward projection of the Pennines and the North Lancashire plain. The church of St. Lawrence is mainly Perpendicular and contains fine woodwork. Textiles, railway-wagon making and metal-working are the chief industries, but there are several coal mines and stone quarries. There is a large reservoir of the Liverpool corporation water works with a capacity for 48,300,000 gal. The beautiful Elizabethan mansion of Astley hall, with park, was presented to Chorley as a World War I memorial. The corporation bought Duxbury park (541 ac.) in 1932.

CHORLU or CORLU, a town of European Turkey, in the vilayet of Adrianople; on the left bank of the Chorlu, a small left-hand tributary of the Ergene, 25 mi. N.E. of Silivri on the Sea of Marmora, and about 75 mi. by rail from Istanbul. Population (1940) 16,979. Chorlu has a station on the Istanbul-Edirne railway.

It manufactures woollen cloth (*shayak*) and native carpets, and exports cereals, oilcloth, carpets, cattle, poultry, fresh meat, game, fruits, wine, alcohol, hides and bones.

CHOROGRAPHY. (1) A description or delineation on a map of a district or tract of country (from the Gr. χώρα, a tract of country, and γράφειν, to write). The word is common in old geographical treatises, but is now superseded by the wider use of "topography."

(2) A system of notation to indicate the steps and movements in dancing.

CHOROTEGA, a group of linguistically related Indian tribes located on the west coasts of Honduras (Choluteca), Nicaragua (Mangue), and Costa Rica (Orotiña). Other groups are found in southern Mexico. All have lost their tribal identity, although the Mangue dialect is still in existence. Archaeological evidence assigns to the Chorotega an important place in the aboriginal culture history of Central America, for early phases of the Chorotega underlie the most ancient remains of the Maya.

See S. K. Lothrop, "Pottery of Costa Rica and Nicaragua," *Contributions from the Museum of the American Indian, Heye Foundation,* vol. viii., 1926, p. 20–100.

CHOROTES, a tribe of South American Indians belonging to the Matacan (*q.v.*) linguistic stock. The Chorotes live in southern Bolivia on the eastern side of the upper Pilcomayo river. They are a tall, long-headed folk, with a simple semi-nomadic type of culture. The dress of both sexes is a short kilt of skins or coarse woollen cloth. To-day, at least, the Chorotes practise some agriculture. They live in small, rudely thatched huts. They have no canoes. The bow is the main weapon. Simple pottery and netted bags are made. Village chiefs are hereditary and have considerable power. The women select their husbands.

See E. Nordenskiold, *Indianerleben; El Gran Chaco* (Leipzig, 1913).

CHÓRUM or ÇORUM, the chief town, pop. (1940) 22,776, of the vilayet of the same name in Turkey, altitude 2,300 ft., on the edge of a plain, almost equidistant from Amasia and Yozgat. Pop. of vilayet (1940) 302,745. The ancient *Euchaïta,* 15 mi. E., was attacked by the Huns A.D. 508, and became a bishopric at an early period. It contained the tomb of the revered St. Theodore, who slew a dragon in the vicinity and became one of the great warrior saints of the Greek Church. (*See* J. G. C. Anderson, *Studia Pontica.*)

CHORUS (Gr. χορός), properly a dance, and especially the sacred dance, accompanied by song, of ancient Greece at the festivals of the gods. The word χορός seems originally to have referred to a dance in an enclosure, and is therefore usually connected with the root appearing in Gr. χόρτος, hedge, enclosure, Lat. *hortus,* garden, and in the Eng. "yard," "garden" and "garth." In the chorus sung in honour of Dionysus the ancient Greek drama had its birth. From that of the winter festival, consisting of the κῶμος or band of revellers, chanting the "phallic songs," with ribald dialogue between the leader and his band, sprang "comedy," while from the dithyrambic chorus of the spring festival came "tragedy." (For the history of the chorus in Greek drama *see* DRAMA: *Greek Drama.*)

The chorus as a factor in drama survived only in the various imitations or revivals of the ancient Greek theatre in other languages. A chorus is found in Milton's *Samson Agonistes.* The Elizabethan dramatists applied the name to a single character employed for the recitation of prologues or epilogues. Apart from the uses of the term in drama, the word "chorus" has been employed chiefly in music. It is used of any organized body of singers, in opera, oratorio, cantata, etc., and, in the form "choir," of the trained body of singers of the musical portions of a religious service in a cathedral or church. As applied to musical compositions, a "chorus" is a composition written in parts, each to be sung by groups of voices in a large body of singers. The word is also used of that part of a song repeated at the close of each verse, in which the audience or a body of singers may join with the soloist.

In the early middle ages the name *chorus* was given to a primitive bagpipe without a drone. Giraldus Cambrensis in his *Topographia Hiberniae* mentions it as one of the three instruments of Wales and Scotland, though there is some reason to believe that he may have been confusing it with the crot or crwth, an entirely different instrument. It is further recorded that King James I. of Scotland was renowned for his skill as a performer on various musical instruments, one of which was the chorus.

CHOSE, a term used in law in different senses. *Chose local* is a thing annexed to a place, as a mill. A *chose transitory* is that which is movable, and can be carried from place to place. But the use of the word "chose" in these senses is practically obsolete, and it is now used only in the phrases *chose in action* and *chose in possession.* A "chose in action," in its more limited meaning, denotes the right to sue for a debt or damages, whether arising out of a contract or a tort. Less accurately, the money itself which could be recovered is frequently termed a chose in action, as is also sometimes the document evidencing a title to a chose in action, such as a bond or a policy of insurance, though strictly it is only the right to recover the money which can be so termed. Choses in action were either *legal* or *equitable.* Where the chose could be recovered by an action at law, as a debt (whether arising from contract or tort), it was termed a legal chose in action; where the chose was recoverable only by a suit in equity, as a legacy or money held upon a trust it was termed an equitable chose in action.

The courts of Common law did not originally (except in the case of negotiable instruments) recognize the assignment of choses in action. Any attempt to assign a chose in action was invalid, and if the debtor paid the assignee, he could be compelled to pay the debt over again to the assignor. The only way in which a debt could be transferred was by a new contract of a trilateral nature in which the debtor was released by the assignor, and consented, in consideration of such release, to become liable to the assignee. This was a novation, not an assignment. But courts of equity at an early date gave effect to an assignment of a chose in action for valuable consideration, treating the assignee as an agent of the assignor with an irrevocable authority to collect and keep the proceeds. By the end of the eighteenth century the law courts adopted a similar doctrine permitting the assignee to sue in the assignor's name. *Winch* v. *Keeley,* 1 T.R. 619. In America statutes known as real party in interest statutes are common permitting the assignee to sue in his own name. In England under the Judicature Act of 1783 as amended by the Law of Property Act, 1925, permits the assignee to sue in his own name without joining the assignor, provided (a) the assignment was absolute and not by way of charge only; (b) the assignment was in writing; and (c) notice in writing was given to the debtor or party to be charged.

See Williston, Contracts, c. 14.

A chose in possession is opposed to a chose in action, and is a thing in actual physical possession. A chose in possession is freely transferable by delivery.

CHOSEN: *see* KOREA.

CHOSROES (koz'rō-ēz), in middle and modern Persian *Khosrau* ("with a good name"), a common name, borne by a king of the Iranian legend (Kai Khosrau); by a Parthian king, commonly called by the Greeks Osroes; and by the following two Sassanid kings.

1. CHOSROES I., "the Blessed" (*Anushirvan*), A.D. 531–579, successor of Kavadh I., and the most famous of the Sassanid kings. At the beginning of his reign he concluded an "eternal" peace with the emperor Justinian, who wanted to be free for the conquest of Africa and Sicily. But successes against the Vandals and Goths caused Chosroes to renew the war in 540. He invaded Syria and took Antioch, and during the next years fought successfully in Lazica or Lazistan (the ancient Colchis, *q.v.*), on the Black sea, and in Mesopotamia. In 545 an armistice was concluded and in 562 a peace for 50 years, in which the Persians left Lazistan to the Romans, and the Romans paid subsidies to Persia. Meanwhile in the east the Hephthalites had been attacked by the Turks, who now appear for the first time in history. Chosroes united with them and conquered Bactria, while he left the country north of the Oxus to the Turks. He also assisted the dynasts of Yemen to expel the Ethiopians and Yemen became dependent on Persia. In 571 a new war with Rome broke out about Armenia, in which Chosroes conquered the fortress Dara on the Euphrates, invaded Syria and Cappadocia, and returned with large booty. During the negotiations with the emperor

Tiberius, Chosroes died in 579, and was succeeded by his son Hormizd IV.

Although Chosroes had extirpated the heretical Persian sect of the Mazdakites (*see* KAVADH) he was a tolerant adherent of Zoroastrian orthodoxy. He introduced a system of taxation, based upon a survey of landed possessions begun by his father.

2. CHOSROES II., "the Victorious" (*Parvez*), 590–628, son of Hormizd IV and grandson of Chosroes I, was raised to the throne by the magnates who had rebelled against his father in 590. At the same time the general Bahram Chobin proclaimed himself king. The war with the Romans, begun in 571, had not yet ended. Chosroes fled to Syria, and persuaded the emperor Maurice (*q.v.*) to send help. Many acknowledged Chosroes, and in 591 he was brought back to Ctesiphon and Bahram Chobin beaten. Peace with Rome was then made, Maurice merely restoring the former frontier and abolishing the subsidies which had formerly been paid to the Persians. When in 602 Maurice was murdered by Phocas, Chosroes began war with Rome to avenge his death. His armies plundered Syria and Asia Minor, and in 608 advanced to Chalcedon. In 613 and 614 Damascus and Jerusalem were taken by the general Shahrbaraz, and the Holy Cross seized. Soon after, Egypt fell. The Romans could offer little resistance, as they were torn by internal dissensions, and pressed by the Avars and Slavs. At last, in 622, the emperor Heraclius (successor of Phocas in 610) was able to take the field. In 624 he advanced into northern Media, where he destroyed the great fire temple of Gandzak (Gazaca); in 626 he fought in Lazistan, while Shahrbaraz advanced to Chalcedon and tried in vain to conquer Constantinople. In 627 Heraclius defeated the Persian army at Nineveh and advanced toward Ctesiphon. Chosroes fled, and as his despotism and indolence had roused opposition, his eldest son, Kavadh II, whom he had imprisoned, was set free and proclaimed king. Four days afterward, Chosroes was murdered (Feb. 628). Meanwhile, Heraclius returned in triumph to Constantinople; in 629 the Cross was given back to him and Egypt evacuated, while the Persian empire, from the apparent greatness which it had reached ten years earlier, sank into hopeless anarchy.

See PERSIA: *Ancient History,* and the references there given. For the Roman wars *see* authorities quoted under MAURICE and HERACLIUS.

CHOTA NAGPUR, a division of British India in Bihar, consisting of five British districts, viz., Hazaribagh, Ranchi, Palamau, Manbhum and Singhbhum. Chota Nagpur consists of a hilly, forest-clad plateau, inhabited mostly by aboriginal races, between the basins of the Son, the Ganges and the Mahanadi. The total area is 27,112 sq.mi. The population in 1941 was 7,516,349. The principal agricultural products are rice, Indian corn, pulses, oilseeds and potatoes. A small quantity of tea is grown in Ranchi district. The principal jungle products are timber, lac, tussur silk and *mahuá* flowers, which are used as food and also distilled into a strong country liquor. Chota Nagpur contains the Jharia, Giridih, Bokaro, Karanpura, Ramgarh and Daltonganj coal fields. It has other valuable mineral resources. Mica is mined in Hazaribagh and iron ore in Singhbhum, where the output is already nearly 500,000 tons; there is a belt of copper ore in the latter district, where also manganese ore, gold, chromite and apatite occur; and important deposits of bauxite have been found in Ranchi and Palamau.

The indigenous inhabitants consist of non-Aryan tribes, the principal of whom are the Hos, Oraons, Santals, Mundas and Bhumij. Except in Palamau these tribes were never subdued by the Mohammedans, who contented themselves with occasional expeditions and an irregular tribute of diamonds. Until the country passed under British rule, moreover, there was very little communication between Chota Nagpur and the plains of India, with the result that the tribes have preserved to a large extent their languages, customs and primitive religions.

CHOUANS, the name given to the bands of peasants, mainly smugglers and dealers in contraband salt, who rose in revolt in the west of France, in 1793, and joined the royalists of la Vendée (*see* FRANCE: *History*). The Breton word *chouan* means "screech-owl," and is supposed to have been originally applied as a nickname to Jean Cottereau (1767–94), the leader of the revolt, and afterward extended to his followers. In any case, it was appropriate; for they were night birds and used the hoot of an owl as a signal. The motive for revolt was less devotion to the monarchy than resentment at interference of the new republican government with their old habits; the ruin of their contraband trade by the abolition of the *Gabelle* (*q.v.*); the attacks by the convention on the priesthood, and, above all, the enforcement of conscription. Their methods of warfare were barbarous and were met by barbarous reprisals. A vivid picture of these wild people is given by Honoré de Balzac in his novel *Les Chouans.*

CHOUETTE, a method whereby three or more persons may participate in a two-hand game. The three or more players establish an order of precedence, by lot or in any other way. Highest in precedence is "in the box" and plays against next highest, who is "captain." All other players bet that the captain (with whom they may consult) will win. If the man in the box wins, he collects the agreed stake from each other player individually; the captain becomes lowest in precedence. If the captain wins, he is in the box for the next game. The player previously in the box pays the agreed stake to each other player individually and becomes lowest in the order of precedence. In either case, the player who was next under the captain in precedence becomes the captain for the next game. (A. H. MD.)

CHOUGH (*Pyrrhocorax pyrrhocorax*), a bird of the crow family. It inhabits mountains and rocky coasts in Europe and North Africa. The combined effects of persecution by man and competition with the jackdaw (*q.v.*) have reduced its numbers greatly and it is now rare. Recognized by its black plumage and bright red legs and red, curved beak, the Cornish chough is more slenderly built than the crows. It is less common in Great Britain and Ireland, though a breeding resident. The Alpine chough (*P. graculus*), smaller and with a yellow bill, is gregarious. It is a European species.

CHOUTEAU, AUGUSTE (1739–1829), American pioneer, was born in New Orleans, La., in 1739. With his younger brother Pierre (1749–1849), he was the founder of the city of St. Louis, Mo. In Aug. 1763, they joined the expedition of Pierre Ligueste Laclède who had received a commission from the director-general of Louisiana to establish the fur trade in the country west of the Mississippi. In this party Auguste was given command of the boat, and in Oct. 1763, they reached the settlement of Sainte Genevieve. In the winter they ascended to a point about 60 miles upstream and chose a site on the western bank for their chief trading station, which they named St. Louis. On Feb. 15, 1764, a party under the direction of Auguste Chouteau began active trading operations. The two brothers remained in the new settlement and built up a profitable fur trade with the Indians of the north and west. Auguste died in St. Louis on Feb. 24, 1829. His son Pierre Chouteau (1789–1869), developed an immense business in furs, becoming an associate of John Jacob Astor (*q.v.*).

CHRESTIEN, FLORENT (1541–1596), French satirist and Latin poet, the son of Guillaume Chrestien, a French writer on physiology, was born at Orleans on Jan. 26, 1541. A pupil of Henri Estienne, the Hellenist, at an early age he was appointed tutor to Henry of Navarre, afterward Henry IV, who made him his librarian. Brought up as a Calvinist, he became a convert to Catholicism. He was one of the authors of the *Satyre Ménippée,* the famous pasquinade in the interest of his old pupil, Henry IV, and his works include a Latin version of *Hero and Leander* and French versions of Buchanan's *Jephthé* and Oppian's *De Venatione.* He died at Vendôme on Oct. 26, 1596.

CHRÉTIEN DE TROYES, a native of Champagne, and one of the famous French mediaeval poets. We possess very few details as to his life, and opinion differs as to the exact date to be assigned to his poems. We know that he wrote *Le Chevalier de la Charrette* at the command of Marie, countess of Champagne (the daughter of Louis VII and Eleanor of Aquitaine, married to the count of Champagne in 1164), and *Le Conte du Graal,* or *Perceval* for Philip, count of Flanders, guardian of the young king, Philip Augustus from 1180 to 1182. As Chrétien refers to the

story as the best tale told *au cort roial* it was probably composed during the regency. It was left unfinished, and later continued by three writers, Wauchier de Denain, Gerbert de Montreuil and Manessier. The second of these says definitely that Chrétien died before he could complete his poem. The extant works in their chronological order are, *Érec, Cligès, Le Chevalier de la Charrette* (*Lancelot*), *Le Chevalier au Lion* (*Yvain*) and *Le Conte du Graal* (*Perceval*) all dealing with Arthurian legend. Besides these he himself mentions a *Tristan,* and certain translations from Ovid's *Ars amatoria,* and *Metamorphoses.* A portion of this last was found by Gaston Paris, included in the translation of Ovid by Chrétien Legouais; of the *Tristan* no trace has yet been discovered. There is also a poem, *Guillaume d'Angleterre,* the authorship of which is a matter of debate. Prof. Foerster claimed it as by Chrétien, and included it in his edition of the poems, but Gaston Paris never accepted it.

Chrétien's poems enjoyed widespread favour, and of the three most popular (*Érec, Yvain* and *Perceval*) there exist old Norse translations, while the first two were admirably rendered into German by Hartmann von Aue. There is an English translation of the *Yvain, Ywain and Gawain,* and there are Welsh versions of all three stories, though their exact relation to the French is still a matter of debate. Chrétien's style is easy and graceful, he is analytic but not dramatic, in depth of thought and power of characterization he is decidedly inferior to Wolfram von Eschenbach, and as a poet he is probably to be ranked below Thomas, the author of *Tristan,* and the translator of Thomas, Gottfried von Strassburg. Much that has been claimed as characteristic of his work has been shown by M. Willmotte to be merely reproductions of literary conceits employed by his predecessors. In the words of so competent a judge as M. J. Bédier he appears to have been "not so much a creative artist as a clever compiler" and this probably represents what will be the final verdict on his work.

Bibliography.—Chrétien's poems, except the *Perceval,* have been critically edited by Prof. Foerster. There is so far no edition of the *Perceval* save that printed from the Mons ms. by M. Potvin (6 vols., 1866–71, out of print and difficult to procure). Prof. Baist published a private and limited edition of ms. 794 of the *Bibl. Nationale.* Dr. Mary Williams is publishing an edition of the Gerbert continuation in the *Classiques Français du Moyen Age.* For general criticism of Chrétien's work, *see* Willmotte, *L'Évolution du roman français aux environs de 1150* (1903); also J. L. Weston, *Legend of Sir Lancelot* and *Legend of Sir Perceval* and for an appreciation, M. Borodine, *La Femme et l'amour au XIIe siècle, d'après les poèmes de Chrétien de Troyes* (1909).

CHRISM, a mixture of olive oil and balm, used for anointing in the Roman Catholic church in baptism, confirmation and ordination, and in the consecrating and blessing of churches, altars, chalices, baptismal water, etc. (through Med. Lat. *chrisma,* from Gr. χρῖσμα, an unguent). The consecration of the chrism is performed by a bishop during the High Mass on Maundy Thursday. In the Orthodox Church the chrism contains, besides olive oil, many precious spices and perfumes, and is known as "muron" or "myron." The "Chrisom," originally a head-cloth to prevent the chrism from being rubbed off a newly-baptized child's forehead, came to mean the white baptismal robe, which was used as the child's shroud if it died within the month, but was otherwise given to the church by the mother at her churching. Children dying within the month were called "chrisom-children" or "chrisoms," as in Mrs. Quickly's description of Falstaff's death (Shakespeare, *Henry V.,* ii. 3).

CHRIST, the Anointed One (Gr. Χριστός), equivalent to the Hebrew Messiah: the title given in the New Testament to Jesus of Nazareth. (*See* Jesus Christ; Messiah; Christianity.)

CHRIST, WILHELM VON (1831–1906), German classical scholar, was born at Geisenheim, on Feb. 8, 1831, and died on Feb. 8, 1906, at Munich, where he had been professor from 1860 to 1902. His most important works are his *Geschichte der griechischen Literatur* (5th ed., 1908 f.), a history of Greek literature down to the time of Justinian, one of the best works on the subject; *Metrik der Griechen und Römer* (1879); editions of Pindar (1887); of the *Poëtica* (1878) and *Metaphysica* (1895) of Aristotle; *Iliad* (1884).

See O. Crusius, *Gedächtnisrede* (Munich, 1907).

CHRISTADELPHIANS, sometimes also called Thomasites, a community founded in 1848 by John Thomas (1805–1871), who, after studying medicine in London, migrated to Brooklyn, N.Y., U.S.A. (Χριστοῦ ἀδελφοι, "brothers of Christ"). There he at first joined the "Campbellites," but afterwards struck out independently, preaching largely upon the application of Hebrew prophecy and of the Book of Revelation to current and future events. Both in America and in Great Britain he gathered a number of adherents, and formed a community which has extended to several English-speaking countries. They believe that they alone hold the true interpretation of Scripture. Their theology is strongly millenarian, centring in the hope of a world-wide theocracy with its seat at Jerusalem. No statistics of the community are published.

See R. Roberts, *Dr. Thomas, his Life and Work* (1884); and F. J. Powicke, art. "Christadelphians" in Hastings' *Encyclopaedia of Religion and Ethics.* The community publishes a monthly magazine, *The Christadelphian,* in Birmingham.

CHRISTCHURCH, municipal borough, Southampton, England, at the confluence of the rivers Avon and Stour, 1½ mi. from the sea, and 25½ mi S.W. of Southampton on the S.R. Pop. (est. 1938) 14,050. Area 8 sq.mi. The neighbourhood was of great importance in late pre-historic times. Much of the late Bronze and early Iron age intercourse of Britain with the continent seems to have focused on Hengistbury Head and Christchurch. The town is mentioned in Saxon documents under the name of Tweotneam or Tweonaeteam, which long survived in the form Christchurch Twineham. In 901 it was seized by Aethelwald, but was recaptured by Edward the Elder. In Domesday, under the name of Thuinam, it appears as a borough belonging to the king, who held 31 messuages there. Henry I granted Christchurch (about 1100) to Richard de Redvers, who erected the castle. Only fragments remain, but the ruined Norman House apparently dates from the later part of the 12th century. The famous Augustinian priory church of the Holy Trinity is cruciform in plan, lacking a central tower but having a Perpendicular tower at the west end. The nave and transepts are principally Norman, and very fine; the choir is Perpendicular. Early English additions appear in the nave, clerestory and elsewhere, and the rood-screen is of ornate Decorated workmanship. The priory attained to such fame that its name of Christchurch finally replaced the older name of Twineham. It was dissolved in 1539.

The first charter was granted by Baldwin earl of Devon about 1150; Baldwin, the seventh earl, granted to the burgesses the tolls of the fair at St. Faith and common of pasture in certain meads shortly after 1257. The Holy Trinity fair is mentioned in 1226.

Christchurch was not incorporated till 1886. The town has never enjoyed any great prosperity, though the salmon fisheries have always been famous. It is mainly residential and is a holiday resort. There is a small harbour.

From 1571 the borough was represented in the house of commons by two members until the Reform act of 1832 reduced the number to one.

Christchurch is included in the New Forest and Christchurch division of Southampton.

CHRISTCHURCH, a city of New Zealand, near the east coast of South Island, to the north of Banks peninsula, in Selwyn county; the capital of the provincial district of Canterbury and the seat of a bishop. Pop. (1936) 92,189 (132,559 including suburbs).

Christchurch stands on the great Canterbury plain; a background is supplied by the distant mountains to the west and by the nearer hills to the south. The small river Avon winds through the city. Christchurch is chiefly dependent on the rich agricultural district which surrounds it, the plain being mainly devoted to cereals and grazing. It is also the site of a number of important industries, including particularly meat freezing and woollen manufacturing. Railways connect with Blenheim to the north and with Dunedin and Invercargill to the south, with many branches through the agricultural districts; also with Lyttelton, the port of Christchurch, 8 mi. southeast. The principal public buildings include the government offices, the museum, with its fine collection

of remains of the extinct bird, moa, and the McDougall Art gallery. There is a fine Gothic cathedral built from designs of Sir G. Gilbert Scott in Early English style, with a tower and spire 240 ft. high. Among the city's many noted educational institutions is Canterbury University college, a constituent college of the University of New Zealand. There is a Roman Catholic pro-cathedral attached to a convent of the Sacred Heart. A large extent of open ground comprises Hagley park, recreation grounds, and the Botanical gardens, which are among the largest and finest in the dominion. Wide streets cross one another for the most part at right angles, and there are well-planted parks, avenues and private gardens. The foundation of Christchurch is connected with the so-called "Canterbury Pilgrims," who settled in this district in 1850. Lyttelton was the original settlement, but Christchurch came into existence in 1851, and is thus the latest of the settlements of the original colony.

The city became a municipality in 1862. In 1903 several populous suburban boroughs were amalgamated with Christchurch.

See *City of Christchurch, New Zealand, Yearbook* (annual).

CHRISTENSEN, JENS CHRISTIAN (1856–1933), Danish politician, was born in North Jutland. The son of a peasant farmer, he was an elementary school teacher from 1877 to 1901. In 1890 he entered Parliament and eventually became leader of the Liberal party. In 1901 he was Minister of Education in the first Liberal government, and from 1905 to 1908 was Prime Minister. In 1909 he was Minister of Defence and in this capacity carried through the Army bill. From 1912 to 1913 he was Speaker of the *Folketing* (Lower House), from 1916 to 1918 minister without portfolio, and Minister of Worship from 1920 to 1922. He retired from politics in 1924. He has published a book, *Fra min Barndom og Ungdom* (1925).

CHRISTIAN II. (1481–1559), king of Denmark, Norway and Sweden, son of John (Hans) and Christina of Saxony, was born at Nyborg Castle on July 1, 1481, and succeeded his father as king of Denmark and Norway in 1513. As viceroy of Norway (1502–12) he had already displayed singular capacity. Patriotism, courage, statesmanship—these qualities were indisputably his; but unfortunately they were vitiated by obstinacy, suspicion and a sulky craftiness, beneath which simmered a very volcano of revengeful cruelty. Christian's succession to the throne was confirmed at the *Herredag* or assembly of notables from the three northern kingdoms, which met at Copenhagen in 1513. A decision as to the Swedish succession was postponed, as the Swedish delegates refused to accept Christian as king. On June 11, 1514, he was crowned king of Denmark and Norway at Copenhagen, and on the same day he married, by proxy, Isabella, sister of the future emperor Charles V. The wedding was celebrated on Aug. 12, 1515. But he would not give up his liaison with Dyveke, a Dutch girl of bourgeois origin, and on the death of the unfortunate girl in 1517, under suspicious circumstances, Christian revenged himself by executing the magnate Torben Oxe, who was supposed to have been Dyveke's murderer, despite the strenuous opposition of Oxe's fellow peers; henceforth the king lost no opportunity of depressing the nobility and raising plebeians to power. His chief counsellor was Dyveke's mother Sigbrit, a born administrator and a commercial genius of the first order. Christian first appointed her controller of the Sound tolls, and ultimately committed to her the whole charge of the finances. A *bourgeoise* herself, Sigbrit soon became the soul of a middle-class inner council, which competed with the *Rigsraad* itself. The patricians naturally resented their supersession and nearly every unpopular measure was attributed to the influence of "the foul-mouthed Dutch sorceress who hath bewitched the king."

Meanwhile Christian was preparing for the inevitable war with Sweden, where the Patriotic Party, headed by the freely elected governor Sten Sture the younger, stood face to face with the philo-Danish Party under Archbishop Gustavus Trolle. Christian, who had already taken measures to isolate Sweden politically, hastened to the relief of the archbishop, who was beleaguered in his fortress of Stäke, but was defeated by Sture and his peasant levies at Vedla and forced to return to Denmark, while the castle was destroyed and the archbishop deposed and imprisoned. A second attempt to subdue Sweden in 1518 was also frustrated by Sture's victory at Bränkyrka. A third attempt made in 1520 with a large army of French, German and Scottish mercenaries proved successful. Christian had persuaded Pope Leo X. to excommunicate Sture and to lay Sweden under an interdict. Sture was defeated at Bogesund and mortally wounded at the battle of Tiveden, on Jan. 19, and the Danish army, unopposed, was approaching Uppsala, where the members of the Swedish *Riksråd* had already assembled. The senators consented to render homage to Christian on condition that he gave a full indemnity for the past and a guarantee that Sweden should be ruled according to Swedish laws and custom; and a convention to this effect was confirmed by the king and the Danish *Rigsraad* on March 31. But Sture's widow, Dame Christina Gyllenstjerna, still held out stoutly at Stockholm, and the peasantry of central Sweden, stimulated by her patriotism, flew to arms, defeated the Danish invaders at Balundsäs (March 19) and were only with the utmost difficulty finally defeated at the bloody battle of Uppsala (Good Friday, April 6). In May the Danish fleet arrived, and Stockholm was invested by land and sea on Sept. 7. Christina surrendered on the promise of a general amnesty. On Nov. 1, the representatives of the nation swore fealty to Christian as hereditary king of Sweden, and on Nov. 4 he was crowned by Gustavus Trolle in Stockholm cathedral. The next three days were given up to banqueting, but on Nov. 7 "an entertainment of another sort began." On the evening of that day a band of Danish soldiers broke into the great hall and carried off several carefully selected persons. By 10 o'clock the same evening the remainder of the king's guests were safely under lock and key. All these persons were charged with heresy and violence against the church by archbishop Trolle, who presided over their trial on the following day. At 12 o'clock on the night of Nov. 8 the patriotic bishops of Skara and Strängnäs were led out into the great square and beheaded. The executions, known as the "Stockholm bath of blood," continued throughout the following day; in all, about 82 people, most of them noblemen, were thus murdered. Sten Sture's body was dug up and burnt, as well as the body of his little child. Dame Christina and many other noble Swedish ladies were sent as prisoners to Denmark. Christian suppressed his political opponents under the pretence of defending an ecclesiastical system which in his heart he despised.

With his brain teeming with great designs Christian II. returned to his native kingdom. Deeply distrusting the Danish nobles with whom he shared his powers, he sought helpers from among the wealthy middle classes of Flanders. In June 1521 he paid a sudden visit to the Low Countries, and remained there for some months. He visited most of the large cities, took into his service many Flemish artisans, and made the personal acquaintance of Quentin Matsys and Albrecht Dürer, the latter of whom painted his portrait. Christian also entertained Erasmus, with whom he discussed the Reformation, and let fall the characteristic expression: "Mild measures are of no use; the remedies that give the whole body a good shaking are the best and surest." On his return to Denmark on Sept. 5, 1521, Christian proceeded at once to inaugurate the most sweeping reforms. Soon after his return, in 1521 and 1522, he issued his great *Landelove*, or Code of Laws. For the most part this is founded on Dutch models, and testifies in a high degree to the king's progressive aims. Provision was made for the better education of the lower, and the restriction of the political influence of the higher clergy; there were stern prohibitions against wreckers and "the evil and unchristian practice of selling peasants as if they were brute beasts"; the old trade guilds were retained, but the rules of admittance thereto made easier, and trade combinations of the richer burghers, to the detriment of the smaller tradesmen, were sternly forbidden. Unfortunately these reforms, excellent in themselves, suggested the standpoint not of an elected ruler, but of a monarch by right divine. Some of them were even in direct contravention of the charter; and the old Scandinavian spirit of independence was deeply wounded by the preference given to the Dutch.

Sweden too was now in open revolt; and both Norway and

Denmark were taxed to the uttermost to raise an army for the subjection of the sister kingdom. In Jan. 1521 a young Swedish noble, Gustave Eriksson Vasa, at the head of a small force of dalesmen, led a revolt against Christian. (For the ensuing struggle which terminated the union between Denmark and Norway, *see* GUSTAVUS I. ERIKSSON and SWEDEN: *History*.) On June 6, 1523, Gustavus Eriksson was elected king of Sweden. Foreign complications were added to these domestic troubles. With the laudable object of releasing Danish trade from the grinding yoke of the Hansa, and making Copenhagen the great emporium of the north, Christian had arbitrarily raised the Sound tolls and seized a number of Dutch ships which presumed to evade the tax. Thus his relations with the Netherlands were strained, while with Lübeck and her allies he was openly at war. Finally Jutland rose against him late in 1522, renounced its allegiance and offered the Danish crown to Duke Frederick of Holstein (Jan. 20, 1523). So overwhelming did Christian's difficulties appear that he took ship to seek help abroad, and on May 1 landed at Veere in Zealand. Eight years later (Nov. 1531) he attempted to recover his kingdoms, and obtained some support from Olaf, archbishop of Trondhjem, who feared for the safety of the church under Frederick's rule. Christian landed with a small army of Dutch mercenaries on the Norwegian coast and proclaimed himself king at Oslo (Nov. 29). But he wasted time and opportunities; his fleet was destroyed by a Danish force, and it was arranged that he should negotiate with Frederick in person, on the understanding that if the negotiations broke down he should be allowed to return to Norway. When he reached Denmark, however, he was thrown into prison, first in Sonderborg Castle, afterwards in Kalundborg Castle. He died in Jan. 1559.

See K. P. Arnoldson, *Nordens enhet och Kristian II.* (Stockholm, 1899); Paul Frederik Barfod, *Danmarks Historie fra 1319 til 1536* (1885); *Danmarks Riges Historie,* vol. 3 (1897–1905); R. N. Bain, *Scandinavia,* chap. 2 (Cambridge, 1905). (R. N. B.; X.)

CHRISTIAN III. (1503–1559), king of Denmark and Norway, was the eldest son of Frederick I. of Denmark and his first consort, Anne of Brandenburg. Educated by German Lutheran teachers, Christian travelled in Germany in 1521 and was present at the Diet of Worms. On his return he found that his father had been elected king of Denmark in place of Christian II. Christian's unconcealed Lutheran views brought him into collision with the Catholic *Rigsraad,* and the religious intolerance which he showed in his capacity of stadtholder of the Duchies in 1526, and as viceroy of Norway in 1529, greatly provoked the Catholic party. On the death of Frederick I. in 1533 confusion arose over the election of his successor. Christian was supported by the nobility of Denmark; a strong Catholic party wished to put his younger brother, Hans, who was a child and still a Catholic, on the throne; while the peasants and burghers hoped for the restoration of the captive Christian II. (*q.v.*), and allied themselves with the citizens of Lübeck, who were led by Count Christopher of Oldenburg. Duke Christian crushed the rising of the peasants, made peace with Lübeck and in March 1535 was proclaimed king of Denmark at Viborg.

Christian III.'s triumph brought about the fall of Catholicism. On Aug. 12, 1536, the archbishop and bishops were arrested; on Oct. 30 a national assembly abolished episcopacy, made over the episcopal property to the Crown and established the Lutheran Church in Denmark, with the king as its head. The royal charter issued the same day proclaimed the Crown of Denmark, hitherto elective, hereditary in Christian's line.

The first six years of Christian's reign in Denmark were marked by a contest between the Danish *Rigsraad* and the German counsellors, both of whom sought to rule "the pious king" exclusively. Though the Danish party won a signal victory at the outset, by obtaining the insertion in the charter of provisions stipulating that only native-born Danes should fill the highest dignities of the State, the king's German counsellors continued paramount during the earlier years of his reign. The ultimate triumph of the Danish party dates from 1539, the dangers threatening Christian III. from the emperor Charles V., and other kinsmen of the imprisoned Christian II., compelling him to lean exclusively on Danish magnates and soldiers. The complete identification of the Danish king with the Danish people was accomplished at the *Herredag* of Copenhagen, 1542, when the nobility of Denmark voted Christian a twentieth part of all their property to pay off his heavy debt to the Holsteiners and Germans.

The pivot of the foreign policy of Christian III. was his alliance with the German Evangelical princes, as a counterpoise to the persistent hostility of Charles V., who was determined to support the hereditary claims of his nieces, the daughters of Christian II., to the Scandinavian kingdoms. War was actually declared against Charles V. in 1542, and though the German Protestant princes proved faithless allies, the closing of the Sound against Dutch shipping proved such an effective weapon in King Christian's hand that the Netherlands compelled Charles V. to make peace with Denmark at the Diet of Spires on May 23, 1544. The foreign policy of Christian's later days was regulated by the Peace of Spires. He carefully avoided all foreign complications; refused to participate in the Schmalkaldic War of 1546; mediated between the emperor and Saxony after the fall of Maurice of Saxony at the battle of Sievershausen in 1553, and contributed essentially to the conclusion of peace. King Christian III. died on New Year's day, 1559. Though not, perhaps, a great, he was, in the fullest sense of the word, a good ruler. A strong sense of duty, genuine piety and a cautious, but by no means pusillanimous common-sense, coloured every action of his patient, laborious and eventful life. He found Denmark in ruins; he left her stronger and wealthier than she had ever been before.

See *Danmarks Riges Historie,* vol. iii. (Copenhagen, 1897–1901); Huitfeld, *King Christian III.'s Historie* (Copenhagen, 1595); R. N. Bain, *Scandinavia,* ch. iv., v. (Cambridge, 1905).

CHRISTIAN IV. (1577–1648), king of Denmark and Norway, the son of Frederick II., king of Denmark, and Sophia of Mecklenburg, was born at Fredriksborg castle on April 12, 1577, and succeeded to the throne on the death of his father (April 4, 1588); during his minority which lasted till Aug. 17, 1596, the government was carried on by a regency of four. The young king's court was one of the most joyous and magnificent in Europe; yet he found time for work of the most various description, including a series of domestic reforms (*see* DENMARK: *History*). New fortresses were constructed under the direction of Dutch engineers. The Danish navy was developed and improved. In the war with Sweden, generally known as the "Kalmar War" (*see* SWEDEN: *History*), Christian compelled Gustavus Adolphus to give way on all essential points (treaty of Knäred, Jan. 20, 1613). After this war Christian made efforts to improve the army, which was composed mainly of mercenaries, though it was not until after the Thirty Years' War that any effective reforms were carried through. He then turned his attention to Germany. His object was twofold: first, to obtain the control of the great German rivers, the Elbe and the Weser; secondly, to acquire the secularized German bishoprics of Bremen and Werden as appanages for his younger sons. He skilfully took advantage of the alarm of the German Protestants after the battle of White Hill in 1620, to secure the coadjutorship to the see of Bremen for his son Frederick (Sept. 1621), a step followed in November by a similar arrangement as to Werden; while Hamburg by the compact of Steinburg (July 1621) was induced to acknowledge the Danish overlordship of Holstein. The growing ascendancy of the Catholics in North Germany in and after 1623 almost induced Christian, for purely political reasons, to intervene directly in the Thirty Years' War. The solicitations of the Western Powers led him in 1625 to plunge into war against the combined forces of the emperor and the League. For this defeat at Lutteram-Barenberge and the invasion of Jutland by Tilly and Wallenstein *see* THIRTY YEARS' WAR. In his extremity Christian now formed an alliance with Sweden (Jan. 1, 1628), whereby Gustavus Adolphus pledged himself to assist Denmark with a fleet in case of need, and shortly afterwards a Swedo-Danish army and fleet compelled Wallenstein to raise the siege of Stralsund. Declining to form a further alliance with Sweden for the defence of the North, and of Protestantism, Christian concluded a separate peace on May 12, 1629 with the emperor at Lübeck, without any

diminution of territory, at the price of abandonment of the Protestant cause. Unfortunately Christian would neither conciliate Sweden, henceforth his most dangerous enemy, nor guard himself against her by a definite system of counter-alliances. By mediating in favour of the emperor, after the death of Gustavus Adolphus in 1632, he tried to minimize the influence of Sweden in Germany, and his whole Scandinavian policy was so irritating and vexatious that Swedish statesmen made up their minds to wage war with Denmark. In May 1643 the Swedish *Riksråd* decided upon war; on Dec. 12 the Swedish marshal Lennart Torstensson, advancing from Bohemia, crossed the northern frontier of Denmark; by the end of Jan. 1644 the whole peninsula of Jutland was in his possession. This totally unexpected attack, conducted from first to last with consummate ability and lightning-like rapidity, had a paralysing effect upon Denmark. Yet in his sixty-seventh year Christian IV. once more displayed something of the magnificent energy of his triumphant youth. Night and day he laboured to levy armies and equip fleets. Fortunately too for him, the Swedish government delayed hostilities in Scania till Feb. 1644, so that the Danes were able to make adequate defensive preparations and save the important fortress of Malmö. Torstensson was unable to cross from Jutland to Fünen for want of a fleet, and the Dutch auxiliary fleet which came to his assistance was defeated between the islands of Sylt and Rönnö on the west coast of Schleswig by the Danish admirals. Another attempt to transport Torstensson and his army to the Danish islands by a large Swedish fleet under Klas Fleming was frustrated by Christian IV. in person on July 1, 1644. On that day the two fleets encountered off Kolberg Heath, S.E. of Kiel Bay, and Christian displayed a heroism which endeared him ever after to the Danish nation. Darkness at last separated the fleets; and though the battle was a drawn one, the Danish fleet showed its superiority by blockading the Swedish ships in Kiel Bay. But the Swedish fleet escaped, and the annihilation of the Danish fleet by the combined navies of Sweden and Holland at the end of September exhausted the military resources of Denmark and compelled Christian to accept the mediation of France and the United Provinces. Peace was finally signed at Brömsebro in 1645. (*See* DENMARK: *History.*)

The last years of the king were still further embittered by struggles with the nobility to whom he was forced to concede more and more power. He died at Copenhagen in Feb. 1648. During his reign Norway made great strides in economic and administrative prosperity under his son-in-law, Hannibal Sehested (*q.v.*), as Stadtholder. (*See* NORWAY: *History.*)

See *Life* (Dan.), by H. C. Bering Liisberg and A. L. Larsen (Copenhagen, 1890–91); *Letters* (Dan.), ed. Carl Frederik Bricka and Julius Albert Fridericia (Copenhagen, 1878); *Danmarks Riges Historie*, vol. 4 (Copenhagen, 1897–1905); R. N. Bain, *Scandinavia*, cap. vii. (1905).

CHRISTIAN V. (1646–1699), king of Denmark and Norway, the son of Frederick III. of Denmark and Sophia Amalia of Brunswick-Luneburg, was born on April 15, 1646, at Flensburg, and succeeded to the throne on Feb. 9, 1670. Christian was very popular among the lower orders, but hated the old noble families, and tried to establish a new nobility by creating two new orders, consisting largely of officials and upper middle class families, which were to take precedence of the older ones. Under the guidance of his great chancellor Griffenfeldt (*q.v.*), Christian carried his ideas of absolute government into practice, introducing extreme centralization into the organization of civil and military affairs. Griffenfeldt pursued an ambitious policy of foreign alliances, but aimed at keeping peace, and for a brief period Denmark seemed to have a chance of regaining her position as a great power; but Christian sacrificed Griffenfeldt to the jealousy of his adversaries, and sentenced him to life-long imprisonment. After this the financial position of the state grew steadily worse, owing partly to the extravagance of the court, partly to the unremunerative war with Sweden (1675–79). Christian was a weak despot, though his personal courage and affability made him popular among the lower orders. During his reign a new code of laws was drawn up for Norway, begun in 1661 and completed in 1683. He died in a hunting accident on Aug. 25, 1699.

See P. E. Holm, *Danmarks indre Historie under Enevaelden* (Copenhagen, 1881–86); A. D. Jörgensen, *Peter Griffenfeldt* (Copenhagen, 1893); R. N. Bain, *Scandinavia* cap. x., xi. (Cambridge, 1905).

CHRISTIAN VII. (1749–1808), king of Denmark and Norway, was the son of Frederick V., king of Denmark, and his first consort Louise, daughter of George II. of Great Britain. He became king on his father's death on Jan. 14, 1766. Badly educated, systematically terrorized by a brutal governor and hopelessly debauched by corrupt pages he grew up a semi-idiot. After his marriage in 1766 with Caroline Matilda (1751–1775), daughter of Frederick, prince of Wales, he abandoned himself to the worst excesses. He ultimately sank into a condition of mental stupor and became the obedient slave of the upstart Struensee (*q.v.*) who, after the dismissal of Bernstorff in 1770, controlled all affairs of State. After the fall of Struensee (the warrant for whose arrest he signed with indifference) in 1772, for the last 26 years of his reign, he was only nominally king, his half-brother, Prince Frederick, acting as regent. He died on March 13, 1808. In 1772 the king's marriage with Caroline Matilda, who had been seized and had confessed to criminal familiarity with Struensee, was dissolved, and the queen, retaining her title, passed her remaining days at Celle in Hanover, where she died on May 10, 1775.

See E. S. F. Reverdil, *Struensee et la cour de Copenhague, 1760–1772* (1858); *Danmarks Riges Historie*, vol. v. (Copenhagen, 1897–1905); and for Caroline Matilda, Sir F. C. L. Wraxall, *Life and Times of Queen Caroline Matilda* (1864), and W. H. Wilkins, *A Queen of Tears* (1904).

CHRISTIAN VIII. (1786–1848), king of Denmark and Norway, the eldest son of the crown prince Frederick and Sophia Frederica of Mecklenburg-Schwerin, was born on Sept. 18, 1786 at Christiansborg castle. His first marriage with his cousin Charlotte Frederica of Mecklenburg-Schwerin was dissolved in 1810. In May 1813 he was sent as stadtholder to Norway to promote the loyalty of the Northmen to the dynasty, which had been very rudely shaken by the disastrous results of Frederick VI.'s adhesion to the falling fortunes of Napoleon. Though his endeavours were opposed by the so-called Swedish party in Norway, which desired a dynastic union with Sweden, he was elected regent of Norway by an assembly of notables on Feb. 16, 1814. This election was confirmed by a *Storthing* held at Eidsvold on April 10 and on May 17 Christian was elected king of Norway. On being summoned by the commissioners of the allied powers at Copenhagen to bring about a union between Norway and Sweden in accordance with the terms of the treaty of Kiel, he replied that, as a constitutional king, he could do nothing without the consent of the *Storthing*, to the convocation of which a suspension of hostilities on the part of Sweden was the condition precedent. A short campaign ensued, in which Christian was easily worsted by the superior skill and forces of the Swedish crown prince (Bernadotte). The brief war was finally concluded by the convention of Moss on Aug. 14, 1814 (*see* NORWAY: *History*). Henceforth Christian's alleged democratic principles made him suspect, and he and his second wife, Caroline Amelia of Augustenburg, whom he married in 1815, lived in comparative retirement. It was not till 1831 that old King Frederick gave him a seat in the council of state. On Dec. 13, 1839 he ascended the Danish throne as Christian VIII. The Liberal party had high hopes of "the giver of constitutions," but he disappointed his admirers by steadily rejecting every Liberal project. He came into conflict with the German element in the duchies of Schleswig and Holstein by issuing (March, 1844) a patent permitting, under certain circumstances, the use of the Danish language in the estates. By his Open Letter of July 8, 1846, in which he declared that the *Kongelov*, Danish royal law in the matter of the succession applied to Schleswig and Lauenburg, though its application to parts of Holstein was doubtful, and by the Constitution of Jan. 28, 1848, he raised the Schleswig-Holstein question in a form which involved his successor in the War of 1848. (*See* SCHLESWIG-HOLSTEIN QUESTION.) He died at Plön on Jan. 20, 1848.

See Just Matthias Thiele, *Christian den Ottende* (Copenhagen, 1848); Yngvar Nielsen, *Bidrag til Norges Historie* (Christiania, 1882–86). A. J. Lange, *Christian Frederik som Norges Statholder regent og Konge* (1914).

CHRISTIAN IX. (1818–1906), king of Denmark, was a younger son of William, duke of Schleswig-Holstein-Sonderburg-Glücksburg (d. 1831), a direct descendant of the Danish king Christian III. by his wife Louise, a daughter of Charles, prince of Hesse-Cassel (d. 1836), and grand-daughter of King Frederick V. Born at Gottorp on April 8, 1818, Christian entered the army, and served with the Danish troops in Schleswig during the insurrection of 1848. In 1842 he married Louise (1817–1898), daughter of William, prince of Hesse-Cassel (d. 1867), and cousin of King Frederick VII. The reigning king, Frederick VII., being childless, the representatives of the great powers met in London and settled the crown on Prince Christian (May 1852), an arrangement confirmed in Denmark in 1853. The "protocol king," as Christian was sometimes called, ascended the throne on Frederick's death in Nov. 1863. By putting into force (Nov. 18) the recently drafted constitution under which Schleswig was to be incorporated with Denmark, he came into conflict with the German confederation. (*See* SCHLESWIG-HOLSTEIN QUESTION.) The German-Danish War followed, which ended by the separation (Oct. 13, 1864) of the duchies from Denmark. Within the narrowed limits of his kingdom Christian's difficulties were more protracted and hardly less serious. During almost the whole of his reign the Danes were engaged in a political struggle between the "Right" and the "Left," the former being supported in general by the *Landsting,* and the latter by the *Fòlketing.* The king was for many years successful in preventing the Radicals from coming into office, but in 1901 he was forced to assent to the formation of a "cabinet of the Left" (*see* DENMARK: *History*). In his later years he occupied a patriarchal position among the sovereigns of Europe to many of whom he was related. His eldest son Frederick had married a daughter of Charles XV. of Sweden; his second son George had been king of the Hellenes since 1863; his youngest Waldemar (1858–1939) was married to Marie d'Orléans, daughter of Robert, duc de Chartres. Of his three daughters, Alexandra married Edward VII. of Great Britain; Dagmar (Marie Feodorovna), the tsar Alexander III.; and Thyra, Ernest Augustus, duke of Cumberland. One of his grandsons, Charles, who married Princess Maud of England, became king of Norway as Haakon VII. in 1905, and another, Constantine, crown prince (afterwards king) of Greece, married a sister of the German emperor William II. Christian was also the ruler of Iceland. He died at Copenhagen on Jan. 29, 1906, and was buried at Roskilde.

See Barfod, *Kong Kristian IX.'s Regerings-Dagbog* (Copenhagen, 1876); and *Hans Majestet Kong Kristian IX.* (Copenhagen, 1888).

CHRISTIAN X., King of Denmark and Iceland (1870–), was born on Sept. 26, 1870, at Charlottenlund Castle, near Copenhagen, the eldest son of Crown Prince Frederik, later King Frederik VIII. (1906–12), and Louise, Princess of Sweden and Norway. After matriculating in 1889, the prince embarked upon a military career, becoming chief of the royal guard, and attained the rank of major-general. He married, in 1898, Alexandrine, duchess of Mecklenburg-Schwerin. In 1906 he became Crown Prince and in 1912 ascended the throne.

During the World War the necessity of friendly intercourse between the Scandinavian kingdoms resulted in several meetings between the three kings, of which the first was held at Malmö in Dec. 1914. On June 5, 1915 King Christian signed the new constitution of Denmark which extended the franchise to women. He signed, on Dec. 1, 1919, the Federal Act, whereby Denmark acknowledged Iceland as an independent kingdom and King of Iceland was incorporated in the King's title. In July 1920 he rode over the old frontier into Slesvig Nord, which had been ceded to Denmark by the Treaty of Versailles, and received an enthusiastic reception from the people. In 1921 the king and queen and their two sons, Crown Prince Frederik (b. 1899) and Prince Knud (b. 1900) journeyed to Iceland and the west coast of Greenland. King Christian has won popularity with all classes. In 1935 the Crown Prince married Princess Ingrid of Sweden.

CHRISTIAN, WILLIAM (1608–1663), Manx politician, a son of Ewan Christian, one of the Manx deemsters, was born on April 14, 1608, and was known as *Illiam Dhone,* or Brown William. In 1648 the lord of the Isle of Man, James Stanley, 7th earl of Derby, appointed Christian his receiver-general; and when in 1651 the earl crossed to England to fight for Charles II. he left him in command of the island militia. Derby was taken prisoner at the battle of Worcester, and his famous countess Charlotte de la Tremouille, who was residing in Man, sought to obtain her husband's release by negotiating with the victorious parliamentarians for the surrender of the island. At once a revolt headed by Christian broke out, partly as a consequence of this step, partly owing to the discontent caused by some agrarian arrangements recently introduced by the earl. The rebels seized many of the forts; then Christian in his turn entered into negotiations with the parliamentarians; and probably owing to his connivance the island was soon in the power of Col. Robert Duckenfield, who had brought the parliamentary fleet to Man in Oct. 1651. The countess of Derby was compelled to surrender her two fortresses, Castle Rushen and Peel Castle, while Christian remained receiver-general, becoming governor of the island in 1656. Two years later, however, he was accused of misappropriating some money; he fled to England, and in 1660 was arrested in London. Having undergone a year's imprisonment he returned to Man, hoping that his offence against the earl of Derby would be condoned under the Act of Indemnity of 1661; but, anxious to punish his conduct, Charles, the new earl of Derby, ordered his seizure; he refused to plead, and a packed House of Keys declared that in this case his life and property were at the mercy of the lord of the island. The deemsters then passed sentence, and in accordance therewith Christian was shot on Jan. 2, 1663. This arbitrary act angered Charles II. and his advisers; the deemsters and others were punished, and some reparation was made to Christian's family. Christian is chiefly celebrated through the Manx ballad *Baase Illiam Dhone,* which was translated into English by George Borrow, and through the reference to him in Sir Walter Scott's *Peveril of the Peak.*

See A. W. Moore, *History of the Isle of Man* (1900).

CHRISTIAN CATHOLIC CHURCH, the name assumed by a religious organization founded at Zion (*q.v.*) city near Chicago, Ill., in 1896, by John Alexander Dowie (*q.v.*). Its members added to the usual tenets of Christianity a special belief in faith-healing, and laid much stress on united consecration services and the threefold immersion of believers. To assist Dowie, assistant overseers were appointed, and the operations of the community included religious, educational and commercial departments. After 1903 considerable dissension arose among Dowie's followers: he was deposed in 1906; and after his death in 1907 his assistant Wilbur Glenn Voliva became general overseer of the organization.

See art. "Enthusiasts (religious)," by G. H. Gray and W. T. Whitley in Hastings, *Encyclopaedia of Religion and Ethics,* vol. v. p. 320; and K. Harlan, *John Alexander Dowie and the Christian Catholic Church,* Evansville, Wisconsin, 1906.

CHRISTIAN CONNECTION, a denomination of Christians in North America formed by secession, under James O'Kelly (1735–1826), of members of the Methodist Episcopal Church in North Carolina in 1793. The predisposing cause was the desire to be free from the "bondage of creed." Some of O'Kelly's followers joined the Disciples of Christ (*q.v.*). Their form of church government is Congregational; they take the Bible as the sole rule of faith and practice, and while adopting immersion as the proper mode of baptism, freely welcome Christians of every sect to their communion. Their position is curiously akin to that outlined by William Chillingworth (*q.v.*) in his famous work *The Religion of Protestants* (1637–1638).

CHRISTIAN ENDEAVOUR SOCIETIES, organizations formed for the purpose of promoting spiritual life among young people. They date from 1881, in which year Dr. Francis E. Clark (*q.v.*) formed a Young People's Society of Christian Endeavour in his (Congregational) church at Portland, Maine, U.S.A. The idea was taken up elsewhere in America and spread to other countries, till, under the presidency of Dr. Clark, a huge number of affiliated societies came into operation throughout the world. They take as their motto "For Christ and the Church," and have done much, especially in the non-episcopal churches, to prepare

young men and women for active services in the Church. The organization is international and interdenominational, a World's Christian Endeavour Union being formed in 1895.

See Francis E. Clark, art. "Christian Endeavour," in Hastings' *Encyclopaedia of Religion and Ethics*, vol. iii. 571 ff. (with reff.) and *Memories of Many Men in Many Lands* (1922); J. R. Fleming, *The Christian Endeavour of the Future* (1903).

CHRISTIANIA, the capital of Norway; *see* OSLO.

CHRISTIANITY, regarded historically as one of the great religions of the world, owes its rise to Jesus of Nazareth, in ancient Galilee (*see* JESUS CHRIST). By reverent disciples His ancestry was traced to the royal family of David and His birth is ascribed by the church to the miraculous act of God. At 30 years of age Jesus Christ appeared in public, and after a short period (we cannot determine how long, but possibly 18 months) he was crucified, upon the accusation of His countrymen, by the Roman authorities.

Relation to Judaism.—His career is understood only in the light of His relation to Judaism (*see* HEBREW RELIGION). This faith, in a peculiarly vivid fashion, illustrates the growth and development of religion, for its great teachers in the highest degree possessed what the Germans call God-consciousness. When the national independence of Israel was destroyed, the prophetic teaching held the people together in the hope of a re-establishment of the Kingdom when all nations should be subject to it and blessed in its everlasting reign of righteousness and peace (Isa. xlix., lx.).

Some of the prophets associated the restoration of the Kingdom with the coming of the Messiah, the anointed one, who should re-establish the line of David (Isa. ix. 6 f., xi. 1 f.; Micah v. 2; Ezek. xxxiv. 23, xxxvii. 24; Zech. ix. 9; Ps. ii. 72). Others said nothing of such a one, but seemed to expect the regeneration of Israel through the labours, sufferings and triumphs of the righteous remnant (Isa. liii., Ezek. xxxvi.–xxxvii.). By the strong emphasis upon righteousness, the tribal Lord of Israel was revealed as the universal God, of one relationship to all men. This monotheism was not primarily cosmological nor metaphysical, but ethical. The Jews showed little capacity for abstract reasoning and never pursued their inquiries to the discovery of ultimate principles. Thus they did not develop a systematic cosmology, nor formulate a system of metaphysics. Their religion was pre-eminently "theocratic"; God was thought of as King, enthroned in heaven and supreme.

But the prophetic teaching was obscured in part by the nationalism of the prophets themselves, who exalted Israel as at once God's instrument and the peculiar object of His love. Inevitably the freedom, spirituality and universality of the prophetic teaching were obscured. In the 1st century A.D. the national and priestly elements were supreme. The triumph of Israel was to be accomplished by the miraculous power of a Messiah who should descend out of heaven. His coming was delayed, in part by the opposition of demons, in part by the failure of the people to obey the law, which embraced both moral and ceremonial elements derived from varied sources, but by the people was all alike regarded as of divine origin. It was to be obeyed without question and without inquiry as to its meaning, because established by God; it was contained in the Sacred Scriptures (*see* BIBLE: *Old Testament*), which had been revealed by God supernaturally, and its meaning was set forth by schools of learned men whose interpretations were authoritative. The priesthood held still the ancient ideas. Salvation was for the nation, and the individual was not necessarily participant in it; life after death was disbelieved or held as the existence of shades; there could be no resurrection of the body and no immortality (in the Greek sense); and with these beliefs were associated a certain worldliness and want of fervour. The more actively and aggressively religious party, on the other hand, adopted the belief in the resurrection of the body, and in the individual's participation in the Messiah's kingdom; all the pious would have their share in it, while the wicked would be outcast. But these doctrines were variously conceived. By some the Messianic kingdom was thought of as permanent, by others as intermediary, the external kingdom being transcendent. So too some thought of a literal resurrection of the body of flesh and blood, while others thought that it would be transformed. The rudiments of some of these ideas can be found in the prophets, but their development took place after the exile, and indeed for the most part after the conclusion of the writings accounted canonical. Thus too the belief in a kingdom of demons held a large place in the mind of the people, though the references to such evil beings are almost absent from the sacred writings of the Old Testament. Again it is to the East that we must look for the origin of these ideas.

The Teaching of Jesus.—Jesus completed the prophetic teachings. He employed the old phraseology and imagery, but He was conscious that He used them in a new sense, and that He preached a new gospel of great joy. Jesus was not a historian, a critic or a theologian. He used the words of common men in the sense in which common men understood them; He did not employ the Old Testament as now reconstructed by scholarship or judged by criticism, but in its simple and obvious and traditional sense, and His background is the intellectual and religious thinking of His time. The ideas of demons and of the future, of the Bible and many other traditional conceptions, are taken over without criticism. So the idea of God which He sets forth is not that of a theologian or a metaphysician, but that of the unlearned man which even the child could understand. Yet though thus speaking in untechnical language, He revolutionized His terms and filled them with new meaning. His emphasis is His own, and the traditional material affords merely the setting for His thought. He was not concerned with speculative questions about God, nor with abstract theories of His relationship to the soul and to the world. God's continual presence, His fatherly love, His transcendent righteousness, His mercy, His goodness, were the facts of immediate experience; not in proofs by formal logic but in the reality of consciousness was the certainty of God. Thus religion was freed from all particular and national elements in the simplest way: for Jesus did not denounce these elements, nor argue against them, nor did He seek converts outside Israel, but He set forth communion with God as the most certain fact of man's experience and as simple reality made it accessible to everyone. Thus His teaching contains the note of universality—not in terms and proclamations but as plain matter of fact. His way for others to this reality is likewise plain and level to the comprehension of the unlearned and of children.

For Him repentance (change of mind, μετάνοια) is placed first. The intricacies of ritual and theology are ignored, and ancient laws which contradict the fundamental beliefs are unhesitatingly abrogated or denied. He seizes upon the most spiritual passages of the prophets, and revives and deepens them; He sums up His teaching in supreme love to God and a love for fellow-man like that we hold for ourselves (Mark xii. 29–31). This supreme love to God is a complete oneness with Him in will, a will which is expressed in service to our fellow-men in the simplest and most natural relationship (Luke x. 25–37). Thus religion is ethical through and through, as God's inner nature, expressed in forgiveness, mercy, righteousness and truth, is not something transcendental, but belongs to the realm of daily life. We become children of God and He our Father in virtue of a moral likeness (Matt. v. 43–48), while of any metaphysical or (so to speak) physical relationship to God, Jesus says nothing. With this clearly understood, man is to live in implicit trust in the divine love, power, knowledge and forgiveness. Hence he attains salvation, being delivered from sin and fear and death, for the divine attributes are not ontological entities to be discussed and defined in the schools, but they are realities, entering into the practical daily life. Indeed they are to be repeated in us also, so that we are to forgive our brethren as we ask to be forgiven (Matt. vi. 12; Luke xi. 4).

As religion thus becomes thoroughly ethical, so is the notion of the Messianic kingdom transformed. Its essential characteristic is the doing of the Father's will on earth as in heaven. Jesus uses parable after parable to establish its meaning. It is a seed cast into the ground which grows and prospers (Matt. xiii. 31–32); it is a seed sown in good ground and bringing forth

fruit, or in bad ground and fruitless (Luke viii. 5–8; Mark iv. 1–32); it is a pearl of great price for which a man should sell all that he possesses (Matt. xiii. 44–46); it is not come "with observation," so that men shall say "lo here and lo there" (Luke xvii. 20–21); it is not of this world, and does not possess the characteristics or the glory of the kingdom of the earth (Luke xxii. 24–26; Mark x. 13–16); it is already present among men (Luke xvii. 21). Together with these statements in our sources are still mingled fragments of the more ordinary cataclysmic, apocalyptic conceptions, which in spite of much ingenious exegesis, cannot be brought into harmony with Christ's predominant teaching, but remain as foreign elements in the words of the Master, possibly brought back through His disciples, or, more probably, used by Jesus uncritically—a part of the current religious imagery in which He shared.

Originality.—It is often declared that in these teachings there is nothing new, and indeed analogies can be found for many sayings; yet nowhere else do we gain so strong an impression of originality. The net result is not only new but revolutionary; so was it understood by the Pharisees. They and Jesus spoke indeed the same words and appealed to the same authorities, but they rightly saw in Him a revolutionist who threatened the existence of their most cherished hopes. The Messianic kingdom which they sought was opposed point by point to the kingdom of which He spoke, and their God and His Father—though called by the same sacred name—were different. Hence almost from the beginning of His public ministry they constantly opposed Him, the conflict deepening into complete antagonism.

Jesus Christ has been termed unique, one of the common people yet separated from them, and this description applies to the breadth, depth and reality of His sympathy. In the meagre records of His life there is evidence that He deemed no form of suffering humanity foreign to Himself. This was not a mere sentiment, nor was His sympathy superficial, for it constituted the essential characteristic of His personality—"He went about doing good." In Him the will of the Father for the redemption of the race was incarnate. This led Him into the society of those outcasts who were condemned and rejected by the respectable and righteous classes. In contemptuous condemnation He was called the friend of the outcasts (Matt. xi. 19; Mark ii. 16–17), and on His part He proclaimed that these sinners would enter into the Kingdom of Heaven before the self-righteous saints (Matt. xxi. 31); even the most repulsive forms of disease and sin drew from Him only loving aid, while he recognized in all other men who laboured for the welfare of their fellows the most intimate relationship to Himself; these constituted His family, and these were they whom His Father will bless.

Jesus recognized His unique position; He could not be ignorant of His powers. Even the prophets had spoken in the name of God; they accepted neither book nor priesthood as authoritative, but uttered their truth as they were inspired to speak, and commanded men to listen and obey. As in Jesus the whole prophetic line culminates, so does its consciousness; reverent toward the Holy Scriptures, He spoke not as their expositor but with a power which invests His words with immediate and full authority. The prophets used the formula, "Thus saith the Lord," but He goes beyond them and speaks in His own name. He believed Himself to be the Messiah of whom the prophets spoke, and only through this self-consciousness can we explain His mission and the career of His disciples. The prophets up to John foretold the coming of the kingdom (Matt. xi. 11–13; Luke xvi. 16), but Jesus opened its doors and made possible entrance into it. Where He is there it is, and hence those who follow Him are God's children, and those who refuse His message are left outside in darkness. He is to sit as enthroned, judge and king, and by Him is men's future to be determined (Matt. xxv. 31 f.; Mark xiii. 26); indeed it was His presence more than His teaching which created His Church. Great as were His words, greater was His personality. His disciples misunderstood what He said, but they trusted and followed Him. By Him they felt themselves freed from sin and fear—and under the influence of a divine power.

Messianic Claims.—Though His claims to authoritative pre-eminence thus took Him out of the class of prophets and put Him even above Elijah and Moses (Mark ix. 2–7; Luke vii. 28; Luke x. 23–24), and though naturally this self-assertion seemed blasphemous to those who did not accept Him, yet as He had transformed the traditional notion of the kingdom, so did He the current thought of the Messiah. The pre-eminence was not to be of rank and glory but of service and self-sacrifice. In His kingdom there can be no strife for precedence, since its King comes not to be ministered unto but to minister and to give His life in the service of others (Mark ix. 33 f., x. 42–45). The formal acknowledgment of the Messiah's worth and position matters little, for to call Him Lord does not ensure entrance into His Kingdom (Matt. vii. 21–23). It is those who fail to recognize the spirit of sympathy and self-sacrificing service as divine and blaspheme redeeming love who are in danger of eternal sin (Mark iii. 28–29). All who do the will of the Father, *i.e.*, who serve their fellows, are the brethren of Christ, even though they do not call Him Lord (Mark iii. 31–35; Matt. vii. 21): and those are blessed who minister to the needy even though ignorant of any relation to Himself (Matt. xxv. 37–40). Finally, membership in His own selected company, or a place in the chosen people, is not of prime importance (Mark ix. 38–40; Luke xiii. 24–30).

Jesus also refuses to conform to the current ideas as to the establishment of the kingdom. The tradition of the people implied a sudden appearance of the Messiah, but Jesus made no claims to a supernatural origin and was content to be known as the son of Joseph and Mary (Mark vi. 3–4). His kingdom is not to be set up by wonders and miraculous powers, nor is it to be established by force (Matt. xxvi. 52); such means would contradict its fundamental character, for as the kingdom of loving service it can be established only by loving service. Even the disciples of Jesus could not grasp the simplicity and profundity of His message; still less could His opponents. He was accused of blasphemy to the ecclesiastical authorities and of insurrection to the civil rulers. He was condemned and crucified. His followers were scattered. Of His work nothing remained, not a written word, nor more than the rudiments of an organization. The decisive event, which turned defeat into victory and re-established courage and faith, was the belief in the reappearance to His disciples. Our sources will not permit the precise determination of the order or the nature of these appearances, but in any case from them arose the faith which was the basis of the Christian Church and the starting-point of its theology.

The death of Jesus as a criminal, and His resurrection, profoundly aroused the belief and hopes of the little group of Jews who were His followers. It is not His word but His person which assumes first place, and faith is acceptance of Him—crucified and risen—as Messiah. Hence His followers early acquire the name Christian from the Greek form of the word. With this emphasis upon the Messiah the Jewish element would seem to be predominant, but as a matter of fact it was not so. The earlier group of disciples, it is true, did not appreciate the universality of the teaching of Jesus, and they continued zealous for the older forms; but Paul through his prophetic consciousness grasped the fundamental fact and in this respect became Jesus' true interpreter. As a result Christianity was rejected by the Jews and became the conquering religion of the Roman empire. In this it underwent another modification of far-reaching consequence.

In our earliest sources—the epistles of St. Paul—Christ is the pre-existent divine man from heaven, He is before and above all things, and had come to earth by a voluntary act of self-humiliation. In the Johannine writings He is the Son of God—the Logos who in the beginning was with God—of Whom are all things—Who lightens every man—and Who was incarnate in Jesus. Here the cosmological element is again made prominent though not yet supreme, and the metaphysical problems are so close at hand that their discussion is imperative. Even in Paul the term Messiah thus had lost its definite meaning and became almost a proper name. Among the Greek Christians this process was complete. Jesus is the "Son of God"; and the great problem of theology becomes explicit. Religion is in our emotions of reverence

and dependence, and theology is the intellectual attempt to describe the object of worship. Doubtless the two do not exactly coincide, not only because accuracy is difficult or even impossible, but also because elements are admitted into the definition of God which are derived from various sources quite distinct from religious experience. Like all concepts the meaning of religious terms is changed with a changing experience and a changing world-view. Transplanted into the world where Greek ideas were prevalent, inevitably the Christian teaching was modified—indeed transformed. Questions which had never been asked came into the foreground, and the Jewish presuppositions tended to disappear, and the Messianic hopes were forgotten or transferred to a transcendent sphere beyond death. When the empire became Christian in the 4th century, the notion of a kingdom of Christ on earth to be introduced by a great struggle all but disappeared, remaining only as the faith of obscure groups. As thus the background is changed from Jewish to Greek, so are the fundamental religious conceptions.

The Semitic peoples were essentially theocratic; they used the forms of the sensuous imagination in setting forth the realities of the unseen world. They were not given to metaphysical speculation, nor long insistent in their inquiries as to the meaning and origin of things. With the Greeks it was far otherwise: for them ideas and not images set forth fundamental reality, and their restless intellectual activity would be content with nothing but the ultimate truth. Their speculation as to the nature of God had led them gradually to separate Him by an infinite distance from all creation, and to feel keenly the opposition of the finite and the infinite, the perfect and the imperfect, the eternal and the temporal. To them, therefore, Christianity presented itself not primarily as the religion of a redemption through the indwelling power of a risen Saviour, as with Paul, nor even as the solution of the problem how the sins of men could be forgiven, but as the reconciliation of the antinomy of the intellect, indicated above. The incarnation became the great truth: God is no longer separated by a measureless distance from the human race, but by His entering into humanity He redeems it and makes possible its ultimate unity with Himself. Such lines of thought provoke discussion as to the relationship of Jesus to God the Father, and, at a later period, of the nature of the Holy Spirit who enters into and transforms believers.

Greek philosophy in the 2nd century A.D. had sunk for the most part into scepticism and impotence; its original impulse had been lost, and no new intellectual power took its place; only in Alexandria was there a genuine effort made to solve the fundamental problems of God and the world; and mingled with the speculations of the Greek philosophers were the ancient legends of gods and heroes, accepted as inspired scripture by the people, and by the philosophers in part explained away by an allegorical exegesis and in part felt increasingly as a burden to the intelligence. In this period of degeneracy there were none the less an awakening to religious needs and a profound longing for a new revelation of truth, which should satisfy at once the intellect and the religious emotions.

Christianity came as supplying a new power; it freed philosophy from scepticism by giving a definite object to its efforts and a renewed confidence in its mission. Monotheism henceforth was to be the belief not of philosophers only but even of the ignorant, and in Jesus Christ the union of the divine and the human was effected. The Old Testament, allegorically explained, became the substitute for the outgrown mythology; intellectual activity revived; the new facts gained predominant influence in philosophy, and in turn were shaped according to its canons. In theology the fundamental problems of ontological philosophy were faced; the relationship of unity to multiplicity, of noumenon to phenomena, of God to man. The new element is the historical Jesus, at once the representative of humanity and of God. As in philosophy, so now in theology, the easiest solution of the problem was the denial of one of its factors: and successively these efforts were made, until a solution was believed to be found which satisfied both terms of the equation and became the fundamental creed of the Church. Its moulds of thought are those of Greek philosophy, and into these were run the Jewish teachings. We have thus a peculiar combination—the religious doctrines of the Bible, as culminating in the person of Jesus, run through the forms of an alien philosophy.

The Doctrine of the Trinity.—The Jewish sources furnished the terms Father, Son and Spirit. Jesus seldom employed the last term and Paul's use of it is not altogether clear. Already in Jewish literature it had been all but personified (*cf.* the *Wisdom of Solomon*). Thus the material is Jewish, though already doubtless modified by Greek influence: but the problem is Greek; it is not primarily ethical nor even religious, but it is metaphysical. What is the ontological relationship between these three factors? The answer of the Church is given in the Nicene formula, which is characteristically Greek, and which affirms that God, the infinite, the absolute, the eternal, is yet not separated from the finite, the temporal, the relative, but, through the incarnation, enters into humanity (*see* ARIUS and ATHANASIUS "THE GREAT"). This entering into humanity is not an isolated act but continues in all the children of God by the indwelling Spirit. Thus, according to the canons of ancient philosophy, justice is done to all the factors of our problem—God remains as Father, the infinitely remote and absolute source of all; as Son, the Word Who is revealed to man and incarnate in Him; as Spirit, Who dwells even in our own souls and by His substance unites us to God.

Jesus was the central fact of faith, because he had led the disciples to God. After the resurrection He was the object of praise, and soon prayers were offered in His name and to Him. Already to the apostle Paul He dominates the world and is above all created things, visible and invisible, so that He has the religious value of God. Metaphysics and speculative theories were valueless for Paul; he was conscious of a mighty power transforming his own life and filling him with joy, and that this power was identical with Jesus of Nazareth he knew. In all this Paul is the representative of that which is highest and best in early Christianity. Speculation and hyperspiritualization were ever tending to obscure this fundamental religious fact: in the interest of a higher doctrine of God His true presence in Jesus was denied, and by exaggeration of Paul's doctrine of "Christ in us" the significance of the historic Jesus was given up. The Johannine writings, which presupposed the Pauline movement, are a protest against the hyperspiritualizing tendency. They insist that the Son of God has been incarnate in Jesus of Nazareth, and that our hands have handled and our eyes have seen the word of life. This same purpose, namely, to hold fast to the historic Jesus, triumphed in the Nicene formula; Jesus was not to be resolved into an aeon or into some mysterious *tertium quid*, neither God nor man, but to be recognized as very God who redeemed the soul. Through Him men were to understand the Father and to understand themselves as God's children.

It is apparent that such a doctrine as the Trinity is itself susceptible of many explanations, particularly as to the distinction and relation between God the Eternal Son and God the Holy Spirit; and minds differently constituted lay emphasis upon its different elements. Especially is this true as its Greek terminology was translated into Latin, and from Latin came into modern languages—the original meaning being obscured or disguised, and the original issues forgotten. For some the first thought of God, the infinite and ultimate reality lying beyond and behind all phenomena, predominates. With these the historic manifestation of Jesus becomes only a guide to lead us to that immediate apprehension of God which is the end of theology, and to that immediate union with God which is the end of religion. Such an end is accomplished either by means of pure thought or by a oneness of pure feeling, giving as results the theological or philosophical construction of the idea of God, or a mystical ecstasy which is itself at once immediate, inexplicable and indescribable. On the other hand, minds of a different and more concrete character so emphasize the distinctions God, Son and Holy Spirit, that a tritheistic construction appears—three individuals in the one Godhead: these individuals appearing, as for example, in the Father and the Son, even in opposition to each other. In general we may say then that the Trinity takes on

three differing aspects in the Christian Church: in its more common and easily apprehended form as three Gods; in its ecclesiastical form as a mystery which is above reason to be accepted by faith; in its philosophic form as a metaphysical interpretation of the finite, the infinite and the relation between them.

To some Christians the doctrine of the Trinity appeared inconsistent with the unity of God which is emphasized in the Scriptures. They therefore denied it, and accepted Jesus Christ, not as incarnate God, but as God's highest creature by Whom all else was created, or as the perfect man who taught the true doctrine of God. The first view in the early Church long contended with the orthodox doctrine, but finally disappeared, and the second doctrine in the modern Church was set forth as easily intelligible, but has remained as a form of "heresy."

The Cross and the Atonement.—Allied with the doctrine of God which seeks the solution of the ultimate problem of all philosophy, the doctrine of salvation has taken the most prominent place in the Christian faith: so prominent, indeed, that to a large portion of believers it has been the supreme doctrine, and the doctrine of the deity of Jesus has been valued only because of its necessity on the effect of the atonement. Jesus alone of the great founders of religion suffered an early and violent death, even the death of a criminal. It became therefore the immediate task of His followers to explain this fact. This explanation was the more urgent because under the influence of Jewish monotheism the rule of God was accepted as an undoubted presupposition, so that the death of Jesus must be in accordance with His will. The early Church naturally used the term and phrases of the prophets. He died the death of a criminal, not for His sins, but for ours. Isaiah liii. was suggested at once and became the central explanation: Christ is the suffering servant Who is numbered with the transgressors and Who bears the sins of many.

It is remarkable that in the earliest centuries of Christian thought there is only the most slender support for theories of the Atonement which became widely current at a later time. The early Fathers did not regard the sufferings of Christ as a vicarious satisfaction of God's wrath, where He underwent punishment due to us and His obedience is imputed to us. Whenever they use language which seems to convey such ideas, they as it were instinctively safeguard it by the idea of our union with Christ, where we share in His obedience and His passion, and only so far as we make them our own do we actually appropriate the redemption He won for us. Their main thought is that man is reconciled to God by the Atonement, and not God to man; the change which it effects is a change in man rather than a change in God. Many centuries later the familiar outlines of the theory of vicarious atonement were drawn, and carved into a rigid scheme by the Reformers. They were deeply convinced that human sin is the violation of an eternal law which has its basis in the very being of God and is the expression of God's justice, which must be satisfied. This is the conviction embodied in the Protestant creeds, and worked out by means of metaphors so legal and even mechanical in character that modern theology has been marked by a widespread revolt against every form of it.

A large part of the history of Christian doctrine deals with controversies arising from theories of the Atonement (*q.v.*); but excepting in relatively narrow circles these theories have been seriously studied only by professed theologians. That Christ died for us, and that we are saved by Him, is indeed the living truth of the Church in all ages, and a false impression of the fact is given by dwelling upon theories as if they were central. At best they bear only the relationship of philosophy to life.

These hopes and theories of salvation do not indeed wholly explain the power of Christianity. Jesus wearied Himself with the healing of man's physical ailments, and He was remembered as the great physician. Early Christian literature is filled with medical terms, applied (it is true) for the greater part to the cure of souls. The records of the Church are also filled with the efforts of Jesus's followers to heal the diseases and satisfy the wants of men. A vast activity animated the early Church: to heal the sick, to feed the hungry, to succour the diseased, to rescue the fallen, to visit the prisoners, to forgive the erring, to teach the ignorant, were ministries of salvation. A mighty power impelled men to deny themselves in the service of others, and to find in this service their own true life. None the less the first place is given to the salvation of the soul, since, created for an unending existence, it is of transcendent importance. While man is fallen and by nature vile, nevertheless his possibilities are so vast that in comparison the affairs of earth are insignificant. The word, "What shall it profit a man if he gain the whole world and lose his own soul?" comes to mean that the individual soul outvalues the whole world. With emphasis upon God as creator and ruler, and upon man as made in God's image, endowed with an unending existence, and subject to eternal torture if not redeemed, the concept of personality has been exalted at the expense of that of nature, and the future has been magnified at the expense of the present. Thus a future heaven is man's true home, and theology instead of philosophy or natural science is his proper study.

Indeed, intellectual interest centred in religion. Natural science was forsaken, except in so far as it ministered to theology. Because the Old Testament contained references to the origin and the objects of the universe, a certain amount of natural science was necessary, but it was only in this connection that it had any value. By Augustine's time this process is complete. His writings contain most of the knowledge of his age, but it is strictly subordinate to his theological purpose. Hence, when the barbarians submerged southern Europe, theology alone survived. The Church entered upon a new task. In the beginning Christianity had been the teacher of religion to highly civilized peoples —now it became the civilizing agent to the barbarians, the teacher of better customs, the upholder of law and the source of knowledge. The learned men were monks and priests, and the universities were Church institutions.

The Sacraments and Salvation.—Belief in mysterious powers attached to food, feasts, ceremonial rites and sacred things is all but universal. Primitive man seldom connects sacrifice with notions of propitiation, indeed only in highly ethicized religions is the consciousness of sin or of guilt pre-eminent. Sacrifice was believed to exert an influence on the deity which is quasi-physical, and in sacrificial feasts God and worshipper are in mysterious union.

So universal are such ideas that the problem in particular religions is not their origin but their form. In the Old Testament repeatedly they are found in conflict with the prophetic ideals. Sometimes the prophets denounce them, sometimes ignore them, sometimes attempt to reform and control them. Jesus ignores them, His emphasis being so strong upon the ethical and spiritual that the rest is passed by. In the early Church, still Jewish, the belief was in the coming of a mysterious power from God which produced ecstasy and worked wonders. Paul also believes in this, but insists that it is subordinate to the peaceable fruits of righteousness. With the naturalization of the Church in the Gentile world ethical ideas became less prominent, and the sacramental system prevailed. By baptism and the Lord's Supper grace is given (*ex opere operato*), so that man is renewed and made capable of salvation. Already in the 2nd century baptism was described as a bath in which the health of the soul is restored, and the Lord's Supper as the potion of immortality. Similar notions present in the ethnic faiths take the Christian facts into their service, the belief of the multitude without essential change remaining vague and undefined. While the theologians discussed doctrine the people longed for mystery, as it satisfied their religious natures; by sacraments they felt themselves brought into the presence of God, and to sacraments they looked for aid. Many sacraments were adopted by portions of the Church, until at last the sacred number seven was agreed upon.

In the earliest period the services were characterized by extreme freedom, and by manifestations of ecstasy which were believed to indicate the presence of the spirit of God; but as time went on the original enthusiasm faded away, the cult became more and more controlled, until ultimately it was completely subject to the priesthood, and through the priesthood to the Church. The power of the priesthood had its centre in the sacrament of the Eucharist (*q.v.*), and in the Roman communion the structure of

the sacred edifice, the positions and attitudes of the priest and the congregation, the order of service, emphasize the mystery and the divine efficacy of the sacrament. The worshipper feels himself in the immediate presence of God, and enters into physical relations with him; participation in the mass also releases from guilt, as the Lamb of God offered up atones for sin and intercedes with the Father in our behalf. Thus in this single act of devotion both objects of all cults are attained.

Organization.—As the teaching and person of Jesus were fitted into the framework of Greek philosophy, and the sacraments into the deeper and broader forms of popular belief, so was the organization shaped by the polity of the Roman empire. Jesus gathered His group of followers and committed to it His mission, and after His resurrection the necessities of the situation brought about the choice of quasi-officials. Later the familiar polity of the synagogue was loosely followed. A completer organization was retarded by two factors, the presence of the apostles and the inspiration of the prophets. But when the apostles died and the early enthusiasm disappeared, a stricter order arose. Practical difficulties called for the enforcement of discipline, and differences of opinion for authority in doctrine; and, finally, the sacramentarian system required a priesthood. In the 2nd century the conception of a Catholic Church was widely held and a loose embodiment was given it; after the conversion of the empire the organization took on the official forms of the empire. Later it was modified by the rise of the feudal system and the re-establishment of the modern European nationalities.

The polity of the Church was more than a formal organization; it touched the life of each believer. Very early, Christianity was conceived to be a new system of law, and faith was interpreted as obedience. Legalism was joined with sacramentarianism, doubling the power of the priest. Through him Church discipline was administered, a complete system of ecclesiastical penalties, *i.e.*, penance, growing up. It culminated in the doctrine of purgatory, a place of discipline, of purifying suffering after death. The Roman genius for law strengthened and systematized this tendency.

The Roman Church.—The hierarchy which centres in the pope constitutes the Church of which the sacramental system is the inner life and penance is the sanction. It is thus a divine-human organization. It teaches that the divine-human Son of God established it, and returning to heaven committed to the apostles, especially to St. Peter, his authority, which has descended in an unbroken line through the popes. This is the charter of the Church, and its acceptance is the first requisite for salvation; for the Church determines doctrine, exercises discipline and administers sacraments. Its authority is accompanied by the spirit of God, who guides it into truth and gives it miraculous power. Outside the Church are only the "broken lights" of man's philosophy and the vain efforts of weak human nature after virtue.

Christianity in its complete Roman development is thus the coming of the supernatural into the natural. The universe falls into these orders, the second for the sake of the first, as nature is of and for God. Without Him nature at its highest is like a beautiful statue, devoid of life; it is of secondary moment compared even to men, for while it passes away he continues for ever. Man is dependent, therefore, not upon nature, but upon God's grace for salvation, and this comes through the Church. Thus the Church ever receives God and has a twofold nature; its sacraments through material and earthly elements impart a divine power; its teachings agree with the highest truths of philosophy and science, yet add to these the knowledge of mysteries which the unaided reason of man could never apprehend. Theology is the queen of the sciences, and nothing should be taught in school or university which contradicts its conclusions. Moreover, nothing should be done by the State which interferes with the transcendent interest committed to the Church. Thus the Church touches and controls all realms of life, and the cycle is complete.

The Reformation.—The idea of the Roman Church was imperfectly embodied at the best; the divine gift was in earthen vessels. The world was never completely cast out; indeed the Church became the scene for ambition and the home of luxury and pleasure. It was entangled also in the political strife of the feudal ages and of the beginning of modern empires. Its control of the sciences embroiled it with its own philosophers and scholars, while saints and pure-minded ecclesiastics attempted, without success, its reform from within. Finally, through Luther, the explosion came, and western Christendom broke into two parts—Catholic and Protestant.

Protestantism in its primary principle is the return to primitive Christianity. The whole development which we have traced, culminating in the ecclesiastical-doctrinal system of the Roman Church, is regarded as a corruption, since foreign and even heathen elements have been brought in, so that the religion established by Christ is obscured or lost. For Protestants the Bible only now becomes the infallible inspired authority in faith and morals. Interpretations by the Fathers or by the councils are to be taken only as aids to its understanding. But in Protestantism reason and the light of nature are in themselves as impotent as in the Roman Church. The Bible interpreted by man's unaided intelligence is as valueless as other writings, but it has a sacramental value when the Holy Spirit accompanies its teaching, and the power of God uses it and makes the soul capable of holiness. In all this the supernatural is as vividly realized as in the Roman Church; it is only its mediation which is different.

These principles are variously worked out in the different churches and variously expressed. In part because of historical circumstances, the divergence from the older systems is more marked in some Protestant churches than in others, yet on the whole these two principles determine cult and in part organization. As in the Roman Church cult centres in the mass, so in the original Reformed Church it centred in the sermon. The ancient Jewish prophetic office was revived, yet with a difference: the ancient prophets acknowledged no external authority, but the Protestant preacher is strictly subordinate to the Scriptures of which he is the interpreter. Besides the sermon, the sacraments are observed as established by Christ—two in number, baptism and the Lord's Supper. But these do not exert a quasi-physical or magical influence, *ex opere operato*. Unless there be faith in the recipient, an understanding of the meaning of the sacrament and an acceptance of it, it is valueless or harmful. Prayer and praise also are effective only as the congregation intelligently joins in them.

The emphasis upon the believer and his freedom from all external authority do not result in a thoroughgoing individualism. Luther clearly held to the unity of all Christians, and Protestants are agreed in this. For them, as for the Roman Church, there is a belief in a catholic or all-embracing Church, but the unity is not that of an organization; Christians are one through an indwelling spirit; they undergo the same experience and follow the same purpose.

Historically these principles were only in part embodied, for the Reformation was involved in political strife. The Reformers turned to the Government for aid and protection, and throughout Europe turmoil and war ensued. In consequence, in the Protestant nations the State assumed the ultimate authority over the Church. Moreover, in the early days of the Reformation the Catholic Church charged it with a lawless individualism, a charge which was seemingly made good by an extreme divergence in theological opinion and by riots in various part of the Protestant world. The age was indeed one of ferment, so that the foundations of society and of religion seemed threatened. The Reformers turned to the State for protection against the Roman Church, and ultimately as a refuge from anarchy, and they also returned to the theology of the Fathers as their safeguard against heresy. Instead of the simplicity of Luther's earlier writings, a dogmatic theology was formed, and a Protestant ecclesiasticism established, indistinguishable from the Roman Church in principle. The main difference was in the attitude to the Roman allegiance and to the sacramentarian system. There was thus by no means a complete return to the Bible as the sole authority, but the Bible was taken as interpreted by the earlier creeds and as worked into a doctrinal system by the scholastic philosophy. Thus Protestantism also came to identify theology with the whole range of human knowledge, and in its official forms was as hostile to the progress

of science as was the Roman Church itself.

Many Protestants rebelled against this radical departure from the principles of the Reformation and of biblical Christianity. To them it seems the substitution of the authority of the Church for the authority of a living experience, and of intellectual adherence to theological propositions for faith. The freedom of the individual was denied. Protestantism divided into many sects and denominations, founded upon special types of religious experience or upon particular points in doctrine or in cult. Thus Protestantism presents a wide diversity in comparison with the regularity of the Roman Church (*see* REUNION, CHURCH).

Christianity and the Modern World.—The coming of the northern peoples into the Roman world profoundly modified Christianity. It shared indeed in the dreariness and corruption of the times commonly called the "dark ages," but when at last a productive period began the Church was the first to profit by it. Since all educated men were priests, it assimilated the new learning—the revived Aristotelianism—and continued its control of the universities. In the 13th century it was supreme, and Christianity was identified with world systems of knowledge and politics. Both were deemed alike divine in origin, and to question their validity was an offence against God. Christianity thus had passed through three stages in politics as in science. At first it was persecuted by the State, then established by it, and finally dominated over it; so its teaching was at first alien to philosophy and despised by it, next was accepted by it and given form and rights through it, and finally became queen of the sciences as theology and ruled over the whole world of human knowledge. But the triumph by its completeness ensured new conflicts; from the disorder of the middle ages arose states which ultimately asserted complete autonomy, and in like fashion new intellectual powers came forth which ultimately established the independence of the sciences.

In the broadest sense the underlying principle of the struggle is the reassertion of interest in the world. It is no longer merely the scene for the drama of the soul and God, nor is man independent of it, but man and nature constitute an organism, humanity being a part of the vaster whole. Man's place is not even central, as he appears a temporary inhabitant of a minor planet in one of the lesser stellar systems. As in the political world the States gained first the undisputed control of matters secular, rejecting even the proffered counsel of the Church, and then proceeded to establish their sovereignty over the Church itself, so was it in the empire of the mind. The rights gained for independent research were extended over the realm of religion also; the two indeed cannot remain separate, and man must subordinate knowledge to the authority of religion—or make science supreme, submitting religion to its scrutiny and judging it like other phenomena. Under this investigation Christianity does not appear altogether exceptional. Its early logic, ontology, and cosmology, with many of its distinctive doctrines, are shown to be the natural offspring of the races and ages which gave them birth. Put into their historical environment they are found to be steps in the intellectual development of man's mind. But when put forward as absolute truths to-day, they are put aside as anachronisms not worthy of dispute. The Bible is studied like other works, its origins discovered and its place in comparative religion assigned. It does not appear as altogether unique, but it is put among the other sacred books. For the great religions of the world show similar cycles of development, similar appropriations of prevalent science and philosophy, similar conservative insistence upon ancient truth, and similar claims to an exclusive authority.

With this interest is involved an attitude of mind toward the supernatural. As already pointed out, nature and super-nature were taken as physically and spatially distinct. The latter could descend upon the former and be imparted to it, neither subject to nature nor intelligible by reason. In science the process has been reversed; nature ascends, so to speak, into the region of the supernatural and subdues it to itself; the marvellous or miraculous is brought under the domain of natural law, the canons of physics extend over metaphysics, and religion takes its place as one element in the natural relationship of man to his environment. Hence the new world-view threatens the foundations of the ecclesiastical edifice. This revolution in the world-view is no longer the possession of philosophers and scholars, but the multitude accepts it in part. Education in general has rendered many familiar with the teachings of science, and, moreover, its practical benefits have given authority to its maxims and theories.

The *Roman Catholic Church* uncompromisingly reasserts its ancient propositions, political and theological. The cause is lost indeed in the political realm, where the Church is obliged to submit, but it protests and does not waive or modify its claims (*see* the *Syllabus* of 1864, par. 19 *seq.*, 27, 54 and 55). In the Greek and Protestant churches this situation cannot arise, as they make no claims to governmental sovereignty. In the intellectual domain the situation is more complex. Again the Roman Church unhesitatingly reaffirms the ancient principles in their extreme form (*Syllabus*, par. 8–9–13; *Decrees of the Vatican Council*, ch. 4, especially canon 4–2); the works of St. Thomas Aquinas are recommended as the standard authority in theology (Encyc. of Leo XIII., *Aeterni Patris*, Aug. 4, 1879). In details also the conclusions of modern science are rejected, as for example the origin of man from lower species, and, in a different sphere, the conclusions of experts as to the origins of the Bible. Faith is defined as "assent upon authority," and the authority is the Church, which maintains its right to supremacy over the whole domain of science and philosophy.

The *Greek Church* remains untouched by the modern spirit. With characteristic oriental conservatism it claims the title of "Orthodox" and retains the creed and organization of the early Church. The *Protestant Churches* also are bound officially to the scholastic philosophy of the 17th century; their confessions of faith still assert the formation of the world in six days, and require assent to propositions which can be true only if the old cosmology be correct.

Compromises.—On the other hand there are individuals and even large bodies of Christians who are intent upon a reinterpretation. Even in the official circles of the Church, not excepting the Roman Church, there are many scholars who find no difficulty in maintaining communion while accepting the modern scientific view of the world. This is possible to some because the situation in its sharp antithesis is not present to their minds: by making certain compromises on the one side and on the other, and by framing private interpretations of important dogmas, they can retain their faith in both and yet preserve their mental integrity.

Thus the crisis is in fact not so acute as it might seem. No great institution lives or dies by logic. Christianity rests on great religious needs which it meets and gratifies, so that its life (like all other lives) is in unrationalized emotions. Reason seeks ever to rationalize these, an attempt which seems to destroy yet really fulfils. As thus the restless reason tests the emotions of the soul, criticizes the traditions to which they cling, rejects the ancient dogmas in which they have been defined, the Church slowly participates in the process; silently this position and that are forsaken, legends and beliefs once of prime importance are forgotten, or when forced into controversy many ways are found by which the old and the new are reconciled; the sharpness of distinctions can be rubbed off, expressions may be softened, definitions can be modified and half-way resting-places afforded, until the momentous transition has been made and the continuity of tradition is maintained. Finally, as the last step, even the official documents may be revised.

Philosophy and Ethical Redemption.—The intellectual crisis cannot be ignored in the interest of the practical life. Men must rationalize the universe. On the one hand there are churchmen who attempt to repeat the historical process which has naturalized the Church in alien soils by appropriating the forces of the new environment, and who hold that the entire process is inspired and guided by the spirit of God. Hence Christianity is the absolute religion, because it does not preclude development but necessitates it, so that the Christianity that is to come shall not only retain all that is important in the Christianity of the past and present but shall assimilate new truth. On the other hand some seek the essential Christianity in a life beneath and separable from the historic forms. In part under the influence of the Hegelian

philosophy, and in part because of the prevalent evolutionary scientific world-view, God is represented under the form of pure thought, and the world process as the unfolding of Himself. Such truth can be apprehended by the multitude only in symbols which guide the will through the imagination, and through historic facts which are embodiment of ideas. The Trinity is the essential Christian doctrine, the historic facts of the Christian religion being the embodiment of religious ideas. The chief critical difficulty felt by this school is in identifying any concrete historic fact with the unchanging idea, that is, in making Jesus of Nazareth the incarnation of God. God is reinterpreted, and in place of an extra-mundane creator is an omnipresent life and power. The Christian attainment is nothing else than the thorough intellectual grasp of the absolute idea and the identification of our essential selves with God. With a less thoroughgoing intellectualism other scholars reinterpret Christianity in terms of current scientific phraseology. Christianity is dependent upon the understanding of the universe; hence it is the duty of believers to put it into the new setting, so that it adopts and adapts astronomy, geology, biology and psychology.

From all these efforts to reconstruct systematic theology with its appropriations of philosophy and science, groups of Christians turn to the inner life and seek in its realities to find the confirmation of their faith. They also claim oneness with a long line of Christians, for in every age there have been men who have ignored the dogma and the ritual of the Church, and in contemplation and retirement have sought to know God immediately in their own experience. To them at best theology with its cosmology and its logic is only a shadow of shadows, for God reveals himself to the pure in heart, and it matters not what science may say of the material and fleeting world. This spirit manifests itself in wide circles in our day. The Gordian knot is cut, for philosophy and religion no longer touch each other but abide in separate realms.

In quite a different way a still more influential school seeks essential Christianity in the sphere of the ethical life. It also would disentangle religion from cosmology and formal philosophy. It studies the historic development of the Church, noting how element after element has been introduced into the simplicity of the gospel, and from all these it would turn back to the Bible itself. In a thoroughgoing fashion it would accomplish what Luther and the Reformation attempted. It regards even the earliest creeds as only more or less satisfactory attempts to translate the Christian facts into the current language of the heathen world. But the process does not stop with this rejection of the ancient and the scholastic theology. It recognizes the scientific results attained in the study of the Bible itself, and therefore it does not seek the entire Bible as its rule of truth. To it Jesus Christ, and He alone, is supreme, but this supremacy does not carry with it infallibility in the realm of cosmology or of history. In these too Jesus participated in the views of His own time; even His teaching of God and of the future life is not lacking in Jewish elements, yet none the less He is the essential element in Christianity, and to His life-purpose must all that claims to be Christianity be brought to be judged. To this school Christianity is the culmination of the ethical monotheism of the Old Testament, which finds its highest ideal in self-sacrificing love. Jesus Christ is the complete embodiment of this ideal, in life and in death. This ideal He sets before men under the traditional forms of the Kingdom of God as the object to be attained, a Kingdom which takes upon itself the forms of the family, and realizes itself in a new relationship of universal brotherhood. Such a religion appeals for its self-verification not to its agreement with cosmological conceptions, either ancient or modern, or with theories of philosophy, however true these may be, but to the moral sense of man. On the one hand, in its ethical development, it is nothing less than the outworking of that principle of Jesus Christ which led Him not only to self-sacrificing labour but to the death upon the cross. On the other hand, it finds its religious solution in the trust in a power not ourselves which makes for the same righteousness which was incarnate in Jesus Christ.

Thus Christianity, as religion, is on the one hand the adoration of God, that is, of the highest and noblest, and this highest and noblest as conceived not under forms of power or knowledge but in the form of ethical self-devotion as embodied in Jesus Christ, and on the other hand it meets the requirements of all religion in its dependence, not indeed upon some absolute idea or omnipotent power, but in the belief that that which appeals to the soul as worthy of supreme worship is also that in which the soul may trust, and which shall deliver it from sin and fear and death. Such a conception of Christianity can recognize many embodiments in ritual, organization and dogma, but its test in all ages and in all lands is conformity to the purpose of the life of Christ. The Lord's Prayer in its oldest and simplest form is the expression of its faith, and Christ's separation of mankind on the right hand and on the left in accordance with their service or refusal of service to their fellow-men is its own judgment of the right of any age or Church to the name Christian.

Christianity has passed through too many changes, and it has found too many interpretations possible, to fear the time to come. Thoroughgoing reconstruction in every item of theology and in every detail of polity there may be, yet shall the Christian life go on—the life which finds its deepest utterance in the words of Christ, "Thou shalt love the Lord thy God with all thy heart and thy neighbour as thyself"; the life which expresses its profoundest faith in the words Christ taught it to pray, "Our Father"; the life which finds its highest rule of conduct in the words of its first and greatest interpreter, "Let this mind be in you which was also in Christ Jesus our Lord."

The view that Jesus deliberately founded a Church (an ecclesiastical institution), appointed the Apostles its rulers, settled its rites, gave it its doctrine and guaranteed its fidelity, can only be maintained by discarding history altogether. In the 19th century this was transformed into the view that Jesus planted "in germ" what has grown to be the present Catholic doctrine and order. Among those who differ only in detail about what happened, there are, however, diametrically opposite judgments of the value of the change. (i.) Liberal Protestant scholars, on the whole, regard it as the kind of corruption to which religions are always subject as they absorb alien elements with their imperfectly instructed converts. They find the essential Christian element to be a power, shown by no other religion, first of elevating and spiritualizing these alien elements and then of eliminating them. This they ascribe to the higher idea of redemption inseparable from the faith in Christ (which, however much overlaid, has always wrought like leaven), and to what goes with it—the Revelation of the Father. Thus, for them, an essential quality of Christianity is its power to regenerate itself by a return to the Jesus of the Gospels. They would maintain that all other religions have their place, but it is as a preparation, or if their elements remain in Christianity, it is only as a temporary substitute for the true Christian redemption. (ii.) Liberal Catholic scholars on the other hand regard it as the highest perfection of Christianity that it can thus "syncretize" (absorb and transform) what has appealed to human need in any religion. By this comprehensiveness, they maintain, Christianity, from being an enthusiastic but incoherent movement, grew into a permanent and effective institution, with its original puritanism enriched in all kinds of religiously valuable ways.

The foregoing statement is a definition not of two positions but of two *directions*, and allows for various intermediate doctrines and interpretations. All these are naturally exemplified in the principal branches of organized Christianity, and reference must be made to the various articles on these subjects: ROMAN CATHOLIC CHURCH; ENGLAND, CHURCH OF; PRESBYTERIANISM; LUTHERANS; CONGREGATIONALISM; METHODISM; etc.

BIBLIOGRAPHY.—On such a vast subject we can here refer to only a few of those books which give guidance for further study and are typical of each of its main lines. For Roman Catholicism: P. Batiffol, *L'Église naissante et le catholicisme* (4th ed., 1909); Wilhelm and Scannell, *Manual of Catholic Theology* (1899); C. S. Devas, *The Key to the World's Progress* (1906); and many articles in the *Catholic Encyclopaedia*. For Anglicanism: *Lux Mundi* (1890); Gore, *Orders and Unity* (1909); *The Reconstruction of Belief* (1927); Darwell Stone, *The Church, its Ministry and Authority* (1902); A. C. Headlam (Bishop of Gloucester), *The Church of England* (1927). For the Free Churches: *Towards Reunion*, by Church of England and Free Church writers (1919); G. K. A. Bell, *Documents on Christian Unity*

(1924); G. K. A. Bell and W. Robertson (ed. by), *The Church of England and the Free Churches* (1925); A. E. Garvie, art. "Christianity" in Hastings' *Encyclopaedia of Religion and Ethics* (for liberal Evangelicalism); J. E. Carpenter (ed. by), *Freedom and Truth* (1925), for Unitarian Christianity (*see* also James Drummond, *Via, Veritas, Vita or Christianity in its simplest and most intelligible form;* Hibbert Lectures, 1894; and Charles Beard, *The Reformation in its Relation to Modern Thought and Knowledge:* Hibbert Lectures, 1883).

For the principles of Protestantism as a Religion: A. Ritschl, *Christian Doctrine of Justification and Reconciliation* (Eng. trans., 1900), most important for its present influence (for a critical estimate, Garvie, *The Ritschlian Theology,* 1897); E. Troeltsch, *Die Absolutheit des Christenthums* (1902); W. Hermann, *Communion of the Christian with God* (Eng. trans., 1895), a discussion in the spirit of Luther; A. Sabatier, *Religions of Authority and the Religion of the Spirit* (Eng. trans., 1904). On primitive Christianity, *see* Harnack, *Mission and Expansion of Christianity in the first three centuries* (Eng. trans., 1904); Wernle, *Beginnings of Christianity* (Eng. trans., 1904); Weizsacker, *The Apostolic Age* (Eng. trans., 1897); Hatch, *Influence of Greek Ideas and Usages on the Christian Church* (Hibbert Lectures, 1888). (G. W. Kn.; S. H. M.)

CHRISTIAN OF BRUNSWICK (1599–1626), bishop of Halberstadt, a younger son of Henry Julius, duke of Brunswick-Wolfenbüttel, was born in Gröningen on Sept. 20, 1599. Having succeeded his father as "bishop" of Halberstadt in 1616, he obtained some experience of warfare under Maurice, prince of Orange, in the Netherlands. Raising an army he entered the service of Frederick V., elector palatine of the Rhine, and attacked the lands of the elector of Mainz and the bishoprics of Westphalia. After some successes he was defeated by Tilly at Höchst in June 1622; then, dismissed from Frederick's service, he entered that of the United Provinces, losing an arm at the battle of Fleurus. In 1623 he was beaten by Tilly at Stadtlohn and driven back to the Netherlands. When in 1625 Christian IV., king of Denmark, entered the arena of the war, he took the field again in the Protestant interest, but after some successes he died at Wolfenbüttel on June 16, 1626. (*See* also Thirty Years' War.)

Bibliography.—Count van Tilly, *Relacion de la vitoria que de dar al Conde de Tylli contra el Duque Cristiano de Bronzuyque* (Madrid, 1623).

CHRISTIANSAND, a fortified seaport of Norway, the chief town of the diocese (*stift*) of Agder on a fjord of the Skagerrack, 175 mi. S.W. of Oslo. Pop. (est. 1936) 18,781. It stands on a square peninsula flanked by the western and eastern harbours and by the Otter river, among wooded hills and islands. It is a fishing centre (salmon, mackerel, lobsters), with sawmills, wood-pulp factories, shipbuilding yards and mechanical workshops. The port is the largest on the south coast; coast and foreign steamers on the way north to Oslo ordinarily touch here. The Saetersdal railway follows that valley north to Byglandsfjord (48 mi.), whence a good road continues to Viken i Valle at the head of the valley. Flekkerö, a neighbouring island, is a favourite pleasure resort. The town was founded in 1641 by Christian IV.

CHRISTIAN SCIENCE, the religion founded by Mary Baker Eddy; the religion represented by the Church of Christ, Scientist. Applicable to health, as the Christian religion originally was, Christian Science is a religious teaching and practice based on the words and works of Christ Jesus. As defined by Mrs. Eddy, it is "divine metaphysics"; it is "the scientific system of divine healing"; it is "the law of God, the law of good, interpreting and demonstrating the divine Principle and rule of universal harmony" (*Science and Health with Key to the Scriptures,* p. 111, 123; *Rudimental Divine Science,* p. 1). For many years prior to 1866 Mrs. Eddy had observed and studied mental causes and effects. Profoundly religious, she was disposed to attribute causation to God and to regard Him as divine Mind. At Lynn, Mass., in that year, she recovered almost instantly from a severe injury after reading an account of healing in the Gospel according to St. Matthew ix. 1–8. The discovery of what she named Christian Science ensued from this incident. As she has said, "I knew the Principle of all harmonious Mind-action to be God, and that cures were produced in primitive Christian healing by holy, uplifting faith; but I must know the Science of this healing, and I won my way to absolute conclusions through divine revelation, reason and demonstration" (*Science and Health,* p. 109).

At Boston, in 1875, Mrs. Eddy published her principal work, first called *Science and Health* but afterward entitled *Science and Health with Key to the Scriptures.* It is known also as the Christian Science text-book. Occasionally revised by the author, "only to be a clearer and fuller expression of its original meaning" (p. 361), this book received from her its final revision in 1907. It is read in Christian Science services in connection with the Bible, and is to be found in all Christian Science reading rooms as well as in public libraries. For other works on Christian Science by Mrs. Eddy, *see* the bibliography under Eddy, Mary Baker. Mrs. Eddy also attached great importance to periodical literature. She founded the *Christian Science Journal* (a monthly in English) in 1883, and the *Christian Science Quarterly* (containing the lesson-sermons for Sunday services) in 1890. It is published in English, Danish, Dutch, French, German, Norwegian, Swedish and in revised Braille. She founded the *Christian Science Sentinel* (a weekly in English) in 1898; *Der Herold der Christian Science* (a monthly in German) in 1903; and the *Christian Science Monitor* (an international daily newspaper) in 1908. *Le Heraut de Christian Science* (a monthly in French) dates from 1918. All except one of these periodicals circulate chiefly among people who have some degree of interest in Christian Science, but the *Christian Science Monitor* has become established as an excellent newspaper in the estimation of many people who are entirely indifferent towards the religion which it promotes but does not obtrude or even stress.

At first, Mrs. Eddy did not expect to found a distinct church or denomination; she hoped that her discovery would be accepted soon by existing churches. In a short time, however, a distinct church became needed to facilitate co-operation and unity between Christian Scientists, to present Christian Science to other people and to maintain the purity of its teaching and practice. Accordingly, at Boston, in 1879, Mrs. Eddy with her followers founded the Church of Christ, Scientist. Soon the original organization became inadequate for the growing denomination. To the first congregation in Boston there were added numbers of Christian Scientists at other places. Local churches as well as a central organization or Mother Church became necessary. Therefore, in 1892, Mrs. Eddy with her followers founded the Christian Science Mother Church, The First Church of Christ, Scientist, in Boston, of which the local churches throughout the world are regarded as branches.

Mrs. Eddy passed away in 1910. Until then she had initiated every step in the progress of Christian Science. Nothing of moment was done without her approval. Furthermore, although the organic law of the Christian Science movement, its *Church Manual,* confers extensive and sufficient powers upon an administrative board, the Christian Science board of directors, yet this board always had functioned under her immediate supervision. Mrs. Eddy's demise, therefore, immediately tested the adequacy of the *Church Manual* as an organic law and the loyalty of Christian Scientists to this law, in the absence of its author. Nevertheless the period since 1910 has been the most fruitful and prosperous in the history of Christian Science.

The theology of Christian Science begins with the propositions that God is the only might or Mind; that He is "the divine Principle of all that really is" (*Science and Health,* p. 275). To define God further, it employs frequently the word Good, besides such terms as Life, Truth, Love, Soul, Spirit and Infinite Person. Next to God, the name Jesus and references to Him occur most frequently in the authorized literature of Christian Science. Concerning Jesus the Christ and His relation to God and men, Christian Science distinguishes between what is in the New Testament and what is in the creeds, doctrines and dogmas of later times. Accordingly, Christian Scientists speak of Him oftenest as the Way or Way-shower and they regard His atonement, His chief work, as "the exemplification of man's unity with God, whereby man reflects divine Truth, Life and Love" (*Science and Health,* p. 18).

The most distinctive feature of Christian Science teaching is its absolute distinction between what is real and what is apparent or seeming but unreal. This distinction Mrs. Eddy explains, for instance, as follows: "All reality is in God and His creation, har-

monious and eternal. That which He creates is good, and He makes all that is made. Therefore the only reality of sin, sickness or death is the awful fact that unrealities seem real to human, erring belief, until God strips off their disguise. They are not true, because they are not of God" (*Science and Health,* p. 472). Contrary to common misapprehension, Christian Science does not ignore what it regards as unreal. This religion teaches its adherents to forsake and overcome every form of error or evil on the basis of its unreality; that is, by demonstrating the true idea of reality. This it teaches them to do by means of spiritual understanding, spiritual law and spiritual power.

In this connection, Christian Science maintains that the truth of being, the truth concerning God and man, includes a rule for its practice and a law by which its practice produces effects. To a certain extent Jesus declared this rule and law when he said, "Ye shall know the truth, and the truth shall make you free" (John viii. 32). Accordingly, for an individual to gain his freedom from any form of error or evil, he should know the truth, the absolute truth of being, applicable to his case; and Christian Science further teaches that this practice is effective when employed by one individual for another, because such is the unity of real being and such is the law of God. For these reasons, evidently Jesus could and did declare the possibility of Christian healing in unlimited terms. *See* Matthew x. 5–10 and xxviii. 16–20; Mark xvi. 14–18; John xiv. 12.

The practice of Christian Science is not merely mental; it must be also spiritual. Indeed, it is truly mental only as it is absolutely spiritual. The non-spiritual elements in the so-called human mind do not contribute to harmony or health. The practitioner must know or realize spiritually, and his ability to do this is derived from the divine Mind. Therefore, he must agree with the Teacher and Way-shower who said, "I can of mine own self do nothing" (John v. 30), and must prepare for the healing ministry and keep himself in condition for it by living the life of a genuine Christian. The practice of Christian Science is not limited, as is commonly supposed, to the healing of the sick. On the contrary, Christian Scientists regard their religion as applicable practically to every human need.

While the adherents of Christian Science are chiefly found among people who read English, it has followers among Christian people everywhere and also among Jews.

In 1928 there were 2,351 churches, besides many groups not yet formally organized. Of these churches, there were in the United States 1,983; in Great Britain, 186; Germany, 47; other countries, 147.

(C. P. S.)

BIBLIOGRAPHY.—Mrs. Eddy, *Science and Health With Key to the Scriptures* (Boston, latest revised edition, 1910); Edward A. Kimball, *Lectures and Articles on Christian Science* (Chesterton, Indiana, 1921); Charles Herman Lea, *A Plea For The Thorough and Unbiased Investigation of Christian Science* (London, 1923).

CHRISTIAN SOCIALISM. In English history, the name given to the doctrines of F. Denison Maurice, E. Vansittart Neale, Charles Kingsley, Thomas Hughes (*qq.v.*), J. R. Ludlow and several others who entered on public propaganda immediately after the failure of the great Chartist demonstration of April 10, 1848 (*see* CHARTISM).

These writers produced a journal named *Politics for the People* in 1848 (in which Kingsley wrote the famous phrase about religion being "an opium dose for . . . the people" now on the walls of the Kremlin in Moscow), *Tracts for Christian Socialists* (1850), *The Christian Socialist* (1850) and *The Journal of Association* (1852), all of which had a small circulation and died an early death.

Industrially, their chief work was a revival of the co-operative movement and to set going small self-governing workshops, none of which was able to survive.

They also founded a "wholesale agency" which is a precursor of the Co-operative Wholesale Society, and signally aided in securing the enactment of the Industrial and Provident Societies Act of 1852, which made possible the growth of the modern co-operative movement.

Later Developments. Though the Christian Socialists had never had many adherents and their movement appeared to have ended in failure, their influence was carried on till the Socialist revival of the end of the century, when it inspired the Guild of St. Matthew, founded in 1877 by the late Stewart Headlam and claiming to be the oldest Socialist body in Britain. At the beginning of the next century a number of small propagandist bodies, of which the most active was the Church Socialist League, were able to record great successes in appealing to the Churches; and certain of their members entertained a hope of an approaching conversion of the Churches to Socialism. The Pan-Anglican Congress of 1908 attacked social conditions in vigorous terms: the Lambeth Conference of the same year, attended by 242 bishops and archbishops, pronounced a similar verdict and approved the 1907 report of a Committee of Convocation which had endorsed the views of those "deep-seeing men, Carlyle, Maurice and Ruskin." Bishop Gore, in the Church Congress sermon of 1906, had summarized the aims of the revived movement: "The question which ought to hold a pre-eminent place in the interests of Churchmen is, how we are to return to a condition of things nearer to the intention of Christ—if it may be, without violence or revolution; but if not, then anyhow to return." But these hopes were frustrated: the enthusiasm of 1908 had but a passing effect on the hierarchy, most of which remained hostile to Socialism, while after the War the Church Socialist League itself was rent by dissension. The C.S.L. passed out of existence in 1923 (becoming the "League of the Kingdom of God"), it being held by a majority of the members that the Church must have its own social programme, and could not adopt a Socialism from outside or ally itself with any particular Party. There are indeed many Christian social reform bodies, some of wide influence, of which the chief is "Copec" a central unifying body founded at a great interdenominational conference at Birmingham in 1924, but they are not specifically Socialist.

On the continent of Europe "Christian Socialist" is used in a wholly different sense to denote parties or trade unions directed by religious leaders as rivals to the Socialist unions or parties and with the object of weakening their influence.

See Conrad Noel, *Socialism in Church History* (1910); C. Raven, *Christian Socialism* (1921). (R. W. P.)

CHRISTIANSUND, a seaport on the west coast of Norway, in Romsdal *amt* (county), 259 mi. N.E. by N. of Bergen, in the latitude of the Faeroe Islands. Pop. (1936) 14,646. It is built on four small islands, by which its harbour is enclosed. The chief exports before World War II were wood, cod, herrings and fish products, and butter to Great Britain. The town is the chief port of the district of Nordmöre. Local steamers serve the neighbouring fjords, including the Sundalsfjord, from which at Sundalsören a driving road past the fine Dovrefjeld connects with the Gudbrandsdal route. Till 1742, when it received town privileges from Christian VI Christiansund was called Lille-Fosen.

CHRISTIAN UNITY, a term used in America for the reunion of churches of different denominations. In other countries the movement is known as Church Reunion. (*See* REUNION, CHURCH.)

The first pronounced appeal for Christian unity in the United States came from Barton W. Stone, a Presbyterian minister of Kentucky, in 1804, and from Thomas Campbell and his son, Alexander, of the Seceder Presbyterian Church in western Pennsylvania, in 1809. Unfortunately the activities of these leaders crystallized into two denominations. Stone and the Campbells were regarded as the leaders in the denomination that came to be known as the Disciples of Christ, and those who did not follow Stone in his union with the Campbells formed a denomination that came to be known as the Christians. The controversies of those periods, in the midst of other interests, quite obscured the message of these movements for Christian unity. Perhaps the times were not ripe for the work of these pioneers. From the middle of the 19th century to nearly its close Philip Schaff, of the Reformed Church, was, perhaps, the foremost voice for Christian unity in the United States. He was one of the founders of the American branch of the Evangelical Alliance.

The extension of the Young Men's Christian Association from

England into the United States in 1844 and the combining of several organizations in England in 1884 into the Young Womens Christian Association, which soon extended to the United States, brought together the leaders of the various Protestant denominations and indirectly contributed to an awakening of interest in Christian unity. The rise of the Christian Endeavor movement in 1881, under the leadership of Francis E. Clark, a Congregational minister of Portland, Maine, brought together the young people of all Protestant denominations except those denominations (Baptist, Methodist, Presbyterian and Lutheran) that pulled away, organizing their young people denominationally. The Christian Endeavor movement, therefore, made possible a generation of young people with new approaches to those of other denominations and opened the way to subsequent adventures toward unity. The Federal Council of the Churches of Christ in America, composed of 30 Protestant denominations, was organized in 1908 in Philadelphia for the co-operation of the various Protestant denominations in service rather than an attempt to unite upon definitions of theology and polity. Its headquarters are located in New York city. Aside from the general service through these denominations, more than 50 municipalities and, likewise, several States, have formed church federations.

The more direct approach to Christian unity in the United States centres around the year 1910. In the summer of that year several Protestant Episcopalians organized the Christian Unity Foundation of New York for the promotion of Christian unity throughout the world by research and conference. They invited representatives of several denominations to be their guests for conference, and published pamphlets announcing the results of these conferences. It was the first attempt on the part of one denomination to set forth under its own authorship and at its own expense a friendly interpretation of another denomination without some adverse criticism.

On Oct. 19 of that same year, at the General Convention of the Protestant Episcopal Church, meeting in Cincinnati, a commission, consisting of seven bishops, seven presbyters, and seven laymen, was appointed to take under advisement the promotion of a world conference on the faith and order of the Church to be participated in by representatives of all Christian bodies throughout the world. On the same day the Disciples of Christ, meeting in their General Convention in Topeka, organized an Association for the Promotion of Christian Unity, emphasizing intercessory prayer, friendly conferences and the distribution of Christian unity literature by writers from all denominations. At the same time the Congregationalists, meeting in their National Council in Boston, appointed a commission on Christian unity, dealing with all churches, but especially with the Protestant Episcopal Church.

The Episcopal movement, under the leadership of Robert H. Gardiner, soon brought into co-operation representatives from most of the Christian denominations, and the first preliminary world conference on faith and order, held at Geneva, Switzerland, in 1920, marked the opening of a new chapter in theological reconciliation. The World Conference, after 17 years' preparation, was held August 3 to 21, 1927, at Lausanne. Of the larger churches only the Roman Catholic Church declined the invitation, but the pope expressed sympathetic interest. For nearly three weeks representatives from the Eastern Orthodox, Anglican and Protestant churches, sat together in friendly conference over such questions as "The Call to Unity," "The Church's Message to the World—the Gospel," "The Nature of the Church," "The Church's Common Confession of Faith," "The Church's Ministry," "The Sacraments," and "The Unity of Christendom and the Relation Thereto of Existing Churches." Their findings were sent to all the participating churches. The headquarters of the World Conference on Faith and Order are in Boston, Mass.

The Disciple movement continued its policy as announced by its Association for the Promotion of Christian Unity for some years and then adopted a rather denominational attitude, confining its work largely to its own denomination. However, out of it came *The Christian Union Quarterly,* which W. H. Hoover, North Canton, Ohio, endowed sufficiently to make it independent of any denomination and to function inter-denominationally, with an inter-denominational editorial council composed of representatives from various denominations in all parts of the world. The Congregational movement functioned in a general agitation for Christian unity, particularly under the leadership of Newman Smyth, who advocated a concordat with the Protestant Episcopal Church. This, however, failed of ratification by either denomination. At the instance of the Presbyterian General Assembly in 1918 the American Council on Organic Union of the Evangelical Churches of America was organized and bore testimony to the necessity of Christian unity by a representative gathering in Philadelphia, in which 16 Protestant denominations took part. Nothing definite came out of this movement.

In May 1927, the Christian Unity League was launched in Baltimore, Md., as an organization to include the study of all Christian unity movements and at the same time to make adventures beyond present day practices. They held a conference at the First Presbyterian Church, Baltimore, Jan. 12 and 13, 1928, with 25 denominations from 11 States and Canada. In their findings they advocated modern biblical interpretations in the historical study of the origin and valuation of Christian creeds and institutions, that representatives in foreign mission fields be given larger freedom as regards Christian unity and that steps be taken gradually to make all denominational schools and all denominational papers inter-denominational. The conference closed with all of the denominations taking part in the celebration of the Lord's Supper.

BIBLIOGRAPHY.—Christian Century, *Historical Documents Advocating Christian Union* (1900); Willett, *Our Plea for Union and the Present Crisis* (1901); Smyth, *Passing Protestantism and Coming Catholicism* (1908); Ainslie, *Message of the Disciples of Christ* (1913); Macfarland, *Christian Unity at Work* (1913); Ashworth, *Union of Christian Forces in America* (1915); Smyth and Walker, *Approaches Towards Church Unity* (1919); Manning, *The Call to Unity* (1920); Brown, *The Church in America* (1922); Lynch, *The Christian Unity Movement in America* (1922); Cowden, *Saint Paul on Christian Unity* (1923); Parks, *The Crisis of the Churches* (1923).

See also REUNION, CHURCH.

(P. A1.)

CHRISTIE, RICHARD COPLEY (1830–1901), English scholar and bibliophile, was born on July 22, 1830, at Lenton, Nottinghamshire, the son of a millowner. He was educated at Lincoln college, Oxford, was called to the bar at Lincoln's Inn in 1857, and in 1872 became chancellor of the diocese of Manchester. This he resigned in 1893. He held numerous appointments, notably the professorships of history (from 1854 to 1856) and of political economy (from 1855 to 1866) at Owens college, Manchester. He always took an active interest in this college, of which he was one of the governors; in 1893 he gave the Christie library building designed by Alfred Waterhouse, and in 1897 he devoted £50,000 of the funds at his disposal as a trustee of Sir Joseph Whitworth's estate for the building of Whitworth Hall, which completed the front quadrangle of the college. He was an enthusiastic book collector, and bequeathed to Owens college his library of about 75,000 vols., rich in a very complete set of books printed by Dolet, a wonderful series of Aldines, and of vols. printed by Sebastian Gryphius. His *Étienne Dolet, the Martyr of the Renaissance* (1880), is the most exhaustive work on the subject. He died at Ribsden on Jan. 9, 1901.

CHRISTIE, SIR WILLIAM HENRY MAHONEY (1845–1922), British astronomer, son of Samuel Hunter Christie, professor of Mathematics at the royal military academy, Woolwich, was born at Woolwich on Oct. 1, 1845. He was educated at King's College school, London, and at Cambridge. In 1870 Christie was appointed chief assistant to Airy at the royal observatory, Greenwich, and in 1881 astronomer royal; he retired from this post at the age of sixty-five.

While Christie was at the observatory the work was considerably extended, and it was largely due to him that regular spectroscopic and photographic observations were started. Some of these photographs form a valuable part of the work of the observatory and the observations are still continued. Between 1890 and 1898 Christie supervised the construction of a new building and the erection of a 30 inch reflector and a 26 inch photographic refractor, enabling the observatory to take part in the international photo-

graphic map of the heavens; the measurements and publication of results occupied a number of years. Christie erected a wooden building for magnetic observations, designed a new altazimuth to replace a faulty one which had been used by Airy and also designed a "duplex" micrometer for identifying stars on overlapping plates.

Christie is the author of a number of papers embodying his work on the solar eclipses observed in Japan (1896), India (1898) and Portugal (1900), on the measurement of double stars, on the observations of Eros for determining the solar parallax and on the duration of exposure in photographing stars.

Christie was a member of many learned societies at home and abroad; he received the C.B. on the occasion of Queen Victoria's Jubilee and the K.C.B. in 1904. He died on Jan. 22, 1922, while on a voyage to Mogador and was buried at sea.

CHRISTINA (MARIA CHRISTINA) (1858–1929), queen regent of Spain (1885–1902), widow of Alphonso XII and mother of Alphonso XIII, was born at Gross Seelowitz, in Austria, on July 21, 1858, being the daughter of the archduke Charles Ferdinand and the archduchess Elizabeth of Austria. In 1879 she married Alphonso XII of Spain, whom she had met at the court of Vienna when he was only a pretender in exile, before the restoration of the Bourbons, and whose first wife, Mercedes, daughter of the duc de Montpensier, had died childless. Queen Christina bore her husband two daughters—Doña Mercedes, born on Sept. 11, 1880, and Doña Maria Theresa, born on Nov. 12, 1882. On her husband's death on Nov. 25, 1885, she became regent, and during the long minority of the posthumous son of Alphonso XII, afterwards Alphonso XIII, she exhibited her wisdom, tolerance and unselfishness. In spite of the excessive rotation of political parties under Sagasta and Canovas, the restlessness of the army, the economic depression and the disastrous war of 1898 with the United States, in which Spain renounced her rights over Cuba, Puerto Rico and the Philippines, the country, under Christina, won the respect of the great powers, and opposition from the ex-royal family gradually diminished. Her regency ended in 1902, when Alphonso XIII came of age.

Christina died Feb. 7, 1929.

See Rubio, *Historia de la Regencia de Maria Christina* (1905) and Martín Alonso, *Diez y seis Años de Regencia* (1914).

CHRISTINA (1626–1689), queen of Sweden, daughter of Gustavus Adolphus and Marie-Eleonore of Brandenburg, was born at Stockholm on Dec. 8, 1626. Her father was killed at Lützen (1632) when she was only six years old. She was educated principally by the learned Johannes Matthiae, in as masculine a way as possible, while the chancellor Oxenstjerna instructed her in politics. Christina became queen in her 18th year (Dec. 8, 1644). Her brilliant and commanding qualities were vitiated by an inordinate pride and egoism and a prodigality regardless of the necessities of the state. She maintained a luxurious court, frequented by French artists, scholars and philosophers; while her unworthy treatment of the great chancellor, Oxenstjerna, was mainly due to her jealousy of his reputation. Recognizing that he would be indispensable so long as the Thirty Years' War lasted, she used every effort to bring it to an end; and her impulsive interference seriously hampered the diplomacy of the chancellor, and materially reduced the ultimate gains of Sweden. Yet she gave fresh privileges to the towns; she encouraged trade and manufactures, especially the mining industries of the Dales; in 1649 she issued the first school ordinance for the whole kingdom; she encouraged foreign scholars to settle in Sweden; and native science and literature flourished under her encouragement. The senate and estates, anxious about the succession to the throne, had repeatedly urged her to marry, and suggested her cousin, Charles Gustavus, as the most suitable consort. Wearied of their importunities Christina settled the difficulty by appointing Charles her successor, and at the *Riksdag* of 1650 the Swedish crown was declared hereditary in Charles and his heirs male. In the summer of 1651 Christina was with difficulty persuaded to reconsider her resolution to abdicate, but three years later the nation had become convinced that her abdication was highly desirable. Within ten years she had created 17 counts, 46 barons and 428 lesser nobles; and, to provide these new peers with adequate appanages, she had sold or mortgaged crown property representing an annual income of 1,200,000 rix-dollars. She may also have been growing weary of the cares of government, while the importunity of the senate and *Riksdag* on the question of her marriage was a constant source of irritation, and the opportunity of astonishing the world by the unique spectacle of a great queen, in the prime of life, voluntarily resigning her crown, strongly appealed to her vivid imagination. From 1651 there was a notable change in her behaviour. She ostentatiously exhibited her contempt for the Protestant religion. Her foreign policy was flighty to the verge of foolishness. She contemplated an alliance with Spain, a state quite outside the orbit of Sweden's influence, the first-fruits of which were to have been an invasion of Portugal. She utterly neglected affairs in order to plunge into a whirl of dissipation with foreign favourites like Bourdelot. The situation became impossible. On June 6, 1654, Christina abdicated, in the presence of the estates, at the castle of Uppsala, and it was with an intense feeling of relief that the Swedes saw her depart, in masculine attire, under the name of Count Dohna. At Innsbruck she openly joined the Catholic Church, was rechristened Alexandra and kept up a royal household in Rome, surrounded by cardinals. In 1656, and again in 1657, she visited France, on the second occasion ordering the assassination of her major-domo Monaldischi for his continuous betrayal of her confidence. Twice she returned to Sweden (1660 and 1667) in the vain hope of recovering the succession, finally settling in Rome, where she lived on the charity of the pope and died on April 19, 1689, poor, neglected and forgotten.

See F. W. Bain, *Queen Christina of Sweden* (1890); R. N. Bain, *Scandinavia* (Cambridge, 1905); H. E. Friis, *Dronning Christina* (Copenhagen, 1896); C. N. D. Bildt, *Christina de Suède et le conclave de Clement X* (1906); *Drottning Kristinas sista dagar* (Stockholm, 1897). Of the many books telling the fantastic story of Christina's later years *see* A. Barine, *Princesses and Court Ladies* (Eng. trans., 1906); F. H. Gribble, *The Court of Christina of Sweden* (1913), and *The History of the Intrigues and Gallantries of Christina, Queen of Sweden, and of her Court whilst she was at Rome* (translated from the French by P. Hollingworth, 1697; repr. 1927).

CHRISTISON, SIR ROBERT, BART. (1797–1882), Scottish toxicologist and physician, was born in Edinburgh on July 18, 1797. He studied in London under John Abernethy and Sir William Lawrence, and in Paris, under Pierre J. Robiquet and Mathieu J. B. Orfila. In 1822 he became professor of medical jurisprudence at Edinburgh. His *Treatise on Poisons* was published in 1829, and in 1829 he became medical officer to the crown in Scotland, and from that time till 1866 he was called as a witness in many celebrated criminal cases, notably in the case of Burke and Hare (1829). Instructions drawn up by him for the examination of dead bodies for legal purposes became the accepted guide for the purpose. He may be said to have placed legal jurisprudence on a scientific basis. In 1832 he gave up the chair of medical jurisprudence for that of medicine and therapeutics, which he held till 1877.

Christison's work on the pathology of the kidneys and on fevers brought him many honours, including a baronetcy in 1871. Christison died at Edinburgh on Jan. 23, 1882.

See The Life of Sir Robert Christison (1885–86), edited by his sons, which contains his autobiography, with chapters on his work by Prof. Gairdner and T. R. Fraser; Fielding H. Garrison, *History of Medicine* (1929).

CHRISTMAS (*i.e.*, the Mass of Christ), in the Christian Church, the festival of the nativity of Jesus Christ. The history of this feast coheres so closely with that of Epiphany (*q.v.*), that what follows must be read in connection with the article under that heading.

Christmas was not among the earliest festivals of the Church, and before the 5th century there was no general consensus of opinion as to when it should come in the calendar, whether on Jan. 6, March 25, or Dec. 25. The earliest identification of Dec. 25 with the birthday of Christ is in a passage, otherwise unknown and probably spurious, of Theophilus of Antioch (*c.* 180), preserved in Latin by the Magdeburg centuriators (i. 3, 118), to the effect that the Gauls contended that as they celebrated the birth of the Lord on Dec. 25, so they ought to celebrate the

resurrection on March 25. A passage, almost certainly interpolated, in Hippolytus's (*c.* 202) commentary on Daniel iv. 23, says that Jesus was born at Bethlehem on Wednesday, December 25, in the 42nd year of Augustus, but he mentions no feast, and such a feast, indeed, would conflict with the then orthodox ideas. As late as 245 Origen (hom. viii. on Leviticus) repudiated the idea of keeping the birthday of Christ, "as if he were a king Pharaoh."

The first certain mention of Dec. 25 is in the Calendar of Philocalus (354), which was first published entire by Mommsen in *Abhandlungen d. sächs. Akad. d. Wissensch.* (1850), and is dealt with in Strzygowski's *Kalenderbilder des Chron. vom Jahre 354* (1888). This states that in "Year 1 after Christ the Lord Jesus Christ was born on Dec. 25, a Friday, and 15th day of the new moon"—though, in fact, Dec. 25 A.D. 1, was a Sunday. Here again no festal celebration of the day is attested.

Clement of Alexandria (*c.* 200) mentions several speculations on the date of Christ's birth, and condemns them as superstitious. Some chronologists, he says, alleged the birth to have occurred in the 28th year of Augustus, on 25 Pachon (an Egyptian month), *i.e.,* May 20. Others assign it to 24 or 25 Pharmuthi (April 19 or 20). Clement himself sets it on Nov. 17, 3 B.C.; and the anonymous author of a Latin tract, *De Pascha computus* (written in Africa, 243), sets it, "by private revelation," on Wednesday, March 28, the supposed anniversary of the creation of the sun, which typifies the Sun of Righteousness. Similar symbolical reasoning led Polycarp (in a fragment preserved by an Armenian writer, Ananias of Shirak, dated before 160) to set His birth on Sunday, when the world's creation began, but His baptism on Wednesday, as the analogue of the sun's creation. On such grounds certain Latins as early as 354 may have transferred the birthday from Jan. 6 to Dec. 25, which was then a Mithraic feast, the *natalis invicti solis* or birthday of the unconquered Sun of Philocalus. The Syrians and Armenians, who clung to Jan. 6, accused the Romans of sun-worship and idolatry, contending that the feast of Dec. 25 had been invented by disciples of Cerinthus and its lections by Artemon to commemorate the *natural* birth of Jesus. Ambrose (*On Virgins,* iii. ch. 1) seems to imply that as late as the papacy of Liberius (352–356) the Birth was feasted together with the Marriage at Cana and the Feeding of the Four Thousand, which were never feasted on any other day but Jan. 6.

Chrysostom, in a sermon preached at Antioch on Dec. 20, 386 or 388, says that the feast of Dec. 25 was known in the West, from Thrace as far as Cadiz, from the beginning. It certainly originated in the West, but spread quickly eastwards. In 353–361 it was observed at the court of Constantius; Basil of Caesarea (d. 379) adopted it; Honorius, emperor (395–423) in the West, told his mother and brother Arcadius (395–408) in Byzantium how the new feast was kept in Rome, separate from Jan. 6 with its own *troparia* and *sticharia;* and they adopted it. The patriarchs Theophilus of Alexandria, John of Jerusalem, and Flavian of Antioch, were won over to it under Pope Anastasius, 398–401. John or Wahan of Nice (Combefis *Historia monotheletarum*) affords the above details. The new feast was communicated by Proclus, patriarch of Constantinople, to Sahak, Catholicos of Armenia, about 440; and the Armenians within the Byzantine pale adopted it for about 30 years, but finally abandoned it, together with the decrees of Chalcedon, early in the 8th century. Many writers of the period 375–450, *e.g.,* Epiphanius, Cassian, Asterius, Basil, Chrysostom and Jerome, contrast the new feast with that of the Baptism as that of the birth *after the flesh,* implying that the latter was generally regarded as a birth according to the Spirit. Usener notes that in 387 the new feast was reckoned according to the Julian calendar by writers of the province of Asia, who in referring to other feasts use the reckoning of their local calendars. As early as 400 in Rome an imperial rescript includes Christmas (with Easter and Epiphany) among the three feasts on which theatres must be closed. Epiphany and Christmas were not made judicial *non dies* until 534.

For some years in the West (as late as 353 in Rome) the birth feast was appended to the baptismal feast on Jan. 6, and was altogether supplanted by it in Jerusalem from about 360 to 440, when Bishop Juvenal introduced the feast of Dec. 25, which about the same time was finally established in Alexandria. The *quadragesima* of Epiphany (*i.e.,* the presentation in the Temple) continued to be celebrated in Jerusalem on Feb. 14 until the reign of Justinian. In most other places it had long before been put back to Feb. 2 to suit the new Christmas. But in Jerusalem, as Armenian historians record, the transference occasioned riots.

In Britain, Dec. 25 was a festival long before the conversion to Christianity, for Bede (*De temp. rat.* ch. 13) relates that "the ancient peoples of the Angli began the year on Dec. 25 when we now celebrate the birthday of the Lord; and the very night which is now so holy to us, they called in their tongue *modranecht* (*môdra niht*), that is, the mothers' night, by reason we suspect of the ceremonies which in that night-long vigil they performed." In England the observance of Christmas was forbidden by act of Parliament in 1644; Charles II. revived the feast, but the Scots adhered to the Puritan view.

Outside Teutonic countries Christmas presents are unknown. Their place is taken in Latin countries by the *strenae,* French *étrennes,* given on New Year's Day. The setting up in Latin churches of a Christmas *crèche* is said to have been originated by St. Francis.

BIBLIOGRAPHY.—K. A. H. Kellner, *Heortologie* (Freiburg im Br., 1906), with bibl.; Hospinianus, *De festis Christianorum* (Genevae, 1574); Edw. Martène, *De Antiquis Ecclesiae Ritibus,* iii. 31 (Bassani, 1788); J. C. W. Augusti, *Christl. Archäologie,* vols. i. and v. (Leipzig, 1817–31); A. J. Binterim, *Denkwürdigkeiten,* v. pt. i. p. 528 (Mainz, 1825, etc.); Ernst Friedrich Wernsdorf, *De originibus Solemnium Natalis Christi* (Wittenberg, 1757, and in J. E. Volbeding, *Thesaurus Commentationum,* Lipsiae, 1847); Anton. Bynaeus, *De Natali Jesu Christi* (Amsterdam, 1689); Hermann Usener, *Religionsgeschichtliche Untersuchungen* (Bonn, 1889); Nik. Nilles, S.J., *Kalendarium Manuale* (Innsbruck, 1896); L. Duchesne, *Origines du culte chrétien* (3e ed., Paris, 1889); C. A. Miles, *Christmas in Ritual and Tradition* (1912); C. C. Polhill, *The Origin of Christmas* (1925). (X.)

Christmas Customs.—Christmas customs are an evolution from times that long antedated the Christian period—a descent from seasonal, pagan, religious and national practices, hedged about with legend and tradition. Their seasonal connections with the pagan feasts of the winter solstice relate them to the beginning of time and their legacy in the birthday of Christ makes them shareholders in the most significant event in the history of the world—an event that gave it a new date, anno Domini.

In the beginning many of the earth's inhabitants were sun worshippers because the course of their lives depended on its yearly round in the heavens, and feasts were held to aid its return from distant wanderings. In the south of Europe, in Egypt and Persia, the sun-gods were worshipped with elaborate ceremonies at the season of the winter solstice, as a fitting time to pay tribute to the benign god of plenty, while in Rome the Saturnalia reigned for a week. In northern lands mid-December was a critical time, for the days became shorter and shorter and the sun was weak and far away, so these ancient peoples held feasts at identically the period that Christmas is now observed; they built great bonfires in order to give the winter sun-god strength, and to bring him back to life again. When it became apparent that the days were growing longer, there was great rejoicing because of the promise of lengthening days to follow. Thus the central idea of the winter solstice—the return of light—became the hope of the world in the birth of Christ, the light of the world.

The exact day and year of Christ's birth have never been satisfactorily settled, but when the fathers of the church in A.D. 340 decided upon a date to celebrate the event, they wisely chose the day of the winter solstice which was firmly fixed in the minds of the people and which was their most important festival. Owing to changes in man-made calendars, the time of the solstice and the date of Christmas vary by a few days.

The transition from paganism to Christianity was gradual but became apparent after the fall of Rome A.D. 476 when the church was the one organization which had the strength and wisdom to withstand the disorganized centuries of the dark ages. During this time great progress was made by the Christian leaders in extending the new faith.

When missionaries were sent from Rome to the outlying provinces A.D. 601, their instructions given by Pope Gregory I made

clear the policy of the church: "Let the shrines of idols by no means be destroyed but let the idols which are in them be destroyed. Let water be consecrated and sprinkled in these temples; let altars be erected . . . so that the people, not seeing their temples destroyed, may displace error, and recognize and adore the true God. . . . And because they were wont to sacrifice oxen to devils, some celebration should be given in exchange for this . . . they should celebrate a religious feast and worship God by their feasting, so that still keeping outward pleasures, they may more readily receive spiritual joys." (Bede, *Eccl. Hist. of the Eng. Nation.*)

For several centuries Christmas was solely a church anniversary observed by religious services. But as Christianity spread among the people of pagan lands many of the practices of the winter solstice were blended with those of Christianity, because of the liberal ruling of Gregory I, the Great, and the co-operation of the missionaries.

Thus Christmas became both religious and secular in its celebration, at times reverent, at others gay. From the pagan accent on light it is not difficult to trace the rise of lights and open fires —from the bonfires of sun worship and their variant the Yule log, to the many customs centring around the candle and its legends to light the Christ child.

Many current customs besides those of light and fire date back in some way to these pre-Christian origins, among them Christmas decorations. The Romans ornamented their temples and homes with green boughs and flowers for the Saturnalia, their season of merrymaking and the giving of presents; the Druids gathered mistletoe with great ceremony and hung it in their homes; the Saxons used holly, ivy and bay.

It is generally believed that the first Christmas tree was of German origin dating from Boniface, English missionary to Germany in the 8th century, who replaced the sacrifices to Odin's sacred oak by a fir tree adorned in tribute to the Christ child. Accounts persist that Luther introduced the tree lighted with candles. It is known that the German Prince Albert, soon after his marriage to Queen Victoria introduced it into England, and that German immigrants brought the custom to America.

Music early became a marked feature of the season. But the first chants, litanies, and hymns were in Latin, and too theological for popular use. The 13th century found the rise of the carol written in the vernacular under the influence of Francis of Assisi; carol, meaning a song in which a religious topic is treated in a style that is familiar or festive, also a merry song. From Italy, it passed to France and Germany, and later to England, everywhere retaining its simplicity, fervour and mirthfulness. Music in itself has become one of the greatest tributes to Christmas, and includes some of the noblest compositions of the great musicians, especially Handel's *Messiah* with its "Hallelujah chorus."

Anthems sung by choirs with organ accompaniment and hymns and carols by the congregation constitute modern Christmas church music. As a setting for the music and services of the Protestant churches, evergreen trees and branches, and other seasonal decorations transform the church, pulpit and choir loft, combining thus the details of customs that have evolved with the centuries. In Roman Catholic churches the heart of the celebration is the crèche or crib, the realistic tableaux in miniature of the Nativity, another custom introduced in an Italian church by Francis of Assisi in 1224, in his efforts to bring Christmas to the people. The secular singing of folk songs and carols on the Christmas theme by minstrels and waits was customary, especially in England. House to house singing pertains in normal times in many communities, when church choirs and other groups go about singing, after the manner of early times.

In keeping with its religious significance, the church, as early as the 6th century, set apart the four Sundays next preceding Christmas as a time of devotional preparation, known as the Advent season, which ends with Christmas Eve. From this date on, the Catholic Church held a midnight mass as one of the solemnities of Christ's birthday. Equally solemn is the Christmas morning service in Lutheran churches, especially the Swedish; a service put at an early hour by the Lutherans because the shepherds, the first to worship Him, came early and then returned to their work.

Merrymaking came to have a share in Christmas observance through popular enthusiasm even while emphasis was on the religious phase. The mediaeval secular celebrations were no matter of a day or two, but lasted for a season extending from Christmas Eve to Epiphany, and in some localities even longer, from St. Thomas' day to Candlemas. In England Christmas became increasingly the great festival of the year from the 11th to the



FROM AN OLD PRINT: CULVER SERVICE

Ceremony of bringing in the yule log to start the hearth fire and festivities on Christmas Eve

17th centuries, with observance from Christmas Eve to Twelfth day. In the holly decked great halls of the feudal lords, whose hospitality extended to all their friends, tenants and household, wassailing, feasting, singing and games, dancing, masquerading, and mummers presenting pantomimes and masques were all part of the festivities. A Lord of Misrule and his jester directed the revels and kept them uproarious, from the dragging in of the Yule log to the end of the holiday. The Christmas feast brought in state into the hall heralded by the Lord of Misrule and the minstrels, and headed by the chief cook carrying the boar's head followed by the servants bearing an incredible number of dishes was the outstanding event. But the wild licence of these celebrations, with no semblance of the inner vision and meaning of Christmas, came under the disfavour of the Puritans and were forbidden by parliament in 1644, after they came into power.

England gradually found Christmas again and made it both a church ceremonial and a home festival. There are family reunions, gifts, decorations, carols, and parties and a pantomime for the children, whose day it is and for whom "Father Christmas" was introduced, the English counterpart of Santa Claus. It is a season of good will among classes, reflecting those early days when the lord of the castle received everyone. There is much hospitality, roast goose and plum pudding always being associated with the day, and every locality boasting its traditional food, as saffron currant cake in Cornwall. The true spirit of the day prevails, as set forth in the immortal *A Christmas Carol* by Charles Dickens, written in the year 1843.

Although many of the picturesque customs were suppressed, they have contributed vicariously to modern observance through Christmas pageants, in the designs of Christmas cards and favours, and in adapted formalities of social functions. Descriptive accounts and crude drawings found in old household or day books and other chronicles, together with the narratives in ballads and carols have aided in this artistic restoration, keeping the old English Christmas always present.

The Scandinavian countries have always had a natural tendency for the keeping of Christmas, because of the northern location and their winter solstice traditions; they have transplanted their customs wherever they have settled. Elaborate preparations are begun weeks in advance for the whole house must be cleaned, renovated and gaily decorated; a great amount of cooking of special meats, baking of breads, fancy cakes and cookies, and other native foods is accomplished as homes must be completely stocked for three weeks of hospitality and leisure.

Festivities begin on Christmas Eve with an elaborate supper, followed by a tree with family worship and singing before the presents are distributed. Early church is attended by everyone on Christmas morning, and throughout the season religious and secular observances mingle. Special holiday fare is given the cattle, because of their presence in the Bethlehem stable, and sheaves of grain for the birds are set up on poles in the yard, especially in Norway.

Germany has kept Christmas with much heartiness in the old manner of a home festival and attendance on church services. The observance centres around the Christmas tree with the presents not on it, but piled under it and on nearby tables, their distribution preceded by the singing of carols including "O Tannenbaum" and "Stille Nacht."

In the Netherlands and Belgium the feast of St. Nicholas, Dec. 6, is the children's holiday when the customs associated with Christmas and feasting are observed, such as family reunions, presents, many surprises and great rejoicing among the boys and girls. Dec. 25 is a religious holiday, with services in the churches, and quiet family gatherings at home, where Christmas cakes and chocolate are served. One of the traditions of Christmas is Santa Claus, a contraction for St. Nicholas who was born in the 3rd century; he became a bishop and gained distinction in the councils of the church being especially famed for unexpected gifts, and later associated with the giving of presents during the season at the end of the year. He seems to have been first adopted by the Netherlands as the patron saint of children, and there, on St. Nicholas Eve, they leave their wooden shoes, filled with hay for the saint's white horse on which he jumps from roof to roof, leaving toys and sweets. He is none the less real to little children the world over, under such various names as *Kris Kringle, La Befana, Yule Tomten, Christkindli,* and driving reindeer and coming down chimneys.

New Year's day is the great festival in France and Scotland and many of the Christmas customs are observed on that day, particularly the giving of presents. The religious features are prominent in France especially the crèche in churches and homes, and the midnight mass followed by an elaborate Christmas supper, family dinners and reunions being the feature of Christmas day. The Feast of the Kings or Epiphany finishes the holiday season with traditional parties; in Normandy where old customs are kept, the children go out on Epiphany Eve to meet the Three Kings on the highway.

The Italian Christmas is a sacred holiday, observed with solemn ceremonies in the churches, especially midnight mass, though there are home customs and special foods, but gifts are reserved for Epiphany.

The *Presepio* or miniature representation of the Nativity, rather than the Christmas tree, is the holiday symbol found in Italian homes. Around it on Christmas Eve candles are lighted, the children recite poems, guests kneel in front of it, and musicians play before it. Both old and young delight in these mangers which are set up with artistry and often made lovely with scenic backgrounds. Flowers are used profusely for decorations, instead of evergreens.

Christmas in the United States, composed of threads from many countries and reflecting their customs in church and home, has evolved into a celebration that is more or less uniform, with some variations according to sections and origins, such as the Pennsylvania Germans in Bethlehem, the Scandinavians in Wisconsin and Minnesota, the fireworks of the southern states, and its historic delayed acceptance in New England until about 1875, because of Puritan influence.

For generations Christmas customs have focused around the fact that it belongs to the season of frost and snow. Transplanted to a climate that knows not winter, its celebration would be different in many ways. An international world has brought this circumstance to attention, for the tropics and the regions "down under" celebrate Christmas in summer.

In tropical Mexico, where Roman Catholicism is the state religion, every home is decorated with flowers and has an altar erected with a representation of the Nativity, in preparation for the *Posadas.* This means "resting place" and commemorates the journey Mary and Joseph took from Nazareth to Bethlehem. The *Posadas* begin on Dec. 16, and groups of nine families hold one every night before Christmas Eve, meeting in the different homes. Carrying candles and following an image of the Virgin and Joseph, they re-enact the search for shelter, stopping at the door of each room and pleading in a Latin chant for entry. In the last room they are admitted, and there sing their thanks.

A southern hemisphere Christmas in Brazil falls in midsummer, giving it the characteristics of a summer festival with flowers for decorations, fireworks, picnics, fiestas and boating excursions. The religious phase is the same as in other Catholic countries, with a *Presepio* in homes and churches; the midnight mass, with an out-of-door procession of the priests to the church, is a colourful part of the festival. Family suppers are served on Christmas Eve; the people hold carnival in the streets and everywhere there is much gaiety. Various customs brought by Americans from the United States have crept in, including Papa Noel; dressed like Santa Claus, he comes with reindeer and sleigh, bringing the Christmas tree and the stocking. Both Christmas and King's day, as Epiphany is called, serve as gift-giving occasions.

BIBLIOGRAPHY.—W. F. Dawson, *Christmas, its Origin and Association* (1902); E. L. Urlin, *Festivals, Holy Days, and Saints' Days* (1915); Sir James George Frazer, *The Golden Bough,* abr. ed. (1922); T. G. Crippen, *Christmas and Christmas Lore* (1928); W. M. Auld, *Christmas Traditions* (1931); R. E. Haugan, ed., *Christmas, an American Annual of Christmas Literature and Art,* 14 vols. (1931–44); A. C. Hottes, *1001 Christmas Facts and Fancies* (1937); Dorothy Gladys Spicer, *Book of Festivals* (1937); A. R. Wright, *British Calendar Customs,* vol. 3 (1940); John Hadfield, ed., *Christmas Companion* (1941). Mary Emogene Hazeltine, *Anniversaries and Holidays,* A Calendar of Days and How to Observe Them, 2nd ed. (1944). (M. E. HE.)

CHRISTMAS-BERRY (*Photinia arbutifolia* or *Heteromeles arbutifolia*), a handsome American shrub or small tree of the rose family (Rosaceae), called also California holly and toyon, native chiefly to the chaparral (*q.v.*) belt of the Sierra Nevada and Coast ranges. It grows from 5 to 15 ft. high and bears oblong, pointed, evergreen leaves and numerous small, white flowers in large, terminal clusters, followed in late autumn by bright red, holly-like fruits. It is very popular for Christmas decoration, being sold in Pacific coast cities in the same manner as holly in the eastern United States.

CHRISTMAS ISLAND, a British possession in the eastern part of the Indian ocean (in 10° 25′ S., 105° 42′ E.), about 190 mi. S. of the western extremity of Java. It is quadrilateral; its greatest length is 11 mi., its extreme breadth 9 mi.; and the area is 60 sq.mi. Pop. (1941) 1,431.

The circumstances of its discovery are unknown, but it appears on a Dutch chart of 1666 under the name of Moni. Dampier visited it in 1688 and found it uninhabited. The anchorage known as Flying Fish Cove was discovered during a visit of H.M.S. "Flying Fish" in 1886. The island was annexed by Great Britain in 1888 and placed under the administration of the governor of the Straits Settlements; in 1900 it was incorporated with the settlement of Singapore. In 1891 an area of 6,000 ac. was leased for 99 years to George Clunies Ross, the owner of the Keeling Islands, and Sir John Murray, and in 1897 they transferred their rights to the Christmas Island Phosphate company, formed to work the deposits of phosphate of lime. In 1940, 238,006 tons were exported. Japanese forces occupied the island in World War II.

The island is the flat summit of a submarine mountain of which some 14,000 ft. are submerged and rather more than 1,000 ft. are above sea level. The slopes are steep, and within 20 mi. of the shore the sea reaches a depth of 2,400 fathoms. It consists of a central plateau descending to the water in three terraces. It is encircled by a reef which is always submerged, except at Flying Fish Cove, the only landing place. On its northern aspect the central plateau has a raised rim having all the appearances of having once been the margin of an atoll. The surface of the plateau is studded with flat-topped hills and low ridges and reefs of limestone. On the rounded hills occurs the deposit of phosphate of lime which gives the island its commercial value. This has

doubtless been produced by the long-continued action of a thick bed of sea-fowl dung, which converted the carbonate of the underlying limestone into phosphate. There occurs on this island a series of tertiary deposits which appear to be unique. The whole series was evidently deposited in shallow water on the summit of a submarine volcano standing in its present isolation, round which the ocean bed has probably altered but a few hundred feet since the Eocene age. Thus, though the rocks of the southern coast of Java in their general character and succession resemble those of Christmas island, there lies between them an abysmal trough 18,000ft. in depth, which renders it scarcely possible that they were deposited in a continuous area, for such an enormous depression could hardly have occurred since Miocene times without involving Christmas island.

The flora is mainly angiospermous, but ferns and a few mosses, lichens and fungi, 17 of which are endemic, also occur, while a considerable number—not specifically distinct—form local varieties, nearly all of which present Indo-Malayan affinities. The fauna consists of 319 animals—54 only being vertebrates—145 of which are endemic. It is noteworthy that a large number show affinity with the species in the Austro-Malayan, rather than in the Indo-Malayan, their nearer, region. The climate is healthy, the temperature varying from 75° to 84° F. The prevailing wind is the south-east trade, which blows during the greater part of the year. There is an ample but not excessive rainfall.

Christmas Island is also the name of a Pacific atoll within the Gilbert and Ellice Islands colony.

CHRISTODORUS, of Coptos in Egypt, epic poet, flourished during the reign of Anastasius I. (A.D. 491–518). According to Suidas, he was the author of Πάτρια, accounts of the foundation of various cities; Λυδιακά, the mythical history of Lydia; Ἰσαυρικά, the conquest of Isauria by Anastasius; three books of epigrams; and many other works. In addition to two epigrams (*Anthol. Pal.* vii. 697, 698) we possess a description in hexameters of 80 statues in the gymnasium of Zeuxippus at Constantinople; this forms the second book of the Palatine Anthology. Some critics regard it as important for the history of art and a model of description; others consider it valueless.

See F. Baumgarten, *De Christodoro poëta Thebano* (1881), and his article in Pauly-Wissowa's *Realencyklopädie,* iii. 2 (1899); W. Christ, *Geschichte der griechischen Literatur* (1898).

CHRISTOPHE, HENRY (1767–1820), negro king of Haiti. After purchasing his freedom from slavery he played a prominent part in the insurrection against the French and in the rising of 1803. He was general-in-chief of the army during the short-lived government of Dessalines. Appointed president of Haiti in 1807, after the ensuing civil war, he was crowned king on June 2, 1812. Under him the country prospered, but his cruelty led to an insurrection, and being deserted by his troops he shot himself on Oct. 8, 1820.

See J. Vandercook, *Black Majesty* (1928).

CHRISTOPHER, SAINT (*Christophorus, Christoferus*), patron saint of ferrymen, is honoured in the Latin Church on July 25 and in the Greek Church on May 9. He appears to have been born a pagan in Syria, to have been baptized by Babylas, bishop of Antioch; he preached in Lycia and was martyred *c.* A.D. 250 during the persecution under the emperor Decius. The more conspicuous of the legends which collected about this nucleus of possibility are included in the Mozarabic *Breviary* and *Missal,* the best known being given in the *Golden Legend* of Jacopus de Voragine. According to this, Christopher was a giant in search of a master stronger than himself. He left the service of the king of Canaan because the king feared the devil, and that of the devil because the devil feared the Cross. He was converted by a hermit; but as he had neither the gift of fasting nor that of prayer, he decided to devote himself to a work of charity, and set himself to carry wayfarers over a bridgeless river. One day a little child asked to be taken across, and Christopher took him on his shoulder. When half way over the stream he staggered under what seemed to him a crushing weight, but he reached the other side and then upbraided the child for placing him in peril. "Had I borne the whole world on my back," he said, "it could not have weighed heavier than thou!" "Marvel not!" the child replied, "for thou hast borne upon thy back the world and Him who created it!"

See Bolland, *Acta Sanct.* vi. 146; Guenebault, *Dict. iconographique des attributs, des figures et des légendes des saints* (Par. 1850); Smith and Wace, *Dict. of Christ. Biog.*

CHRISTOPHORUS, pope or anti-pope, elected in 903 against Leo V., whom he imprisoned. In January 904 he was treated in the same fashion by his competitor, Sergius III., who had him strangled.

CHRISTOPOULOS, ATHANASIOS (1772–1847), Greek poet, was born at Castoria in Macedonia. He studied at Buda and Padua, and became teacher of the children of the Vlach prince Mourousi. After the fall of Mourousi in 1811 he was employed by Prince Caradja, hospodar of Moldavia and Walachia, in drawing up a code of laws for that country. On the removal of Caradja, he retired into private life and devoted himself to literature. He wrote drinking songs and love ditties which are very popular among the Greeks. He also wrote *Politika Parallela* (a comparison of various systems of government), translations of Homer and Herodotus, a tragedy and some philological works on the connection between ancient and modern Greek.

His *Hellenika Archaiologemaia* (Athens, 1853) contains an account of his life.

CHRIST'S HOSPITAL (the Blue Coat school) was originally one of three royal hospitals in the city of London, founded by Edward VI. Christ's hospital was specially devoted to fatherless and motherless children. The buildings of the monastery of Grey Friars, Newgate street, were appropriated to it; liberal public subscription added to the king's grant endowed it richly, and the mayor, commonalty and citizens of London were nominated its governors in its charter of 1552. Not long after its opening Christ's was providing home and education (or, in the case of the very young, nursing) for 400 children. The popular name of the Blue Coat school is derived from the dress of the boys—originally (almost from the time of the foundation) a blue gown, with knee-breeches, yellow petticoat and stockings, neck-bands and a blue cap. The petticoat and cap were given up in the middle of the 19th century, and thereafter no head-covering was worn. In 1902 the buildings on the Newgate street site were vacated by the school, which was moved to extensive new buildings at Horsham. It includes a preparatory school for boys, established in 1683 at Hertford, where the buildings have been greatly enlarged for the use of the girls' school on the same foundation.

CHRISTUS, PETER (*c.* 1400–1473). A Flemish painter, born at Baerle in North Brabant soon after 1400. He became a citizen of Bruges in 1444. His style was modelled on that of the Van Eycks. His execution was conscientious but lacked the vital qualities of his great forerunners. He signed his pictures "Petrus XPR or XPI." The following paintings bear his signature and are dated:—"The Portrait of Edward Grimston" in the Earl of Verulam's collection, Gorhambury, England (1446); "The Portrait of a Monk" in the collection of Marquis de Dos Aguas at Valencia (1446); "The Interior of a Goldsmith's Shop" in the possession of Philip Lehmann at New York (1449); a half length "Madonna Nursing the Child" at Schloss Vollrads near Wiesbaden (1449); two wings of an altar piece representing "The Nativity," the "Annunciation," and the "Last Judgment" at the Berlin museum (1452); the "Madonna with Saints" at the Staedel, Frankfurt (1457). Besides these a number of unsigned pictures are ascribed to him, among which are two fine portraits, one in the Salting collection at the National Gallery, London, the other at the Berlin museum; and "The Nativity" in the possession of Henry Goldman at New York. The last known picture by Christus is the "Pietà" in the Brussels gallery (*c.* 1460). An earlier version of the same subject is in the New York museum. There is reason to believe that Christus visited Italy and taught Antonello da Messina the Van Eyck method. He had a son Sebastian and a grandson Peter II. who were both painters.

See W. H. Weale, *Peintres Brugeois, Les Cristus* (1909); Sir Martin Conway, *The Van Eycks and their Followers* (1921); Max Friedländer, *Petrus Christus* (1924). (I. A. R.)

CHRISTY, HENRY (1810–1865), English ethnologist, was born at Kingston-on-Thames on July 26, 1810. From 1850–58 he travelled in Europe and America, studying ethnology. In 1858 the discoveries by Boucher de Perthes of flint implements in France and England were first held to have proved the great antiquity of man. Christy joined the Geological Society, and with his friend Edouard Lartet explored the caves in the valley of the Vézère. An account of the explorations appeared in *Comptes rendus* (Feb. 29, 1864) and *Transactions of the Ethnological Society of London* (June 21, 1864). He died, on May 14, 1865, leaving a half-finished book, entitled *Reliquiae Aquitanicae*, which was issued in parts and completed first by Lartet and, after the latter's death in 1870, by Professor Rupert Jones. Christy left his magnificent archaeological collection to the nation. In 1884 it was placed in the British Museum.

CHROMATES AND DICHROMATES, inorganic chemical compounds, or salts, in which the element chromium appears as part of the acid or "negative" component of the salt. Chromium trioxide, CrO_3, commonly but incorrectly termed chromic acid, forms no crystalline hydrates with water, though its strongly acid aqueous solution is supposed to contain chromic acid, H_2CrO_4. The salts of this acid are known as chromates. Only normal salts, for example potassium chromate, K_2CrO_4, are known, which are analogous to and frequently isomorphous with normal sulphates. Acid or hydrogen salts, analogous to potassium bisulphate, $KHSO_4$, are unknown. If an equivalent of acid be added to a solution of a normal chromate, the colour changes from yellow to orange-red, and from the mixture dichromates, for example potassium dichromate, $K_2Cr_2O_7$, alone can be isolated. If further equivalents of acid or, better, chromium trioxide, be added, the solutions become darker red and trichromates such as potassium trichromate, $K_2Cr_3O_{10}$, and tetrachromates such as potassium tetrachromate, $K_2Cr_4O_{13}$, are formed. The solid tri- and tetrachromates are decomposed on solution in water to form dichromates and free chromic acid.

Normal chromates are known of nearly all the stronger bases, both organic and inorganic, and are generally yellow. Ammonium, lithium, sodium, potassium, cuprous, cupric, rubidium, caesium, magnesium, calcium, zinc, cobalt and nickel chromates are soluble in water; strontium and the "rare-earth" chromates are sparingly soluble in water; mercuric chromate is decomposed by water, while silver, thallous, mercurous, cadmium, barium and lead chromates are insoluble in water. With the exception of cuprous, mercurous and magnesium dichromates which are unknown, all the metals forming soluble chromates also yield soluble red dichromates. Barium, lead and silver dichromates are known but are decomposed by water to form normal chromates and chromic acid. Cadmium dichromate is soluble in water, whereas mercuric and thallous dichromates are insoluble. Dark red trichromates are known of ammonium, sodium, potassium, rubidium, caesium, thallous, zinc, cadmium and nickel. Dark red tetrachromates are known of ammonium, sodium, potassium, rubidium and caesium.

Chromates and polychromates are readily reduced by hydrochloric acid, sulphurous acid, hydrogen sulphide, ferrous salts, alcohol, etc., with formation of chromic salts or hydroxide. The chromates of the strongly basic elements are not readily decomposed by heating, but those of the feebler bases yield chromium sesquioxide and oxygen. Ammonium chromate, on heating or exposure to air, loses ammonia and yields the dichromate, which decomposes with explosive violence on further heating, leaving a residue of chromium sesquioxide, while nitrogen, ammonia, oxides of nitrogen, water and oxygen are also formed.

On treatment of chromates or dichromates with concentrated cold solutions of the halogen acids, or phosphorous halides, salts are obtained, derived from hypothetical half-acid halides; for example, hydrochloric acid and potassium dichromate yield potassium chlorochromate, a salt of the unknown chlorochromic acid $HCrO_3Cl$ or $CrO_2Cl{\cdot}OH$, the half-acid chloride of chromic acid $CrO_2(OH)_2$. Fluorochromates, chlorochromates, bromochromates and iodochromates of some of the strong bases are known. If chromates or dichromates are treated with a large excess of hydrofluoric or hydrochloric acid, chromyl fluoride, CrO_2F_2, and chromyl chloride, CrO_2Cl_2, are formed. These compounds, which are red volatile liquids yielding red vapours, are the acid fluoride and acid chloride of chromic acid. The bromine and iodine analogues are unknown.

Though chromates and dichromates are readily decomposed by warm solutions of hydrogen peroxide to form oxygen and chromic salts or chromic hydroxide, cold solutions yield little or no oxygen and form peroxidized compounds, nearly all of which yield hydrogen peroxide by suitable treatment and all readily evolve oxygen. It is accordingly inferred that all contain sexavalent chromium as in chromates and dichromates, the extra equivalents of oxygen being in the same form as in hydrogen peroxide. The highest stage of peroxidation is found in the red perchromates of the general formula R_3CrO_8. These salts are obtained by the action of 30% hydrogen peroxide solutions on alkaline solutions of the chromates at low temperatures. They are unstable at ordinary temperatures and occasionally evolve oxygen explosively. The acid corresponding to these salts has not been isolated. When 97% hydrogen peroxide is added at −30° to chromium trioxide, a dark blue crystalline acid is formed, having the empirical formula H_7CrO_{10} or $H_3CrO_8{\cdot}2H_2O$. An intense blue coloration is formed on adding hydrogen peroxide to an acidified solution of a chromate, the reaction being sufficiently delicate to detect traces of either reagent. The blue colour is extracted by ether, and the ethereal solution on neutralization by alkalis yields dark blue salts. These salts have the general formula RH_2CrO_7, and are as unstable as the more oxygenated red salts. If the red or blue salts are treated with excess of an organic base such as pyridine, blue or violet salts are obtained having the general formula $RCrO_5$. If the red perchromates are heated with ammonia to about 40°, or with potassium cyanide solution, derivatives of a chromium peroxide of the formula CrO_4 or Cr_2O_8 are obtained. This peroxide may be regarded as an acid anhydride, formed by the loss of a molecule of hydrogen peroxide from two molecules of the acid $HCrO_5$, or one molecule of the dimeric acid $H_2Cr_2O_{10}$. The derivatives of this peroxide yield oxygen and chromates with alkalis, and oxygen, hydrogen peroxide and chromic salts with acids.

Analytical.—Chromates and dichromates are readily detected by the blue coloration (above) or by formation of chromyl chloride with hydrochloric acid. Soluble chromates may be precipitated and estimated as barium chromate, or precipitated as mercurous chromate and ignited to chromium sesquioxide. Volumetrically, chromates and dichromates may be estimated by reduction with ferrous salts or acidified potassium iodide solution. Dichromates may be detected in the presence of chromates by the formation of a brown precipitate on addition of a hot sodium thiosulphate solution. Free chromic acid may be detected in presence of chromates and dichromates by the liberation of iodine from neutral potassium iodide solution.

Uses.—Chromic acid, chromates and dichromates are used industrially in the production of pigments, dyes and dye intermediates, in photography, in tanning, in water-resistant glues and cements, and in the production of inorganic pigments such as barium chromate (lemon chrome), lead chromate (chrome yellow), basic lead chromate, $PbCrO_4{\cdot}PbO$ (chrome red or orange), and various basic zinc chromates (zinc yellow and, mixed with Prussian blue, zinc green). The alkali dichromates find extensive application as mordants in dyeing.

Chromates and dichromates are all therapeutically dangerous, being strongly caustic and destructive of the red corpuscles of the blood. They have, however, been used as external caustics and antiseptics for ulcers, etc., with success. (J. D. M. S.)

CHROMATIC, a term meaning "coloured," used in science, particularly in the expression "chromatic aberration" or "dispersion" (*see* ABERRATION OF LIGHT). In Greek music χρωματικὴ μουσική was one of three divisions—diatonic, chromatic and enharmonic—of the tetrachord. Like the Latin *color*, χρῶμα was often used of ornaments and embellishments, and particularly of the modification of the three *genera* of the tetrachord. The chromatic, being subject to three such modifications, was regarded as particularly "coloured." To the Greeks chromatic music was sweet and plaintive. From a supposed resemblance to the notes

of the chromatic tetrachord, the term is applied to a succession of notes outside the diatonic scale, and marked by accidentals. A "chromatic scale" is thus a series of semi-tones.

CHROMATOMETER or **TINTOMETER,** an instrument for standardizing the *intensity* and *hue* of a given colour (*q.v.*). The specimen is compared with a standard by viewing the two simultaneously and interposing in front of the standard various standard coloured plates until a match is obtained. Instead of the plates, strata liquids of the three primary colours may be used. (*See* also COLORIMETER.)

CHROME STEEL: *see* IRON AND STEEL.

CHROMITE, a member of the spinel group of minerals; an oxide of chromium and ferrous iron, $FeCr_2O_4$. It is the chief commercial source of chromium and its compounds. It crystallizes in regular octahedra, but is usually found as grains or as granular to compact masses. In its iron-black colour with submetallic lustre and absence of cleavage it resembles magnetite (magnetic iron-ore) in appearance, but differs from this in being only slightly if at all magnetic and in the brown colour of its powder. The hardness is $5\frac{1}{2}$; specific gravity 4·5. The theoretical formula $FeCr_2O_4$ corresponds with chromic oxide (Cr_2O_3) 68%, and ferrous oxide 32%; the ferrous oxide is, however, usually partly replaced by magnesia, and the chromic oxide by alumina and ferric oxide, so that there may be a gradual passage to picotite or chrome-spinel. Much of the material mined as ore does not contain more than 40 to 50% of chromic oxide. The earliest worked deposits of chromite were those in the serpentine of the Bare hills near Baltimore, Md.; and it is now mined in Southern Rhodesia, Quebec, New Caledonia, India, Greece, Asia Minor, Ural Mountains, California, etc. It abounds in Chester county, Pa., at Hoboken, N.J., and in various parts of North Carolina. Chrome-iron ore is largely used in the preparation of chromium compounds for use as pigments (chrome-yellow, etc.), and in calico-printing.

CHROMIUM is a metallic chemical element, called so from the Greek χρῶμα, colour, on account of the varied colours of its compounds. In 1798, L. N. Vauquelin and M. H. Klaproth simultaneously and independently discovered a new element in addition to lead in the mineral crocoisite or crocoite (lead chromate, $PbCrO_4$) first described by Lehmann in 1762. The metal was not isolated, however, until 1859, when F. Wöhler obtained small quantities of it by reduction of the trichloride with potassium. Owing to the difficulty of reduction and of electro-deposition, the metal remained a chemical curiosity for many decades, though it is now produced on a large scale for use in stainless and alloy steels. Its symbol is Cr, and it has an atomic number of 24 and an atomic weight of 52·01. Owing to the possession of six valency electrons it has a maximum of valency of six.

Occurrence and Production.—The metal is not found free in nature, and, though the element has a minimum valency of two, all of the ores contain trivalent or sexavalent chromium. The chief mineral from which the metal and commercial chromium compounds are obtained is chromite, or chrome iron ore, which consists largely of ferrous chromite, $Fe(CrO_2)_2$ or FeO,Cr_2O_3. This ore is widely distributed, but Rhodesia, the United States and India are the chief producers. In addition to chromite and crocoisite, chromium is also found as sesqui-oxide in chrome ochre, Cr_2O_3, as potassium chromate, K_2CrO_4, as redingtonite (a hydrated sulphate), as phospho-chromates, as basic chromates, as ferrous thiochromite, $Fe(CrS_2)_2$, and in various other combinations. The green colour of emerald, serpentine, chrome-mica and chrome-garnet is due to chromium, as is also the red colour of ruby, and some sapphires and spinels.

The chromium compounds of commerce are practically all derived from the alkali chromates and dichromates (*see* CHROMATES AND DICHROMATES), obtained by roasting chromite with lime in an oxidizing atmosphere and subsequent treatment with an aqueous solution of alkali sulphate. Metallic chromium is obtained by H. Goldschmidt's alumino-thermic process, in which chromium sesquioxide or potassium dichromate is reduced by heating with aluminium powder. It may also be obtained by electro-deposition from solutions of chromic sulphate mixed with much "chromic acid," CrO_3, this method being used for plating iron and steel. Pure chromium may be obtained by reduction of the sesquioxide at 1,500° C with pure hydrogen, while pure chromium amalgam is obtained on treating concentrated solutions of chromic chloride with sodium amalgam. If the amalgam be distilled at 350° C in hydrogen, or 300° C *in vacuo,* a residue of pyrophoric (spontaneously inflammable) chromium powder remains. Ferro-chrome alloys may be obtained by direct smelting of chromite, with or without addition of chromium sesquioxide, by means of carbon in the electric furnace. The natural or enriched ferro-chrome alloy is utilized in the manufacture of stainless steels and chrome alloy steels.

Properties.—Chromium is a steel-white metal, harder than iron, cobalt or nickel, and capable of taking a brilliant polish. It is non-magnetic at ordinary temperatures, but becomes magnetic at −15° C. The melting point is 1,540° C and the boiling point 2,200° C, the melting point being higher than that of manganese, iron, cobalt or nickel, though the boiling point is less than that of any of these. The density of the metal varies from 6·7 to 7·1. The electrolytically deposited metal occludes about 250 times its volume of hydrogen. It crystallizes either as rhombohedra or tetragonal pyramids, and X-ray examination discloses that it can exist in two allotropic modifications.

Though pyrophoric in the finely divided condition, chromium in the massive form is not affected by moist air, and only very slowly by dilute acids. Neither fuming nitric acid nor aqua regia attacks it, but with hot concentrated sulphuric acid it gives sulphur dioxide and a dark solution. Warm dilute hydrochloric or sulphuric acid slowly dissolves the metal, hydrogen being evolved with the formation of chromous salts. Heated in hydrogen chloride, the metal yields crystalline colourless chromous chloride, while chlorine yields violet chromic choride. Chromium is not attacked even by fused alkalis, but fused potassium nitrate or chlorate oxidizes it rapidly to potassium chromate. Heated with sulphur or in hydrogen sulphide, chromium yields chromous sulphide, CrS, whereas with carbon, silicon or boron, various carbides, silicides or borides are formed. Though a chromium carbonyl, $Cr(CO)_6$, is known, it is not formed by heating chromium in carbon monoxide, but by treating chromic chloride with carbon monoxide in the presence of magnesium phenyl bromide. Pyrophoric chromium combines directly with nitrogen to form a magnetic nitride. Chromium amalgam also combines with nitrogen to form chromic nitride (CrN), chromous nitride (Cr_3N_2) being formed by heating chromium to 850° in ammonia.

Chromium is known in five conditions of oxidation, having all valencies from two to six. The salts of bivalent chromium (chromous) are all powerful reducing agents, thus resembling the bivalent salts of vanadium and titanium. Chromous salts of nearly all the commoner acids have been prepared and are generally colourless in the anhydrous state and blue when hydrated or in solution. Chromous fluoride (CrF_2) is green; potassium chromous carbonate, $K_2Cr(CO_3)_2,3H_2O$, is yellow; and chromous acetate, $Cr(CH_3CO_2)_2$, is red. Chromous sulphate, which is isomorphous with copperas, $FeSO_4,7H_2O$, also yields double sulphates of the type $CrSo_4,R_2So_4,6H_2O$, where R is a monovalent metal.

Chromic Compounds.—Chromic salts, derived from the trivalent form, are very stable and are neither reducing nor oxidizing agents. They can be reduced or oxidized only with difficulty, to the chromous stage by zinc and acid, and to the chromate stage by alkaline peroxides, hypochlorites or hypobromites. Chromates, like permanganates, are reduced by hydrogen peroxide on warming in acid solution, but the reduction is not carried to the bivalent stage, chromic salts only being formed. Chromic oxide, Cr_2O_3, is a much feebler base than chromous oxide, CrO, and chromic salts are consequently always hydrolysed in solution and have an acidic reaction. Chromic oxide, in fact, has decided acidic properties and yields salts with alkalis, of which barium chromite, $Ba(CrO_2)_2$, is a characteristic example. This acidic nature of chromic oxide gives rise to an extended series of natural and artificial gem-like minerals called chrome-spinels, for example, nickel spinel, NiO,Cr_2O_3, brilliant green crystals belonging to the cubic system. All chromic salts are highly coloured, most be-

ing green or violet, though the chromicyanides are yellow or orange, $R_3Cr(CN)_6$, and the chromithiocyanates are ruby-red, $R_3Cr(CN)_6,4H_2O$. Chromium yields purple double-sulphates of the type $R_2SO_4,Cr_2(SO_4)_3,24H_2O$, which are alums.

Chromic salts closely resemble cobaltic salts in their capacity for forming double and complex salts. In nearly all these salts it is possible to discern six non-ionising groups attached or co-ordinated to the chromium atom, which is accordingly said to possess the co-ordination number six like cobalt. In the case of the ammonia-addition compounds (*see* AMMINES) whole series are known which are indistinguishable in appearance and general properties from the corresponding cobaltammines. These comprise such types as luteo-chromic ammines, $Cr(NH_3)_6Cl_3$, purpureo-ammines, $CrCl(NH_3)_5SO_4$, and among many others, praseo-ammines, $CrCl_2(NH_3)_4NO_3$. Complex salts are also formed by replacing ammonia with pyridine, ethylenediamine, and similar organic bases. Some of these complex salts have been shown to be capable of existing in optically active forms, thus proving that the groups co-ordinated to the chromium atom are not planar but have a spatial distribution which is octahedral. The use of chrome alum and chromic fluoride as mordants in fixing soluble dyestuffs on fabrics has been shown to be due to the capacity of the chromium atom to enter into complex formation with the dyestuffs, yielding highly insoluble compounds, often of different colour from the combined dyestuff, firmly fixed on or in the fibre. It is probable that the use of chromium compounds in tanning is due to complex reaction with the organic substances present in hides.

F. Hein has recently proved that chromium can possess the valency four, a fact long suspected from the existence of an oxide having the empirical formula CrO_2, hitherto regarded as chromous chromate, $CrCrO_4$, or as basic chromic chromate, $(CrO)_2CrO_4$. Hein prepared triphenyl chromium hydroxide $(C_6H_5)_3CrOH$, a powerfully alkaline base, yielding a series of neutral salts such as the perchlorate, Ph_3CrClO_4. He also prepared compounds containing chromium with valency five, for example, tetraphenyl chromium hydroxide, and salts such as the iodide, Ph_4CrI, were isolated. The only inorganic compounds of chromium known with the valency of five are the oxytrichloride, $CrOCl_3$ and its derivatives.

Without exception all inorganic compounds containing chromium with valency six contain oxygen, and are derivatives of the trioxide, CrO_3, commonly but improperly called chromic acid. Chromium trioxide is properly the anhydride of the hypothetical acids, H_2CrO_4 and $H_2Cr_2O_7$, analogous to sulphuric acid and pyrosulphuric acid. The salts of these two acids, chromates and dichromates respectively, are known for the majority of the stronger bases. (*See* CHROMATES AND DICHROMATES.) Chromic anhydride was originally obtained by the hydrolysis of chromyl fluoride, CrO_2F_2, but is nowadays made commercially by the action of concentrated sulphuric acid on solutions of chromates or dichromates, usually potassium dichromate. It forms dark red rhombic needles, which decompose at 330° evolving oxygen and leaving green chromium sesquioxide, Cr_2O_3. It is extremely soluble in water, giving acid solutions from which chromates and dichromates can be produced.

Analysis and Uses.—Chromium can be detected in compounds by the formation of a green borax bead, by the yellow colour of chromates formed on fusion with potassium nitrate, by the formation of red chromyl chloride, and by the blue colour of perchromic acid. Dichromates may be detected in the presence of chromates by the brown precipitate formed on addition of a hot solution of sodium thiosulphate, while free chromic acid may be detected in the presence of dichromates by the liberation of iodine from a solution of potassium iodide. Chromium is separated in group analysis from aluminium and ferric hydroxides by oxidation to soluble chromate with sodium peroxide. Gravimetrically, chromium is usually precipitated with ammonia as chromic hydroxide, and ignited to the sesquioxide. Volumetrically, as chromate or dichromate, it may be estimated by reduction with ferrous salts or acidified potassium iodide.

Metallic chromium is used industrially in the manufacture of steels, and is a common constituent of many ferrous and non-ferrous alloys. Stainless steel, commonly used for rustless cutlery, tools and machinery, is essentially a ferro-chrome alloy, the percentages of chromium and iron usually being about 13 and 86 respectively. As a protective surface for metals, chromium is also used in the form of plate which may be applied electrolytically or by welding. Chromium compounds, usually dichromates or chrome alum, are used in the manufacture and application of dyes and pigments, in tanning hides, and in photography. Chromic salts are practically non-toxic, but the soluble chromates and dichromates are therapeutically dangerous.

See J. N. Friend, *Text-book of Inorganic Chemistry* (vol. vii., part 3, 1926). (J. D. M. S.)

CHROMOLITHOGRAPH: *see* LITHOGRAPHY; COLOUR PRINTING.

CHROMOSOME. So called on account of their affinity for certain dyes, the chromosomes are minute bodies seen in the dividing cells of which the bodies of animals and plants are composed. Their characteristic configurations and remarkable behaviour in cell division, in the process of development, and in the union and formation of the reproductive elements have been the subject of a large body of research, since their discovery in 1873 by Anton Schneider, Flemming, Bütschli and others. The progress achieved during the three decades that followed their discovery made it possible, when Mendel's law of segregation was rediscovered in the opening years of the present century, to identify the structural mechanism predicted by him. From that time to the present day, intensive study of the behaviour of the chromosomes in relation to breeding experiments has resulted in the building up of one of the most spectacular generalizations of modern biology. An exposition of this chromosome hypothesis is given in the article CYTOLOGY. The word was first used by Waldeyer (1888). (*See* also HEREDITY; GENE.) (L. T. H.)

CHROMOSPHERE is the name which was given by Sir Norman Lockyer in 1868 (at the suggestion of Sharpey, then secretary of the Royal Society) to the layer of the sun's atmosphere, just outside the photosphere, which is observed visually when the sun is totally eclipsed and is spectroscopically observable at other times. Observations of the chromosphere had in fact been made before 1868. Thus Young (*The Sun,* 1882) mentions that Capt. Stannyan, in a report on the eclipse of 1706 observed by him at Berne, noticed "a blood-red streak of light visible for six or seven seconds upon the western limb," just before the emergence of the sun. It was observed also by Halley in 1715, and by Arago, Airy, Secchi and others at eclipses in the 19th century. Attention was however directed mostly at that time to solar prominences, and the chromosphere escaped serious study. In 1868 Janssen and Lockyer independently discovered that solar prominences, hitherto only observed at total eclipses, could be seen in full daylight by means of the spectroscope—the principle being that the white light from the sky surrounding the sun's disc was weakened by dispersion on passing through the spectroscope, whilst any monochromatic constituent of the light from the prominences passed through undispersed and gave rise to a bright line. Lockyer shortly afterwards (Nov. 5, 1868) noticed that the prominences jutted out from a continuous spherical envelope surrounding the sun. This envelope was at all times visible in the red (C or Hα) and blue (F or Hβ) lines of hydrogen and in the yellow (D_3) line of the then unidentified element helium. It was to this continuous envelope that Lockyer gave the name chromosphere, in reference to the colour effects seen in the spectroscope.

At a time of total solar eclipse, at the moment of second contact, the chromosphere becomes visible as a thin red crescent, some 10 sec. in thickness, on the east side of the disc. The advancing moon rapidly covers up the layer, which reappears at the western limb just before third contact. The red colour is due to the visual dominance of the Hα line of hydrogen.

Astronomers soon recognized that in the chromosphere they must be viewing tangentially the upper layers of the same gases which, when projected against the bright disc, produce the ordinary Fraunhofer absorption spectrum of sunlight, and it was

natural to look for confirmation of this. The complete spectrum of the light from the chromosphere might be expected to correspond with the Fraunhofer spectrum, a bright line in the chromospheric spectrum corresponding to each dark line in the Fraunhofer spectrum. This was first verified by C. A. Young at the total eclipse of Dec. 22, 1870. Placing the slit of his spectroscope tangential to the advancing limb of the moon, he saw the Fraunhofer spectrum suddenly replaced by a spectrum of bright lines which lasted only two or three seconds. This spectrum was hence called by Young the "flash spectrum." In Young's own words, "as the moon advances, making narrower and narrower the remaining sickle of the sun's disk, the dark lines of the spectrum remain sensibly unchanged though becoming somewhat less intense. A few, however, begin to fade out, and some even turn partially bright a minute or two before totality begins. But the moment the sun is hidden, through the whole length of the spectrum, in the red, the green, the violet, the bright lines flash out by hundreds and thousands, almost startlingly; as suddenly as stars from a bursting rocket, and as evanescent, for the whole thing is over in two or three seconds."

Photography was first successfully applied to the photography of the flash spectrum by A. Fowler and W. Shackleton at the eclipse of April 16, 1893. The flash spectrum may be observed by the use of a tangential slit, as in Young's original observation. But the crescent of atmosphere left exposed by the moon's disk during the period of the flash is so thin that it behaves as a crescent-shaped slit. A direct photograph of the flash spectrum with a prismatic camera without slit reveals a series of crescents, one corresponding to each bright line in the flash spectrum. (*See* illustration under article ECLIPSE.) Each gives an image of the chromosphere and prominences in the corresponding radiation. The thicker the atmosphere as viewed in the light of a particular radiation, the longer will be the arc in the photograph, and it is a matter of simple geometry to deduce the height of the chromosphere in any given radiation from a measurement of the distance from cusp to cusp, using the known diameters of the sun and moon. The following table shows chromospheric heights derived in this way by Lockyer (eclipse of 1898), Mitchell (1905), Davidson and Stratton (1926) and Menzel (1931).

Heights of Elements in Chromosphere from Lengths of Arcs

Element	Radiation	Lockyer 1898	Mitchell 1905	Davidson and Stratton 1926	Menzel 1931
		Km.	Km.	Km.	
H	λ6563 Hα	7,500	..	8,400	..
	λ4861 Hβ	..	8,000	8,400	9,000
	λ4341 Hγ	..	8,000	8,000	..
He	λ4713	..	3,900	6,000	..
	λ5876(D_3)	..	7,500	7,500	..
	λ4471	6,500	7,500	7,400	..
	λ4026	4,500	6,000	4,400	..
He^+	λ4686	..	1,580	2,200	..
Na	λ5896, λ5890(D_1, D_2)	..	1,200	1,000	..
Ca	λ4227	3,500	5,000	2,500	..
Ca^+	λ3968, λ3933(H,K)	9,500	14,000	9,200	10,000
Sr^+	λ4215, λ4077	4,500	6,000	5,200	..

Number of Atoms a a Height H in Kilometres

Menzel, all atoms:

From multiplet intensities $\exp\left(-\frac{H}{4950}\right)+59\exp\left(-\frac{H}{1560}\right)$

From microphotometer intensities $\exp\left(-\frac{H}{3580}\right)+56\exp\left(-\frac{H}{1650}\right)$

Mitchell and Williams:

Singly ionized Titanium $\exp\left(-\frac{H}{5000}\right)+60\exp\left(-\frac{H}{2000}\right)$

Iron (of excitation potential 1 volt) $\exp\left(-\frac{H}{3333}\right)+50\exp\left(-\frac{H}{1667}\right)$

Pannekock and Minnaert:

Hydrogen $\exp\left(-\frac{H}{617}\right)$

Apart from the heights to which the various elements are detected in the chromosphere, the question of greatest interest concerns the distribution of density in the chromosphere. The table also shows the results of various investigations by Menzel, Mitchell and Williams, and Pannekock and Minnaert.

As regards wave length, the flash spectrum is an almost exact copy of the Fraunhofer spectrum. The Balmer series of hydrogen extends however much further (Stratton and Davidson at Sumatra, in 1926, observed 36 members of the series); also helium is prominent in the flash, while it only appears fitfully and faintly in the Fraunhofer spectrum. But the intensities of the lines in the flash are markedly different from the intensities in the Fraunhofer spectrum. Lines faint in the Fraunhofer spectrum give rise to short intense arcs in the flash; this is easily explained since the faint lines in the Fraunhofer spectrum are probably produced by low-lying vapours at a high temperature, which accordingly shine brightly when viewed tangentially. But in addition many lines are enormously increased in intensity in the flash. It was pointed out by Lockyer that such lines are almost invariably "enhanced" lines, *i.e.*, lines which are relatively strengthened from arc spectra to spark spectra. For example the D-lines of sodium (arc lines) are relatively inconspicuous in the flash; the blue line λ4227 of calcium is much less intense and extends to a smaller height than the H and K lines; the enhanced lines of iron, scandium, titanium and chromium are all strengthened in the flash, and usually extend to greater heights than the unenhanced lines. The flash spectrum, in fact, resembles in many ways the spectrum of stars much hotter than the sun. This was for many years a difficulty, for it was hard to believe that the high-level chromosphere could be hotter than the low-level reversing layer.

The explanation was given by Megnad Saha in 1920. Enhanced lines are now known to be due to the ionized atom, *i.e.*, the atom which has lost one or more electrons, and Saha showed that ionization was promoted not only, as in Lockyer's experiments, by high temperature but also by low pressure. At high temperatures the process of the dissociation of an atom into an electron and a positive ion goes on of its own accord, according to the reversible equation

$$A \rightleftharpoons A^+ + e^-$$

until a balance is obtained between the rate of dissociation and the rate of recombination. Reduction of pressure reduces the rate of recombination, while leaving the rate of ionization unchanged, and so favours an increased degree of ionization. Saha showed that at a given temperature and pressure the degree of ionization was calculable, given the ionization potential of the atom. The following table gives the percentage ionization of calcium at 5,000° C. at the pressures mentioned:—

Pressure (atmospheres)	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}
Percentage ionization	6.5	20.2	54.5	90	99	(100).

The pressure at the base of the chromosphere is probably less than 10^{-6} atmosphere, and so in the high-level chromosphere calcium must be almost completely ionized. The spectrum must therefore be that of the ionized atom, not the neutral atom; hence the predominance of enhanced lines in the chromospheric spectrum. Similar calculations apply to other elements. The D-lines of sodium, for example, which are due to the neutral atom, are not found in the upper chromosphere, because any sodium there would be completely ionized; the lines of the ionized atom are too far in the ultra-violet to be observable.

The question remains why the chromosphere should extend to such great heights in certain elements. Gravity at the solar surface is some 27 times as powerful as at the earth's surface, and it is readily calculated that under gravity only the solar atmosphere would have a thickness which would be measured in tens of kilometres instead of thousands. (E. A. MI.)

An explanation with specific reference to the ionized calcium chromosphere was given by E. A. Milne in a series of papers published during the years 1924–27. This theory of Milne is based on the following considerations: when an atom absorbs a quantum of light, and thereby undergoes a transition from one stationary state to another, it experiences a blow in the direction in which the light was moving. In the case of the sun this blow will be in the outward direction. After a short interval the atom must re-emit the quantum, suffering thereby a blow from the recoil, but the recoil blows will be random in direction and will neutralize one another on the average. The net result is that in a succession of absorptions and emissions the atom experiences a series of outward blows. An atom of ionized calcium in the high level chromosphere experiences some 20,000 such blows per second and this is just sufficient to keep it suspended against gravity. In other words, the pressure of radiation is able to support the ionized calcium atom against gravity and this will account for the enormous extension of the calcium chromosphere. This theory of Milne, attractive in many ways, encounters certain difficulties. For one thing, the density distribution which it predicts does not seem to be in accord with the observations. For another, it appears too special in the sense that it is unable to account for the extent of the other atoms in the chromosphere. This latter failure of Milne's theory, particularly in the case of hydrogen, throws serious doubts on the adequacy of the whole picture; for hydrogen is the most abundant constituent of the chromo-

sphere. These remarks apply not only to Milne's theory but also to other variants of it as given for example by Chandrasekhar.

In view of the difficulties encountered by theories based on support from radiation pressure, W. H. McCrea has advanced an alternative theory based on the notion of turbulence. McCrea supposes that the chromospheric gases can be divided into volume elements of finite extent V such that the atomic motion in each group is temperature motion (the temperature corresponding to the ionization and excitation exhibited by the chromosphere) but the elements V themselves have a Maxwellian distribution in velocity corresponding to a temperature $\mathbf{T}$ characterized by a mean velocity C. In the case of an atmosphere consisting of nothing but neutral hydrogen we can expect a relation of the form

$$k\,\mathbf{T} = k\,T + \tfrac{1}{3}MC^2$$

where M is the mass of the hydrogen atom and k is the so called Boltzmann constant. The pressure p will be given by

$$p = n\,k\,\mathbf{T}$$

where n is the number of hydrogen atoms per c.c. Under these circumstances it is not difficult to visualize that the density distribution in the chromosphere will imitate an isothermal atmosphere at the fictitious temperature $\mathbf{T}$. The density distributions in the chromosphere as indicated by the observations would lead to a temperature $\mathbf{T}$ of the order of 18,000° corresponding to a velocity C of about 18 km./sec. It would not seem impossible that turbulent motions of this magnitude exist in the chromosphere. Indeed there are observations which would lead one to suspect velocities of exactly this order.

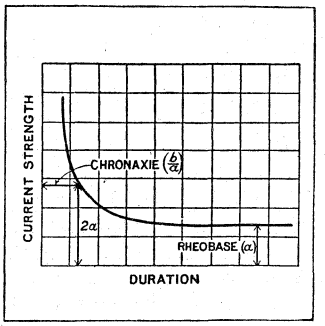
Finally we may refer to an outstanding problem of the chromosphere. The high level chromosphere rotates round the sun's axis faster than the reversing layer, and moreover does not have the retardation experienced by the latter. No satisfactory explanation had been suggested up to 1945. (Su. C.)

Bibliography.—General accounts of the chromosphere are contained in the following standard works: E. Pringsheim, *Physik der Sonne* (1910); C. G. Abbot, *The Sun* (1911); H. Dingle, *Modern Astrophysics* (1924); S. A. Mitchell, *Eclipses of the Sun* (1924); F. J. M. Stratton, *Astronomical Physics* (1925). *See* also A. S. Eddington, *Stars and Atoms* (1927) and F. J. M. Stratton, *Modern Eclipse Problems* (Halley Lecture, 1927). J. N. Lockyer's early researches on the chromosphere are contained in *Contributions to Solar Physics* (1874) and *Chemistry of the Sun* (1887). Original records of eclipse observations on the chromosphere are given in the following fundamental memoirs: *Phil. Trans. Roy. Soc.*, vol. 187A, 1896 (J. N. Lockyer, A. Fowler and W. Shackleton); *Mem. Roy. Astron. Soc.*, vol. 54 (appendices) (1901 and 1902, J. N. Lockyer; 1901 and 1903); J. Evershed, vol. 57 (appendix) (1906, F. W. Dyson); *Astrophys. Journ.*, vol. 38 (1913, S. A. Mitchell); *Mem. Roy. Astron. Soc.*, vol. 64 (1927, C. R. Davidson and F. J. M. Stratton). For the rotation of the chromosphere see W. S. Adams, *Astrophys. Journ.*, vol. 29 (1909). Saha's fundamental paper on ionization in the chromosphere occurs in *Phil. Mag.*, vol. 40 (1920). The mathematical theory of the equilibrium of the chromosphere is given in E. A. Milne's papers in *Monthly Notices R.A.S.*, vols. 84–87 (1924–27). See also *Monthly Notices*, vol. 87 (1927, S. R. Pike and P. A. Taylor). For recent views on the height of the chromosphere *see* correspondence in *Observatory*, vol. 48, 49 (1925, 1926: J. Evershed, S. A. Mitchell, E. A. Milne, A. A. Buss and G. Abetti). F. Dyson and R. v. d. R. Woolley, *Eclipses of the Sun and the Moon* (1937); Menzel, *Lick Obs. Publ. 17*, part I (1931); S. Chandrasekhar, *Monthly Notices R.A.S.*, 94, 13 (1933); W. H. McCrea, *Monthly Notices R.A.S.*, 89, 718 (1929). (E. A. Mi.; Su. C.)

CHRONAXIE, a term introduced by Louis Lapicque in 1909 to define the character of the stimulus which is required to excite various types of living tissue, particularly muscle and nerve. The most convenient form of stimulus is an electric current, since this can be made to excite (*i.e.*, to cause the tissue to display its characteristic activity) without doing any damage. It is found that a current must fulfil three conditions if it is to excite—(1) it must flow for more than a certain minimal duration; (2) the final strength must exceed a certain value; and (3) the rate of increase of the current from zero must exceed a definite velocity. The need for a minimal duration is shown by the fact that a current alternating at a million cycles a second is powerless to excite any tissue in the body; and the modern surgical technique of diathermy is based on this.

The curve relating minimal duration and minimal strength has the form shown in the figure, and as a first approximation it obeys the formula of Weiss, $i = a + \frac{b}{t}$, where i is the current, t its duration and a and b are constants. Lapicque has shown that curves of the same form are obtained from the most diverse tissues, ranging from the human nerve, where the minimal duration is less than ·0001sec., to the cells of a plant where it may be longer than 1sec. Thus the character of the stimulus for a given tissue can be defined at once if we know the constants a and b for that tissue. The constant a (the "Rheobase") is given by the minimal current strength at long durations. The other constant b is the more important, for it determines the slope of the curve, it can be fixed by measuring the "Chronaxie," which is equal to $\frac{b}{a}$ and is the least duration required when the current strength is $2a$.

The true form of the curve differs somewhat from that given by Weiss's equation, and it has been used as a basis from which to deduce the mechanism of excitation. In Lapicque's hands the measurement of the Chronaxie has also been used to investigate the passage of the state of excitation from one tissue to another (*e.g.*, from nerve to muscle). (E. D. A.)



FORM OF A STIMULATING CURRENT IN LIVING TISSUE
The curve shows the relation between the strength and the duration of the smallest current which will excite a living cell. The Chronaxie and the Rheobase are the two constants which define the curve

CHRONICLE. The historical works written in the middle ages are variously designated "histories," "annals," or "chronicles" (from Gr. χρόνος, time); it is difficult, however, to give an exact definition of each of these terms, since they do not correspond to determinate classes of writings. Perhaps the most reasonable definition is that given by H. F. Delaborde at the École des Chartes, that chronicles are accounts of a universal character, while annals relate either to a locality, or to a religious community, or even to a whole people, but without attempting to treat of all periods or all peoples. The primitive type, he says, was furnished by Eusebius of Caesarea, who wrote (*c.* 303) a chronicle in Greek, which was soon translated into Latin and frequently recopied throughout the middle ages; it embraced the history of the world since the Creation. It is certain, however, that mediaeval authors or scribes were not conscious of any clear distinction between annals and chronicles; indeed, they often apparently employed the terms indiscriminately.

In any case, chronicles and annals (*q.v.*) have points of great similarity. Chronicles are accounts generally of an impersonal character, and often anonymous, composed of passages copied from sources which the chronicler is seldom at pains to indicate, and of personal recollections the veracity of which remains to be determined. Some of them are written with so little intelligence that the work of composition seems a mere piece of drudgery imposed on the clergy and monks by their superiors. To distinguish what is original from what is borrowed, to separate fact from falsehood, and to establish the value of each piece of evidence, is thus a difficult undertaking, and one which has exercised the sagacity of scholars, especially since the 17th century.

The Christian chronicles were first written in the two learned languages, Greek and Latin. At an early stage we have proof of the use of national languages, the most famous instances being the Anglo-Saxon Chronicle (*q.v.*), the most ancient form of which goes back to the 10th century, and the so-called Chronicle of Nestor, in Palaeo-Slavonic, written in the 11th and 12th centuries. In the 13th and 14th centuries the number of chronicles written in the vulgar tongue continued to increase more rapidly on the Continent than in England. From the 15th century, with the revived study of Greek and Roman literature, the traditional form of chronicles, as well as of annals, tended to be replaced by another based on the models of antiquity—that of the historical composition combining skilful arrangement with elegance of style. It was not, however, until the 17th century that the traditional form became practically extinct.

See E. Bernheim, *Lehrbuch der historischen Methode* (4th ed.,

1903); H. Bloch, "Geschichte der deutschen Geschichtsschreibung im Mittelalter" in the *Handbuch* of G. von Below and F. Meinecke (Munich, 1903 *seq.*); Max Jansen, "Historiographie und Quellen der deutschen Geschichte bis 1500," in Aloïs Meister's *Grundriss* (Leipzig, 1906); and the Introduction (1904) to A. Molinier's *Les Sources de l'histoire de France.* (C. Bem.)

CHRONICLES, BOOKS OF, two Old Testament books of the Bible. The name is derived from *Chronicon,* first suggested by Jerome as a rendering of the title which they bear in the Hebrew Canon, viz. *Events of the Times.* (1 Chron. xxviii. 24; Esth. x. 2, etc.) The Greek translators divided the long book into two, and adopted the title Παραλειπόμενα, *Things omitted* (*scil.* in the other historical books).

Authorship and Date.—The book of Chronicles begins with Adam and ends abruptly in the middle of Cyrus's decree of restoration, which reappears complete at the beginning of Ezra. A closer examination of those parts of *Ezra* and *Nehemiah* which are not extracted from earlier documents or original memoirs leads to the conclusion that *Chronicles-Ezra-Nehemiah* was originally one work, displaying throughout the peculiarities of language and thought of a single editor, who, however, cannot be Ezra himself as tradition states. The style of the language, and also the position of the book in the Jewish Canon, stamp the book as one of the latest in the Old Testament. In 1 Chron. xxix. 7, which refers to the time of David, a sum of money is reckoned by *darics,* which certainly implies that the author wrote after this Persian coin had been long current in Judaea. In 1 Chron. iii. 19 *sqq.* the descendants of Zerubbabel seem to be reckoned to six generations (the Septuagint reads it so as to give as many as 11 generations), and this agrees with the suggestion that Hattush (v. 22), who belongs to the fourth generation from Zerubbabel, was a contemporary of Ezra (Ezra viii. 2). With this it accords that in Nehemiah five generations of high priests are enumerated from Joshua (xii., 10 *seq.*), and that the last name is that of Jaddua, who, according to Josephus, was a contemporary of Alexander the Great (333 B.C.). A date some time after 332 B.C. is now accepted by most modern critics. *See* Ezra and Nehemiah, Books of.

Scope and Object.—The writer lived a considerable time after Ezra and stood entirely under the influence of the religious institutions of the new theocracy. This standpoint determined the nature of his interest in the early history of his people. The true importance of the history of Israel centred in the fact that this petty nation was the people of Yahweh, the spiritual God. The tragic interest which distinguishes its annals from the forgotten history of Moab or Damascus lies wholly in that contest which vindicated the reality of spiritual things and the supremacy of Yahweh's purpose, in the political ruin of the nation which was the faithless depository of these sacred truths. After the return from the Exile it was impossible to write the history of Israel's fortunes otherwise than in a spirit of religious pragmatism. But within the limits of the religious conception of the plan and purpose of the Hebrew history more than one point of view might be taken up. The book of Kings looks upon the history in the spirit of the prophets—in that spirit which is still echoed by Zech. i. 5 *seq.,* but which had become extinct before the Chronicler wrote. The New Jerusalem of Ezra was organized as a municipality and a church, not as a nation. The centre of religious life was no longer the living prophetic word but the ordinances of the Pentateuch and the liturgical service of the sanctuary. The religious vocation of Israel was no longer national but ecclesiastical or municipal, and the historical continuity of the nation was vividly realized only within the walls of Jerusalem and the courts of the Temple, in the solemn assembly and stately ceremonial of a feast day. These influences naturally operated most strongly on those who were officially attached to the sanctuary. To a Levite, even more than to other Jews, the history of Israel meant above all things the history of Jerusalem, of the Temple, and of the Temple ordinances. Now the writer of Chronicles betrays on every page his essentially Levitical habit of mind. It even seems possible from a close attention to his descriptions of sacred ordinances to conclude that his special interests are those of a common Levite rather than a priest, and that of all Levitical functions he is most partial to those of the singers, a member of whose guild he may have been. From the standpoint of the post-exilic age, the older delineation of the history of Israel, especially in the books of Samuel and Kings, could not but appear to be deficient in some directions, while in other respects its narrative seemed superfluous or open to misunderstanding, as for example by recording, and that without condemnation, things inconsistent with the later post-exilic law. The history of the ordinances of worship holds a very small place in the older record. Jerusalem and the Temple have not that central place in the book of Kings which they occupied in the minds of the Jewish community after the Exile. Large sections of the old history are devoted to the religion and politics of the ten tribes, which are altogether unintelligible and uninteresting when measured by a strictly Levitical standard; and in general the whole problems and struggles of the prophetic period turn on points which had ceased to be cardinal in the life of the New Jerusalem, which was no longer called to decide between the claims of the Word of Yahweh and the exigencies of political affairs and social customs, and which could not comprehend that men absorbed in deeper spiritual contests had no leisure for the niceties of Levitical legislation. Thus there seemed to be room for a new history, which should confine itself to matters still interesting to the theocracy of Zion, keeping Jerusalem and the Temple in the foreground, and developing the divine pragmatism of the history, not so much with reference to the prophetic word as to the fixed legislation of the Pentateuch, so that the whole narrative might be made to teach that the glory of Israel lies in the observance of the divine law and ritual.

Contents.—For the sake of systematic completeness the book begins with Adam, as is the custom with later Oriental writers. The early history is contracted into a series of tribal and priestly genealogies, which were doubtless by no means the least interesting part of the work at a time when every Israelite was concerned to prove the purity of his Hebrew descent (*cf.* Ezra ii. 59, 62). Commencing abruptly (after some Benjamite genealogies) with the death of Saul, the history becomes fuller and runs parallel with the books of Samuel and Kings. The limitations of the compiler's interest in past times appears in the omission, among other particulars, of David's reign in Hebron, of the disorders in his family, and the revolt of Absalom, of the circumstances of Solomon's accession, and of many details as to the wisdom and splendour of that sovereign, as well as of his fall into idolatry. In the later history the ten tribes are quite neglected ("Yahweh is not with Israel," 2 Chron. xxv. 7), and political affairs in Judah receive attention, not in proportion to their intrinsic importance, but according as they serve to exemplify God's help to the obedient and His chastisement of the rebellious. That the compiler is always unwilling to speak of the misfortunes of good rulers is not necessarily to be ascribed to a deliberate suppression of truth, but shows that the book was throughout composed not in purely historical interests, but with a view to inculcating practical lessons. The more important additions to the older narrative consist partly of statistical lists (1 Chron. xii.), partly of full details on points connected with the history of the sanctuary and the great feasts or the archaeology of the Levitical ministry (1 Chron. xiii., xv., xvi., xxii.–xxix.; 2 Chron. xxix.–xxxi., etc.), and partly of narratives of victories and defeats, of sins and punishments, of obedience and its reward, which could be made to point a plain religious lesson in favour of faithful observance of the law (2 Chron. xiii., xiv. 9 *sqq.;* xx., xxi. 11 *sqq.,* etc.). The minor variations of *Chronicles* from the books of Samuel and Kings are analogous in principle to the larger additions and omissions, so that the whole work has a consistent and well-marked character, presenting the history in quite a different perspective from that of the old narrative.

Value.—For a critical study of the book it is necessary to compare carefully Chronicles with the parallel narrative in *Samuel–Kings.* "A careful comparison of Chronicles with Samuel and Kings is a striking object lesson in ancient historical composition; it is an almost indispensable introduction to the criticism of the Pentateuch and the older historical works" (W. H. Bennett, *Chronicles,* p. 20 *seq.*). Where *Chronicles* directly con-

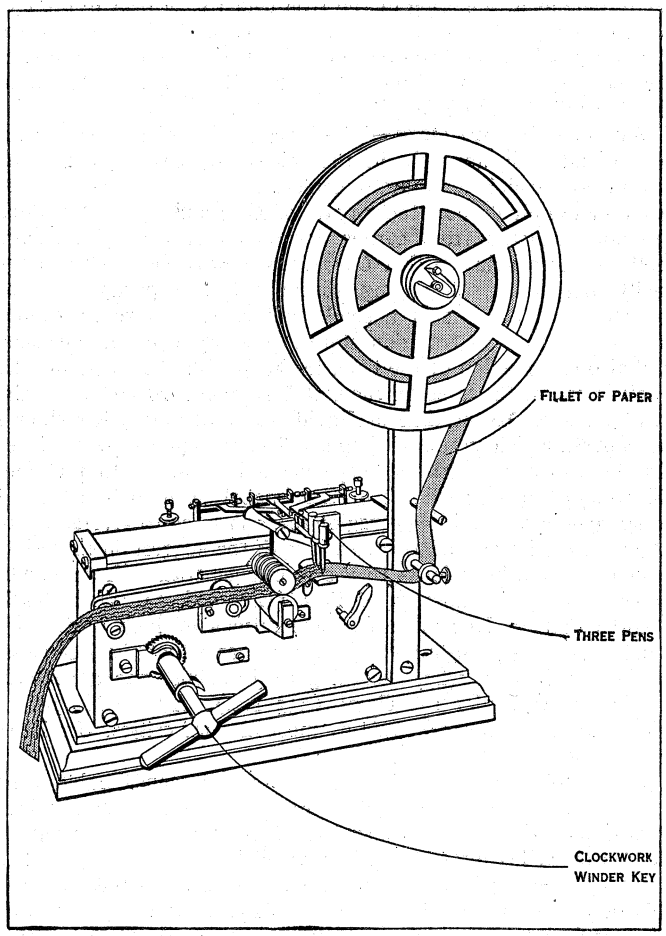
tradicts the earlier books there are few cases in which an impartial historical judgment will decide in favour of the later account, and in any point that touches difference of usage between its time and that of the old monarchy it is of no authority. A certain freedom of literary form was always allowed to ancient historians; and the typical speeches in Chronicles are of little value for the periods to which they relate, especially where they are inconsistent with the evidence from earlier writings. According to the ordinary laws of research, the book, being written at a time long posterior to the events it records, can have only secondary importance, although here and there valuable material has been preserved. It must be remembered that the earlier books contain only a portion of the material to which the compilers had access. Hence it may well happen that the additional details, which unfortunately cannot be checked, were ultimately derived from sources as reputable as those in the books of Samuel, Kings, etc. As examples may be cited Rehoboam's buildings, etc. (2 Chron. xi. 5–12, 18 *sqq.*); Jeroboam's attack upon Abijah; (2 Chron. xiii., *cf.* 1 Kings xv. 7); the invasion of Zerah in Asa's reign (2 Chron. xiv.; *see* ASA); Jehoshaphat's wars and judicial measures (2 Chron. xvii. xx.; *see* 1 Kings xxii. 45); Jehoram's family (2 Chron. xxi. 2–4); relations between Jehoiada and Joash (2 Chron. xxiv. 3, 15 *sqq.*); conflicts between Ephraim and Judah (2 Chron. xxv. 6–13); wars of Uzziah and Jotham (2 Chron. xxvi. *seq.*); events in the reign of Ahaz (2 Chron. xxviii. 8–15, 18 *seq.*); reforms of Hezekiah (2 Chron. xxix. *sqq.*, *cf.* Jer. xxvi. 19); Manasseh's captivity, repentance, and buildings (2 Chron. xxxiii. 10–20; *see* 2 Kings xxi. and MANASSEH); the death of Josiah (2 Chron. xxxv. 20–25). In addition to this reference may be made to such tantalizing statements as those in 1 Chron. ii 23 (R.V.), iv. 39–41, v. 10, 18–22, vii. 21 *seq.*, viii. 13, xii. 15, examples of the kind of tradition, national and private, upon which writers could draw. Although in their present form the additional *narratives* are in the chronicler's style, it is not necessary to deny an older traditional element which may have been preserved in sources now lost to us.

BIBLIOGRAPHY.—Robertson Smith's famous article in the 9th ed. of the *Ency. Brit.* was modified by his later views in *Old Test. in the Jewish Church*, pp. 140–148. Later literature is summarized by Driver in his revision of Smith's article in *Ency. Bib.* and in his *Lit. of Old Test.*, by F. Brown in Hasting's *Dict. Bib.* and by Elmslie (in the Cambridge Bible). (W. R. S.; S. A. C.)

CHRONOGRAPH, an instrument for recording the passage of time; thus the name is applied to the stop-watch used for timing races, etc. Press a key and the index of the dial sets to zero; press again and the index starts to move at normal rate, say one revolution per 60 secs., by steps of one-fifth sec.; press a third time and the index stops, and the event is "timed" by reading the dial. Attention to the defects of this crude form of chronograph will show the necessity for the refinements described below. In the first place, by setting the start of the event at zero the timing instrument is detached from other clocks and therefore the absolute time of start and finish are lost; secondly, a watch or other time-piece cannot be trusted to move at a standard pace immediately after it is set in motion; thirdly, no means are provided for checking its going; fourthly, the step-by-step movement of the hand of a watch limits the precision of the reading to one whole step; fifthly, the observer must note the beginning of the event and simultaneously start his watch, and note the end, and simultaneously stop it—otherwise he will introduce an error. In some cases the first condition is of no importance; the others are always important.

The faults relating to the clock are met by a double device. An independent, well-made piece of clock-work moves a paper band at an approximately uniform rate; on this a standard clock, the rate and error of which can be found otherwise (*see* TIME MEASUREMENT) impresses a mark every second or every two seconds; the "personal" error of the observer is eliminated by making the event itself impress a similar mark, which as a rule will fall between two of the seconds-marks of the clock, so that the event may be timed with any degree of precision by measuring the distances of its mark from the two adjacent seconds-marks. The exactness of the chronograph is limited by the precision with which these requirements can be carried out in practice; this will be best shown by describing some standard forms.

The figures show the front and back view of a three-pen chronograph by H. Wetzer, Pfronten, Bavaria. A fillet of paper is wound at a regulated and approximately constant speed from a roll over a small bench, above which are three pens in light contact with



BY COURTESY OF H. WETZER

FIG. 1.—FRONT VIEW OF A CHRONOGRAPH. WHEN A SIGNAL PASSES, THREE PENS, MOVED INDEPENDENTLY OF ONE ANOTHER BY ELECTRO-MAGNETS, TRAIL ON A FILLET OF PAPER RELEASED BY CLOCKWORK

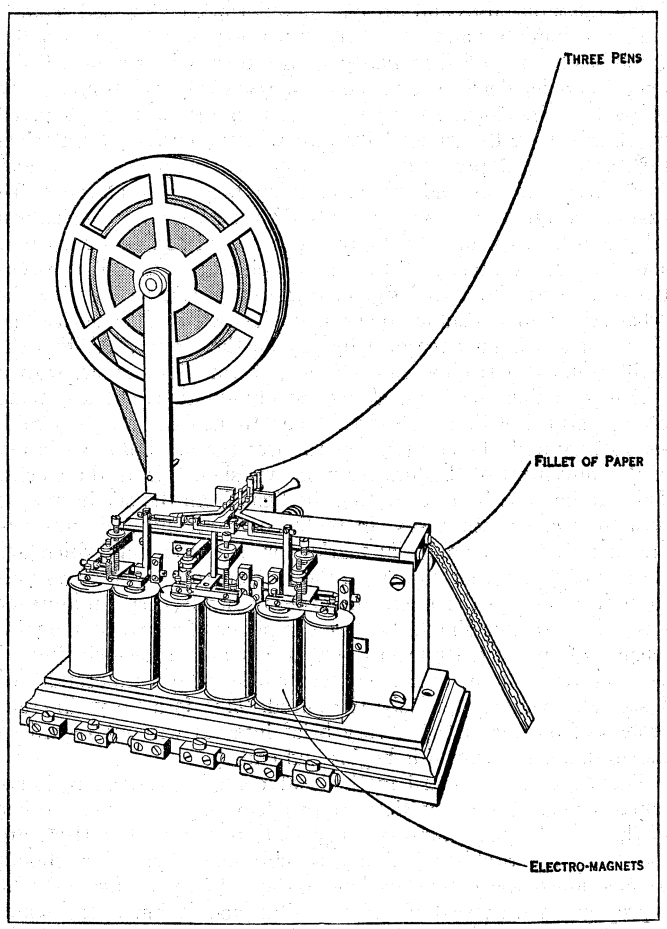
it, so that when nothing is happening the paper trails beneath them and they leave straight traces. Each pen is carried on an independent arm which is linked to the armature of a pair of electro-magnets. If a current passes in one of these magnets, the armature is depressed and the arm moves sharply backwards, indenting the trace in the manner shown in fig. 3 where several traces are given, taken from a six-pen chronograph, corresponding to different settings. Usually the standard clock governs the signals sent to one pair of magnets, say the third trace in this figure, so that the beginning of the indentations would correspond with its seconds. A taper scale, ruled on glass and laid across the paper, permits the time corresponding to any other mark on the paper to be read at sight to, say, one hundredth of a second. If a higher degree of subdivision is wanted, it is advisable to proceed by quite a different method, as described below. In other forms of chronograph the pens are replaced by needle points which prick the paper when the armature descends. The needle is carried in a rocking head so that as the paper moves on, the needle, after pricking the paper, trails until the armature is released again, so as not to retard the movement of the fillet. In other forms again the fillet of paper is replaced by a sheet wound upon a drum, which the clock-work causes to rotate once a minute, while a carriage containing the pens and magnets moves longitudinally beside it. The figure shows a pattern made by the Société Génevoise. In this pattern the motion is derived from

a small electro-motor, and not from weight-driven clock-work.

The chronograph may be arranged so as to yield a print in plain figures of the time recorded. Three wheels, engraved with embossed figures showing minutes, seconds and hundredths of a second, are driven at a rate which is controlled so as to agree with the standard clock, and a fillet of paper, with an inking ribbon between, passes over them. When a signal passes that has to be recorded, electro-magnets cause three hammers to descend and print upon the paper the figures that are exposed below it. Fig. 3 shows a specimen trace.

In order to make this form of chronograph effective the clock-work for driving the type wheels requires rather special attention. The minutes (and seconds) wheels are readily controlled with sufficient accuracy, but the hundredths-of-a-second wheel should not be geared with the others, but should be run by an independent drive, accurately cut, with sensitive appliances for regulating as required its approximate rate. It is run normally slightly fast, and the control of the standard clock is exercised by a check once a second from the signal of the standard clock. It is desirable also to cause the standard clock itself to record at will its own signals, so that the amount by which the wheel is fast may be noted and applied as an index correction.

The electro-magnets for all these forms require to be fairly powerful, and are usually wound to about 20 ohms. resistance,



BY COURTESY OF HERR H. WETZER

FIG. 2.—A DIAGRAM SHOWING THE BACK VIEW OF A CHRONOGRAPH

being worked with batteries of 4 or 6 volts; the current that runs, 0·2amp. or 0·3amp., is therefore much greater than that of the signal from the standard clock which will never exceed about 10 milliamps. A relay must therefore be interposed. It will be noted that the time the relay takes to act, and the time between the commencement of its secondary current and the first movement of the armature, appear as a lag making the record of the chronograph slow on the clock signal. If, however, the error of the clock itself is determined with the same apparatus, the same lag will appear again, and will thus eliminate itself. This supposes the lag to be constant. Experiments show that with the ordinary well-constructed commercial relay, if worked on currents greater than 5 or 6 milliamps, the lag is sensibly constant for the same setting of the relay and should not exceed a few thousandths of a second. *See* some tests of two Siemens Relays, published by the *Commission Géodésique Suisse*, 73rd. Sitting, 1927. (Société-Helvétique des Sciences Naturelles, Neuchatel, 1927.) The part which is due to the electro-magnets of the chronograph may similarly be kept constant by attention to the accumulators that operate them.

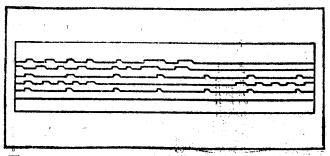


FIG. 3.—TRACE FROM CHRONOGRAPH OF GENERAL TYPE EQUIPPED WITH 6 PENS

As regards the event which has to be timed, any form of contact-maker, connected with its occurrence, and in series with a battery and one of the pairs of electro-magnets of the chronograph, will serve. It may be necessary to interpose a relay. The process may be illustrated by astronomical timing, which is one of the most refined forms, and is done as follows. A star in passage across the field of view of a transit instrument is held bisected by a spider thread, the carrier of which for this purpose travels along a screw shaft actuated by a terminal pair of hand drums. Connected with this shaft is a rotating contact maker. At each revolution a contact is made and is recorded on the chronograph, which thus obtains a record of the time when the star passed a number of fiducial positions in the field of view. Manipulation of the drums requires skill, and is sometimes replaced by an automatic drive, but in any case the observer is unaware when he is making a contact and therefore his bias or "personality" cannot enter in that way. Other events would require different arrangements, but the guiding principles would be the same.

It will be noticed that in all these forms of chronograph, except the printing chronograph, the timing of the mark recording the desired event is found by measuring its distance from two time marks, giving as a rule successive seconds. The accuracy therefore depends upon the uniformity of movement of the paper. The clock-work drive, with continuous motion, is liable to fluctuate more or less. If it does so smoothly, so that it moves the paper at the same rate for several successive seconds, its absolute rate of movement matters little and the measurement may be made at sight, with accuracy up to one-hundredth of a second,

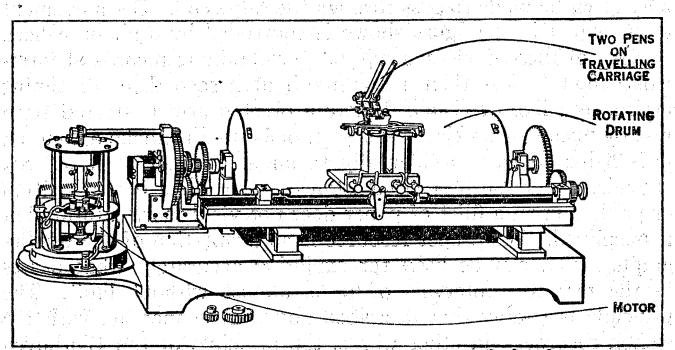


FIG. 4.—DRUM CHRONOGRAPH MADE BY THE SOCIÉTÉ GÉNEVOISE, IN WHICH THE MOTION IS DERIVED FROM A SMALL ELECTRO-MOTOR

by the usual device of a taper scale, engraved on glass, showing seconds of different lengths within the ranges that are likely to occur, and divided into tenths. Sliding the scale across the marked paper, the seconds-marks are fitted to the boundary lines of the scale, and the interpolation of the time of the event in tenths and estimated hundredths is read off. For making this operation accurately the character of the mark on the paper is important. Perhaps the best form in point of accuracy is the circular perforation made by a needle, in place of an ink mark by a pen, but it is trying to the sight unless the illumination is specially arranged, and it is rather easily effaced.

In all cases the signal of the standard clock is so arranged as to indicate the beginning of the minutes, either by omitting a signal or by duplicating it. If it is of importance to feed the

paper quite regularly, the device called the phonic wheel may be employed. Clock-work for the drive is replaced by a small electric-motor, which is driven synchronously with a maintained tuning-fork. A fork of 50 periods per second is found suitable. The system gets rid of substantial fluctuations in the feed, but it is far from ideal, for a tuning-fork maintained in the usual way by means of a small electro-magnet excited by a contact made

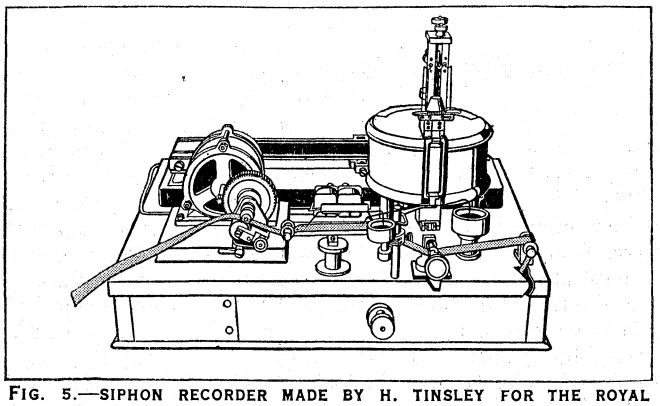


FIG. 5.—SIPHON RECORDER MADE BY H. TINSLEY FOR THE ROYAL OBSERVATORY, EDINBURGH

The signal passes through the coil, which hangs between the poles of a permanent magnet, and carries a siphon pen leading from an inkwell to the paper fillet. A second siphon, actuated by a pair of electro-magnets, gives independent signals

at the extremity of its excursion cannot be relied upon to keep closely a set period as when free.

The introduction of relays in the system, in order to replace the weak signal from the standard clock, or that given by the event to be recorded, may be avoided by using the siphon recorder. The illustration shows a recorder manufactured by H. Tinsley and Co. Between the poles of a strong permanent magnet a coil is suspended through which the weak signal current is made to pass. When a current passes, the coil is deflected. Attached to the coil is the "siphon," which usually consists of a very fine glass tube, bent to an appropriate shape and conveying ink from a well to the fillet of paper which travels at a lower level. A very small current may be made to record directly on this apparatus. Both the signals, from the clock and from the events for record, may often be made to pass through the same coil. The movement of the paper in the figure shown is controlled by a phonic wheel.

None of these devices is suitable for obtaining records of intervals definitely less than a hundredth of a second, or of timing events to a like precision. Where a pivoted arm is started from rest by means of an electro-magnet, or is used to make a contact, it is liable to vary accidentally to an amount of at least ·003 seconds, under the best circumstances. Further a record written or pricked upon a fillet of paper does not yield more information if magnified. The proper resource is an adaptation of the oscillograph, which can be used for exploring accurately what passes in the minutest intervals of time, almost without limit. The principle is simply that described above in connection with the siphon recorder—in other words, the principle of the Einthoven galvanometer, in which a feeble current is passed around a coil or loop which is suspended in a strong magnetic field. The field deflects the coil when a current passes. By suspending the coil with an appropriate reaction to return to its normal position, and by changing the magnetic field, the deflection may be made of any suitable amount, and to take place in a given period of time which may be made very short. With air damping the motion is perfectly dead beat. Further, whether the signal current is constant or not, the interval of time between its onset and the final set of the coil is strictly constant, so that the lag introduced is the same in every case, and the variation of the actuating current is recorded without distortion. A small light mirror mounted on the coil or loop shows the deflection by reflecting a fixed spot of light, or alternatively the current may pass along a single wire or thread and the deflection of this thread by the magnetic field may be projected optically. The projection is recorded photographically. Any degree of rapidity of change may be met by suitable movement of the recording film. For speeds that are not too great, and for prolonged records, a cinema camera with its roll of film is driven by an electric motor. For great speeds a plate may be allowed to fall between guides past the exposure window. Feebleness of signal current is met by intensifying the magnetic field, and again the photographic record may be magnified in a microscope. By this device the details of the oscillating discharge of a condenser may be made evident, or, on the other hand, the feeblest physiological currents may be recorded. Clearly it only requires adaptation to the problem to make it an instrument practically perfect for pure time recording.

It has thus been applied in "sound-ranging" in artillery, which consists in the location of the position of a gun by noting the difference of time of arrival of the sound at three known points. A special form of detector permits the use of very small currents; the oscillograph or galvanometer is used in the form where the signals for record, whether event or clock, pass through single threads, the movements of which are projected side by side and photographed on a moving strip. In this way the true times of arrival of the sound of all the guns of a battery, side by side and fired by intention as nearly as possible at the same moment, are sorted out from one another with perfect distinctness.

For most purposes and for continuous work high speed records are too voluminous and too costly. But the method of the oscillograph has been applied regularly at the Royal Observatory, Edinburgh, and incidentally elsewhere, to the study of chronometric problems. No clock, for example, has so far been constructed which will hold the same daily rate without change, even when kept at constant pressure and at constant temperature. Under what circumstances and by what amounts does it change? To answer this question it is essential to dispense with any mechanical relay and have an instrument that can record as small a current and as short an interval of time as we please; further it is essential to analyse the actual signal, make or break, to identify the "chattering" of a contact piece upon its bed and to notice the effects of self-inductance or a by-pass in the circuit. All this the oscillograph can readily do. The loop form of detector, with a mirror spanning the loop, a slit for illumination and a cinema camera armed with a cylindrical lens to concentrate the light, serves very well. It only remains to meet the inevitable variation of the movement of the film between two signals from the clocks. This can be done by interrupting the light from the slit by means of a tongue, vibrating, say, in tenths of a second and thus impressing on the film fiducial marks for measurement, which are close enough together to permit the motion to be treated as uniform from one to the next. For experiments lasting a minute or less such a tongue should be left completely free without maintenance of any sort. By means of this appliance the clock time of the occurrence of any event may be recorded to one-thousandth of a second, or more precisely if desired. This is a very different problem from measuring a very brief interval without regard to the absolute times when it begins and ends.

These are the standard methods of dealing with the registration of time. A great variety of problems involve one or other of them, and some require very special appliances, but these are special to the problem and not to chronography. First should be mentioned the determination of the velocity of light. Light is propagated at a speed of 186,000 miles (300,000km.) per second, and the speed is measured by the time of passage to and from across a measured base line. The exceedingly short interval of time involved is not recorded but is merely determined in terms of the period of a standardized tuning-fork. (*See* the articles "Velocity of Light" and "Measurement of Time" by A. A. Michelson, in the *Astrophysical Journal* of the University of Chicago, Vol. 65 [1927] p. 1.) Problems of the flight of projectiles resolve themselves into the question of causing the projectile to make suitable signals at definite points, which is most simply done by making it sever wires conveying electric currents. If the question is merely to ascertain the speed of a small projectile, the chronograph is not involved, as the speed may be ascertained by firing

the projectile into a massive wooden block mounted as a pendulum, and then measuring the momentum conveyed to the block by noting the angle to which it swings. (R. A. S.)

CHRONOLOGY, a time-scale, a system of reckoning time massively. In testimony of the social memory and of the classification and exploitation of social experiences embedded therein mankind has learnt to recognize the orderly recurrence of natural phenomena and to base thereon his calendar (*q.v.*).

Astronomy.—Every science has now its chronology. The astronomer reminds us that "looked at in the astronomical time-scale, humanity is at the very beginning of its existence—a new born babe, with all the unexplored potentialities of babyhood" (J. H. Jeans in *Nature,* Supplement, March 1928); so that the chronology of the astronomer "uses a clock which does not tick seconds but years: its minutes are the lives of men." It tells us "that light travelling 186,000 m. a second, takes about 140 million years to come to us from the most remote objects visible in the biggest telescope on earth" (*ibid.*).

Geology.—We turn now from chronology of this vastness—to the chronology of this habitable globe, to the time scale of geology (*q.v.*) which is based for its larger divisions on the record of physical events, displaying ice-ages, periods of mountain building, of tectonic activity. By the aid of palaeontology, smaller divisions are established: yet here again we deal with vast figures.

Anthropology.—The earth (*q.v.*) must be 2,000 million years old and man from the best evidence now available, has existed thereon for something like 300,000 years.* Where then—with a 12 in. measure as our scale—shall we place the beginnings of our race? Each division of an inch stands for 160,000,000 years, so we divide the last of our inches of our scale by 50 and there place the first appearance of man. Where shall we place the Piltdown man (*see* MAN, EVOLUTION OF), or Heidelberg man? Divide one fiftieth of an inch into tenths and mark the fifth of these divisions as the age of Piltdown man.

Archaeology.—Where shall we put the beginnings of the Neolithic age, when agriculture, domestication, settled life, metallurgy all have their beginning? It is so near us that we cannot mark it successfully. We can no longer use our big scale. We must change our scale and take a scale of 12 in. to represent the 300,000 years of man's existence. Each inch stands for 25,000 years and we must place the dawn of what is essential to modern life about halfway in the last or 12th of our inches. Ur and its treasures go to 3500 B.C. or 5,000 years ago and are one-fifth of an inch from to-day. Egypt is but a century or two later. The Indus civilization comes next and then that of China. The archaic culture of Central America is 3,000 years old, but by then great empires in the East had waxed and waned and disappeared. Egypt was then old Egypt; and the Greeks like Herodotus were as children in cultural growth.

History.—Again we must change our scale. If we take the Neolithic age as 12,000 years ago, as a basal point (ignoring thereby all the Palaeolithic and Eolithic periods), each inch stands for 1,000 years. The discovery of the New World called America comes half way in the last inch upon this scale and there is so much to cram into the last tenth of the last inch that we are almost tempted to augment our scale once more.

Dynastic Reckoning.—When we come to the great civilizations of antiquity in the valleys of the Euphrates, the Tigris and the Nile or in China, we find established the method of chronological computation by reckoning dynasties of rulers. Social continuity finds its expression and its measure in this development of social organization. But dynasties are human, and disappear. Within the framework of historical chronology we may at will establish periods based on the varying phases and variable elements of human culture. The founders of great religions are remembered in the chronologies of their followers. There are great periods in art, in literature, in science, not inaptly recorded and recollected and concentrated by the names of great individuals. It is still true that the world forgets. The record of their existence and often their deeds are being revealed to us by archaeology (*q.v.*) so that we seem to know more of them and their fore-runners than they even knew themselves. Yet in their flourishing days, which by scale of time are so near to us and by scale of culture seem so different, there was behind them a long past, unheeded, ignored, yet potent in their lives as their achievements are still potent in and even essential to our lives. (*See* CALENDAR.)

*Sir A. Keith places the Piltdown skull as of a million years ago.

CHINESE

From the time of the emperor Yao, upwards of 2,000 years B.C., the Chinese had two different years—a civil year, regulated by the moon, and an astronomical year, which was solar. The civil year consisted in general of twelve months or lunations, but occasionally a thirteenth was added to preserve its correspondence with the solar year. Even at that early period the solar or astronomical year consisted of $365\frac{1}{4}$ days, like our Julian year, arranged in the same manner, a day being intercalated every fourth year. The civil day begins at midnight and ends at the midnight following.

Since the accession of the emperors of the Han dynasty, 206 B.C., the civil year of the Chinese has begun with the first day of that moon in the course of which the sun enters into the sign of the zodiac which corresponds with our sign Pisces. From the same period also they have employed, in the adjustment of their solar and lunar years, a period of nineteen years, twelve of which are common, containing twelve lunations each, and the remaining seven intercalary, containing thirteen lunations. It is not, however, precisely known how they distributed their months of thirty and twenty-nine days, or, as they termed them, great and small moons.

The Chinese divide the time of a complete revolution of the sun with regard to the solstitial points into twelve equal portions, each corresponding to thirty days, ten hours, thirty minutes. Each of these periods, which is denominated a *tsieh,* is subdivided into two equal portions called *chung-ki* and *tsie-ki,* the *chung-ki* denoting the first half of the *tsieh,* and the *tsie-ki* the latter half. The *tsieh* are thus strictly portions of solar time, and give their name to the lunar months, each month or lunation having the name of the *chung-ki* or sign at which the sun arrives during that month. As the *tsieh* is longer than a synodic revolution of the moon, the sun cannot arrive twice at a *chung-ki* during the same lunation; and as there are only twelve *tsieh,* the year can contain only twelve months having different names. It must happen sometimes that in the course of a lunation the sun enters into no new sign; in this case the month is intercalary, and is called by the same name as the preceding month, with the addition of the word *jun* (intercalary). (X.)

EGYPTIAN

The chronology of Ancient Egypt has been ascertained by means of the various statements of classical authors, by regnal years and the numerous other indications on the monuments, by the results of close archaeological study, and the ascertaining of certain fixed astronomical data, checked by comparison with the known chronology of the ancient nations which afford synchronisms with events in Egyptian history. The Egyptians never possessed a regular era, as the Assyrians did with their list of *limmu* officials (*see* ASSYRIA). Only once is an era mentioned, in the description of Rameses II., mentioning the 400th year of the Hyksos king (?) Nubti which fell in his reign. We only hear of such and such a regnal year of a king or, in early days, of the years of certain fiscal numberings. Regular regnal annals are very rarely preserved, though we have fragments of them in the Old Kingdom in the *Palermo Stone,* and there is of course the famous *Turin Papyrus of Kings,* which is invaluable even in its mutilated condition. Under the 12th and 22nd Dynasties the custom of the association of fathers and sons on the throne enables us to check the chronology of the overlapping years of those periods (as when the 10th year of one king is stated to be the first of another), and so reconstitute the length of the dynasty with some accuracy. The use of synchronisms with Mesopotamian history is evident when we see that the reign of Rameses II. is contemporary with that (of certain date) of Shalmaneser I. of Assyria (*c.* 1250 B.C.), a datum with which other synchronisms agree. And dates fixed astronomically are of great importance. The Egyptian did not note eclipses

as the Mesopotamian did, so that we have not this evidence. But we have the observations of the heliacal risings of the star Sothis (Sirius), which have supplied us with certain fixed dates which are of great importance, the more so as they agree with the results obtained from synchronisms. The Egyptian calendar was regulated by the observations of the heliacal risings of Sirius, which were supposed to take place on the first day of the first month of the year. But as an additional leap year day was not intercalated every four years in addition to the year of 360–5 "epagomenal" days, the months gradually lost all relation to the seasons, and it was not till 1,460 years after the last accurate coincidence that the heliacal rising of Sirius again took place accurately on the first day of the first month. When it did the event was celebrated as the beginning of a new "Sothic cycle." We know that a new cycle began either in 139 or in 143 A.D. An Alexandrian mathematician calls the initial year of the preceding cycle (1321 or 1317 B.C.) the "epoch of Menophres." The "throne-name" of Rameses I., who began to reign, it is known from the synchronism of Rameses II. with Shalmaneser III., about 1320 B.C., is Menpehtira or more shortly Menpehra' (a form that constantly occurs), which is obviously "Menophres." Now it would appear from contemporary evidence that Sothis rose heliacally on the first day of the month Pharmouthi in the seventh year of Senusret III., of the 12th Dynasty; so that it would seem easy to calculate that the seventh year of that king should be 1876 or 1872 B.C. (although another computer [Nicklin] has arrived at the date 1924 B.C. for the same year), on the assumption that this king reigned during the immediately preceding cycle which began in 2781 or 2778 B.C. Here, since synchronisms fail us, our knowledge of the historical development of Egyptian civilization and art comes to our aid to assure us that this must have been so, in spite of the fact that it is very difficult to square the lengthy list of kings given us by the Egyptians themselves with so short an interval as the two hundred years only which, if this conclusion is right, can have elapsed between the end of the 12th Dynasty and the beginning of the 18th. If it is right, the 12th Dynasty must have ended about 1788 B.C., and we know that the 18th cannot have begun later than 1580, from our full knowledge of the length of the reigns of that dynasty, confirmed by records of certain new-moon festivals at the time, as well as by synchronisms. So short is this period that Prof. Sir Flinders Petrie has preferred the view that Senusret and the 12th Dynasty really belong to the preceding cycle, and so go back to the fourth millennium B.C. This view however goes clearly against our archaeological knowledge. The resemblances between the culture of the early 18th Dynasty and the 12th are enough to forbid us to suppose that 1600 years elapsed between them, an epoch as long as that which separates Augustus from Queen Elizabeth. And our knowledge of the development of Minoan civilization (*see* AEGEAN CIVILIZATION) confirms this prohibition. The 12th Dynasty was contemporary with the Second Middle Minoan period; the early 18th with the First Late Minoan period. No student of Minoan archaeology could admit that these two Cretan epochs were separated by more than two or three centuries; 16 is impossible. Yet the fact remains that only two centuries or at the most three between the 12th and the 18th Dynasties are rather hard to accept. Four would seem more probable; and so it remains a moot question whether or not something has happened, some mistake in the observation of the star, or some unrecorded modification of the calendar, which would invalidate the modern calculation of the distance of time between Senusret and Rameses I. If, however, it is maintained that no such mistake is possible, then we must accept 1788 as the latest date of the end of the 12th Dynasty, 1861 B.C., as the earliest. The length of the dynasty we know from its recorded reigns to have been 212 years, so that it began about 2000 B.C. or about a century earlier, unless we choose to allow a little more time for a possible error, and suppose a date for it of *c.* 2212–2000 B.C. Further back we reach a state of great uncertainty. There are no synchronisms and no Sothic records to help us. The length of time between the beginning of the 12th Dynasty and the end of the 6th is unknown, but it cannot have been longer than two or three centuries. The Turin papyrus comes to our help with the statement that 955 years elapsed between the beginning of the 1st Dynasty and the end of the 8th, a statement that agrees with historical and archaeological probability, and if we reckon the latter at about 2400 B.C. we reach 3350 as that of "Menes," the conflate founder of the kingdom (=the historical kings "Scorpion," Narmerza, and "Ahai") (*see* EGYPT: *History; Art*). But Prof. Meyer now takes *c.* 3200 B.C. as the date of "Menes," assuming, as we have not, that the Sothic date of Senusret III. is incontrovertible. We have assumed 2212 as the beginning of the 12th Dynasty, and 2370 as that of the beginning of the 11th. The 8th may well have been contemporary with the 9th and 10th (Herakleopolites) and have lasted until *c.* 2400. If the "Kahun" date is correct, as Meyer assumes, and the end of the 8th dynasty is brought down to 2300, the Sothic cycle that began in 2781 or 2778 B.C. will then have fallen about the time of the 3rd Dynasty. If 2400 is taken as the date it will have fallen as late as the 5th. In either case, the yet earlier cycle-era in 4241 or 4238 B.C. will belong well before the beginning of the kingdom. And it has been supposed that the calendar must have been invented at that time, because the calendar was known before the 4th Dynasty. But the invention of a calendar presupposes a settled state and civilization, not the undeveloped culture of the predynastic period, though we do not know that there did not exist in Lower Egypt before the unification a political state where culture was sufficiently developed for such an invention to be made, and there have been considered to exist indications of the existence of such a state. Still, eight centuries between the invention and the unification under Menes is a very long time for such a hypothetical civilization to have endured apart from the fact that such an invention as a calendar must have occurred at the end of its development rather than its beginning; and recently a suggestion has been made by Dr. Scharff that revolutionizes our ideas on this point. This is that since the older date is so improbable the invention of the calendar in reality took place in 2781–2778 B.C., and since it was known before the time of the 4th Dynasty, this dynasty must in reality be later than that date, so that this Sothic cycle probably began about the time of the 3rd Dynasty. And it is significant that it is precisely in the time of the 3rd Dynasty, in the reign of king Zoser, that the great development of Egyptian culture took place that is ascribed to the inspiration of that king's minister, Imhotep, who was later deified as the patron of art and learning, including medicine, architecture, astronomy and science generally. It is then surmised that the calendar was invented by Imhotep or in his time, and that therefore the date 2781–2778 falls in the reign of Zoser. Now if this new surmise is correct, the 1st Dynasty will have begun rather later than 3200 B.C., and then the end of the 8th Dynasty will certainly fall about 2300. But in this case we shall have to assume the astronomically calculated "Kahun" date of Senusret III. to be unquestionably correct, as Meyer does, and must accept two centuries only between the 12th Dynasty and the 18th, in spite of the long Turin list of kings of this period, who then must have been mostly very ephemeral rulers. In any case the ancient list-compilers were evidently as much at sea in the two "intermediate" periods (6th–12th and 12th–18th Dynasties), as we are, for they suffered from absence of reliable material just as we do.

In later days, after the time of Rameses II., we have various data to help us. The date of Sheshonk (Shishak), the contemporary of Rehoboam and founder of the 22nd Dynasty, is fixed to *c.* 930 B.C. by Assyrian and biblical evidence, and for the Ethiopian kings, Shabak, Taharka and the rest, we have the fixed synchronisms with Assyrian kings whose dates are fixed by the *limmu*-lists. From the time of Psammetichus I., the founder of the 26th Dynasty, Babylonian and Greek authorities assist us, and his date is definitely known to be 663 (651 independent of Assyria)–609 B.C. After him we are dealing with the known facts of general ancient history as reported by the classical historians.

BIBLIOGRAPHY.—E. Meyer, *Die ältere Chronologie Babyloniens, Assyriens u. Aegyptens* (1925), *Aegyptische Chronologie, Bbh. Berlin Acad.* (1904), *Nachfrage zur äg. Chr., do.* (1907); T. Nicklin, "The Origin of the Egyptian Year," *Class. Rev.* 1900, pp. 146–148; H. R. Hall, *Anc. Hist. Near East* (1924), p. 15 ff. Cambr. Anc. Hist. i. p. 166 ff; Scharff, *Grundzüge d. Aegyptische Vorgeschichte* (1927), p. 46 ff; "Beitrag zur Chronologie der 4ten Aegyptischen Dynastie," *Orientalische Litterarische Zeitung* (1928) p. 73 ff. (H. R. H.)

BABYLONIAN AND ASSYRIAN

Evidence of Babylonian documents, from 330 B.C. onwards, dated by kings' regnal years has settled many points in relation to the chronology of late as well as of early periods, though this evidence has been much discussed and often wrongly represented. It is now fairly clear that the era of the Arsacid dynasty was reckoned from 1st Nisan, 246, and that apparent divergences from this reckoning depend on ancient scribal errors or modern errors of interpretation. The Seleucid era was reckoned from 1st Nisan 311. There was no difference between "civil" and "religious" reckoning, as has sometimes been maintained. The reckoning of the Seleucid era from 311 B.C. must have been introduced in or before 305 B.C.; the years before that were actually spent by the Babylonians in a state of confusion as to dating which was introduced with the advent of Alexander the Great. The confusion was due in part to the use of two systems; in one reckoning, the year-dates according to the Macedonians was used, in another a dating strictly true of Babylon only, but this will not explain every case. The effect of this may be seen from the following list:—

Year.	King.	Numbering.	
		(*a*)	(*b*)
330–329	Alexander the Great	7th	1st
323–322	Philip Arrhidaeus	2nd	1st
317–316	Alexander IV.	..	1st
316–315	Antigonus	1st	2nd

The exact method of dating between 311 and 305 is not certain; a broken document renders it possible that 311 was called "the seventh year of Alexander and Seleucus," *i.e.*, that Seleucus associated his name with the king's for the first time, and that would account for the Babylonian reckoning of the Seleucid era. It should be noted that from the advent of Alexander the year reckoning commenced immediately from the accession of the king.

From 626 B.C.–331 B.C.—The ordinary Babylonian reckoning of regnal years, always observed before the Macedonian invasion, was from the 1st Nisan after a king's accession; months or days prior to Nisan were reckoned "beginning of kingship." There are two sources for the chronology of the New Babylonian and Persian empires, the canon of the Greek historian Ptolemy, and the reckoning which can be traced almost month by month and day by day; the tablets give names of rebels against the Persian kings otherwise unknown, and allow of more accuracy in dating, *e.g.*, the coregency of Cambyses to the first year only of his father's reign.

New Babylonian Empire.	Accession.	First full year.
Nabopolassar	626	625
Nebuchadrezzar II.	605	604
Evil-Merodach	562	561
Neriglissar	560	559
Labashi-Marduk	556	..
Nabu-na'id	..	555
Persian Empire.		
Cyrus	539	538
Cambyses	..	529
"Smerdis," Nebuchadrezzar III.	..	522
Darius I.	522	521
Xerxes I.	486	485
Artaxerxes I.	465	464
Darius II.	..	423
Artaxerxes II.	..	404
Artaxerxes III. (Ochus)	..	358
Arses	..	337
Darius III.	..	335

Between 648 and 626 B.C.—The dating of the New Babylonian empire secures the long uncertain dating of the fall of Nineveh; a chronicle, dating by the regnal years of Nabopolassar, places that event in 612 B.C. The period from 648 to 626, the accession year of Nabopolassar, is still very obscure; the statements of Ptolemy's canon cannot exactly accord with the facts. Dating by Sin-sharishkun, the last king of Assyria up to the 7th year has been found at Sippar; since this year must at latest be 616, his first full year must at latest be 622. A certain Sin-shumlishir, intervened between Assur-etil-ilani, who reigned at least four years, and Sin-sharishkun, so that reckoning by Ashur-etil-ilani commenced in 627 at latest. Between 648 and 626 documents were dated by Kandalanu, the Kineladan of Ptolemy's canon; that this was a name assumed by Assur-bani-pal as king of Babylon is doubtful, as there are good grounds for assuming that cuneiform scribes distinguished between the two. But since a building inscription dating from Assur-bani-pal's 30th year has been found in Babylon, *i.e.*, 639 B.C., the Assyrian must have claimed the kingship also.

From 911–648 B.C.—Assyrian chronology depends on lists of eponymous officials called *limmu*, by whom years were dated. These lists were drawn up in two ways; the first class consists of simple lists of names, the second gives in a column opposite the name an entry concerning the events of the year. An entry opposite the name Pur-Sagale reads, "Governor of Gozan. Revolt in the city of Ashur. In Siwan there was an eclipse of the sun," and this eclipse has been astronomically fixed as having taken place on June 15, 763 B.C. This fixes the years of all *limmus* in the continuous list which reaches from 890–648. There are discrepant versions of these *limmu* lists which affect the reigns of Adad-nirari III. and Shalmaneser III.; these kings are allowed 29 or 28 and 35 or 34 eponyms to their reign. The weight of authority seems to lie with the lower numbers, but the question is not definitely settled; otherwise the Assyrian chronology of the period is fixed.

The Babylonian chronology of the time is less certain. Ptolemy's canon and cuneiform documents give the regnal years from Nabonassar's first year, 747 B.C. The belief that some kind of era commenced then is baseless; it was chosen by Ptolemy for some accidental reason, perhaps because that was the first fixed point that was known to him, but not for any scientific reason. Before Nabonassar, the continuous king-list is now known to have included between Shamash-mudammiq, who was reigning about 910 B.C., and Nabonassar 16 names, an average of about 10 years apiece, but the exact lengths of reigns cannot yet be ascertained.

Babylonia		*Assyria*	
Shamash-mudammiq, abt.	910	Adad-nirari II.	911–889
Nabu-shum-ukin		Tukulti-Enurta II.	889–884
Nabu-apal-iddin	?–851	Assur-nasir-pal II.	884–859
Marduk-bel-usate	851–850	Shalmaneser III.	859–824
Marduk-zakir-shum	850–839		
Marduk-balatsu-iqbi	?–811		
Bau-akh-iddin	810	Shamshi-Adad V.	824–812
(Five names missing including Adad-shum-ibni)		Adad-nirari III.	811–782
Marduk-bel-zeri			
Marduk-apal-usur		Shalmaneser IV.	782–772
Eriba-Marduk		Assur-dan III.	772–754
Nabu-shum-ukin		Ashur-nirari V.	754–745
Nabonassar	747–732	Tiglathpileser III.	745–727
Nabu-nadin-zer	733–732		
Nabu-shum-ukin	732		
Ukin-zer	731		
Pulu (-T.-P.III.)	731–727	Shalmaneser V.	726–722
Ululai	726–722	Sargon II.	722–705
Merodachbaladan II.	721–710		
Sargon	709–705	Sennacherib	705–681
Sennacherib	705–703		
Merodachbaladan III.	703–702		
Bel-ibni	702–700		
Assur-nadin-sum	699–694		
Nergal-ushezib	693–692		
Mushezib-Marduk	692–689		
Sennacherib	688–681		
Esar-haddon	680–669	Esar-haddon	680–669
Shamash-shum-ukin	668–648		
Kandalanu	647–626	Assur-bani-pal	668–638 (?)

From About 1380–911 B.C.—There are broken *limmu* lists which once gave the eponymous officials from about 1200 B.C.; in their present state they give a framework for the Assyrian kings

from about 1068–911, the margin of error within which is not more than ten years. Complete king-lists for Assyria being now obtained from broken documents, approximate dates for the kings of the 13th century can be based on intervals sometimes mentioned between them and later kings. The approximate date of Ashur-uballit can be determined from his correspondence with Akhnaton, the Pharaoh of Egypt, with a marginal error of ten years, as about 1380.

Babylonian chronology depends upon the cases where the number of years are known, and on synchronisms with the Assyrian kings. The result can only be an approximation with a margin of error perhaps exceeding a decade. The arrangement is then roughly:—

Babylonia	*Assyria*	
Burnaburiash	Ashur-uballit . .	1380–1335
Karaindash		
Kadashman-kharbe		
Shuzigash		
Kurigalzu III. (23 years)	Enlil-nirari . . .	1335–
	Arik-den-ili . . .	–1311
Nazimaruttash (26 years)	Adad-nirari I. . .	1310–1280
Kadashman-turgu (17 years)	Shalmaneser I. . .	1280–1250
Kadashman-Enlil (6 years)		
Kudur-Enlil (9 years)		
Shagarakti-shuriash (13 years)	Tukulti-Enurta I. .	1250–1216
Kashtiliash (8 years)		
Enlil-nadin-shum (1½ years)		
Kadashman-Kharbe (1½ years)		
Adad-shum-iddin (6 years)		
Adad-shum-nasir (30 years)	Ashur-nadin-apal .	1215–1212
	Ashur-nirari III. .	1211–1206
	Enlil-kudur-usur .	1205–1201
Meli-shipak (15 years)	Enurta-apal-ekur .	1200–1188
Merodachbaladan I. (13 years)	Ashur-dan I. . .	1187–1150
Ilbaba-shum-iddin (6 years)		
Enlil-nadin-akhkhe (3 years)		
Marduk-shapik-zeri (17 years)		
Enurta-nadin-shum (6 years)		
Nebuchadrezzar I.	Enurta-tukulti-Ashur	
	Mutakkil-Nusku	
Enlil-nadin-apal	Ashur-resh-ishi I. .	?–1099
Marduk-nadin-akhkhe	Tiglathpileser I. . .	1098–1068
Itti-Marduk-balatu	Enurta-apal-ekur II .	1067–
Marduk-shapik-zer-mati	Ashur-bel-kala	
Adad-apal-iddin (22 years)	Eriba-Adad II.	
	Shamshi-Adad IV. .	–1048
Marduk-akhkhe-eriba (1½ years)	Ashurnasirpal I. . .	1047–1027
Marduk-zer (12 years)	Shalmaneser II. . .	1026–1015
Nabu-shum-libur (8 years)	Ashur-nirari V. . .	1014–1009
Simmash-Shipak (18 years)	Ashur-rabi II. . .	1008–?
Ea-mukin-zer (5 months)		
Kashshu-nadin-akhkhe (3 years)		
Eulmash-shakin-shum (17 years)		
Enurta-kudur-usur (3 years)		
Shiriqtum-Shuqamuna (3 mos.)		
Marbiti-apal-usur (6 years)		
Nabu-mukin-apal (36 years)	Ashur-resh-ishi II. . .	?–964
Enurta-kudur-usur	Tiglathpileser II. . .	963–933
Marbiti-akh-iddin	Ashur-dan II. . . .	932–912

Before 1380 B.C.—All earlier chronology must be subject to considerable margin of error. It depends on (1) Babylonian king-lists which give the number of regnal years; in many instances, where these figures can be checked by other sources, they are proved unreliable; (2) statements of Assyrian kings about their predecessors; the figures given are sometimes round numbers, and are never absolutely reliable; (3) dead reckoning on the basis of generations, coupled with the use of the rare synchronisms known between the two countries.

The Babylonian king-list allows 36 kings, and 576 years 9 months for the period during which the country was ruled by Kassite kings. Enlil-nadin-akhkhe, the last of the dynasty, succeeded to the throne in the time of Ashur-dan I., roughly about 1170, within a decade, and ruled three years: this would place Gandash, the first king, about 1743–42, but an increased margin of error must be allowed owing to the inaccuracy of the list. The 13th Kassite king, Ulam-Buriash, may have ruled about 1530–20; he occupied the Sea-land, the marshes at the head of the Persian gulf, when the last independent king of the Sea-land fled to Elam. This Sea-land dynasty numbered, according to variant accounts, 11 or 12 kings, who ruled for the long period of 368 years, which would place Iluma-ilum, the first king, about 1900 B.C., if the last king fled just before 1530. But Iluma-ilum can be proved by various documents to be a contemporary of Samsu-iluna and Abi-eshu', kings of the 1st dynasty of Babylon. Iluma-ilum is said to have reigned 60 years, and Samsu-iluna and Abi-eshu' reigned respectively 38 and 28; it is not probable that Samsu-iluna began to reign before Iluma-ilum, and if he be assigned a date about 1900–1863, the end of the 1st dynasty is brought to about 1746, almost immediately before the accession of the first Kassite king. This cross-reckoning is satisfactory in itself and supported by the Assyrian king-list. There were 42 kings between Ilushuma, an early governor of Ashur, and Ashur-uballit, about 1380. According to kings' statements Ilushuma lived about 2000 B.C., and this accords roughly with other statements about his son. It is certain from an entry in a chronicle that Ilushuma carried out some military enterprise in Babylonia in the time of Sumu-abu, the first king of the 1st dynasty. If the 1st dynasty ended about 1746–45, the first king dated about 2045–44 to 2032–31. This would accord with the Assyrian statements.

Some modern authorities hold that a fixed dating, not based on the king-lists, can be secured from tablets dealing with observations of Venus. From an entry for the sixth year of Ammizaduga they calculate certain astronomical possibilities, and check the date obtained—one out of four or five possible—by calculations as to the probable period of the date-harvest. Arguing on these lines they hold the sixth year of Ammizaduga to be 1916–15, which would place the commencement of the 1st dynasty in 2170, its close in 1871; another, arguing on the same lines, would date these events 2049–1750. The former, if correct, will necessitate the abandonment of a great deal of Babylonian historical writing as worthless; the question is at present open, and scholars differ by some 120 to 130 years for this period.

Accepting the dating 2045–1745, admittedly open to a margin of error, for the 1st dynasty as fairly accurate, the date lists for the kings' reigns provide an accurate scheme which correct the king-lists in many places. These date-lists arose from the custom of naming a year by some event; in some cases the event was one of religious importance, and may actually have taken place in the year so named, but where military campaigns are mentioned the event probably belongs to the previous year. These date lists establish a synchronism between Hammurabi and Rim-Sin which leads to a date about 2175 for the commencement of the rival dynasties of Isin and Larsa, subject to an error not greater than the date given for the 1st dynasty. Similarly, the 3rd dynasty of Ur of which date-lists are extant may be dated 2282-2175 with the same error. Probably less than seven years actually passed between the accession of Utu-khegal, who ended the oppression by the foreign dynasty of Gutium, and Ur-Nammu's assumption of sovereignty in 2282; this places the Gutium dynasty about 2375–2287, with an increased margin of error. Dating earlier than this is a matter of speculation, for the king-lists, which are complete, give figures that cannot be checked, and for earlier dynasties quite impossible reigns are assigned. There is a general probability that Sargon of Agade commenced his reign between 2550 and 2525, and that the 4th dynasty of Kish began to rule not earlier than 2580. An estimate for the 1st dynasty of Ur, the third after the Flood, based upon comparison with objects from Lagash and the generations, would assign a date between 3000 and 2900 for the commencement of that dynasty, the earliest historical kings known belonging to it. (S. Sm.)

Bibliography.—F. X. Kugler, *Sternkunde und Sterndienst in Babel* (1914–24); *Cambridge Ancient History*, vols. i. and ii. (1923–24; bibl.); Sidney Smith, *Early History of Assyria* (1928; bibl.).

HINDU

The early Hindu astronomers selected a period in the course of which a given order of things is completed by the sun, moon and planets returning to the state of conjunction from which they started. This is known as the Great age of 4,320,000 sidereal solar years, the aggregate of the *Krita* or Golden age, the *Trēta* or Silver age, the *Dvāpara* or Brazen age, and the *Kali* or Iron age (in which we now are). There is, however, the system of the *Kalpa* or aeon, consisting of 1,000 (or 1,008) Great ages.

The Hindus now recognize three standard sidereal solar years determined in that manner. (1) A year of 365 days 6 hours 12 min. 30 sec. according to the *Āryabhaṭīya,* otherwise called the *First Ārya-Siddhānta,* which was written by the astronomer Āryabhaṭa (b. A.D. 476); this year is used in the Tamil and Malayālam districts, and in Ceylon. (2) A year of 365 days 6 hours 12 min. 30·915 sec. according to the *Rājamṛigā ka,* a treatise based on the *Brāhma-Siddhānta* of Brahmagupta (b. A.D. 598) and attributed to king Bhōja, of which the epoch, the point of time used in it for calculations, falls in A.D. 1042: this year is used in parts of Gujarāt (Bombay) and in Rājputānā and other western parts of Northern India. (3) A year of 365 days 6 hours 12 min. 36·56 sec. according to the present *Sūrya-Siddhānta,* a work of unknown authorship which dates from probably about A.D. 1000: this year is used in almost all the other parts of India. According to modern science, the true mean sidereal solar year measures 365 days 6 hours 9 min. 9·6 sec., and the mean tropical year measures 365 days 5 hours 48 min. 46·054440 seconds.

The result of the use of this sidereal solar year is that the beginning of the Hindu astronomical solar year, and with it the civil solar year and the lunar year and the nominal incidence of the seasons, has always been, and still is, travelling slowly forward in our calendar year by an amount which varies according to the particular authority. For instance, Āryabhaṭa's year exceeds the Julian year by 12 min. 30 seconds. This amounts to exactly one day in 115$\frac{1}{5}$ years, and five days in 576 years. Thus, if we take the longer period and confine ourselves to a time when the Julian calendar (old style) was in use, according to Āryabhaṭa the Mēsha-saṁkrānti began to occur in A.D. 603 on March 20 and in A.D. 1179 on March 25. The intermediate advances arrange themselves into four steps of one day each in 116 years, followed by one step of one day in 112 years: thus, the Mēsha-saṁkrānti began to occur on March 21 in A.D. 719, on March 22 in A.D. 835, on March 23 in A.D. 951, and on March 24 in A.D. 1067 (whence 112 years take us to March 25 in A.D. 1179). It is now occurring sometimes on April 11, sometimes on the 12th; having first come to the 12th in A.D. 1871. (*See* CALENDAR: *Hindu.*)

Eras.—The Kalachuri or Chēdi era, commencing in A.D. 248 or 249, is known best from inscriptional records, which range from the 10th to the 13th century A.D., of the Kalachuri kings of the Chēdi country in Central India; and from them it derived its name. In earlier times, this era was well established, without any appellation, in Western India, in Gujarāt and the Ṭhāṇa district of Bombay, where it was used by kings and princes of the Chalukya, Gurjara, Sēndraka, Kaṭachchuri and Traikūṭaka families. It is traced back there to A.D. 457, to the reign of a Traikūṭaka king named Dahrasēna. Beyond that point, we have at present no certain knowledge about it. But it seems probable that its founder was an Ābhīra king Īśvarasēna, or his father Śivadatta, who was reigning at Nāsik about A.D. 248–249.

The Gupta era, commencing in A.D. 320, was founded by Chandragupta I., the first paramount king in the great Gupta dynasty of Northern India. When the Guptas passed away, their reckoning was taken over by the Maitraka kings of Valabhī, who succeeded them in Kāṭhiāwār and some of the neighbouring territories; and so it became also known as the Valabhī era.

From Halsī in the Belgaum district, Bombay, we have a record of the Kadamba king Kākusthavarman, which was framed during the time when he was the Yuvarāja or anointed successor to the sovereignty, and may be referred to about A.D. 500. It is dated in "the eightieth victorious year," and thus indicates the preservation of a reckoning running from the foundation of the Kadamba dynasty by Mayūravarman, the great-grandfather of Kākusthavarman. But no other evidence of the existence of this era has been obtained.

The records of the Gāṅga kings of Kaliṅganagara, which is the modern Mukhaliṅgam-Nagarikaṭakam in the Gañjām district, Madras, show the existence of a Gāṅga era, which ran for at any rate 254 years. And various details in the inscriptions enable us to trace the origin of the Gāṅga kings to Western India, and to place the initial point of their reckoning in A.D. 590, when a certain Satyāśraya-Dhruvarāja-Indravarman, an ancestor and probably the grandfather of the first Gāṅga king Rājasiṁha-Indravarman I., commenced to govern a large province in the Koṅkaṇ under the Chalukya king Kīrtivarman I.

An era beginning in A.D. 605 or 606 was founded in Northern India by the great king Harshavardhana, who reigned first at Ṭhāṇēsar and then at Kanauj, and who was the third sovereign in a dynasty which traced its origin to a prince named Naravardhana. This era continued in use for apparently four centuries after Harshavardhana, though his line ended with him.

The inscriptions assert that the Western Chālukya king Vikrama or Vikramāditya VI. of Kalyāṇi in the Nizam's dominions, who reigned from A.D. 1076 to 1126, abolished the use of the Śaka era in his dominions in favour of an era named after himself. He or his ministers adopted, for the first time in that dynasty, the system of regnal years, according to which, while the Śaka era also remained in use, most of the records of his time are dated, not in that era, but in the year so-and-so of the Chālukya-Vikrama-kāla or Chālukya-Vikrama-varsha, "the time or years of the Chālukya Vikrama." There is some evidence that this reckoning survived Vikramāditya VI. for a short time. But his successors introduced their own regnal reckonings; and that prevented it from acquiring permanence.

In Tirhut, there is still used a reckoning which is known as the Lakshmaṇasēna era from the name of the king of Bengal by whom it was founded. The exact initial point of this reckoning appears to be in A.D. 1119. This era prevailed at one time throughout Bengal, from a passage in the *Akbarnāma,* written in A.D. 1584, which specifies the Śaka era as the reckoning of Gujarāt and the Dekkan, the Vikrama era as the reckoning of Mālwā, Delhi and those parts, and the Lakshmaṇasēna era as the reckoning of Bengal.

The Rājyābhishēka-Śaka, "the era of the anointment to the sovereignty," was in use for a time in Western India. It dated from the day Jyaishṭha śukla 13 of the Śaka year of 1597 current, =June 6, A.D. 1674, when Śivajī, the founder of the Marāṭhā kingdom, had himself enthroned.

There are four reckonings which it is difficult at present to class exactly. Two inscriptions of the 15th and 17th centuries, recently brought to notice from Jēsalmēr in Rājputānā, present a reckoning which postulates an initial point in A.D. 624 or in the preceding or the following year, and bears an appellation, Bhāṭika, which seems to be based on the name of the Bhaṭṭi tribe, to which the rulers of Jēsalmēr belong. No historical event is known, referable to that time, which can have given rise to an era. It is possible that the apparent initial date represents an epoch, at the end of the Śaka year 546 or thereabouts, laid down in some astronomical work composed then or soon afterwards and used in the Jēsalmēr territory. But it seems more probable that it is a purely fictitious date, set up by an attempt to evolve an early history of the ruling family.

In the Tinnevelly district of Madras, and in the territories of the same presidency in which the Malayāḷam language prevails, namely, South Kanara below Mangalore, the Malabar district, and the Cochin and Travancore States, there is used a reckoning which is known sometimes as the Kollam or Kōlamba reckoning, sometimes as the era of Paraśurāma. The years of it are solar: in the southern parts of the territory in which it is current, they begin with the month Siṁha; in the northern parts, they begin with the next month, Kanyā. The initial point of the reckoning is in A.D. 825; and the year 1076 commenced in A.D. 1900. The popular view about this reckoning is that it consists of cycles of 1,000 years; that we are now in the fourth cycle; and that the reckoning originated in 1176 B.C. with the mythical Paraśurāma, who exterminated the Kshatriya or warrior caste, and reclaimed the Koṅkaṇ countries, Western India below the Ghauts, from the ocean. But the earliest known date in it, of the year 149, falls in A.D. 973; and the reckoning has run on in continuation of the thousand, instead of beginning afresh in A.D. 1825. It seems probable, therefore, that the reckoning had no existence before A.D. 825. The years are cited sometimes as "the Kollam year (of such-and-such a number)," sometimes as "the year (so-and-

so) after Kollam appeared"; and this suggests that the reckoning may possibly owe its origin to some event occurring in A.D. 825, connected with one or other of the towns and ports named Kollam, on the Malabar coast; perhaps Northern Kollam in the Malabar district, perhaps Southern Kollam, better known as Quilon, in Travancore. But the introduction of Paraśurāma into the matter, which would carry back (let us say) the foundation of Kollam to legendary times, may indicate, rather, a purely imaginative origin. Or, again, since each century of the Kollam reckoning begins in the same year A.D. with a century of the Saptarshi reckoning, this reckoning may be a southern offshoot of the Saptarshi reckoning, or at least may have had the same astrological origin.

In Nēpāl there is a reckoning, known as the Nēwār era and commencing in A.D. 879, which superseded the Gupta and Harsha eras there. One tradition attributes the foundation of it to a king Rāghavadēva; another says that, in the time and with the permission of a king Jayadēvamalla, a merchant named Sākhwāl paid off, by means of wealth acquired from sand which turned into gold, all the debts then existing in the country, and introduced the new era in commemoration of the occurrence. The era may have been founded by some ruler of Nēpāl: but nothing authentic is known about the particular names mentioned in connection with it. This era appears to have been discarded for State and official purposes, in favour of the Śaka era, in A.D. 1768, when the Gūrkhas became masters of Nēpāl; but manuscripts show that in literary circles it has remained in use up to at any rate A.D. 1875.

Inscriptions disclose the use in Kāṭhiāwār and Gujarāt, in the 12th and 13th centuries, of a reckoning, commencing in A.D. 1114, which is known as the *Siṁha-saṁvat*. No historical occurrence is known, on which it can have been based, and the origin of it is obscure.

The eras mentioned above have for the most part served their purposes and died out. But there are three great reckonings, dating from a very respectable antiquity, which have held their own and survived to the present day. These are the Kaliyuga, Vikrama and Śaka eras. The Kaliyuga era is the principal astronomical reckoning of the Hindus. It is frequently, if not generally, shown in the almanacs: but it is not now in practical use for civil purposes; and in previous times we have instances of its use in inscriptions from Southern India, one of A.D. 634, one of A.D. 770, three of the 10th century, and then, from the 12th century onwards, but more particularly from the 14th, a certain number of instances extremely small in comparison with the use of the Vikrama and Śaka eras and other reckonings: from Northern India the earliest known instance is A.D. 1169 or 1170, and the later ones number only four. Its years are by nature sidereal solar years, commencing with the Mēsha-saṁkrānti, the entrance of the sun into the Hindu constellation and sign Mēsha, *i.e.*, Aries (for this and other technical details, *see* above, under the Calendar); but they were probably cited as lunar years in the inscriptional records which present the reckoning; and the almanacs appear to treat them either as Mēshādi civil solar years with solar months, or as Chaitrādi lunar years with lunar months *amānta* (ending with the new-moon) or *pūrṇimānta* (ending with the full-moon) as the case may be, according to the locality. Its initial point lay in 3102 B.C.; and the year 5002 began in A.D. 1900.

The Vikrama Era, the earliest of all the Hindu eras, is the dominant era and the great historical reckoning of Northern India—that territory on the north of the rivers Narbadā and Mahānadī to which part of the country its use has always been practically confined. Like, indeed, the Kaliyuga and Śaka eras, it is freely cited in almanacs in any part of India; and it is sometimes used in the south by immigrants from the north: but it is, by nature, so essentially foreign to the south that the earliest known inscriptional instance of the use of it in Southern India only dates from A.D. 1218, and the very few later instances, prior to the 15th century A.D., come, along with that of A.D. 1218, from the close neighbourhood of the dividing-line between the north and the south. The Vikrama era has never been used for astronomical purposes. Its years are lunar, with lunar months, though sometimes regarded as solar, with solar months, when cited in almanacs of Southern India which present the solar calendar. Originally they were Kārttikādi, with *pūrṇimānta* months (ending with the full-moon). They now exist in the following three varieties: in Kāṭhiāwār and Gujarāt, they are chiefly Kārttikādi, with *amānta* months (ending with the new-moon); and they are shown in this form in almanacs for the other parts of the Bombay Presidency: but there is also found in Kāṭhiāwār and that neighbourhood an Āshāḍhādi variety, commencing with *Āshāḍha śukla* 1, similarly with *amānta* months; in the rest of Northern India, they are Chaitrādi, with *pūrṇimānta* months. The era has its initial point in 58 B.C., and its first civil day, *Kārttika śukla 1,* is Sept. 19, in that year if we determine it with reference to the Hindu Tulā-saṁkrānti, or October 18, if we determine it with reference to the tropical equinox. The years of the three varieties, Chaitrādi, Āshāḍhādi and Kārttikādi, all commence in the same year A.D.; and the year 1958 began in A.D. 1900.

The Śaka Era, which had its origin in the south-west corner of Northern India, is the dominant era and the great historical reckoning of Southern India. It is also the subsidiary astronomical reckoning, largely used, from the 6th century A.D. onwards, in the *Karaṇas,* the works dealing with practical details of the calendar, for laying down epochs or points of time furnishing convenient bases for computation. As a result of that, it came to be used in past times for general purposes also, to a limited extent, in parts of Northern India. And it is now used more or less freely, and is cited in almanacs everywhere. Its years are usually lunar, Chaitrādi, and its months are *pūrṇimānta* (ending with the full-moon) in Northern India, and *amānta* (ending with the new-moon) in Southern India; but in times gone by it was sometimes treated for purposes of calculation as having astronomical solar years, and it is now treated as having Mēshādi civil solar years and solar months in those parts of India where that form of the solar calendar prevails. It has its initial point in A.D. 78; and its first civil day, *Chaitra śukla* 1, is March 3 in that year, as determined with reference either to the Hindu *Masanikrānti* or to the entrance of the sun into the tropical Pisces. The year 1823 began in A.D. 1900. (X.)

GREEK

The difficulty besetting Greek chronology, for ancient and modern investigators alike, is the absence, for the earlier periods especially, of a universally understood era, corresponding to our reckoning, B.C. or A.D., or the Muslim, dating from the Hejira. Generally speaking, each state had its own fashion of dating, the usual method of specifying time being to name the annual magistrate who was then in office, as "in the archonship of Apsephion," or a king, priest etc., as "in the reign of King Agis," "in the third year of such a one's tenure of office as priestess of Hera at Argos." This had the grave disadvantage that unless a list of the functionaries in question was available, the date was unintelligible. Hence the best-known of them, the Athenian archons, were most commonly referred to, and often several parallel dates were given, as "when Chrysis had been priestess at Argos for 47 years, Aenesuis being then ephor at Sparta, Pythodorus having yet four months left of his archonship at Athens" (Thucydides, ii.,2,1; = April, 431 B.C.).

Dating by Olympiads.—Gradually, however, the system of dating by Olympiads came into use; this was much more convenient, for the successive celebrations of the festival at Olympia were numbered, not merely named, and the date of the first was conventionally fixed at 776 B.C. of our reckoning. This is due largely to the Alexandrian chronologists, Eratosthenes and the rest, who also drew up the received list of Olympiads. There remained, however, a further difficulty, viz., that various Greek civic years started at different times (*see* CALENDAR: *Greek*); hence there was often used a conventional Olympiad, beginning at the Attic new year, the summer solstice.

The diligence of the Alexandrians resulted in a fairly satisfactory chronology being drawn up for the fully historical periods,

i.e., back to about 600 B.C.; from about 500 onwards the number of dates which are seriously doubtful, where the ancient evidence survives, is comparatively small, although minor divergencies are common. But for earlier times, and especially before the beginning of the series of Olympiads (itself not very dependable until Olymp. 50), even the ancient investigators had but few documents to go upon, and were obliged to trust largely to genealogies. By comparing these, they made out a pre-historic and proto-historic chronology, arrived at by allowing three generations to a century. Supposing the genealogies to be authentic and complete, this was a tolerably accurate method; but, although they contained a large element of real tradition, we know enough of them to be sure that they were often interpolated, telescoped by the omission of obscure persons, and otherwise corrupted; so that the earlier dates, such as that of the fall of Troy, must be taken as being, at best, very rough approximations.

The ancient chronologists are represented, for us, by a few historians, such as Diodorus of Sicily, who adopt the annalistic method, and by the Christian chronologists, such as Eusebius and his Latin translator and continuator, S. Jerome, also by later writers, such as Iulius Africanus and Georgius Syncellus. The desire of apologists to prove the Biblical revelation earlier than any other led to the prominence of this branch of learning among them, and to the creation of a new, Hebraizing chronology, made by combining the existing systems with data from the Old Testament. Although uncritical and biased, these writers are of immense value to modern historians of antiquity.

Contribution of Archaeology.—Further help is given by the results of modern archaeology. By careful and minute study of the details of artistic technique, the stratification of material remains of all sorts, the styles of pottery, coins, and other common objects, and comparison with the comparatively few pieces which are in some way dated (*e.g.*, by bearing the name of an owner or dedicator whose epoch is accurately known) it is possible, not only to determine often within a few years and not infrequently with much greater exactness the date of objects found, but also by working backwards to come to reasonable conclusions as to the epoch of many events long previous to documentary history, whereof only vague accounts, largely mythological, had come down to us. Thus, the stratification of the seven cities at Hissarlik, the ancient Troy, has given us a relative chronology, or order of events, for the history of that place; while careful comparison of the finds there with those from Cretan and Mycenaean sites, and of these again with certain Egyptian and other documents which can be at least approximately dated, is gradually enabling us to fix, at any rate within a century or so, the absolute date of Agamemnon's expedition. But at present such dates must be largely provisional, and subject to revision, sometimes of a sweeping kind, in the light of further discoveries. For instance, there are differences of some four centuries in the dating of the Dorian invasion, and even doubts as to its historicity.

It is usual, in giving an ancient date, to extend the Julian period backwards and speak, for instance, of March 2, 290 B.C., meaning the day which would have been so styled if the Greeks of that time had had our calendar and could have foreseen when our era would begin. As these imaginary Julian years frequently cut across the real Greek ones, it is best, when the year only is given, to use a double date and say, for instance, 501/500 B.C.

In dealing with events in late Greek history (Roman and Byzantine epochs) we frequently find non-Greek systems used, such as the Julian calendar. For these, *see* under *Roman Chronology*.

The most important ancient works are cited in the text. For modern authorities, *see* CALENDAR: *Greek;* GREECE: *History; Ancient to 146* B.C.: *General.* Of modern writers, Clinton (*Fasti Hellenici,* 3 vols., 1834) is still useful, although needing much correction in detail.

ROMAN

Roman chronology was in antiquity wholly dependent upon Greek methods, and hence suffered from all the drawbacks of the latter (*see* above, *Greek*), together with a further one, viz., the scarcity and untrustworthiness of native documents. Working along the lines of the Alexandrians, several Roman scholars, notably Varro and Atticus (the friend of Cicero) arrived at chronological schemes for the early history of Rome, whereof considerable fragments have come down to us in the various historians and antiquarians whose works survive, in lists of magistrates such as the fragmentary Fasti Capitolini, and in S. Jerome's chronicle. They are without exception highly untrustworthy for the regal period and the earlier centuries of the Republic (*see* ROME: *Ancient History*), but at least provide us with an epoch by which to reckon: that from the conventional date (753 B.C. of our reckoning) of the foundation of Rome.

Founding of Rome.—Even this date was by no means a matter on which unanimity was reached; that given is the one which ultimately found most favour, and to which the majority of ancient authors refer when they use the expression *a.u.c.* (*ab urbe condita,* or *anno urbis conditae*). The official method of dating was by consuls, as *M. Messalla et M. Pupio Pisone consulibus* (abbreviated *cos.* or *coss.*), "in the consulship of Marcus Messalla and Marcus Pupius Piso" (Caesar, *de bell. Gall.*, I, 2, 1 (61 B.C.). This never quite went out of use; but under the empire, official documents emanating from the emperors or referring to them reckoned by their years of tribunician power, to which were frequently added other, less regularly recurring, distinctions, such as the consulate or the salutation as *imperator*, *e.g., Imperator Caesar Vespasianus Augustus pontifex maximus, tribuniciae potestatis viiii, imp(erator) xiix, consul viii, i.e.*, "Vespasian (name and titles in full), in the ninth year of his tribunician power, having been saluted *imperator* 18 times, consul for the eighth time" (A.D. 77; from an official letter *C.I.L., II,* 1423). As, however, documents relating to the emperors are very numerous, this method of dating seldom raises much difficulty; our list of consuls also, for the fully historical periods, is tolerably complete. Naturally, in dealing with pre-Caesarian years (*see* CALENDAR: *Roman*) calculations more or less elaborate are needed to convert the year *urbis conditae* into the conventional Julian year (*see* above, *Greek*). These are based on a few facts, such as the mention of an eclipse or other event which we can date accurately. One such eclipse was that of the sun on Oct. 19, 202 B.C.; we gather from various authors that its civic date was about the beginning of December, and this enables us to calculate the condition of the calendar at that time.

Julian Calendar.—The reformed calendar of Julius Caesar was not imposed by Rome on her empire, but naturally it was widely adopted in various modifications. It became the calendar of Christian Rome and also of Constantinople; but gradually a change was made in the era; the supposed date of the birth of Christ replacing that of the foundation of the city (Christian or Dionysian era). This, however, was very slow to win official recognition, despite its convenience; Charlemagne appears to have been the first secular authority to use it. Before that, Christian chronologists used frequently to reckon in years of Abraham, *i.e.*, from his birth, which was placed by Eusebius at a date corresponding to Oct. 2016 B.C.

More important for the determining of Roman imperial dates, than the former, and for some of the later Republican dates also, are the provincial eras and the indictions. It was a wide-spread custom in Hellenistic times to count years from some notable event. The accession of the reigning king was, and continued to be, commonly used, and this, as we have seen, was followed by the emperors; but the Seleucidae and their subjects counted from 312/11 B.C., the date of Seleucus Nicator's decisive victory at the battle of Gaza and his capture of Babylon. In like manner a few Roman chronologists counted from 45 B.C., the date of the Julian reform; and Spain had an era of its own, beginning with 38 B.C., a date chosen for no very obvious reason. Again, several independent cities, such as Antioch, had local eras. When, therefore, we find a year mentioned in an inscription or other piece of evidence, it is necessary to know where this was written, and thus whether the Seleucid era, or that of Spain, or Antioch, or some other place, is meant; or, if the author be a historian, whether he may be using some peculiar era of his own, counting, for example, from the date which he accepts for the fall of Troy, or from the death of Alexander the Great.

The indictions are late, but important for late events, for they

appear in all manner of official documents, ecclesiastical and secular. Properly, *indictio* means an assessment of taxes; *nec novis indictionibus pressi ad vetera tributa deficiunt,* says the younger Pliny (*Paneg.* 29), "the provincials are not so ground down with fresh exactions as to be unable even to pay the old taxes." Under Diocletian, a five-yearly assessment was ordered, and three of these periods grouped together made what was now called an indiction. One authority traces this arrangement back to comparatively early times, making the first indiction begin in 49 B.C.; but the real date seems to be A.D. 297, although even at the beginning of the empire the germ of such a system existed in Egypt. Its chronological importance is, that it provided a means of dating, without mentioning the several emperors who, by Diocletian's arrangement, ruled simultaneously. A disadvantage was that the cycle began on different days at different times and places. Despite these differences, and the fact that *indictio* meant now the whole cycle, now a year of it, it remained in use until the middle ages, and here and there even later.

See CHRONOLOGY: *Greek;* CALENDAR: *Greek*; CALENDAR: *Roman;* also Clinton, *Fasti Romani,* vol. i., 1845, vol. ii., 1850; Seeck, art. "Indictio," in Pauly-Wissowa, *Realencyclopädie,* and literature there cited. (H. J. R.)

JEWISH

The era which is in present vogue among Jews (*Anno Mundi, li-yitzirah* or *libriath olam,* from the creation of the world) appears not to have come into popular use before the 9th century, though possibly it may have been known to learned writers earlier. The era is supposed to begin, according to the mnemonic *Beharad,* at the beginning of the lunar cycle (*see* CALENDAR: *Jewish*) on the night between Sunday and Monday, Oct. 7, 3761 B.C., at 11 hours 11⅓ minutes P.M. This is indicated by *be* (*beth,* two, *i.e.,* 2nd day of week), *ha* (*he,* five, *i.e.,* fifth hour after sunset) and *Rad* (*Resh, dalet,* 204 minims after the hour). Rühl's theory that this era existed already in A.D. 222 is disputed by Poznanski on strong grounds. In the Bible various eras occur, *e.g.,* the Flood, the Exodus, the Earthquake in the days of King Uzziah, the regnal years of monarchs and the Babylonian exile. During the exile and after, Jews reckoned by the years of the Persian kings. Such reckonings occur not only in the Bible (*e.g.,* Daniel viii., 1) but also in the Assouan papyri. After Alexander, the Jews employed the Seleucid era (called *Minyan Shetaroth,* or era of deeds, since legal deeds were dated by this era). So great was the influence exerted by Alexander, that this era persisted in the East till the 16th century, and is still not extinct in south Arabia. This is the only era of antiquity that has survived. Others, which fell into disuse, were the Maccabaean eras, dating from the accession of each prince, and the national era (143–142 B.C.), when Judaea became free under Simon. That the era described in Jubilees (*see* CALENDAR: *Jewish*) was other than hypothetical, is probable. Dates have also been reckoned from the fall of the second Temple (*Le-Ḥorban hab-bayyith*). The equation of the eras is as follows: 1 after destruction = A.M. 3831 = 383 Seleucid = A.D. 71. Jewish chronology falls into two periods, biblical and post biblical. With the latter alone is this article concerned; for the former *see* BIBLE: *Old Testament: Chronology* and *New Testament: Chronology.* The earliest Jewish chronologies have not survived. Demetrius, a Jew of Alexandria, wrote a treatise in which he endeavoured to deduce the dates of Hebrew history from the Scriptures. Of this work only a very few remnants are extant; they have been published by C. Müller (*Fragmenta Hist. Graecorum,* iii. 214–217). The *Book of Jubilees,* written in the second pre-Christian century, subordinates chronology to its peculiar views on the calendar and theology. For present purposes Josephus must be left out of account, for chronology and history are separate studies. The most important and the earliest of all surviving chronologies is the *Seder 'Olam Rabbah.* This Hebrew book is mentioned in the Talmud; the author and date are unknown, but the authorities cited in the book belong almost exclusively to the 2nd century A.D. According to R. Johanan, the work was transmitted by R. Jose ben Halafta, a pupil of Aqiba, and it is possible that this tradition is correct. The author was possibly the first to make use of the era of Creation. Owing to defective sources he makes many errors in the Persian period. The chronology extends from the creation of Adam to Bar Kochba's fight for liberty in Hadrian's days, but the period from Alexander to Hadrian is compressed into the end of one chapter. The best edition is that of B. Ratner (Wilna, 1897). Various Latin translations exist (*vide* bibliography in *Jewish Encyclopedia, s.v.*).

The *Seder 'Olām Zūta,* a smaller work, was written probably in the 8th century; it completes the *Rabbah* and is based on it. The object of the book, which enumerates the 39 generations of Babylonian exitarchs, is to show that the latter were lineal descendants of David. The best text is that of Neubauer, *Mediaeval Jewish Chronicles,* ii., 67.

Megillat Ta'anith, or scroll of Fasting, is a chronicle rather than a chronology, since the events are grouped according to the months of the year and not in chronological sequence. The book enumerates 35 eventful days in five groups: I., pre-Maccabaean; II., Maccabaean; III., pre-Sadducean; IV., pre-Roman; V., the Diaspora. The author was probably, as stated in the Talmud (Sabbath 13 *b*), Hananya ben Hezekiah of the family of Garon, and the date would be about A.D. 7. A Latin translation exists (*vide* bibliography, *s.v.* in *Jewish Encyclopedia,* to which add the edition of Solomon Zeitlin, New York, 1922).

Tanna debe Eliyahu, a composite Midrash finally redacted in the 10th century, can scarcely be termed a chronology, since the underlying theme is the growth of the world-system; human history is arranged in *Shiṭṭōth* (series) in order to bring the moral into prominence. The absence of dates excludes this book from the category of chronology proper, although it contains much historical information.

For modern purposes the best chronology is that at the end of H. Graetz's *History of the Jews* in the American edition. Others are included in the bibliography in the *Jewish Encyclopedia, s.v.* Chronology. *See* also M. L. Margolis and A. Marx, *History of Jewish People* (1927). (H. M. J. L.)

MAYA AND MEXICAN

For technical terms relating to the calendar, which must be used to explain the chronology, the reader is referred to article CALENDAR: *Maya and Mexican.*

Maya: The Long Count.—The Maya calendar is based upon a year of 365 days, but it seems clear that the Mayas themselves recognized no such period. In their view 365 days was one tun (360-day period) and five days, and they so expressed the distance from a month-day in one year to the same month-day in the following year; *e.g.,* from 9 Imix 19 Zip to 10 Cimi 19 Zip. They never used a year of 365 days in counting the distance in time from one date to another. No glyph for the 365-day year is found, and there is no word with that meaning in the Books of Chilan Balam. It has been stated that haab meant 365-day year, but in fact it means tun (360-day period). All authorities agree, however, as to the method of counting time. The units used are the kin or day, the uinal of 20 days, the tun of 18 uinals, the katun of 20 tuns, and the cycle of 20 katuns. The Maya name for the cycle is unknown, and until proof is available it is undesirable to give it a hypothetical Maya name. In transcribing Maya numerals the numbers are written with a dash between each. Thus 9–10– 6– 5– 9 means 9 cycles, 10 katuns, 6 tuns, 5 uinals, and 9 kins. By this method the Maya counted the time elapsed from a certain day, 4 Ahau 8 Cumhu, which was the starting-point of their era, and thereby fixed dates in the Long Count, as the Maya era is called. What is called an Initial Series shows the position of a date in the Long Count. Thus 8 Muluc 2 Zip will recur every 52 years, but if it is expressed as an Initial Series date, 9–10– 6– 5– 9, 8 Muluc 2 Zip, its position in time is fixed, as its distance from the starting-point of the Long Count is given. In the Inscriptions an Initial Series always begins the inscription (hence the name) and commences with an "introducing glyph" which appears merely to mean "This is an Initial Series." Then follow the Maya numerals written in descending order, that is commencing with the largest period (cycle) and ending with the kin, and then the terminal date (in the above example, 8 Muluc

2 Zip). More often than not, the day number and day name (as 8 Muluc) are separated from the month day (as 2 Zip) by a Supplementary Series. In such cases the month day regularly follows the last glyph of the Supplementary Series. A date which is not fixed in the Long Count is called a "Calendar Round date," as it can recur every 52 years.

Another method of giving dates is by "period-endings." This somewhat resembles the European method of giving the last two figures of the year without the century. Thus '98 may mean 1798 or 1898, etc., recurring every 100 years. But the Maya method differs in that it always denotes a certain day instead of a larger period such as a year, and further it is a day terminating a certain round number. It is as if the European method only denoted Dec. 31, and then only when it ended a decade or century. The most usual period-ending is the katun-ending. This is expressed by (1) a glyph meaning "ending," (2) the number of the katun, (3) the Calendar Round date on which a katun of such a number ended. Example: "Ending Katun 13, 8 Ahau 8 Uo." Such a date cannot occur again in the Long Count for 374,400 years, so it is fixed as effectually as if the Initial Series had been given. The "ending sign" may be omitted. Less common are cycle-ending dates, as "2 Ahau 3 Uayeb ending Cycle 2." These cannot recur for 748,800 years. Very common are the lahuntun-endings, expressed by a special glyph meaning "end of Tun 10" together with the Calendar Round date. This means Tun 10 from the last katun-ending. These cannot recur for 18,720 years. Also common are the hotun-endings, expressed by a special glyph meaning "end of Tun 5" and the Calendar Round date. This Tun 5 may mean either Tun 5 from the last katun or Tun 5 from the last lahuntun (therefore Tun 15 from the last katun). These cannot recur for 9,360 years and are, therefore, practically as much fixed as the others. Example: "4 Ahau 13 Mol, Hotun." This must be 9–11–15– 0– 0 4 Ahau 13 Mol, because that date does not end Tun 5 or 15 elsewhere in cycles 8, 9 or 10 or indeed for 9,360 years before or after. No other satisfactory case of tun-ending occurs in the old empire except the 13– tun ending, expressed by glyphs meaning "ending Tun 13" and the Calendar Round date. These cannot recur for 18,720 years. As all period-endings denote the ends of even periods in the Long Count which itself starts from 4 Ahau 8 Cumhu, they must themselves all end on a day Ahau.

Many dates in the inscriptions are connected with other dates by "Secondary Series" numbers. If a date is connected by a Secondary Series with another date which is fixed in the Long Count, then the former date is called a Secondary Series date and is, of course, itself fixed in the Long Count, as it can be calculated by the Secondary Series from the known date. Example: "6 Imix 19 Zotz, connected by Secondary Series of 2–1–13–19 with 4 Ahau 13 Mol." But the latter is fixed by a period-ending in same inscription as 9–11–15– 0– 0 4 Ahau 13 Mol. so the former is 9–9–13– 4– 1 6 Imix 19 Zotz. But dates may be connected by a Secondary Series, and neither of them may be fixed in the Long Count, in which case both are merely Calendar Round dates.

All Initial Series in the Dresden Codex, and all except two in the inscriptions, start from 4 Ahau 8 Cumhu. But there are two Initial Series in the inscriptions which start from a date 4 Ahau 8 Zotz which occurred 13 cycles before the date 4 Ahau 8 Cumhu, the starting-point of all the rest. In the Dresden Codex a "great cycle" is used containing 20 cycles. Dr. Sylvanus G. Morley shows that this was used in the inscriptions, and also a great-great cycle of 400 cycles, and a great-great-great cycle of 8,000 cycles. This has been confirmed by Long's discovery of a new interpretation of an inscription at Palenque.

It will be noted that all the Maya time periods (except the tun) are each 20 times the next lower one. In the inscriptions these numbers are written with the glyphs for the periods as well as the numbers. Thus 9–10– 0– 0– 0, if an Initial Series, is expressed by glyphs reading 9 cycles, 10 katuns, 0 tuns, 0 uinals, 0 kins. This is similar to the usual mode of writing measures; *e.g.*, 10ft. 11in. Secondary Series are written in the same manner except that in them the lowest denomination (kin) comes first and the highest last. There are only three or four Secondary Series which do not follow this order, all at Palenque. But in the Dresden Codex the glyphs for the periods are omitted, and the value of the numbers depends upon position alone, as in the Arabic numerals.

Cyrus Thomas remarks that there is nothing to show that the 4 Ahau 8 Cumhu to which the Initial Series count back is the same in actual time in all. This is so, because 4 Ahau 8 Cumhu will recur every 52 years. But Thomas agrees that the assumption that it is the same actual day in all gives the most credible result, as this makes the terminal dates of the inscriptions fall within a reasonable distance of each other, and no doubt the assumption is correct. The earliest dated monument is Stela 9 at Uaxactun, 8–14–10–13–15 and the latest in the old empire is Stela 12 at the same site and is 10– 3– 0– 0– 0. This gives an extreme range of 1– 8– 9– 4– 5 (about 561 years), quite a probable time for any phase of civilization to last. But since the Maya erected the first dated monument about 3,443 years after the beginning of their era, it is clear that 4 Ahau 8 Cumhu represents no historical event and must have fallen long before there was any Maya civilization. Like the Julian period used by astronomers, it was a date calculated by skilled chronologists long after the invention of the calendar, doubtless with the object of harmonizing lesser periods.

But in general the range of Maya dates is even shorter. Many of the monuments record only one date, and where there are several the last date, or at least the last period-ending, seems generally to be the contemporaneous one. Now the dated monuments are very rare in cycle 8, more numerous, but still confined to a few sites, from 9– 0– 0– 0– 0 to 9– 10– 0– 0 0, become very numerous from 9–10– 0– 0– 0– to 9–15– 0– 0– 0, increase much more after 9–15– 0– 0– 0, reach a maximum in 9–18– 0– 0– 0, and then suddenly diminish, becoming much fewer after 9–19– 0– 0– 0, and ceasing after 10– 3– 0– 0– 0. The style of the monuments likewise shews a steady advance in art up to about 9–18– 0– 0– 0. Change is also observable in the method of dating. In cycle 8 the monuments were erected on casual dates which did not end any tun or other time period, and the dates were usually shewn by Initial Series, but early in cycle 9 the practice was adopted of setting up the monuments to mark each hotun. Unfortunately hotun is used by Maya scholars in this case to mean the end of either a katun, lahuntun, or hotun, that is, it means any number of tuns of the Long Count which is divisible by five. Initial Series were still used, and at about 9– 8–15– 0– 0 the practice began of giving several dates on a monument besides the Initial Series, the last one marking the hotun. After 9–10– 0– 0– 0 monuments dated by period-endings became fairly frequent, and after 9–15– 0– 0– 0 the Initial Series became rarer, and monuments were dated mostly by period-endings or Calendar Round dates. Geographically we also see change. The old empire area was roughly triangular with Uaxactun and Tikal in the north-east, Copan and Quirigua in the south-east, and Piedras Negras in the west. Uaxactun and its neighbour, Uoluntun, alone show dates in cycle 8. In the first half of cycle 9 the monuments are almost confined to Uaxactun, Tikal, Copan and Piedras Negras, outliers in the area, while after 9–10– 0– 0– 0 they are numerous everywhere till 9–18– 0– 0– 0, when they cease at Piedras Negras and the west, ceasing at Quirigua and Copan and the south-west after 9–19– 0– 0– 0. Some new cities appear towards the close of cycle 9 in the north-east, and the closing date is at Uaxactun and Xultun near it. It is noteworthy that Uaxactun and Tikal, though at the north-east of the old empire, are almost in the centre of the whole Maya area if we consider the old and new empire territories together, and these sites were probably the original seats of the Maya.

The New Empire.—The Long Count was wanting in the new empire. Instead they used the U Kahlay Katunob, which was a simplification of the older period-ending method. The cycle had entirely dropped out of use, and the only periods were the katun and the tun, the katun being the more important. The katuns were cited by the day Ahau with its day number on which they ended. Thus "Katun 13 Ahau" or simply "13 Ahau." Such a date can recur every 13 katuns (about 256 years) because in

that time the 13 day numbers will be exhausted. The order of succession is 13.11. 9. 7. 5. 3. 1, 12.10. 8. 6. 4. 2. Often nothing was mentioned save the katun in which the event occurred, so that not only could the katun recur about every 256 years, but the event might have occurred anywhere within the katun, leaving about 20 years uncertainty. At times an event is described as occurring in tun so-and-so of such a katun, thus fixing it within a period of 360 days within the katun. But if the Calendar Round date is given as well, as *e.g.*, "Katun 13 Ahau, Tun 13, 9 Imix 18 Zip," then (depending upon what date it is) the date can either only occur once in 18,720 years or can occur twice in that time, at intervals of 7,436 years and 11,284 years respectively.

Correlations.—The state of knowledge about the Maya of the old empire has no parallel in archaeology. While on the one hand we do not even know the names of the peoples who erected the monuments, much less their history, nor even if they spoke Maya, seeing that all knowledge of the calendar is based upon Landa's account of the new empire, yet so accurate were their dates that it is possible to date the monuments with regard to each other to the exact day. But widely different views are held by scholars as to the correlation with Christian chronology. The principal elements of the problem are: (1) correlation of the old and new empire chronologies, (2) correlation of the new empire and Christian chronologies, (3) correlation with astronomical discoveries of Teeple. (1) If the month-days on which the katuns of the new empire ended had been stated, there would have been an absolute correlation with the old empire. A tun ends on the same day number every 13 tuns, but will end on the same month-day only every 73 tuns, and on the same day number and month-day only every 949 tuns. Similarly a katun will only end on the same day number and month-day every 949 katuns (18,720 years). But as the new empire method did not state the month, the Katun 13 Ahau which occurred in the 16th century is identified with various katuns of the Long Count by different writers. The Books of Chilan Balam carry back the new empire chronology to about A.D. 163. Mr. J. Eric Thompson alone shortens this. (2) Opinions differ as to what year in the 16th century a katun 13 Ahau ended in, so the new empire chronology is only loosely correlated with Christian chronology within the limits of about a katun. The Maya year was a shifting one and Landa says that in his time Pop began on July 16 O.S. This was in or near 1553. No correlation can stand which does not agree with Landa's statement, consequently all are ruled out but the three given below. (3) Teeple shows certain lunar and Venus dates agreeing with Thompson, but probably the last word has not yet been said on this subject.

The Bowditch correlation depends on a statement as to the month-day and has considerable historical evidence in its favour. Thompson's correlation depends on another statement as to the month-day and raises some difficulties owing to the shortness of its chronology. Dr. Herbert J. Spinden's correlation is at variance with both of these month-dates and also with Teeple's results. Moreover, the astronomical observations on which he relies have been shown by further measurement to be incorrect. The dates of 4 Ahau 8 Cumhu in these correlations are in the Gregorian Calendar (astronomical reckoning):—

Bowditch, Joyce and Long	Feb. 10 3641 B.C.
Spinden	Oct. 14 3373 B.C.
Thompson	Aug. 13 3113 B.C.

As the Maya chronology was the only efficient one in pre-Columbian America it would, if fixed, throw much light on that of America as a whole. Excavation of Maya sites has yielded objects obtained in trade from both northwards and southwards, so that if the correlation was established, the period when these neighbouring cultures flourished could be approximated.

Solving Dates.—A word in conclusion on solving dates. Given such a series as 9–10–6–5–9 and that its starting-point is a known date such as say 4 Ahau 8 Cumhu, the day name can at once be determined by counting the kin number (in this case 9) from the starting-point; thus 9 days from Ahau will reach Muluc. But the finding of the day number and the month-day is a more difficult matter. It is possible to reduce the whole series to single days and then find the day number by dividing by 13 and counting the remainder forward from the day number of the starting point, similarly to find the month-day by dividing the total number of days by 365 and counting forward the remainder from the month-day of the starting-point. But the student is advised not to use this time-wasting method. Many problems can be solved by tables, of which the best are J. T. Goodman's and those of Mr. Thomas A. Joyce, but not all cases can be directly done by tables, and though they are valuable for checking results, it is well to be able to calculate independently of them. By far the best rule is that of Mr. Raymond K. Morley (*see* Bibliography), by which all series can be quickly calculated without any tables.

Cakchiquel Calendar.—This is the only era found in ancient America except the Maya. It was a pure vigesimal count, the units being the *kih* or day; the *vinak* (meaning "twenty") or 20 *kih*, the *a* or 20 *vinak*, and the *may* or 20 *a*. No higher units are known or were required, as the era only started from the day 11 Ah, the date of the revolt of the Tukuche tribe, equivalent to May 20 1493 O.S. This era is altogether unique, not only from its purely vigesimal character, but also that it only commenced in the lifetime of persons who were living at the Spanish conquest. No hint of any other era appears in the Annals, before the revolt, but the use of the special words such as *a* and *may* shows that such a mode of counting from some other epoch or epochs had been previously known. The Cakchiquel, living southwards of the old empire, like the Yucatan Maya to the north of it, used a later simplification of the older time counts. Dates were expressed thus: On 1 Ah was completed 1 *may* and 5 *a*; after the revolt, on 12 Camey (a certain event occurred). Sometimes the number of *vinak* and *kih* was also given.

Mexican Calendar.—There was no chronological system beyond the calendar round. The codices show no means of giving the numbers of years elapsed from one date to another except the clumsy one of stating the year-bearers of all the intervening years. The calendar round began with the year 2 Acatl, in which year the great festival of the "year-binding," *xiuhmolpilli*, was held. The codices denote such a year by a special sign along with the year-bearer, but this is merely the same thing as noting the occurrence of such an event in that year. The sign for the year-binding was never used as an arithmetical sign to show that 52 years or a multiple thereof had elapsed. To do this they had to set out all the individual years. Naturally, there is much confusion in Mexican history and the same event is placed by different authorities at varying numbers of calendar rounds before the Spanish conquest. Mexico surrendered to Cortez on the day 1 Coatl, year 3 Calli, which was Aug. 13 1521 O.S. This was 3 Xocouetzi, as the year-bearers were taken from 1 Toxcatl instead of from the first month of the year. The explanation is probably that the monthly festivals were displaced in the shifting calendar to agree with the seasons, but this question is very obscure.

BIBLIOGRAPHY.—C. P. Bowditch, *The Numeration, Calendar Systems, and Astronomical Knowledge of the Mayas* (Cambridge, U.S.A. 1910); T. A. Joyce, *Mexican Archaeology* (London, 1914), and *Guide to the Maudslay Collections of Maya Sculptures* (British Museum, 1923); S. G. Morley, *An Introduction to the Study of Maya Hieroglyphs* (Washington, Bureau of American Ethnology, 1915), and *The Inscriptions at Copan* (Washington, Carnegie Institution, 1920); R. K. Morley, "Computations for the Maya Calendar" in *American Anthropologist* (1918); R. C. E. Long, "Maya and Christian Chronology," *Journal Royal Anthropological Institute* (1923), "The Age of the Maya Calendar," *Journal Royal Anthropological Institute* (1924), "Maya High Numbers," Man. No. 39 (1923), "The Bowditch and Morley Correlations of Maya Chronology," Man. No. 2 (1925); J. E. Teeple, "Maya Inscriptions, Glyphs," C. D. & E. of the Supplementary Series, and "Further Notes on the Supplementary Series," in *American Anthropologist* (1925); also "Maya Inscriptions, The Venus Calendar and another Correlation," in *American Anthropologist* (1926); H. J. Spinden, *The Reduction of Mayan Dates* (Cambridge, U.S.A., Peabody Museum); J. E. Thompson, *A Correlation of the Mayan and European Calendars* (Chicago, Field Museum of Natural History, 1927).

The student is recommended to read first Joyce's *Guide*, then his *Mexican Archaeology*, then Morley's *Introduction* (with good bibliography), and then Bowditch. The last two are absolutely essential. Morley's *Copan*, a truly great book, presupposes a knowledge of the subject and contains an extensive bibliography. (R. C. E. L.)

MUSLIM

The Muslim Calendar (*see* CALENDAR: *Muslim*) may evidently be carried on indefinitely by successive addition, provided care be taken to allow for the additional day occurring in bissextile and intercalary years. The purely lunar years of this calendar are partitioned into cycles of 30 years, 19 of which are common years of 354 days each, the remaining 11 being intercalary years having an additional day appended to the last month. The mean length of the year is, therefore, $354\frac{11}{30}$ days (354 days, 8 hours, 48 minutes). This gives $29\frac{191}{360}$ days (29 days, 12 hours, 44 minutes) as a period of mean lunation, and this differs from the astronomical mean lunation by only 2·8 seconds. This small error amounts to a day in about 2,400 years.

To find if a year is intercalary or common, divide it by 30; the quotient will be the number of completed cycles and the remainder will be the year of the current cycle; if this last be one of the numbers 2, 5, 7, 10, 13, 16, 18, 21, 24, 26, 29, the year is intercalary and consists of 355 days; if it be any other number, the year is ordinary.

Year of the current cycle (y)				Number of the period of seven cycles = $\left(\frac{C}{7}\right)_r$						
				0	1	2	3	4	5	6
0	8	..	..	Mon.	Sat.	Thur.	Tues.	Sun.	Frid.	Wed.
1	9	17	25	Frid.	Wed.	Mon.	Sat.	Thur.	Tues.	Sun.
*2	*10	*18	*26	Tues.	Sun.	Frid.	Wed.	Mon.	Sat.	Thur.
3	11	19	27	Sun.	Frid.	Wed.	Mon.	Sat.	Thur.	Tues.
4	12	20	28	Thur.	Tues.	Sun.	Frid.	Wed.	Mon.	Sat.
*5	*13	*21	*29	Mon.	Sat.	Thur.	Tues.	Sun.	Frid.	Wed.
6	14	22	30	Sat.	Thur.	Tues.	Sun.	Frid.	Wed.	Mon.
*7	15	23	..	Wed.	Mon.	Sat.	Thur.	Tues.	Sun.	Frid.
..	*16	*24	..	Sun.	Frid.	Wed.	Mon.	Sat.	Thur.	Tues.

To find from this table the day of the week on which any year of the Hejira begins, the rule to be observed will be as follows:—

Rule.—Divide the year of the Hejira by 30; the quotient is the number of cycles, and the remainder is the year of the current cycle. Next divide the number of cycles by 7, and the second remainder will be the Number of the Period, which being found at the top of the table, and the year of the cycle on the left hand, the required day of the week is immediately shown.

The intercalary years of the cycle are distinguished by an asterisk.

For the computation of the Christian date, the ratio of a mean year of the Hejira to a solar year is:

$$\frac{\text{Year of Hejira}}{\text{Mean solar year}} = \frac{354\frac{11}{30}}{365{\cdot}2422} = 0{\cdot}970224.$$

The year 1 began July 16, 622, Old Style, or July 19, 622, according to the New or Gregorian Style. Now the day of the year answering to July 19, is 200, which, in parts of the solar year, is 0·5476, and the number of years elapsed $= Y-1$. Therefore, as the intercalary days are distributed with considerable regularity in both calendars, the date of commencement of the year Y expressed in Gregorian years is:

$$0{\cdot}970224\ (Y-1)+622{\cdot}5476,$$
$$\text{or } 0{\cdot}970224\ Y+621{\cdot}5774.$$

This formula gives the following rule for calculating the date of the commencement of any year of the Hejira, according to the Gregorian or New Style.

Rule.—Multiply 970,224 by the year of the Hejira, cut off six decimals from the product, and add 621·5774. The sum will be the year of the Christian era, and the day of the year will be found by multiplying the decimal figures by 365.

The result may sometimes differ a day from the truth, as the intercalary days do not occur simultaneously; but as the day of the week can always be accurately obtained from the foregoing table, the result can be readily adjusted.

CHRONOMETER. A marine timekeeper, used for determining longitude at sea. The word was originally used to denote any time-measuring instrument. The first instance of its employment in its accepted modern meaning is to be found in Jeremy Thacker's "The Longitudes Examined . . ." (London, 1714). On the Continent the analogous term "chronomètre" is still used to describe any high-class timekeeper, whether for marine purposes or otherwise.

History.—The possibility of determining longitude at sea by the use of a timekeeper was first pointed out by the Flemish astronomer Gemma Frisius, in a work on navigation published at Antwerp in 1530. At that date, however, and for long afterwards, the mechanical difficulties in the way of constructing an accurate marine timekeeper appeared to be insurmountable. The first attempt to put Frisius' suggestion into practice was made in 1662–79 by the celebrated Dutch scientist, Christiaan Huygens, of Zulichem, who constructed several marine timekeepers controlled by pendulums and subjected them to actual tests at sea. It was found that the timekeeping of the machines was quite unreliable, owing to the effects of temperature and of the ship's motion. Many later inventors fared no better, but during 1729–60 John Harrison, a self-taught Yorkshire carpenter, invented and constructed four practical marine timekeepers, with the fourth of which (now preserved, in going order, at Greenwich Observatory) he won the reward of £20,000 offered in 1714 by the British Government for any means of determining a ship's longitude within 30 nautical miles at the end of a six weeks' voyage. It may be noted that a timekeeper fulfilling this condition would have to keep time within three seconds per day—a standard which, at the date when the reward was offered, had not been attained by the best pendulum clocks on shore.

Harrison's mechanism, although unquestionably efficient, was complicated, delicate and costly—the Board of Longitude paid Larcum Kendall, a London watchmaker, £450 for a duplicate of the No. 4 timekeeper. Accordingly, it had little direct effect upon the evolution of the modern chronometer. But in 1765 Pierre Le Roy, of Paris, invented and constructed a marine timekeeper whose mechanism embodied, in an embryonic but perfectly recognizable form, practically all the essential features of the modern chronometer. This machine, or a contemporary duplicate, is preserved in the Conservatoire des Arts et Métiers in Paris. Le Roy's work was followed up by Ferdinand Berthoud in France and by John Arnold and Thomas Earnshaw in England. The last-named produced, as early as 1785, several chronometers which, both in appearance and mechanism, are scarcely distinguishable from the machine of to-day.

Description.—The modern chronometer is, broadly speaking, a large, well-made watch, suspended in gimbals (a set of two bearings at right-angles, connected by a ring) and so poised as to remain horizontal whatever the inclination of the ship. It is thus safeguarded from those alterations of position which slightly affect the timekeeping of even the best watches. In addition, it differs somewhat in its mechanism from an ordinary watch, the spiral balance-spring and lever escapement of the latter being replaced by a helical balance-spring and a spring-detent or "chronometer" escapement. This form of escapement is mechanically superior to any other, and requires no oiling, but it is unsuitable for use in pocket watches, as if stopped it has no tendency to re-start itself. For the purpose of equalizing the force of the mainspring, almost all chronometers are fitted with a device known as a "fusee," which has for some time past been discarded in watches, and their compensation-balances, by which the effects of heat and cold upon their timekeeping are practically nullified, also differ in some respects from the ordinary watch type, as well as being considerably larger and heavier.

Accuracy.—The modern chronometer is capable, with fair usage, of going with what must be regarded, in view of the unfavourable conditions to which it is necessarily exposed on board, as astonishing accuracy. Both during the official tests at Greenwich Observatory (which has been held annually, on practically unaltered lines, from 1844 to 1914) and in their subsequent service afloat, many hundreds of chronometers have shown themselves capable of keeping time in all ordinary variations of temperature for six months at a time with an error not exceeding a second a

day—an amount which, in a month's voyage along the equator, would involve an error in the ship's final position of less than eight nautical miles. (*See* also NAVIGATION.)

U.S. Marine Chronometer.—During the years 1942 to 1944 a marine chronometer of very high precision was developed in the United States by the Hamilton Watch company. In general appearance, this chronometer is like any other, but certain changes have been made in the escapement. The hairspring used is made of nickel steel, similar to elinvar; the balance wheel is uncut and has a stainless steel rim with an invar arm. There are a number of timing screws, as in a watch, which permit very close adjustment of the rate. This chronometer shows a practically uniform variation with temperature, with daily rates at 5° C. and 35° C. differing by only a few tenths of a second. The rate during run-down remains uniform for 48 hours after winding.

See R. T. Gould, *The Marine Chronometer, its History and Development* (1923), a general history of the subject. (R. T. Go.; X.)

CHRYSALIS, the common name for the pupa of the Lepidoptera (*q.v.*) (butterflies and moths).

CHRYSANTHEMUM, a genus of nearly 300 species of annual or perennial herbs of the family Compositae; popularly the name given to forms of certain old world species of this genus which have been remarkably developed by cultivation. Most varieties of the so-called Chinese and Japanese chrysanthemums extensively grown by gardeners and florists are blended hybrids or other forms derived from *C. morifolium* and *C. indicum,* natives of eastern Asia. Other species of interest to flower growers are *C. coccineum* (pyrethrum), *C. parthenium* (feverfew), and *C. frutescens* (marguerite). Other representatives of the genus are *C. balsamita* (costmary) and *C. leucanthemum* (ox-eye daisy), the latter often a pestiferous weed. The common chrysanthemum has probably been known for at least 2,000 years. In Japan, where it can be traced back many centuries, it is the national flower. Breynius in 1689 was the first European to mention the chrysanthemum, giving it the name of *Matricaria japonica maxima.* M. Pierre Louis Blancard introduced the first large-flowering chrysanthemum into England in 1789. This first flowered in 1790. The plant was first introduced into America in 1847. The work of hybridization was first taken up by Dr. H. P. Walcott and later in the '80s by John Thorpe, who organized the Chrysanthemum Society of America in 1890. The only species of economic importance are certain forms of *C. coccineum,* much grown for the aromatic flower heads, the source of pyrethrum powder, widely used in insecticides. Chrysanthemums are popular with the gardeners, both professional and amateur, as an exhibition flower because of their great size and variety of shape and colour, and also because some varieties are extremely hardy, which permits their use in the perennial garden. Chrysanthemums owe their popularity with commercial florists not so much to their value as a crop as to the fact that they may be planted in the late spring and early summer when the greenhouse otherwise would be empty. Moreover, the chrysanthemum is a quick-maturing crop, many varieties being grown without artificial heat, since they bloom from late August to December.

The cultural requirements for chrysanthemums may be adjusted to many rotation schemes, so that the same greenhouse may be used for growing other floral crops, such as calendulas, sweet peas, stocks, snapdragons, annuals and lilies.

Classification of Types.—(1) *Incurved Chinese types* are nearly globular in form and regular in outline; the florets are smooth, rounded or somewhat toothed at the top, and sufficiently long to form a graceful curve (commercial varieties are Maj. Bonaffon, Mrs. Nellie T. Ross, Citronelle). (2) *Japanese types* are varieties with long loosely arranged florets; the florets may be flat, fluted, quilled or tubulated and may be incurved or reflex. Many exhibition varieties (Mrs. H. S. Firestone, F. E. Nash, Miss Ruth C. Twombly, Majestic) come in this type. (3) *Anemones* have high, neatly formed centres with elongated quilled florets, surrounded by flat, more or less horizontally arranged ray flowers. Examples are Gorza, Chestnut, Mapleleaf. (4) *Pompons* may be somewhat flat or nearly globular, generally very neat and compact, formed of short, flat, fluted or quilled florets. The florets of each bloom are all of one form, such as the varieties Varsity, Co-ed, Baby, Pink Dot and Nuggets. (5) *Singles* are arranged sufficiently close together to form a regular fringe. There may be one or two rows of ray flowers and sometimes as many as three or five. The centres of the florets are always tubular, either short or somewhat elongated. Golden Mensa, Mrs. E. D. Godfrey and Margaret Waite are good examples. (6) *Cascades,* derived from a wild Japanese species, comprise a group of showy pot plants which by pinching make handsome, usually drooping, very floriferous sprays of bloom.

During 1936–38 a group of chrysanthemums was launched under the name of *azaleamum.* Most of them were related to old varieties such as Amelia, etc., with no relationship to azalea.

Propagation.—The chrysanthemum is generally propagated by cuttage, seedage or division. Cuttage is by far the most satisfactory, since insects and diseases may be controlled by the careful selection of clean stock. Plants grown from cuttings make better growth, give better flowers and are easier to stake and tie in the garden. Nearly all chrysanthemums grown in commercial greenhouses are produced from cuttings. Division is practised by many outdoor gardeners. Seedage is practised only by breeders who seek new varieties.

Plants for propagation are packed in flats, benches or cold frames, after the flowering season, and wintered over in either a cold greenhouse or frame. In March or April the strong shoots are ideal for making cuttings 2 to 4 in. long. If aphides are present, the cuttings should be placed in a 1-to-500 or 1-to-800 solution of nicotine sulphate in water before planting. Clean sand is best for rooting cuttings, which should be firmly packed and watered. The bed should be lightly shaded for a few days to prevent wilting.

Wilted cuttings generally die, but if they root the resulting plants are stunted. Syringing on warm days will help to keep the cuttings fresh. A temperature of 50° F. is sufficient, but quicker rooting is obtained if 60° F. is maintained.

When the roots are about ½ in. long the plants should be potted in a fibrous loam soil. If allowed to remain too long in the cutting bed, they become hard and are not responsive to good culture. The plants are usually ready for their permanent quarters by early June or July. A good fibrous, well-drained loam is the ideal soil medium for chrysanthemums. If this soil is packed before planting or directly afterward, the new growth becomes firmer and the internodes shorter. Newly set plants should be watered only lightly, since wet soil is unfavourable for their growth. The tops of the plants may, however, be syringed often to keep them fresh.

The planting distances vary with the different types. Commercial growers vary the planting of the large flowering chrysanthemums as follows: 6 in. by 6 in., 7 in. by 8 in., 7½ in. by 8 in., 10 in. by 10 in. Pompons are planted 12 in. by 12 in. and 12 in. by 15 in. inside, while outdoors 15 in. by 15 in. and 18 in. by 18 in. is the general practice.

As soon as the plants are placed they should be staked and tied. The tying should be done as the plant grows so that the stem will remain straight. When the stem becomes 6 in. long the plant should be "topped" (top pinched out), if more than one stem is desired. Topping should continue for small-flowered plants until August. Watering, syringing and tying are of chief importance during the summer months.

The plants should be kept as cool as possible by spraying and syringing and by wetting the walks.

In the late summer and early fall "disbudding" becomes a factor. The first bud to appear is generally the crown bud. This bud will flower early and give a large flower, but the shape, colour and habit are not as desirable for commercial use as are flowers from lateral buds. The crown bud is surrounded by vegetative shoots, one of which may be saved to produce the desired flower bud. The terminal bud of the final shoot is surrounded by other buds, which should be removed if only one large flower is desired.

If the soil is a good composted fibrous loam, no fertilizer should be given until the bud is selected. Thereafter, liquid manure should be given once a week until the buds show colour. Continued

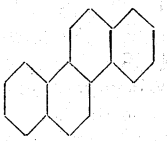
use of any fertilizer, especially those that are too strong, will cause the flowers to "blast" and "burn." The foregoing cultural directions apply equally as well to the chrysanthemums in the garden. Systematic fumigation and the propagation of clean stock are the greatest factors in the prevention and control of pests. Upwards of 500 named varieties of the chrysanthemum are listed in catalogues and horticultural works, and new forms are constantly being produced.

For more extensive details, *see* L. H. Bailey, *The Standard Cyclopedia of Horticulture* (1933); for list of recognized American varieties, *see Standardized Plant Names* (Salem, Mass., 2nd edition, 1939). *See* also E. A. White, *The Chrysanthemum and Its Culture* (1930).

(H. O. Y.; N. Tr.)

CHRYSANTHIUS, Greek philosopher of the 4th century A.D. He was a pupil of Aedesius and an exponent of the mystical side of Neoplatonism (*q.v.*). Invited by the emperor Julian to assist in the scheme for the revival of Hellenism, he declined, probably foreseeing its failure. As high-priest of Lydia he kept the respect of Christians and pagans alike.

CHRYSELEPHANTINE, the architectural term given to statues which were built up on a wooden core, with ivory representing the flesh and gold the drapery (Gr. χρυσός, gold, ἐλέφας, ivory). The most celebrated examples are by Pheidias, the statue of Athena in the Parthenon and of Zeus in the temple at Olympia.

CHRYSENE, a hydrocarbon discovered by Laurent in the high boiling point fractions of coal tar distillate, is produced in small quantity in the distillation of amber, or on passing the vapour of benzyl-α-naphthylmethane through a red-hot tube. When impure, it is of a yellow colour; hence its name (χρύσεος, golden yellow). Chrysene, $C_{18}H_{12}$,  crystallizes in colourless plates or octahedra (from benzene), which exhibit a violet fluorescence, and melt at 250° C. It boils at 448° C. Chromic acid in glacial acetic acid solution oxidizes it to chrysoquinone $C_{18}H_{10}O_2$, which, distilled with lead oxide, gives chrysoketone $C_{17}H_{10}O$. *See* A. E. Everest, *The Higher Coal-tar Hydrocarbons* (1927).

CHRYSIPPUS (*c.* 280–206 B.C.), Greek philosopher, third leader of the Stoics, born at Soli, Cilicia (Diog. Laert. vii. 179). He came to Athens and studied possibly under Zeno, certainly under Cleanthes. It is said also that he became a pupil of Arcesilaus and Lacydes, heads of the middle academy. His chief fame rested on his controversies in the academy, for which he was called "the column of the portico." Diogenes Laertius says "without Chrysippus there had been no Porch." Of the 750 treatises with which he is credited only fragments survive. The style is said to have been crabbed, the argument lucid.

See G. H. Hagedorn, *Moralia Chrysippea* (1685), *Ethica Chrysippi* (1715); J. F. Richter, *De Chrysippo Stoico fastuoso* (1738); F. Baguet, *De Chrysippi vita doctrina et relinquiis* (1822); C. Petersen, *Philosophiae Chrysippeae fundamenta* (1827); A. B. Krische, *Forschungen auf dem Gebiete der alten Philosophie* (1840); R. Nicolai, *De logicis Chrysippi libris* (1859); R. Hirzel, *Untersuchungen zu Ciceros philosophischen Schriften,* ii. (1882); A. Gercke, "Chrysippea" in *Jahrbücher für Philologie,* suppl. vol. xiv. (1885); Christos Aronis, Χρύσιππος γραμματικός (1885); L. Stein, *Die Psychologie der Stoa* (1886); J. E. Sandys, *Hist. Class. Schol.* i. 149; E. Brehier, *Chrysippe* (Les Grands philosophes, Paris, 1910). *See* also Stoics.

CHRYSLER CORPORATION, with main offices in Detroit, Mich., was formed June 6, 1925, succeeding the Maxwell Motor Corporation. In the period 1925–40 it built more than 8,000,000 motor cars and trucks; it also manufactures air-conditioning and heating equipment, marine and industrial engines, and other products. The first car bearing the name of Walter P. Chrysler (1875–1940) appeared in 1924. In 1928 the Chrysler Corporation purchased the Dodge Brothers Motor Company, Inc., and in addition to continuing manufacture of Chryslers and Dodges introduced the DeSoto and Plymouth cars. Properties in 1940 included 25 plants in the U.S., Canada and Europe. Its assets amount to more than $200,000,000, and the only obligations were current liabilities. The stock is made up of 6,000,000 shares of $5 par value common stock of which 4,351,132 shares are outstanding. (K. T. K.)

CHRYSOBERYL, a yellow or green gem-stone, remarkable for its hardness, being exceeded in this respect only by the diamond and corundum. The name suggests that it was formerly regarded as a golden variety of beryl. Its composition is $BeAl_2O_4$, or $BeO{\cdot}Al_2O_3$. It is yellow or pale green, occasionally passing into shades of dark green and brown. Chrysoberyl is often mistaken by its colour for chrysolite (*q.v.*), and has indeed been termed oriental chrysolite, but it is a much harder and denser mineral. A contrast of their chief characters is as follows:

	Chrysoberyl.	Chrysolite.
Hardness	8·5	6·5 to 7
Specific gravity	3·65 to 3·75	3·34 to 3·37
Chemical composition	$BeAl_2O_4$.	Mg_2SiO_4.

Chrysoberyl is not infrequently cloudy, opalescent and chatoyant, and is then known as "cymophane" (Gr. κυμα, cloud). The cloudiness is referable to the presence of multitudes of microscopic cavities. Some of the cymophane, when cut with a convex surface, forms the most valuable kind of cat's-eye (*see* Cat's-eye). A remarkable dichroic variety of chrysoberyl is alexandrite (*q.v.*).

Most chrysoberyl comes from Brazil, chiefly from the district of Minas Novas in the State of Minas Geraes, where it occurs as small water-worn pebbles. The cymophane is mostly from the gem-gravels of Ceylon. Chrysoberyl is a constituent of certain kinds of granite, pegmatite and gneiss. In the U.S.A. it occurs at Haddam, Conn.; Greenfield Center, near Saratoga Springs, N.Y.; Greenwood, Me. and Manhattan island. It is known also in the province of Quebec, Canada, and near Gwelo, Rhodesia.

CHRYSOCOLLA, a hydrous copper silicate occurring as a decomposition product of copper ores. It is never found as crystals, but always as encrusting and botryoidal masses. It is green or bluish-green in colour, and often has the appearance of opal or enamel, being translucent and having a conchoidal fracture with vitreous lustre; sometimes it is earthy in texture. Not being a definite crystallized substance, it varies widely in chemical composition, the copper oxide (CuO), for example, varying in different analyses from 17 to 67%. The hardness (2–4) and sp. gr. (2·0–2·8) are also variable. The mineral occurs in the upper parts of veins of copper ores, and has resulted from their alteration by the action of waters containing silica in solution. Pseudomorphs of chrysocolla after various copper minerals (*e.g.*, cuprite) are not uncommon. Chrysocolla is found in most copper mines. The name chrysocolla (from χρυσός, gold and κόλλα, glue) was applied by Theophrastus and other ancient writers to materials used in soldering gold, one of which, from the island of Cyprus, may have been identical with the mineral now known by this name. Borax, which is used for this purpose, has also been called chrysocolla.

CHRYSOLITE, a transparent green gem-stone. The name chrysolite, meaning "golden stone" (χρυσός and λίθος), has been applied to various yellowish gems, notably to topaz, to some kinds of beryl and to chrysoberyl. The true chrysolite of the modern mineralogist is a pale green olivine (*q.v.*).

CHRYSOLOGUS, PETER (*c.* 405–*c.* 450), bishop of Ravenna, was born at Imola and died at Ravenna. He opposed Arianism, Pelagianism and Eutychianism. Of the works printed in Migne's *Patrol. Lat.*, vol. lii., only about 100 sermons are genuine.

See F. V. Stablewski, *Der heilige Kirchenvater P. von Ravenna* (1871), F. J. Peters, *Petrus Chrysologus als Homilet* (Cologne, 1918).

CHRYSOLORAS, MANUEL [or Emmanuel] (*c.* 1355–1415), a pioneer in spreading Greek literature in the West, was born at Constantinople. He was a pupil of Gemistus Pletho (*q.v.*). In 1393 the emperor Manuel Palaeologus sent him to Italy to seek the aid of the Christian princes against the Turks. About 1395 he became professor of Greek at Florence, where he taught for three years and became famous as a translator of Homer and Plato. In 1413 he went to Germany on an embassy to the emperor Sigismund, to fix the site of a general council. It was decided to hold the meeting at Constance, Ger.; and Chrysoloras was on his way thither, having been chosen to represent the Greek Church,

when he died suddenly on April 15, 1415. Only two of his works have been printed, his *Erotemata* (published at Venice in 1484), which was the first Greek grammar in use in the West, and *Epistolae III. de comparatione veteris et novae Romae.*

JOHN CHRYSOLORAS, a relative of the above, who, like him, had studied and taught at Constantinople, and had then gone to Italy, shared Manuel's reputation as one of those who spread the influence of Greek letters in the West. His daughter married Filelfo (*q.v.*).

CHRYSOPRASE is a transparent variety of crypto-crystalline silica of an apple-green colour (Gr. *χρυσός*, gold and *πράσον*, leek), the latter being due to the presence of nickel, probably in the form of hydrous silicate. A very similar artificial gem may be prepared by immersing chalcedony in solutions of nickel salts. On exposing a natural chrysoprase to light or heat its colour becomes paler, though this may be restored by placing the stone in a damp medium. It is surprising that the colour of the natural gem should be susceptible to the action of light and heat, whilst the artificial product is quite unaffected. (*Precious Stones,* by Max Bauer; trans. L. J. Spencer, 1904.)

CHRYSOSTOM (ST. JOHN CHRYSOSTOM) (*Χρυσόστομος*, golden-mouthed) (A.D. 345–407), the most famous Greek Father, was born at Antioch about A.D. 345. At the school of Libanius, the sophist, he gave early indications of his mental powers and love of classical culture. On being baptized (*c.* 370) by Meletius, bishop of Antioch, he retired to the desert, where for ten years he led a life of asceticism and study. Illness compelled him to return to the world, and in 381 he was ordained deacon, and in 386 priest. He won great reputation by his preaching at Antioch, especially by his homilies on *The Statues,* delivered when the people feared the consequences of the destruction of the statues of the emperor Theodosius during a riot.

On the death of Nectarius, Chrysostom was appointed bishop of Constantinople (398). In this capacity he won the love of the people by his eloquent and devout homilies and by the application of his ample revenues to the establishment of hospitals. But his reforming zeal also made him many enemies. The clergy were forbidden to keep lay sisters as servants, aimless monks were confined to their monasteries, and the extravagances of the court were strongly denounced. His enemies found a pretext for revenge in the shelter which he had given to four Nitrian monks who had been excommunicated by their bishop, Theophilus of Alexandria. Theophilus was invited to Constantinople (403) and charging Chrysostom with Origenism, thrice summoned him to appear before a synod. He refused to appear and finally was declared deposed, arrested and exiled. The threats of the people, however, led the empress Eudoxia to recall him. Shortly afterwards his denunciation of the honours addressed to a statue of the empress almost within the precincts of St. Sophia led to the calling of a second council, which again deposed him (404) for having resumed his functions without its permission. The people fired the cathedral and the senate-house, but Chrysostom was hurried away to Cucusus (Cocysus) among the ridges of Mount Taurus. His correspondence with the different churches and the recognition of his orthodoxy by Pope Innocent I. and the emperor Honorius caused the emperor Arcadius to order his removal to the extreme desert of Pithyus. He died on the way at Comana in Pontus in 407. His exile gave rise to a schism and the Johannists (as they were called) only returned to communion with the bishop of Constantinople after the relics of the saint were brought back (437) and the emperor had publicly implored divine forgiveness. The feast of St. John Chrysostom falls on Nov. 13 in the Greek Church and on Jan. 27 in the Latin Church.

He elevates the ascetic element in religion and stresses the importance of knowing the Scriptures. In exegesis he is pure Antiochene, basing his expositions upon thorough grammatical study and not on the allegorical interpretation of Origen and the Alexandrian school. His writings contain the germ of later Eucharistic teaching and the invocation of the saints, but give no direct expression of the primacy of the pope or the necessity of private confession. As early as 425 Chrysostom was cited by the Greeks and Latins as a great authority.

His voluminous works include the early-monastical treatises, including *On Priesthood,* the many homilies and commentaries written during his priesthood and episcopate, the best known being those *On the Statues* and on *Genesis, Psalms, Matthew and Romans,* and the letters which belong to the time of his exile and are valuable sources of history.

The best edition is that of Migne (*Patrol. Graec.* xlvii.–lxiv.) but many of the treatises have been edited more recently. English translations of some of the homilies and commentaries are in the Oxford Library of the Fathers. The most valuable authorities for his life are the ecclesiastical histories of Palladius, Socrates, Sozomen and Theodoret.

See W. R. Stephens, *St. John Chrysostom* (1871); F. H. Chase, *Chrysostom, A Study in Biblical Interpretation* (1887); Naegle, *Die Eucharisticlehre Des hl. Joh. Chrysostom* (Freiburg, 1900); C. Baur, *S. Jean Chrysostome et ses oeuvres* (Louvain, 1907); J. M. Vance, *Beiträge zur Byzantinischen Kulturgeschichte aus den Schriften des Chrysostom* (Jena, 1907); A. Harnack, *Hist. of Dogma* iii. and iv.

CHRYSOTILE, a variety of serpentine, a hydrous silicate of magnesia, which is characterized by a fine, more or less silklike fibrous structure; this is the principal fibrous mineral used in commerce under the name asbestos (*q.v.*). (The name is derived from the Greek *χρυσός*, gold and *τίλος*, down or hair, literally hair of gold.)

CHUB (*Leuciscus cephalus*), a Cyprinid fish distinguished from others of the family in English rivers by the broad head and strong jaws and by feeding to a considerable extent on little fish. In England a length of 2ft. and a weight of 8 lb. is reached, but on the Continent 12 lb. In America the name is applied to other large-headed Cyprinids, *e.g.,* the river chub (*Hybopsis kentuckiensis*) and the silver chub (*Semotilus corporalis*).

CHUBB, CHARLES (d. 1845), English locksmith, started a hardware business at Winchester, subsequently removing to Portsea. Here he improved on the "detector" lock originally patented in 1818 by his brother, Jeremiah Chubb. He soon moved to London and then to Wolverhampton, where he employed two hundred workers. In 1835 he patented a process intended to render safes burglar-proof and fireproof, and eventually established a large safe-factory in London. He died on May 16, 1845, and was succeeded in the business by his son, John Chubb (1816–72), who patented various improvements in the products of the firm.

CHUBB, THOMAS (1679–1746), English deist, was born at East Harnham, near Salisbury, on Sept. 29, 1679. The son of a maltster, he was apprenticed to a glove-maker and subsequently worked for a tallow-chandler. Later he lived for some years in the house of the master of the rolls, Sir Joseph Jekyll, apparently as a servant of some kind. He died in Salisbury on Feb. 8, 1746. He appeared as an author during the Arian controversy with an essay, *The Supremacy of the Father Asserted,* published on Whiston's authority in 1715. Mainly interesting as showing the spread of rationalism in the popular mind of the period, he was regarded by Voltaire as one of the most logical of his school. (*See* DEISM.) His chief works are *Discourse concerning Reason* (1731); *True Gospel of Jesus Christ* (1739); and *Posthumous Works* (1748).

CHUBUT, a territory of the southern Argentine Republic, part of what was formerly called Patagonia, bounded north by Río Negro, south by Santa Cruz, east by the Atlantic and west by Chile. Pop. (1942) 89,400; area, 86,751 sq.mi. Except for the valleys in the Andean foot-hills, which are fertile and well forested, and the land along the banks of the Chubut river, which flows entirely across the territory from the Andes to the Atlantic, the country is a steppe land covered with scanty dwarfed vegetation, with occasional shallow saline lakes. The larger rivers are the Chubut and the Senguerr, the latter flowing into Lake Colhué Huapí. There are a number of large lakes among the Andean foothills, the best known of which are Fontana, Menéndez and General Paz, and, in the interior, Colhué Huapí and Musters, the latter named after the English naval officer who traversed Patagonia in 1870. Petroleum was found at Comodoro Rivadavia, in the southern part of the territory, toward the close of 1907, at a depth of 1,768 ft. and is being exploited. Chubut is known chiefly by the Welsh colony near the mouth of the Chubut river and its branch,

the 16th of October colony, farther up the river. The chief town of the Welsh, Rawson, is the capital of the territory, and Port Madryn on Golfo Nueva is its best port. Other colonies have been founded in the fertile valleys of the Andean foot-hills, but their growth is greatly impeded by lack of transportation facilities. (*See* PATAGONIA.)

CHUCK, a device for holding work in a lathe (*q.v.*) or a drill (*see* DRILL and BORING) and consisting essentially of three or four converging jaws.

CHUDE, a tribal name used in both a special and a general sense. (1) It was the name given by the Russians to certain Estonian tribes with whom they came in contact as they spread gradually over their present empire. It would seem that the northern Chudes are the Vepsas. (2) As the Russians advanced eastwards they extended the name to various tribes whom they considered to be like the Estonians, and in popular use it has come to be applied to any ancient non-Russian people in Siberia, at least as far east as the Altai.

CHUGUYEV, a town in the Kharkov county of the Ukrainian S.S.R., on the right bank of the river Donetz, where the railway linking Kharkov to Kupyansk crosses the river. Lat. 49° 49′ N. Long. 36° 41′ E. Pop. (1926) 13,311.

CHUKCHI, CHANKTUS ("Men") or TUSKI ("Brothers" or "Confederates"), a Mongoloid people inhabiting the north-easternmost portion of Siberia on the shores of the Arctic Ocean and Bering Sea. They are settled in small groups along the Arctic coast between the Bering Strait and the Kolyma river, or wander as far inland as the Anadyr basin. They are tall, lean, with somewhat irregular features and round-headed. The nose is set deep between the cheeks. The lips are thick, and the brow low. The hair is coarse, lank and black. They are classed as Nearetic.

The Chukchi are divided into the "Fishing Chukchi," who have settled homes on the coast, and the "Reindeer Chukchi," who are nomads. The latter breed reindeer in large herds, live on the flesh and milk, and are generally fairly prosperous; while the fishing folk are very poor, begging from their richer kinsfolk hides to make tents and clothes. They kill off the old and infirm. They believe in a future life, but only for those who die a violent death. It is thus an act of filial piety for a son to kill his parent or a nephew his uncle. This custom is known as *kamitok*. The Chukchi sacrifice animals to the spirits of the rivers and mountains, and also practise Shamanism. The use of drums in these rites is general. They are polygamous, but the women are treated kindly. The children are specially petted. Chukchi women are often tattooed with two black-blue convex lines running from the eye to the chin. Since their adoption of Christianity the men sometimes have a Latin cross tattooed on their chins. The Chukchi burn their dead or expose them on platforms to be devoured by ravens.

See Harry de Windt, *Through the Gold Fields of Alaska to Bering Strait* (1898); Dittmar, "Über die Koriaken u. ihnen nahe verwandten Tchouktchen," in *Bul. Acad. Sc.* (St. Petersburg), xii. p. 99; Hooper, *Ten Months among the Tents of the Tuski;* W. H. Dall, *Contributions to North American Ethnology,* vol. i. (1877); M. Czaplicka, *Aboriginal Siberia* (1914).

CHULALONGKORN, PHRA PARAMINDR MAHA (1853–1910), king of Siam, eldest son of King Maha Mongkut, was born on Sept. 21, 1853, and succeeded his father on the throne on Oct. 1, 1868. The young king, who had according to custom been brought up in a Buddhist monastery, again retired into seclusion until he came of age in 1873, the government being entrusted to a regency. He then took the step, unprecedented for an eastern Asiatic potentate, of travelling outside his dominions, in India and the Dutch East Indies. The fruits of his appreciation of foreign institutions appeared in the reforms which he instituted in Siam: the abolition of slavery, the simplification of court etiquette, the grant of liberty of conscience, the erection of schools and hospitals, and the further development of the army and navy. He established a standard coinage, postal and telegraph services, and arranged for the policing, sanitation, and lighting of Bangkok. Several of his sons, including the Crown Prince, were educated in England, and he himself visited Europe in 1897. He died at Bangkok on Oct. 23, 1910.

CHUMASH, the natives of the Santa Barbara coast and islands, California. When discovered by Cabrillo in 1542, and missionized from 1771 on, they numbered perhaps 8,000–10,000, but were virtually extinct by 1900. They made sea-going plank canoes, harpoons and spear-throwers, many shell ornaments and fine baskets. Technologically they ranked with their neighbours, the Gabrielino, at the head of all Californian tribes. Their society and religion are almost unknown, but may be assumed as similar to those of the Gabrielino.

CHUMBI VALLEY, a valley connecting Tibet (*q.v.*) with the frontier of British India. On the southern slopes of the Himalayas about 9,500 ft. above the sea, the valley is wedged in between Bhutan and Sikkim, and does not belong geographically but only politically to Tibet. This was the route by which the British mission of 1904 advanced. The valley is sparsely cultivated on small flats by the river.

CHUNAR, a town and ancient fortress of India, in the district of Mirzapur, in the United Provinces, on the south bank of the Ganges. Pop. (1941) 8,654. The fort occupies a site on the summit of an abrupt rock which commands the river. It was once a place of great strength, and contains the remains of a Hindu palace with interesting carvings. The town, which consists of one or two straggling streets, was once a European settlement, for the invalid or veteran battalion of the East India Company's army. In the church, the school, some ruinous houses, and the graveyards, are traces of that colony of war-worn exiles. The chief industry is the excellent building stone which is found in the neighbourhood. In 1530 Chunar became the residence of Shere Shah the Afghan, and 45 years later was recovered by the emperor Akbar after sustaining a siege of six months. It fell into the hands of the English under General Carnac in 1763 after a prolonged resistance. A treaty with the nawab of Oudh was signed here by Warren Hastings on behalf of the East India Company in Sept. 1781, and for a time it enjoyed a military importance as the frontier post of the company's jurisdiction.

CHUNCHO, a tribe of South American Indians, living in the forests east of Cuzco, central Peru. Chuncho has also been used to describe one of three aboriginal stocks of Peru, the others being Quichua and Aymara.

CHUNGKING, former treaty port and commercial emporium of the isolated but important and densely peopled Inland Basin of Szechwan in West China (situation, 29° 35′ N., 106° 37′ E.). It is built on a rocky peninsula at the confluence of the Kialingkiang, the most easterly of the great rivers draining the Red Basin, with the Yangtze Kiang, the arterial line of communication in Middle China. Chungking is therefore the natural gateway through which Szechwan communicates with the rest of China and the ocean. Moreover it gathers up the trade of E. Tibet and of much of the north of Kweichow and Yünnan.

Chungking claims a history of more than 4,200 years. It was the birthplace of the imperial consort of the legendary Emperor Yu of the Hsia dynasty of the 22nd century B.C. When Emperor Wu of the Chow dynasty became ruler of China he made the viscount of Pahtzeku ruler over the territory now called Chungking and its neighbouring towns. It was made a kingdom about 340 B.C. Pahtzekuo was absorbed, as a county, under the Chin dynasty. The region of Chungking served occasionally as basis for independent rebellious leaders as General Min Yu-chen at the end of the Yuan dynasty in 1367–68 and Chang Hsien-chung in 1645–51 at the end of the Ming dynasty. The Sino-British treaty of Chefoo in 1876 and the treaty of Peking in 1890 opened Chungking as a treaty port. The Japanese gained the right to establish a concession in Chungking after the treaty of Shimonoseki in 1895. The Japanese concession which was established in 1901 was taken over by the Chinese authorities when war broke out in 1937.

Chungking became a municipality in Feb. 1923; on Nov. 20, 1937, Chungking became the wartime capital of China. In May 1939 it was placed under the control of the Executive Yuan and became a special municipality. After being officially named an auxiliary capital in Oct. 1940, its municipal limits were extended to include the four districts of Hsiaolungkan, Shapingpa, Tzechi-

kow and Koloshan. Total area after expansion equals 116 sq.mi.

Extensive damage was caused by the repeated bombings of the Japanese from the period 1938 to 1941. Large sections of the downtown area were destroyed. General Ho Yao-tsu was appointed mayor of Chungking in Dec. 1942, replacing Dr. K. C. Wu who had formerly been mayor of Hankow. Although the population of Chungking has fluctuated there has been marked increase with the growing importance of the city. Population (1927) 208,294; (1939) *c.* 550,000. The police survey of Aug. 1942 shows the population of Chungking to be 723,704. The total population as indicated in the registration for residents' identification cards was around 1,000,000 at the end of 1942.

CHUPATTY. An Anglo-Indian term for an unleavened cake of bread. The word represents the Hindustani *chapati,* and is applied to the usual form of native bread, the staple food of upper India. The chupatty is generally made of coarse wheaten flour, patted flat with the hand, and baked upon a griddle. In 1857, chupatties were circulated as a sign of discontent.

CHUPRIYA or CUPRIJA, a city in the Morava department of Serbia, Yugoslavia. The old name was Korea Margi. (Pop., 1931, 8,235.) It is on the railway from Belgrade to Nish, and on the Morava, which is navigable up to this point by small sailing vessels. A light railway runs to Senje, which has lignite and other collieries that were seriously damaged in World War I. Fine Serbian cattle are bred in the neighbouring lowlands, and the town has a large sugar beet factory and considerable trade in plums and farm produce. A government nursery for mulberry trees has been started; sericulture, which flourished in the middle ages, died down under Turkish rule. There is a government stud farm in the district. In World War I Chupriya was the central ammunition depôt of the Serbian army; in World War II it was occupied by Germany. Cloth is woven, and there are glass works at Paracin, 5 mi. S. Jagodina, 8 mi. W. by N., is an important market town. Both are connected with Chupriya by rail and road.

The 14th-century Ravanitsa monastery, with a ruined fort and an old church (their walls and frescoes pitted by Turkish bullets) is about 7m. distant. Legend says that here the Serbian tsar Lazar (1374–89) was visited by an angel who bade him choose between an earthly and a heavenly crown. In accordance with his choice Lazar fell fighting at the battle of Kosovo. He was buried at Ravanitsa, but his body was afterwards removed. His crucifix is treasured among the monastic archives, which also contain a charter signed by Peter the Great of Russia (1672–1725). Manasia (*Manasiya*), the still more celebrated foundation of Stephen, the son and successor of Lazar, lies 12m. N. of Ravanitsa. Built in a cleft among the hills, this monastery is enclosed in a fortress, whose square towers, and curtain without loopholes or battlements, remain largely intact. Within the curtain stand the monastic buildings, a large garden and a cruciform chapel, with many curious old stone carvings, half hidden beneath whitewash. Numerous gifts from the Russian court, such as gospels lettered in gold and silver relief, and jewelled crucifixes, are preserved on the spot, but the valuable library was removed in the 15th century to the monastery of Hilendar on Mt. Athos.

CHUQUET, NICOLAS (1445–1500), French mathematician, was born at Paris. He studied and qualified in medicine, probably at Lyons. In 1484 he wrote a work on arithmetic, *Triparty en la science des nombres.* This was circulated in manuscript form and was first printed in 1880. The first part deals with rational numbers, the second with irrational numbers and square roots, and the third part is a study of equations. The *Triparty* was very largely used and its influence can be traced in the *Arithmetic* of de la Roche.

See A. Marre, "Notice sur Nicolas Chuquet et son Triparty," *Bulletino Boncampagni* xiii.

CHUQUISACA, a department of S.E. Bolivia. It lies partly upon the eastern plateau of Bolivia and partly upon the great plains of the upper La Plata basin; area, 36,132 sq.m. The Pilcomayo, a large tributary of the Paraguay, crosses N.W. to S.E. the western part of the department. The climate of the lowlands is hot, humid and unhealthy, but that of the plateau is salubrious, though subject to greater extremes in temperature. The seasons are sharply divided into wet and dry, the eastern plains becoming great lagoons during the wet season, and parched deserts during the dry. The mineral resources are important, but are less developed than those of Potosí and Oruro. Grazing is the principal industry of the plains, and cattle, sheep, goats and llamas are raised and cereals grown in the fertile valleys of the plateau. Rough highways connect Chuquisaca with its neighbours on the N. and W., and pack animals are the common means of transporting merchandise. The only railway and the best highway in the department connect Sucre with Potosí. The population was estimated at 407,000 in 1940, and is largely composed of Indians and mestizos. The plateau Indians are generally Aymaras, but on the eastern plains there are considerable settlements of partly civilized Chiriguanos, of Guaraní origin. The department is divided into five provinces, the greater part of the lowlands being unsettled and without effective political organization. Its principal towns are Sucre, the capital, San Lucas, Tarabuco and Yotala.

CHUR, the capital of the Swiss canton of the Grisons (Fr. *Coire,* Ital. *Coira*). It lies 1,950 ft. above sea-level on the valley-floor of the Vorder Rhein in the angle between the Plessur and the Rhine, and is overshadowed by the Mittenberg and Pizokel, hills that guard the entrance to the deep-cut Schanfigg (Plessur) valley. Pop. (1941) 17,074. In 1920 12,644 were German-speaking, 1,871 were Romansch and 943 Italian. Protestants numbered 9,783, and Roman Catholics 5,733. The old city is on the west, and includes the cathedral church of St. Lucius (traditionally a 2nd-century British king), which was built between 1178 and 1282, on the site of an older church. Opposite is the Bishop's Palace, and not far off is the Episcopal Seminary (built on the ruins of a 6th-century monastic foundation). The Raetian Museum contains a great collection of objects relating to Raetia. Chur is 74 m. by rail from Zürich: it is the meeting-point of routes from Italy over many Alpine passes (the Lukmanier, the Splügen, the San Bernardino) and is the centre of an active trade, particularly in wine from the Valtelline. Electric trains run to Davos, St. Moritz, Arosa and Andermatt.

The episcopal see is first mentioned in 452, but probably existed a century earlier. The bishop soon acquired great temporal powers, and became a prince of the Empire in 1170. In 1392 he became head of the league of God's House (originally formed against him in 1367), one of the three Raetian leagues, but in 1526, after the Reformation, lost his temporal powers, having fulfilled his historical mission. The bishopric still exists, with jurisdiction over the Cantons of the Grisons, Glarus, Zürich, and the three Forest Cantons, as well as over Liechtenstein.

The guild constitution of the city of Chur lasted from 1465 to 1839.

BIBLIOGRAPHY.—W. von Juvalt, *Forschungen über die Feudalzeit im Curischen Raetien,* 2 parts (1871); C. Kind, *Die Reformation in den Bisthümern Chur und Como* (1858); Conradin von Moor, *Geschichte von Curraetien* (2 vols., 1870–74); P. C. von Planta, *Verfassungsgeschichte der Stadt Cur im Mittelalter* (1879); *Das Bürgerhaus d. Schweiz,* vol. xiv. (1924).

CHURCH, SIR ARTHUR HERBERT (1834–1915), British chemist, was born on June 2, 1834, in London. He was educated at the Royal College of Chemistry in London and at Oxford. In 1863 he was appointed professor of chemistry at the Royal Agricultural college, Cirencester, and during this period Church studied chemical problems connected with agriculture. He was a man of wide and varied tastes, and applied chemistry to the subjects in which he was interested, such as mineralogy (he discovered a new mineral, Churchite), archaeology and chiefly painting. In 1879 Church was appointed professor of chemistry at the Royal Academy of Arts; he retired from this post in 1911. During this period he worked on the chemistry of painting and his book, *The Chemistry of Paints and Painting* (1890), has run into many editions and has been translated into German.

He was an authority on precious stones and porcelain; he left instructions to his wife that various collections of curios and antiques were to go to the Ashmolean Museum at Oxford and his cut precious stones to the British Museum. He died in London on May 31, 1915.

Some of his works are *Handbook of Precious Stones* (1883); *English Earthenware* (1884); *English Porcelain* (1885); *Food Grains of India* (1886); *Josiah Wedgwood* (1894), and *The Conservation of Historic Buildings and Frescoes* (1907).

CHURCH, FREDERICK EDWIN (1826–1900), American landscape painter, was born at Hartford (Conn.) on May 4, 1826. He was a pupil of Thomas Cole at Catskill (N.Y.), where his first pictures were painted. Developing unusual technical dexterity, Church from the beginning sought for his themes such marvels of nature as Niagara Falls, the Andes, and tropical forests—he visited South America in 1853 and 1857—volcanoes in eruption, and icebergs, the beauties of which he portrayed with great skill in the management of light, colour, and the phenomena of rainbow, mist and sunset, rendering these plausible and effective. In their time these paintings awoke the wildest admiration and sold for extravagant prices, collectors in the United States and in Europe eagerly seeking them, though their vogue has now passed away. In 1849 Church was made a member of the National Academy of Design. His "Great Fall at Niagara" (1857) is in the Corcoran Art Gallery, Washington (D.C.), and a large "Twilight" is in the Walters Gallery, Baltimore (Md.). Among his other canvases are "Andes of Ecuador" (1855), "Heart of the Andes" (1859), "Cotopaxi" (1862), "Jerusalem" (1870), and "Morning in the Tropics" (1877). He died on April 7, 1900, at his house on the Hudson river above New York city, where he had lived and worked for many years. He was the most prominent member of the "Hudson river school" of American artists.

CHURCH, GEORGE EARL (1835–1910), American geographer, was born in New Bedford (Mass.), on Dec. 7, 1835. He was educated as a civil engineer, and was early engaged on the Hoosac tunnel. In 1858 he joined an exploring expedition to South America. During the American Civil War he served (1862–65) in the Army of the Potomac, rising to the command of a brigade and the rank of colonel; and in 1866–67 he was war correspondent of the *New York Herald* in Mexico. He explored the Amazon (1868–79), and gradually became the leading authority on that region of South America. In 1880 he was appointed U.S. commissioner to report on Ecuador, and in 1895 visited Costa Rica to report on its debt and railways. He wrote extensively on South and Central American geography, and became a vice-president of the Royal Geographical Society (London), and in 1898 president of the geographical section of the British Association.

CHURCH, SIR RICHARD (1784–1873), British military officer and general in the Greek army, was the son of a Quaker, Matthew Church of Cork. He was born in 1784, and at the age of 16 ran away from home and enlisted in the army. For this violation of its principles he was disowned by the Society of Friends, but his father bought him a commission in the 13th (Somersetshire) Light Infantry. He served in the demonstration against Ferrol, and in the expedition to Egypt under Sir Ralph Abercromby in 1801. He accompanied the expedition which landed in Calabria, and fought a successful battle against the French at Maida on July 6, 1806. In the summer of 1809 Church sailed with the expedition sent to occupy the Ionian islands. Here he formed a Greek regiment in English pay. It included many of the men who were afterwards among the leaders of the Greeks in the War of Independence. Church drew up a report on the Ionian islands for the Congress of Vienna, in which he advocated the retention of the islands under the British flag and the permanent occupation by Great Britain of Parga and of other formerly Venetian coast towns on the mainland, then in the possession of Ali Pasha of Iannina. In 1817 he entered the service of King Ferdinand of Naples as lieutenant-general, with a commission to suppress the brigandage then rampant in Apulia. In 1820 he was appointed governor of Palermo and commander-in-chief of the troops in Sicily. The revolution which broke out in that year led to the termination of his services in Naples.

In 1827 Church became commander-in-chief of the Greek army. The rout of his army in an attempt to relieve the acropolis of Athens, then besieged by the Turks, proved that it was incapable of conducting regular operations. The acropolis capitulated, and Sir Richard (he had been knighted by George IV.) turned to partisan warfare in western Greece. Here his activity had beneficial results, for it led to a rectification in 1832, in a sense favourable to Greece, of the frontier drawn by the Powers in 1830 (*see* his *Observations on an Eligible Line of Frontier for Greece,* 1830). Church had, however, surrendered his commission, as a protest against the unfriendly Government of Capo d'Istria, on Aug. 25, 1829. He lived for the rest of his life in Greece, was created general of the army in 1854, and died at Athens on March 30, 1873.

See *Sir Richard Church,* by Stanley Lane Poole (1890); Z. D. Feniman, *Some English Philhellenes* (1917); *Sir Richard Church in Italy and Greece,* by E. M. Church (Edinburgh, 1895), based on family papers (an Italian version, *Brigantaggio e società segrete nelle Puglie, 1817–1828,* executed under the direction of Carlo Lacaita, appeared at Florence in 1899). The ms. correspondence and papers of Sir Richard Church, in 29 vols., now in the British Museum (add. mss. 36,543–36,571), contain invaluable material for the history of the War of Greek Independence, including a narrative of the war during Church's tenure of the command, which corrects many errors in the published accounts and successfully vindicates Church's reputation against the strictures of Finlay, Mendelssohn-Bartholdy and other historians of the war (see *Cam. Mod. Hist.* x. p. 804).

CHURCH, RICHARD WILLIAM (1815–1890), English divine, son of John Dearman Church, brother of Sir Richard Church (*q.v.*), a merchant, was born at Lisbon on April 25, 1815, his early years being mostly spent at Florence. He went up to Wadham college, Oxford, in 1833, took first-class honours in 1836, and in 1838 was elected fellow of Oriel. He was appointed tutor of Oriel in 1839, and was ordained the same year. He was an intimate friend of J. H. Newman at this period, and closely allied to the Tractarian party. In 1841 No. 90 of *Tracts for the Times* appeared, and Church resigned his tutorship. In 1844–45 he was junior proctor, and in that capacity, in concert with his senior colleague, vetoed a proposal to censure Tract 90 publicly. In 1846 Church, with others, started *The Guardian* newspaper, and he was an early contributor to *The Saturday Review.* He accepted in 1852 the small living of Whatley in Somersetshire, near Frome. In 1869 he refused a canonry at Worcester, but in 1871 he accepted, most reluctantly (calling it "a sacrifice *en pure perte*"), the deanery of St. Paul's, to which he was nominated by W. E. Gladstone. Dean Church died on Dec. 9, 1890.

His chief pub. works are a *Life of St. Anselm* (1870); the lives of *Spenser* (1879) and *Bacon* (1884) in Macmillan's "Men of Letters" series; an *Essay on Dante* (1878); *The Oxford Movement* (1891), together with many other vols. of essays and sermons. A coll. of his journalistic arts. was pub. in 1897 as *Occasional Papers.*

See *Life and Letters of Dean Church,* by his daughter, M. C. Church (1895); memoir by H. C. Beeching in *Dict. Nat. Biog.;* and D. C. Lathbury *Dean Church* (1907).

CHURCH. The word church refers both to the Christian religious community and to the building used for Christian worship. This article, after discussing the etymology of the word itself, will deal separately with these two subjects.

Etymology of the Word Church.—According to most authorities, the word is derived from the Gr. κυριακὸν (δῶμα), "the Lord's (house)," and is common to many Teutonic, Slavonic and other languages, under various forms—*e.g.,* Scottish *kirk,* Ger. *kirche,* Swed. *kirka,* Dan. *kirke,* Russ. *tserkov,* Bulg. *cerkova,* Czech. *cirkev,* Finn. *kirkko,* etc. The word was originally applied to the building used for Christian worship, and subsequently extended to the Christian community (*ecclesia*) itself. Conversely, the Greek word *ecclesia* (ἐκκλησία) was transferred from the community to the building, and is used in both senses, especially in the modern Romance and Celtic languages (*e.g.,* Fr. *église,* Welsh *eglwys,* etc.). The Gothic New Testament of Ulfilas has *aikklesjo.*

A. THE CHURCH: THE RELIGIOUS COMMUNITY

The English word "church" represents the Greek ἐκκλησία (naturalized in Latin as *Ecclesia*) in its specifically Christian use. Other uses of the Greek word shed no light on this, and may prove misleading if brought into comparison. As so used, its earliest appearance that we can date is in the Epistles of St. Paul, where it is evidently a familiar term. In the earliest of them the apostle

writes, "ye have heard of my manner of life in time past in the Jews' religion, how that beyond measure I persecuted the Church of God, and make havock of it." This phrase, *the Church of God* (*τὴν ἐκκλησίαν τοῦ Θεοῦ*), has a history behind it, which will show exactly in what sense it was here used.

In the Old Testament are two Hebrew words *'edah,* and *ḳahal,* which in the LXX. are indiscriminately rendered *συναγωγὴ* or *ἐκκλησία.* In the Pentateuch both alike signify the general assembly of the people of Israel during the Wanderings. The word *ἐκκλησία,* which is so far confined to Deuteronomy is in this connection a natural Hellenism. Elsewhere they mean the people itself, especially in its relation to God, with little or no reference to assembling. Striking examples are Nehemiah xiii. 1 where the phrase is *ἐκκλησία θεοῦ,* and Ps. lxxiv. 2, *τῆς συναγωγῆς σου.* The word *συναγωγὴ* is the more frequent, and this alone survived in current use among Hellenistic Jews in the sense of a local congregation, the familiar *synagogue.* What has to be considered is the reason why the other word was revived in Christian use. The origin and the essential character of the Church are involved in this enquiry.

As historical sources there is nothing else, except in some sections of the Acts, so entirely contemporary as St. Paul's Epistles; but in the Gospels and in the rest of the Acts, though the language may be coloured by later thought or experience, valuable material can be found. It is clear that the gospel began as a proclamation of the Kingdom of God (or of Heaven) having close affinity both with older Messianic prophecy referring to the lineage of David, and with more recent apocalyptic dreams. The proclamation was renewed in both aspects by the Apostles on the basis of belief in the resurrection and ascension of Jesus as the Christ. They gathered at Jerusalem a considerable number of disciples, forming a close community which was entered by the rite of baptism. There is reason to think that it was organized as a synagogue, one of the many in Jerusalem. In Aramaic "synagogue" is *knishta.* The Church is still so called by the Aramaic Christians of Palestine. Hence, perhaps, the word *synagogue* in James ii. 2. In the 4th century Epiphanius writes clumsily of the Ebionites, *συναγωγὴν καλοῦσι τὴν ἑαυτῶν ἐκκλησίαν καὶ οὐχὶ ἐκκλησίαν* (*Adv. Haeres,* i. ii. 18). We hear of it later (Acts xv.) as governed by James with a bench of Presbyters, the usual equipment of a synagogue. Some Pharisees and some priests joined, and the disciples regularly took part in the worship of the Temple; but the high priest and the Sanhedrim were hostile, making intermittent attempts to suppress the movement.

The episode of Stephen was a turning point. It is evident that this Hellenistic Jew was out of sympathy with the dominant religious sentiments of Jerusalem, probably shared by the Apostles and most of their disciples. He seems to have anticipated revolutionary changes, involving the suppression of the Mosaic ordinances and even of the Temple. His defence before the Sanhedrim was a rapid survey of Old Testament history. That history is a record of repeated relapses and ruin of God's chosen people, followed by the recovery of a small remnant, the common subject of prophecy. Stephen is just approaching a prophetic warning when he is silenced. It is probable that this worked in the mind of St. Paul, as preparation for his conversion. It became a prominent element in his teaching that the prophetic doctrine of the Remnant was being fulfilled. The Jewish people as a whole had fallen away by their rejection of Jesus as Messiah; those who accepted him were the faithful remnant which was to be the beginning of a reconstitution of God's people. He develops the argument in Romans ix., xi., but the conclusion is condensed into one remarkable sentence, Philip iii. 3, "We are the circumcision, who worship by the spirit of God, and glory in Christ Jesus, and have no confidence in the flesh." In current speech "the circumcision" meant the Jewish people regarded as bound in covenant to God. The actual rite of circumcision was being abandoned by Christians, and the sentence may be paraphrased: "Not those who practise the circumcision of the flesh, but the believers in Jesus as the Christ, are all that circumcision signifies, the covenanted People of God." It is the proper conclusion of Stephen's interrupted argument. St. Paul himself, having heard the argument and taken an active part in the persecution that followed, was soon afterwards convinced of its truth. So he said that he had persecuted "the *ecclesia* of God."

Why that Greek word? It occurs in Stephen's defence, but we do not know that he spoke in Greek. It would be familiar to any diligent reader of the LXX. and peculiarly appropriate, as it appears in Nehemiah xiii. 1, where *ἐκκλησία Θεοῦ* means the returning exiles, the Remnant on which the people of God was to be reconstructed. Its use appears to be a deliberate archaism; the exact equivalent *συναγωγὴ* being current, but unsuitable because of its immediate associations. In the Aramaic of the Christians of northern Syria *'edta,* a variant of the Hebrew *'edah,* is a precisely similar archaism. A common place of origin is, perhaps, to be found at Antioch. Hort's hesitating suggestion that it may have been derived from the saying of our Lord recorded in Matt. xvi. 18 is unacceptable in view of the improbability that Greek was the language used on that occasion. If not, the use of *ἐκκλησία* there will be due to later coloration.

The use of the word thus indicates the definite application of the prophetic teaching about the Remnant to the new Christian community. This application was not peculiar to St. Paul; it is found also in the words quoted by James in Acts xv. 16, "I will build again the tabernacle of David which is fallen, and I will build again the ruins thereof." The rest of his quotation marks a second crisis: "That the residue of men may seek the Lord, and all the Gentiles, upon whom my name is called." It was not long after the episode of Stephen that St. Peter startled the community at Jerusalem by baptizing Cornelius the centurion at Caesarea, an example which appears to have been soon followed at Antioch. The Jewish Commonwealth had always been open to proselytes who received circumcision and undertook to observe the Mosaic law, but these new entrants did not conform to either condition. When the community at Jerusalem consented, perhaps reluctantly, to the innovation, a complete break with Judaism was bound to come. St. Paul was inclined to press it, arguing (rather inconsistently with the doctrine of the Remnant) that Jews and Gentiles had to enter equally into the new covenant (*Gal.* iii.), but he afterwards spoke of the Gentiles as engrafted into the stock of Israel (*Rom.* xi. 17).

The Church now became a Diaspora, like that of Judaism, extended in all directions by the work of the Apostles and their helpers, but retaining its headquarters at Jerusalem. Consequently, the word *ecclesia* speedily went the same way that the word *synagogue* had gone; from being the designation of the whole People of God, it became the designation also of local groups. This development was already complete when St. Paul addressed his first extant epistle to "the Churches of Galatia." Of the organization of these Churches we know very little, for our only informants had no occasion to describe what was familiar to those for whom they were writing. Two opinions on the subject stand in sharp contrast. The one is linked with Luther's conception of an "invisible" Church, the members of which are known only to God. Rudolph Sohm is the ablest recent exponent of this idea. According to him, believers in Jesus as Christ were at first united only by a spiritual nexus; but before long there was an inevitable attempt to bind together all putative believers in an external organization, which eventually claimed to be the true Church of God, thus corrupting the pure spirituality of the Gospel. The other opinion postulates a completely organized society, existing from the beginning and continuing, not indeed without changes, but in consistent development through subsequent ages. In reply to Sohm, Harnack stated this with much exaggeration, asserting that the Church began with an "abundant and elaborate equipment," and even with a "legal code" of complicated structure.

The truth seems to lie in a synthesis of the ideal and the actual contained in these extremes. Lightfoot constructed such a synthesis in his essay on *The Christian Ministry.* What discipleship meant was a spiritual union with the risen Christ, but this union was held to be mediated by the rite of baptism. According to St. Paul, to be baptized was to "put on Christ," (*Gal.* iii. 27). Those who thus "live by the Spirit" must also "walk by the Spirit"

(*Gal.* v. 25). But this spiritual walking was strictly controlled by the Apostles, who ruled the several Churches in a most peremptory manner, "So ordain I in all the Churches" (I. *Cor.* vii. 17) says St. Paul about the conduct of marriage. Their control secured some measure of uniformity; "We have no such custom, neither the Churches of God" (I. *Cor.* xi. 16) was sufficient reason for repressing an innovation. To keep things in order they visited the Churches, personally or by delegates, and in case of need wrote directive letters. In a striking metaphor they are to the Church as the foundation to a house (*Eph.* ii. 20), and this cannot refer only to the original preaching of the Twelve, for St. Paul certainly included Barnabas and himself. Thus the Apostolate extended as the Church extended, and was in the way of becoming a permanent institution. Of the interior order of the local Churches we know at least the existence of Presbyters, some of whom were called ἐπίσκοποι or overseers. Details must be treated elsewhere. The Church of the first age, therefore, certainly had an official equipment and some rules of conduct, but probably nothing so elaborate as Harnack supposed. Nor was this equipment alien to the spiritual character of the Church, for every function depended on a special gift of the Spirit, however mediated (I. *Cor.* xii.; *Eph.* iv.). (*See* MINISTRY, THE CHRISTIAN; EUCHARIST.)

For 30 years after St. Paul's latest epistle we are left without information. The *First Epistle of Clement* supplies nothing new, but 20 years later the *Epistles of Ignatius* show a development. The five Churches in Asia which he addresses are equipped with a hierarchy of deacons and presbyters under a chief who bears the old title of ἐπίσκοπος (*bishop*) but no longer as a subordinate; he appears to execute in that one Church all the functions of an apostle. It is a disputed question whether his office has grown out of the presbyterate or is a continuation of the apostolate. If he were invariably attached to a single city, the former theory would be strengthened; but it is not so, for Ignatius calls himself "bishop of Syria," and some years later a single bishop is found serving the whole of Gaul north of the Narbonensian province, a truly apostolic charge. The system of city-bishops became general within the Roman empire, but in northern Europe and elsewhere the system of regionary bishops has always prevailed from the earliest times.

In Ignatius we find the important word "Catholic" describing the whole Church as distinct from local Churches. It is evidently a current term. He relates the bishop to a local Church as Jesus Christ to the Catholic Church (*Smyrn.* viii. 2). But in the *Martyrium Polycarpi,* some years later, the Church of Smyrna is called Catholic, perhaps as locally representing the whole. The word afterwards takes on a much larger content, indicating adhesion to the Christian religion as a whole, in contrast with the particularities of heresy, and so can be applied even to individual persons.

The First Reasoned Theory.—The 3rd century presents to us for the first time in its history a reasoned theory of the Church in the writings of St. Cyprian. He bases it on the episcopate, which he entirely identifies with the apostolate. Bishops are appointed by Christ himself, as the Apostles were, though the divine appointment is mediated by consecration, and even by some elements of popular election. The episcopate is one, and he illustrates its unity by terms borrowed from the Roman law of corporations. Nevertheless in each single place there is a single bishop who represents the whole, and of that place those inhabitants who communicate with the bishop, and none else, are in the communion of the Catholic Church. He has been generally followed, except in two particulars. He maintained: (1) that all bishops are precisely equal in authority, and (2) that a bishop is responsible only to God, and can be removed from his place, as he was appointed, only by God. The latter contention was confronted, in his own practice, by the obvious difficulty of ascertaining when the Divine judgment has fallen. A solution was soon found in the obvious inferiority of a single bishop to a council of bishops, which could therefore depose him. The case of Paul of Samosata settled this. Irenaeus had already noted the special weight of authority (*potentior principalitas*) exerted by the bishop of Rome, and this was equally true of the other great capital cities, Alexandria and Antioch; Constantinople was afterwards added next to Rome, and the honorary addition of the restored Jerusalem completed the system of the patriarchates which dominated the Church in the eastern half of the Roman empire from Italy to the Euphrates. In the same part of the empire there was a similar aggrandisement of the bishop seated in the metropolis of each province, who presided over a manageable council of comprovincial bishops, and acquired a commanding influence in their appointment; a system which with some differences, was gradually extended westward, and into the countries beyond the empire.

Such is the working system of the Catholic Church, evolved from elements which we can discern in the first age. From the 5th century onward it has been complicated by claims made for the Church of Rome based on the promise of the Keys to St. Peter in Matt. xvi. 19. This requires separate treatment. It has been complicated also by obstinate schisms. Donatism in Africa was a passing trouble. Such also was the Arianism of the Goths, which for three centuries delayed the settlement of the Church in the new nations carved out of the Western empire. More permanent has been the separation, much more racial than theological, of Nestorians and Monophysites in the East from the orthodoxy of Constantinople. A succession of temporary quarrels between Constantinople and Rome led to the great breach of 1054 still continuing. (*See* PAPACY.)

In the 16th century the Reformation shattered the unity of the Western Church, contrary to the intention of the promoters, who aimed at reforming the whole Church "in head and members." The predestinarianism alike of Luther and of Calvin brought in the theory of the Invisible Church mentioned above, reducing the hierarchy to the level of a not indispensable expedient. Luther, regarding the Visible Church in this light, gave the chief control of it to the civil magistracy, in which he was followed or preceded by the Swiss Reformers and by those of the middle Rhine. Calvin established at Geneva a system of Presbytery, modelled on indications drawn from the Pauline Epistles and the Acts, acting in close connection with the magistracy and this was carried by his disciple, Theodore Beza, to the Reformed of France, in complete independence of a hostile State. The Genevan model was extended to the Netherlands, and the independent Presbytery of Beza was planted in Scotland by John Knox, to be afterwards perfected by Andrew Melville. This Presbyterianism followed with some exaggeration the lines of the Cyprianic episcopacy, while dropping the title of *bishop,* with all the associations which had gathered round it. In the Scandinavian countries the historic episcopate was retained by the reformers, and in England the organized administration connected with it also remained almost intact. The doctrinal aspects of the Reformation do not concern us here. (*See* REFORMATION.)

English Puritanism began as a demand for further reformation on the Swiss model, and with Thomas Cartwright took the form of an assertion of the Divine right of Presbyterianism, but a native development became much more important. Robert Browne, and after him Henry Barrow, deduced from the doctrine of the Invisible Church their conception of the "gathered Church," a group of believers voluntarily associated in complete independence, which they declared to be the only true Visible Church of the New Testament. This *Independency,* dominant during the crisis of the Civil War, survived its political failures, and remains, with various modifications, one of the chief factors in the Protestantism of English-speaking countries, where a "Church" is usually taken to be such an association, whether in its original form of a single congregation or in a close-knit and extensive system like those of the various Methodist connections. These developments will be found severally treated elsewhere. In their mutual antagonisms the idea of the Christian Church as a whole has been almost lost sight of, but it has recently revived in more friendly discussion, and is found to be firmly rooted in history.

BIBLIOGRAPHY.—Hort, *The Christian Ecclesia;* Lightfoot, *The Christian Ministry;* Sohm, *Wesen und Ursprung des Katholizismus;* Harnack, *Enstehung und Entwickelung der Kirchenfassung,* etc. (Eng. trans. by Pogson, *The Constitution and Law of the Church in the*

First Two Centuries); Lindsay, *The Church and the Ministry in the Early Centuries;* Gore, *The Church and the Ministry* (ed. 1919); Swete, *Essays on the Early History of the Church and the Ministry, by Various Writers;* Lacey, *The One Body and the One Spirit.*

(T. A. L.)

B. THE CHURCH BUILDING

It is generally held that the Church, when established as part of the organization of the Roman Empire, adopted for its buildings the plan of the secular basilica, and the name basilican has been given to the plan consisting of a long hall or nave with aisles, and with a projecting semicircular apse at the end opposite the main entrance. It should be remembered that the secular basilica followed no stereotyped form of plan, and that other influences may have combined to determine the plan assumed by the Christian church fabric. Further, although the term basilica was very commonly applied to early Christian churches, it was by no means confined to aisled buildings, but was also used of simpler structures. The internal arrangement of the apse, however, closely resembled that of the apse of the basilican law-court. The altar, on the chord of the apse, took the place of the altar on which oaths were taken by deponents: the seats of the bishop and clergy, ranged behind it, corresponded to those of the secular magistrates. The *cancelli* or screen, which divided the tribunal from the body of the court, became the barrier between the congregation and the sacred rites, and gave its name to the chancel of the church.

Circular Plan.—An alternative plan to that of the long aisled nave was the circular or polygonal plan, radiating from a central point, of which the most famous example is the church of San Vitale at Ravenna. This had its origin in the plan of the Christian baptistery, which was symbolically derived from the centralized plans of funeral monuments. The centralized church-plan, however, was provided with an encircling aisle or ambulatory, above which was a tribune or gallery, and with a chancel for the altar. Thus the fundamental characteristic of the Christian church-plan is its division into the nave for the worshippers and the chancel for the altar and clergy. Covering the main entrance to the nave there was frequently a narthex or vestibule, originally used by catechumens or by penitents excluded from participation in the holy mysteries. In the earliest churches the chancel was at the west end of the building, and the celebrant at the altar faced the congregation, but eventually the custom of placing the chancel at the east end of the church, which first appears in the basilicas of Ravenna prevailed, the celebrant still facing eastward. Beneath the altar there was often a crypt, the *martyrium* or *confessio,* so called from its traditional identity with the place of death or burial of the saint to whom the church was dedicated. The choir of singers was accommodated on the altar platform on either side of which were the *ambones* or pulpits from which the epistle and gospel were read.

In the larger Romanesque churches of western Europe, the aisled nave was practically universal, and the problem of covering these long structures with vaults of stone produced the characteristic art of the middle ages. Towers rose at the west ends of the aisles, and the erection of a tower on piers and arches between nave and chancel led to the development of the transept or cross-arm for purposes of abutment. It was, however, at the east end of the church that the principal development of plan took place. An aisled presbytery was interposed between the apse and the nave, and the aisles were in many instances continued round the apse, forming an ambulatory with a ring of chapels opening eastward from it. This arrangement, dictated by the requirements of processions and by the need of additional altars, became the regular plan of the French Gothic church, producing those magnificent *chevets* of apse and chapels which are the greatest masterpieces of mediaeval art. The process of enlargement and rebuilding, which attained its height in the thirteenth century, was due to the necessity of a larger ritual space and to the multiplication of endowments for masses. The east arms of churches were reconstructed on a large scale. Behind the altar in many churches rose the shrine of the local saint, the object of pilgrimages which enriched the church and its fabric. A Lady chapel, where the mass of the Blessed Virgin was celebrated daily, was often the most prominent of the chapels at the east end of the church, though its position on the plan varied. The transepts had their eastern aisles of chapels, and the spaces between the buttresses of the nave were utilised for the same purpose.

The Small Parish Church, usually an aisleless structure with nave and chancel, and with western or central tower, also underwent enlargement as local needs demanded. The nave was aisled; the chancel was lengthened; chapels were added at various points in the plan, which sometimes became extremely complex. Such enlargements and additions did not imply growth of population and the consequent need of a larger area for worshippers. Their cause was local anxiety to contribute to the pious work of church-building, and, where the means of benefactors allowed, to provide altars at which masses, maintained by their endowments, could be celebrated for the health of their souls. In certain districts church-building was encouraged by agricultural or commercial prosperity, by the existence of gilds which vied with one another in founding chantries, and by abundance of good local material and ease or cheapness of carriage. The architectural history of parish churches was much affected by the division of responsibility for cost between the rector, who met the repairs of the chancel, and the parishioners, who maintained the rest of the building by their contributions to the fabric fund or "works," under the administration of the church wardens, the *custodes fabricae* or *operis.*

It is often stated that the church architecture of the middle ages was dictated by an elaborate scheme of religious symbolism. While symbolical ideas entered into the adoption of certain types of plan, as in the transference, already mentioned, of the mausoleum plan to the baptistery, experience shows that the lay masons who usually carried out the work of building were guided by practical considerations, structural and ritual, whose free and natural expression would have been fettered by adherence to artificial rules of symbolism. Anomalies or deviations from regularity of plan, for which deep significances have been sought, can generally be assigned to errors of setting-out or to imperfect workmanship. The beauty and nobility of mediaeval church architecture is the result of the perfectly natural and unaffected response of the builders to the necessities of construction and to the immediate demands of the religious cult for which they laboured.

Artistic Development.—In some later mediaeval churches, especially those of friars, wide naves were provided for preaching purposes. Usually the interior of the church was broken up by the screens which enclosed the chapels in the aisles and beneath the arches. Between the nave and chancel was the screen, the western counterpart, with open tracery in its panels, of the closed iconostasis of the Eastern Church: above it was the loft or gallery and the beam on which stood the crucifix. In cathedral and collegiate churches the screen was habitually a solid erection of stone, shutting off the choir services from the nave; while in monastic churches, including several of the English cathedrals, there were two transverse screens, the choir-screen with its *pulpitum* or loft to the east, and the rood-screen a bay or two west of it. As the middle ages advanced, with the growth of specialization in various departments of church fittings, the church became more and more the frame and setting for works of art in stone, marble, alabaster, wood and stained glass. From the beginning colour played a large part in internal effect, as in the mosaic incrustation of early Christian churches. Rough walls were plastered and pictures or patterns painted on the dry surface or in fresco. The window-openings were filled with stained glass; pigments were lavishly employed on ceilings, on the surface of piers and vaults, and on furniture. In such prodigality of colour the mediaeval mind found the fullest satisfaction of its religious ideals. By the contemplation of the works of art that filled his church, Suger, the great abbot of Saint-Denis, tells us that he felt himself lifted in spirit from the world to a purer clime; and in Italy and Flanders the art of painting grew to perfection in the decoration of church walls and altars.

The Renaissance.—In countries which embraced the Reformation, the work of church-building was checked. The prime motive which up to that time had prompted the rebuilding or extension of so many churches was gone and existing buildings fully met the requirements of reformed worship. But in any case the Gothic art of the middle ages was already disappearing before the revival of classic art which had its birth in Italy. The ruthlessness which mediaeval artists had shown to the work of their predecessors was pursued by the architects of the Renaissance, who thought nothing of sweeping away great historic monuments like St. Peter's at Rome to make way for buildings in their new style. At the same time, while this implied a change in methods of construction and decoration, those methods were adapted to the traditional Christian church plan, and the combination of classical architecture with mediaeval traditions of planning and design is nowhere more clearly seen than in St. Paul's Cathedral and in other churches designed by Wren and the English architects who followed in his footsteps. While the church plan, during the period of Renaissance influence, underwent some simplification, and the idea of the large auditorium or hall of worship superseded the practice of the middle ages and survived in the churches of the Gothic revival, it still retained the fundamental character of the plan which had approved itself as suitable for the needs of the early Church and had reached its highest development in conformity with the requirements of mediaeval ritual. (A. H. T.)

See RELIGIOUS AND MEMORIAL ARCHITECTURE.

CHURCH AND STATE. The relation of Church and State in England, conveniently summed up in the word "establishment," is curiously complicated, including elements of great antiquity and arrangements made as recently as the year 1919. The antiquary, the historian, the lawyer, and the ecclesiastic find ample materials for their several studies in the Church of England as by law established. With the partial exception of Sweden, England was the only country in which the Reformation did not involve an almost complete breach with the system of the mediaeval Church. The main lines of the existing ecclesiastical system are mediaeval—the hierarchy, the parochial system, the convocations, the presence of the archbishops and bishops in the House of Lords, the canon law in so far as it was perpetuated by the legislation of Henry VIII., and the ecclesiastical courts. The Reformation effected a threefold change—social, doctrinal and constitutional. By the abolition of the monasteries, and the confiscation of the monastic property, the spiritual estate was weakened and impoverished: by the changes in doctrine and discipline the Church of England abandoned the distinctive beliefs and devotions of mediaeval Christianity; and by the acceptance of the royal supremacy, it not only repudiated the authority of the Roman pope, but received the status and constitution of an independent national Church. Since the 16th century the acceptance of the policy of religious toleration by the State, and the evolution of democracy, have affected importantly the system of the Established Church. The growth of nonconformity, the expansion of the insular kingdom into the British empire, the secularisation of parliament, and the development of denominational self-assertion within the Church itself have all affected the existing relations of Church and State in England. Establishment in its present form may be conveniently considered under five heads, viz., the royal supremacy, the authority of parliament, the ecclesiastical courts, patronage, the tenure of the ancient endowments.

The Royal Supremacy.—Henry VIII. forced the convocations to recognize his "headship" of the Church of England, but mitigated the unquestionable innovation by the pretence that he was but vindicating and restoring to the Crown the authority in ecclesiastical matters which was inherent in the monarchy by divine right, and had been recognized in practice until the usurpation of the Roman popes had obscured and superseded it. The revolutionary statutes which abolished the papal authority, and severed the national Church from the larger ecclesiastical system of which it had hitherto formed part, adopted a demurely constitutional tone, emphasizing the ancient independence and imperial self-sufficiency of the realm under its monarch. Thus the Restraint of Appeals, A.D. 1533, begins:

> Where by divers sundry old authentic histories and chronicles it is manifestly declared and expressed, that this realm of England is an empire, and so hath been accepted in the world, governed by one supreme head and king, having the dignity and royal estate of the imperial crown of the same, unto whom a body politic, compact of all sorts and degrees of people, divided in terms, and by names of spiritualty and temporalty, be bounden and ought to bear, next to God, a natural and humble obedience, etc.

That the royal authority over the Church in England had been very great in the past, and that the power of the popes had grown to exorbitant proportions in the period immediately preceding the Reformation, were unquestionable facts, and they gave plausibility to a contention which was, none the less, essentially untrue. The supremacy which the royal headship implied was a new thing in Christendom, and had no real precedents in history. It owed its origin to the novel conditions of the age, and its form to the masterful despot who arrogated it to himself. The functions withdrawn from the pope were accumulated on the monarch. Henry VIII., uniting in his own hands the plenitude of power both civil and spiritual, became in Bishop Stubbs's notable phrase, "the pope, the whole pope, and something more than the pope." (*Lectures on Mediaeval and Modern History*, p. 301.) So monstrous a claim could not be maintained. Under Elizabeth the royal supremacy was defined and delimited, and the much debated title, "head of the Church," was laid aside. Article XXXVII., which still binds the English clergy, claims for the sovereign "that only prerogative, which we see to have been given always to all godly Princes in holy Scriptures by God himself; that is, that they should rule all estates and degrees committed to their charge by God, whether they be Ecclesiastical or Temporal, and restrain with the civil sword the stubborn and evildoers." The Article adds that "the Bishop of Rome hath no jurisdiction in this Realm of England." So long as the royal supremacy was exercised by a sovereign who was himself a Christian man this definition served well enough: but the development of the English constitution from the practical autocracy of the Tudor sovereigns to the limited monarchy of their latest successors, has had its effect on the ecclesiastical system, and raised some formidable questions, of which the answer is not yet apparent.

Parliament.—The legislative authority of the mediaeval Church had been "spiritual." In the last resort the Church in England was governed by the canons of general councils and by the decretals of the popes. These controlled the action of the provincial convocations, which held the status of subordinate legislatures. The abolition of extra-national authorities, papal and conciliar, left nothing but the convocations of Canterbury and York in existence. In these circumstances the king and parliament may be said to have taken over the legislative functions of the pope and the general council. The Church of England before the Restoration was governed by ordinances and statutes. Church and nation were identified, at first practically, and then theoretically. The identification was defended with impressive eloquence by Hooker (d. 1600) and became the assumption of the English establishment. The convocations continued to legislate under the severe limitations imposed by 25 Henry VIII. cap. 19. (The Submission of the Clergy and Restraint of Appeals, 1534), and the mediaeval canon law retained under the same act a carefully restricted authority, but the right of parliament to legislate for the national Church even in "spiritual" matters was asserted and acted upon. The right was grounded on the Christian character of parliament, and on its essential function. Only by recognizing the legislative supremacy of parliament could the unity of the church-nation be secured. The 17th century witnessed the triumph of constitutional government, and the beginning of religious toleration. Legislative authority once shared between king and parliament became vested in parliament alone. The national Church was no longer governed partly by royal ordinance. James II.'s claim to the dispensing power was disallowed. While, however, the Act of Settlement (1701), provided that "whosoever shall hereafter come to the possession of this Crown shall join in communion with the Church of England, as by law established," it did not provide

against the danger implicit in a change in the religious character of parliament. The danger of Roman Catholic members was indeed guarded against by the Test Act (1673); but 45 Presbyterians were admitted by the Act of Union with Scotland, A.D. 1707, and in the course of the 19th century parliament was opened to Nonconformists, Roman Catholics, Jews, and non-believers of every description. Parliament, thus frankly divorced from an ecclesiastical character, retained its ecclesiastical functions unaltered. The anomaly was apparent and increasingly resented as the Church of England, waking from the deep slumbers of the 18th century, felt and acted as a spiritual society. The influence of the Oxford Movement tended powerfully in the same direction. In 1852 the convocations, which had been suspended for 135 years, again were permitted to function. Parliament ceased to be the sole organ of ecclesiastical legislation and henceforth found its action conditioned by the constitutional rights of a clerical legislature, subordinate indeed, but as ancient as itself, and within its own sphere as independent. Nor was this all. While parliament became patently unqualified for ecclesiastical legislation, its secular task, ever waxing with the expansion of the empire, and the complexity of social life, required its undivided concern. Urgent ecclesiastical reforms were postponed for no better reason than the congestion of parliamentary business. Accordingly the demand for better legislative machinery became general, and, in the general reconstruction of the national system which followed the World War, was met by the Enabling Act (1919). A new body, the National Assembly, was created consisting of three "houses"—the diocesan bishops, the members of both convocations and elected laity. To this body legislative authority, subject to the veto of either house of parliament, was given. Measures affecting the Church of England passed by the National Assembly, certified as constitutional by an ecclesiastical committee created for the purpose, and approved by both houses of parliament, were to have the force of statutes on receiving the royal assent. The constitution of the National Assembly both reserved unaltered "the powers belonging to the convocations of the provinces of Canterbury and York or of any House thereof," and prohibited the Assembly from "exercising any power or performing any function distinctively belonging to the bishops in right of their episcopal office." This devolution of legislative power by parliament to the Assembly did not destroy the right of parliament to make laws for the Church of England, but rendered the exercise of that right abnormal and improbable. The right of a spiritual society to be truly autonomous in spiritual matters is obviously patient of large secular control in other directions: but the line between spiritual and secular is not always easy to trace, and the intermingling of secular and ecclesiastical interests in an anciently Christian community is extremely close. The Enabling Act, however, carries the possibility of future trouble. In twice rejecting the Prayer Book Measure (1927 and 1928) the House of Commons has precipitated a conflict on a plainly spiritual issue, which must affect gravely the Establishment itself, and may even bring about its destruction.

The Ecclesiastical Courts.—The unique character of the English Reformation as at once conservative and revolutionary is nowhere better exhibited than in the ecclesiastical courts. They are the provincial and diocesan courts of the mediaeval Church, but they are held in the king's name, the law they administer is the king's ecclesiastical law, and they are subject to the appellant authority of the king's privy council. The modern system has departed in some important respects from that which the Reformation created. It is much more nakedly secular, for the study of canon law having practically ceased, and the race of canonists having died out, there was left no effective check on the secularising tendency of the lawyers, who of old time cherished a professional dislike of the ecclesiastical jurisdiction, and sought after a simplification of the legal system which paid little heed to tradition and the claims of the "spiritualty." In the course of time, notably during the 19th century the limits of ecclesiastical jurisdiction have been greatly contracted by the withdrawal of suits relating to wills, marriage, and tithes. Acts of parliament are administered in the ecclesiastical courts, not any more the mediaeval canon law, save where this has acquired statutory force from the provisional legislation of Henry VIII. The ecclesiastical judges are laymen, and they acknowledge the supreme appellant authority of the judicial committee of the privy council. This progressive secularisation of the Church's legal system did not provoke resentment until, largely as a consequence of the Oxford Movement, the ecclesiastical courts had to deal with suits affecting the interpretation of rubrics and doctrinal standards. That such subjects, affecting the worship and belief of churchmen, should be handled by secular lawyers, who might not even themselves be Christians, offended the new sense of ecclesiastical independence, and did violence to the religious conscience of many devout persons. The courts were denounced as "Erastian," and a disposition manifested itself to repudiate their authority. This disposition has certainly been strengthened by the course of national politics. A breach has opened between the general sentiment of English churchmen and the settled policy of the State in the matters of religious education and the marriage law, which is not likely to be closed, and which tends to create an attitude of apprehension and suspicion not favourable to the easy working of the establishment. A commission charged to make recommendations for the reform of the ecclesiastical courts was appointed by the National Assembly, and has issued its report. It is understood (1928) that legislation will be shortly attempted. Meanwhile the general discontent with the existing courts, and the widely extended disposition to ignore their verdicts, add an element of special embarrassment to the problem of maintaining discipline in the Church.

Patronage.—No part of the establishment is more distinctive, and none more perplexing than "patronage," that is, the process by which clergymen are appointed to office. It presents a curious blending of ancient and modern elements. The higher ecclesiastics —bishops, deans, some canons and many incumbents—are appointed by the crown on the nomination of the prime minister. In the case of the ancient sees, the mediaeval process is still followed, viz., *congé d'élire* to the dean and chapter accompanied by letters missive containing the name of the person whom they are desired to elect, confirmation by the archbishop, consecration, homage, and enthronement in the cathedral. In the case of modern sees which have no cathedral chapters, the bishop is appointed by letters patent. Two archbishops and 24 bishops sit in parliament—the archbishops and the bishops of London, Durham and Winchester by right of their sees, the other bishops by seniority of their consecration. The incumbents are nominated to the bishop of the diocese by patrons, who are either public (the lord chancellor, the bishops, colleges, the deans and chapters and other ecclesiastics holding patronage by title of their benefices), or private. The bishop has a limited power of refusing institution, but, in the absence of disqualification duly proved, he must institute and induct the patron's nominee to the benefice. This system is criticised as providing no adequate protection of parishioners against unsuitable appointments, and various projects for amending it have been advanced: but it is generally allowed that patronage, although anomalous in theory does not work badly, and there is no agreement as to a satisfactory substitute. The system is closely bound up with the method by which the parochial clergy are remunerated. The parish is also a benefice, and the incumbent possesses a life-tenure of the endowment attached to it. This also is much objected against by reformers, but it does not lack apologists. Opinion, however, seems to be tending towards an age-limit, which would remedy the principal fault of the existing system, viz., the incompetence of aged and ailing clergymen. A recent measure securing a modest pension at the age of 70 has laid the foundation for further reforms.

Tenure of the Ancient Endowments.—The Church of England is an endowed Church, and, if it were disestablished, its claim to retain possession of the ancient endowments would certainly be disallowed. These endowments—fabrics, tithes, glebes, investments—are held by a multitude of corporations, sole and aggregate, on a service tenure, which is stated in the statutes which prescribe the functions of the bishops and clergy. Disestablishment would involve the dissolution of all these corporations. Such property as might be left to the disestablished Church would

be held under conditions which the Act of Disestablishment and Disendowment would create. It is the tenure of the endowments which forms now the most important aspect of the English establishment, and the prospect of their partial or total loss constitutes the weightiest of all arguments against disestablishment. Statesmen shrink from the grievous social and economic disturbance which disendowment could not but involve. Churchmen dread the loss of the material resources which maintain throughout the country the ministrations of religion. Neither the reluctance of the first nor the apprehensions of the last could avert the catastrophe if a breach between Church and State on a point of religious principle were to take place, and prove incapable of remedy.

SCOTLAND

If the establishment in England is the most complicated, that in Scotland is the simplest which Christendom includes. In Scotland a "clean sweep" of the mediaeval system was effected. The Church was equipped with a new polity, and in the course of history acquired an unprecedented independence. Its constitution as set out in the Church of Scotland Act, 1921, exhibits the model of "a free Church in a free State," such as Cavour projected in the middle of the 19th century. The 3rd Article "declaratory of the Constitution of the Church of Scotland in Matters Spiritual" runs thus:

> This Church, as part of the Universal Church wherein the Lord Jesus Christ has appointed a government in the hands of Church office-bearers, receives from Him, its Divine King and Head, and from Him alone, the right and power subject to no civil authority to legislate and to adjudicate finally, in all matters of doctrine, worship, government, and discipline in the Church, including the right to determine all questions concerning membership and office in the Church, the constitution and membership of its Courts, and the mode of election of its office-bearers and to define the boundaries of the spheres of labour of its ministers and other office-bearers. Recognition by civil authority of the separate and independent government and jurisdiction of this Church in matters spiritual, in whatever manner such recognition be expressed, does not in any way affect the character of this government and jurisdiction as derived from the Divine Head of the Church alone, or give to the civil authority any right of interference with the proceedings or judgments of the Church within the sphere of its spiritual government and jurisdiction.

Partly, this unique independence may be ascribed to the presbyterian polity which, while magnifying the ministry, gave comparatively little importance to any section of it. There was nothing in Scotland parallel in political function to the episcopate in England. Partly, the emphasizing of ecclesiastical independence has grown from the union of the kingdoms, at first personal and then, since 1707, parliamentary also. When the centre of national government had been removed to London, and Scottish business became a comparatively subordinate element in British politics, the Church of Scotland ceased to move the anxious concern of statesmen, while it acquired in the popular regard an ever greater importance as the principal, almost the only surviving, witness of an independent Scottish nationality. In more recent times, in Scotland as elsewhere, the secularisation of society has deprived all ecclesiastical concerns of much of their former importance. The attendance of the king's commissioner at the annual meeting of the general assembly, and the appointment of a number of presbyterian ministers as royal chaplains, form the chief tokens of that connection with the State which is the core of establishment. The State exercises no control over legislation, or ecclesiastical courts, or patronage. Establishment in Scotland has no practical importance, though unquestionably its sentimental value as a solemn recognition of national Christianity is still great, and its abolition would be regretted by many, probably by most, Scottish citizens.

THE UNITED STATES AND THE BRITISH DOMINIONS

Save in Great Britain, there is no established Church throughout the English-speaking communities, though the relations of the Churches to the State are everywhere friendly. Bryce's description of the situation in the United States holds good throughout the British Dominions:

> The legal position of a Christian church is in the United States simply that of a voluntary association, or group of associations, corporate or unincorporate, under the ordinary law. There is no such thing as a special ecclesiastical law; all questions, not only of property but of church discipline and jurisdiction, are, if brought before the courts of the land, dealt with as questions of contract; and the court, where it is obliged to examine a question of theology, as for instance whether a clergyman has advanced opinions inconsistent with any creed or formula to which he has bound himself—for it will prefer, if possible, to leave such matters to the proper ecclesiastical authority—will treat the point as one of pure legal interpretation, neither assuming to itself theological knowledge, nor suffering considerations of policy to intervene.
>
> Religious bodies are in so far the objects of special favour that their property is in most States exempt from taxation; and this is reconciled to theory by the argument that they are serviceable as moral agencies, and diminish the expense incurred in respect of police administration.

It would perhaps be true to say that there is an informal establishment of Christianity though not of the Churches. It is assumed that society is Christian. Religious acts inaugurate the sessions of the representative assemblies, and no public function would be considered complete without them. Undoubtedly this informal establishment by public opinion and social habit is menaced by the increasing secularisation of society, but it is still strongly entrenched in the public sentiment of all English-speaking communities. Establishment in the true sense is limited to England and Scotland, and only in England does it possess any importance, or present any legal and constitutional problems.

(H. H. H.)

For special relationships between Church and State in Europe (anti-clericalism, *Kulturkampf*), *see* ANTICLERICALISM; FRANCE: *History;* GERMANY: *Mediaeval History, History from 1519 to 1648,* etc.

CHURCH ARMY, an English religious organization, founded in 1882 by the Rev. Wilson Carlile (afterwards prebendary of St. Paul's), who banded together in an orderly army of "soldiers" and "officers" a few working men and women, whom he and others trained to act as "Church of England evangelists" among the outcasts and criminals of the Westminster slums. Previous experience had convinced him that the moral condition of the lowest classes of the people called for new and aggressive action on the part of the Church, and that this work was most effectively done by laymen and women of the same class as those whom it was desired to touch. It is essentially a working men's and women's mission to working people. As the work grew, a training institution for evangelists was started in Oxford, but soon moved (1886) to London, where, in Bryanston Street near the Marble Arch, the headquarters of the army are now established. Working men are trained as evangelists, and working women as mission sisters. Officers and sisters are paid a limited sum for their services either by the vicar or by voluntary local contributions. Church Army mission and colportage vans circulate throughout the country parishes, if desired, with itinerant evangelists, who hold simple missions, without charge, and distribute literature. Each van missioner has a clerical "adviser." Missions are also held in prisons and workhouses, at the invitation of the authorities. In 1888 (before the similar work of the Salvation Army was inaugurated) the Church Army established labour homes in London and elsewhere, with the object of giving a "fresh start in life" to the outcast and destitute. The Army has lodging homes, employment bureaus, cheap food depots, old clothes department, dispensary and a number of other social works. There is also an extensive emigration system, under which carefully tested men and families, of good character, chiefly of the unemployed class, are placed in permanent employment in Canada through the agency of the local clergy.

See Carlile, art. "Church Army" in Hasting's *Encyclopaedia of Religion and Ethics;* Rowan, *Wilson Carlile and the Church Army; The Church Army Review,* and other publications of Headquarters.

CHURCH ASSEMBLY: *see* CANON LAW: *Canon Law in England and in the Anglican Communion;* CONVOCATION; and ENGLAND, THE CHURCH OF.

CHURCH CONGRESS, originally an annual meeting of members of the Church of England, lay and clerical, to discuss matters religious, moral or social, in which the church is interested. It has no legislative authority, and there is no voting on the questions discussed. The first congress was held in 1861 in the

hall of King's College, Cambridge, and was the outcome of the revival of convocation in 1852. The term is now used to designate similar meetings of laymen and ministers of any religious denomination. *See* ENGLAND, CHURCH OF.

CHURCH COUNCIL: *see* COUNCIL and CHURCH HISTORY.

CHURCH HISTORY. In the following account of the historical evolution of the Church, the subject will be treated in three sections:—(A) The ancient Church to the beginning of the pontificate of Gregory the Great (A.D. 590); (B) The Church in the middle ages; (C) The modern Church.

A. THE ANCIENT CHURCH

The crucifixion of Jesus Christ resulted in the scattering of His followers, but within a short time they became convinced that He had risen from the dead, and would soon return to set up the expected Messianic kingdom, and so to accomplish the true work of the Messiah (*cf.* Acts i. 6 ff.). They were thus enabled to retain the belief in His Messiahship which His death had threatened to destroy permanently. This belief laid upon them the responsibility of bringing as many of their countrymen as possible to recognize Him as Messiah, and to prepare themselves by repentance and righteousness for the coming kingdom (*cf.* Acts ii. 21, 38, iii. 19 *et seq.*). In Jerusalem the new movement had its centre, and the church established there is rightly known as the mother church of Christendom. The life of the early Jewish disciples, so far as can be judged from our very meagre sources, was very much the same as that of their fellows. They continued faithful to the established synagogue and temple worship (*cf.* Acts iii. 1), and did not think of founding a new sect, or of separating from the household of Israel (*cf.* Acts x. 14, xv. 5, xxi. 21.) There is little evidence that their religious or ethical ideals differed in any marked degree from those of the more serious-minded among their countrymen, for the emphasis which they laid upon the need of righteousness was not at all uncommon. In their belief, however, in the Messiahship of Jesus, and their consequent assurance of the speedy establishment by Him of the Messianic kingdom, they stood alone. The first need of the hour, therefore, was to show that Jesus was the promised Messiah in spite of His crucifixion, a need that was met chiefly by testimony to the resurrection, which became the burden of the message of the early disciples to their fellow-countrymen (*cf.* Acts ii. 24 ff., iii. 15 ff., v. 31). It was this need which led also to the development of Messianic prophecy and the ultimate interpretation of the Jewish Bible as a Christian book (*see* BIBLE). The second need of the hour was to bring the nation to repentance and righteousness in order that the Kingdom might come (*cf.* Acts iii. 19).

Its Early Difficulties.—Meanwhile the new movement spread quite naturally beyond the confines of Palestine and found adherents among the Jews of the dispersion. Among the Christians who did most to spread the gospel in the Gentile world was the apostle Paul, whose conversion was the greatest event in the history of the early Church. In his hands Christianity became a new religion, fitted to meet the needs of all the world, and freed entirely of the local and national meaning which had hitherto attached to it. Paul saw in Jesus much more than the Jewish Messiah. He saw in Christ the divine Spirit, who had come down from heaven to transform the lives of men, all of whom are sinners. The Kingdom of which the early disciples were talking was interpreted by Paul as righteousness and peace and joy in the Holy Ghost (Rom. xiv. 17), a new principle of living, not a Jewish State. But Paul taught also, on the basis of a religious experience and of a distinct theory of redemption, that the Christian is freed from the obligation to observe the Jewish law. He thus did away with the fundamental distinction between Jews and Gentiles. The transformed spiritual life of the believer expresses itself not in the observance of Jewish law, but in love, purity and peace. This precipitated a very serious conflict, of which we learn something from the Epistle to the Galatians and the Book of Acts (xv. and xxii.).

It was Christianity in its universal form which won its great victories, and finally became permanently established in the Roman world. The appeal which it made to that world was many-sided. It was a time when men were awaking to the need of better and purer living. To all who felt this need Christianity offered high moral ideals, and a tremendous moral enthusiasm, in its devotion to a beloved leader, in its emphasis upon the ethical possibilities of the meanest, and in its faith in a future life of blessedness for the righteous. It was a time of great religious interest, when old cults were being revived and new were finding acceptance on all sides. Christianity, with its one God, and its promise of redemption and a blessed immortality based upon divine revelation, met as no other contemporary faith did the awakening religious needs. It was a time also of great social unrest. With its principle of Christian brotherhood, its emphasis upon the equality of all believers in the sight of God, and its preaching of a new social order to be set up at the return of Christ, it appealed strongly to multitudes, particularly of the poorer classes. That it won a permanent success, and finally took possession of the Roman world, was due to its combination of appeals.

Christianity was essentially a proselytizing religion, not content to appeal simply to one class or race of people, and to be one among many faiths, but believing in the falsity or insufficiency of all others and eager to convert the whole world, but it did not win its victory without a struggle. Superstition, misunderstanding and hatred caused the Christians trouble for many generations, and governmental repression they had to suffer occasionally, as a result of popular disturbances. No systematic effort was made by the imperial authorities to put an end to the movement until the reign of Decius (250–251), whose policy of suppression was followed by Diocletian (303 ff.) and continued for some years after his abdication. In spite of all opposition the Church steadily grew, until in 311 the emperor Galerius upon his death-bed granted it toleration; and in 313 the emperors Constantine and Licinius published the edict of Milan, proclaiming the principle of complete religious liberty, and making Christianity a legal religion in the full sense.

Constantine, recognizing the growing strength of the Church and wishing to enlist the loyal support of the Christians, treated them with increasing favour, and finally was baptized upon his death-bed (337). Under his successors, except during the brief reign of Julian (361–363), when the effort was made to reinstate paganism in its former place of supremacy, the Church received growing support, until, under Theodosius the Great (379–395), orthodox Christianity, which stood upon the platform adopted at Nicaea in 325, was finally established as the sole official religion of the state, and heathen worship was put under the ban. The union between Church and State thus constituted continued unbroken in the East throughout the middle ages. The division of the Empire resulted finally in the division of the Church, which was practically complete by the end of the 6th century, but was made official and final only in 1054, and the Eastern and Western halves, the Greek Catholic and the Roman Catholic Churches, went each its separate way.

For long after the establishment of Christianity as the State religion, paganism continued strong, especially in the country districts, and in some parts of the world had more adherents than Christianity, but at length the latter became, at any rate nominally, the faith of the whole Roman world. Meanwhile already before the 3rd century it went beyond the confines of the Empire in Asia, and by the end of the period was strong in Armenia, Persia, Arabia and even farther east. It reached the barbarians on the northern and western borders at an early day, and the Goths were already Christians of the Arian type before the great migrations of the 4th century began. Other barbarians became Christian, some in their own homes beyond the confines of the Empire, some within the Empire itself, so that when the hegemony of the West passed from the Romans to the barbarians the Church lived on. Thenceforth for centuries it was not only the chief religious, but also the chief civilizing, force at work in the Occident.

The Christian Life.—The most notable thing about the life of the early Christians was their vivid sense of being a people of God, called and set apart. They regarded themselves as separate from the rest of the world and bound together by peculiar ties; their citizenship was in heaven, not on earth (*cf.* Phil. iii.

20, and the epistle to Diognetus, c. 5), and the principles and laws by which they strove to govern themselves were from above: the present world was but temporary, their true life was in the future; Christ was soon to return, and the employments and labours and pleasures of this age were of small concern. The belief that the Church was a supernatural institution found further expression in the conviction of the presence and power of the Holy Spirit, supposed to be manifest in various striking ways, in prophecy, speaking with tongues and miracle-working. In this idea Paul also shared, but he carried the matter farther than most of his contemporaries and saw in the Spirit the abiding power and ground of the Christian life. Not simply in extraordinary phenomena, but also in the everyday life of Christians, the Holy Spirit was present, and all the Christian graces were the fruits (*cf.* Gal. v. 22). A result of this belief was to give their lives a peculiarly enthusiastic or inspirational character. Theirs were not the everyday experiences of ordinary men, but of men lifted out of themselves and transported into a higher sphere. With the passing of time the early enthusiasm waned, the expectation of the immediate return of Christ was widely given up, the conviction of the Spirit's presence became less vivid, and the conflict with heresy in the 2nd century led to the substitution of official control for the original freedom (*see* below). The late 2nd century movement known as Montanism was in essence a revolt against this growing secularization of the Church, but the movement failed, and the development against which it protested was only hastened. The Church as an institution now looked forward to a long life upon earth and adjusted itself to the new situation, taking on largely the forms and customs of the world in which it lived. This did not mean that the Church ceased to regard itself as a supernatural institution, but only that its supernatural character was shown in a different way; the early conviction of the essential difference between the life of this world and that of the next lived on, and, as the Church became increasingly a world-institution, found vent in monasticism, which was simply the effort to put into more consistent practice the other-worldly life, and to make more thoroughgoing work of the saving of one's soul.

There were Christian monks as early as the 3rd century, and before the end of the 4th monasticism (*q.v.*) was an established institution both in East and West. The monks and nuns were looked upon as the most consistent Christians, and were honoured accordingly. Those who did not adopt the monastic life endeavoured on a lower plane and in a less perfect way to realize the common ideal, and by means of penance to atone for the deficiencies in their performance. The existence of monasticism made it possible at once to hold up a high moral standard before the world and to permit the ordinary Christian to be content with something lower. With the growth of clerical sacerdotalism the higher standard was demanded also of the clergy, and the principle came to be generally recognized that they should live the monastic life so far as was consistent with their active duties in the world. The chief manifestation of this was clerical celibacy, which had become widespread already in the 4th century. Among the laity, on the other hand, the ideal of holiness found realization in the observance of the ordinary principles of morality recognized by the world at large, in attendance upon the means of grace provided by the Church, in fasting at stated intervals, in eschewing various popular employments and amusements, and in almsgiving and prayer. Christ's principle of love was widely interpreted to mean chiefly love for the Christian brotherhood, and within that circle the virtues of hospitality, charity and helpfulness were widely exercised.

Worship.—The primitive belief in the immediate presence of the Spirit affected the religious services of the Church. They were regarded in early days as occasions for the free exercise of spiritual gifts. As a consequence the completest liberty was accorded to Christians to take such part as they chose, it being assumed that they did so only under the Spirit's prompting. But the result of this freedom was confusion and discord, as is indicated by Paul's 1st Epistle to the Corinthians (*see* ch. xi., xiv.). This led to the erection of safeguards. Particular Christians were designated to take charge of the services, and orders of worship were framed out of which grew ultimately elaborate liturgies (*see* LITURGY). The Lord's Supper first took on a more stereotyped character, and prayers to be used in connection with it are found in the *Didachē* (ch. ix., x.). There developed in the 3rd or 4th century what is known as the *arcani disciplina,* or secret discipline of the Church, involving concealment from the uninitiated and unholy of the more sacred parts of the Christian cult, such as baptism and the eucharist, with their various accompaniments, including the Creed and the Lord's Prayer. The same interest led to the division of the services into two general parts, which became known ultimately as the *missa catechumenorum* and the *missa fidelium,*—that is, the more public service of prayer, praise and preaching open to all, including the catechumens or candidates for Church membership, and the private service for the administration of the eucharist, open only to full members of the Church in good and regular standing. Meanwhile, as the general service tended to grow more elaborate, the *missa fidelium* tended to take on the character of the current Greek mysteries (*see* EUCHARIST). Many of the terms in common use in them were employed in connection with the Christian rites, and many of the conceptions, particularly that of sharing in immortality by communion with deity, became an essential part of Christian doctrine. Thus the early idea of the services, as occasions for mutual edification through the interchange of spiritual gifts, gave way in course of time to the theory that they consisted of sacred and mysterious rites by means of which communion with God is promoted. The emphasis accordingly came to be laid increasingly upon the formal side of worship, and a value was given to the ceremonies as such, and their proper and correct performance by duly qualified persons, *i.e.,* ordained priests, was all-important.

Doctrine.—Two tendencies appeared in the thought of the primitive Church, the one to regard Christianity as a law given by God for the government of men's lives, with the promise of a blessed immortality as a reward for its observance; the other to view it as a means by which the corrupt and mortal nature of man is transformed, so that he becomes a spiritual and holy being. The latter tendency appeared first in the New Testament in Paul, and afterwards in the Gospel and 1st Epistle of John. The former found expression in most of our New Testament writings, in all of the apostolic fathers except Ignatius, and in the Apologists of the 2nd century. The two tendencies were not always mutually exclusive, but the one or the other was predominant in every case. Towards the end of the 2nd century they were combined by Irenaeus, bishop of Lyons. To him salvation bears a double aspect, involving both release from the control of the devil and the transformation of man's nature by the indwelling of the Divine. Only he is saved who on the one hand is forgiven at baptism and so released from the power of Satan, and then goes on to live in obedience to the divine law, and on the other hand receives in baptism the germ of a new spiritual nature and is progressively transformed by receiving the body and blood of the divine Christ in the eucharist. This double conception of salvation and of the means thereto was handed down to the Church of subsequent generations and became fundamental in its thought.

The twofold conception referred to had its influence also upon thought about Christ. The effect of the legal view of Christianity was to make Christ an agent of God in the revelation of the divine will and truth, and so a subordinate being between God and the world, the Logos of current Greek thought. The effect of the mystical conception was to identify Christ with God in order that by His incarnation the divine nature might be brought into union with humanity and the latter be transformed. In this case too a combination was effected, the idea of Christ as the incarnation of the Logos or Son of God being retained and yet His deity being preserved by the assertion of the deity of the Logos. The recognition of Christ as the incarnation of the Logos was practically universal before the close of the 3rd century, but His deity was still widely denied, and the Arian controversy which distracted the Church of the 4th century concerned the latter question. At the council of Nicaea in 325 the deity of Christ received official sanction and was given formulation in the

original Nicene Creed. Controversy continued for some time, but finally the Nicene decision was recognized both in East and West as the only orthodox faith. The deity of the Son was believed to carry with it that of the Spirit, who was associated with Father and Son in the baptismal formula and in the current symbols, and so the victory of the Nicene Christology meant the recognition of the doctrine of the Trinity as a part of the orthodox faith.

The assertion of the deity of the Son incarnate in Christ raised another problem which constituted the subject of dispute in the Christological controversies of the 4th and following centuries. What is the relation of the divine and human natures in Christ? At the council of Chalcedon in 451 it was declared that in the person of Christ are united two complete natures, divine and human, which retain after the union all their properties unchanged. This was supplemented at the 3rd council of Constantinople in 680 by the statement that each of the natures contains a will, so that Christ possesses two wills. The Western Church accepted the decisions of Nicaea, Chalcedon and Constantinople, and so the doctrines of the Trinity and of the two natures in Christ were handed down as orthodox dogma in West as well as East.

Meanwhile in the Western Church the subject of sin and grace, and the relation of divine and human activity in salvation, received special attention; and finally, at the 2nd council of Orange in 529, after both Pelagianism and semi-Pelagianism had been repudiated, a moderate form of Augustinianism was adopted, involving the theory that every man as a result of the Fall is in such a condition that he can take no steps in the direction of salvation until he has been renewed by the divine grace given in baptism, and that he cannot continue in the good thus begun except by the constant assistance of that grace, which is mediated only by the Catholic Church. This decision was confirmed by Boniface II., and became the accepted doctrine in the Western Church of the middle ages.

Organization.—The origin and early development of ecclesiastical organization are involved in obscurity.

In the earliest days the Church was regarded as a divine institution, ruled not by men but by the Holy Spirit. At the same time it was believed that the Spirit imparted different gifts to different believers, and each gift fitted its recipient for the performance of some service, being intended not for his own good but for the good of his brethren (*cf.* 1 Cor. xii.; Eph. iv. 11). The chief of these was the gift of teaching, that is, of understanding and interpreting to others the will and truth of God. Those who were endowed more largely than their fellows with this gift were commonly known as apostles, prophets and teachers (*cf.* Acts xiii. 1; 1 Cor. xii. 28; Eph. ii. 20, iii. 5, iv. 11). The apostles were travelling missionaries or evangelists; there were many of them in the primitive Church, and only gradually did the term come to be applied exclusively to the twelve and Paul. There is no sign that the apostles, whether the twelve or others, held any official position in the Church: that they had a large measure of authority goes without saying, but it depended always upon their brethren's recognition of their possession of the divine gift of apostleship, and the right of Churches or individuals to test their claims and to refuse to listen to them if they did not vindicate their divine call was everywhere recognized. Witness, for instance, Paul's reference to false apostles in 2 Cor. xi. 13, and his efforts to establish his own apostolic character to the satisfaction of the Corinthians and Galatians (1 Cor. ix. 1 ff.; 2 Cor. x. 13; Gal. i. 8 ff.), and the reference in Rev. ii. 2 to the fact that the Church at Ephesus had tried certain men who claimed to be apostles and had found them false.

Between the apostles, prophets and teachers no hard-and-fast lines can be drawn. The apostles were commonly missionary prophets, called permanently or temporarily to the special work of evangelization (*cf.* Acts xiii. 1), while the teachers seem to have been distinguished both from apostles and prophets by the fact that their spiritual endowment was less strikingly supernatural. The indefiniteness of the boundaries between the three classes, and the free interchange of names, show how far they were from being definite offices or orders within the Church.

But at an early day we find regular officers in this and that local Church, and early in the 2nd century the three permanent offices of bishop, presbyter and deacon existed at any rate in Asia Minor. Their rise was due principally to the necessity of administering the charities of the Church, putting an end to disorder and confusion in the religious services, and disciplining offenders. Regular officers within the local Churches gradually made their appearance, sometimes simply recognized as charged with responsibilities which they had already voluntarily assumed (*cf.* 1 Cor. xvi. 15), sometimes appointed by an apostle or prophet or other specially inspired man (*cf.* Acts xiv. 23; Titus i. 5; 1 Clement 44), sometimes formally chosen by the congregation itself (*cf.* Acts vi.). These men naturally acquired more and more, as time passed, the control and leadership of the Church in all its activities, and out of what was in the beginning more or less informal and temporary grew fixed and permanent offices, the incumbents of which were recognized as having a right to rule over the Church, a right which once given could not lawfully be taken away unless they were unfaithful to their trust. Not continued endowment by the Spirit, but the possession of an ecclesiastical office now became the basis of authority. The earliest expression of this genuinely official principle is found in Clement's Epistle to the Corinthians (ch. xliv.).

The earliest distinct evidence of the organization of Churches under a single head is found in the Epistles of Ignatius of Antioch, which date from the latter part of the reign of Trajan (*c.* 116). Ignatius bears witness to the presence in various Churches of Asia Minor of a single bishop in control, with whom are associated as his subordinates a number of elders and deacons. This form of organization ultimately became universal. Where there were one bishop and a number of presbyters and deacons in a church, the presbyters constituted the bishop's council, and the deacons his assistants in the management of the finances and charities and in the conduct of the services.

Meanwhile the rise and rapid spread of Gnosticism (*q.v.*) produced a crisis in the Church of the 2nd century, and profoundly affected the ecclesiastical organization. The views of the Gnostics, and of Marcion as well, seemed to the majority of Christians destructive of the gospel, and it was widely felt that they were too dangerous to be tolerated. The original dependence upon the Spirit for light and guidance was inadequate. The men in question claimed to be Christians and to enjoy divine illumination as truly as anybody, and so other safeguards appeared necessary. It was in the effort to find such safeguards that steps were taken which finally resulted in the institution known as the Catholic Church. The first of these steps was the recognition of the teaching of the apostles as the exclusive standard of Christian truth. This found expression in the formulation of our New Testament, and of an apostolic rule of faith, of which the old Roman symbol, the original of our present Apostles' Creed, is one of the earliest examples. Over against the claims of the Gnostics that they had apostolic authority, either oral or written, for their preaching, were set these two standards, by which alone the apostolic character of any doctrine was to be tested (*cf.* Irenaeus, *Adversus Haereses,* i. 10, iii. 3, 4; Tertullian, *De Prescriptione Haereticorum*). But these standards proved inadequate to the emergency, for it was possible, especially by the use of the allegorical method, to interpret them in more than one way, and their apostolic origin and authority were not everywhere admitted. In view of this difficulty, it was claimed that the apostles had appointed the bishops as their successors, and that the latter were in possession of special divine grace enabling them to transmit and to interpret without error the teaching of the apostles committed to them. This is the famous theory known as "apostolic succession." The idea of the apostolic appointment of church officers is as old as Clement of Rome, but the use of the theory to guarantee the apostolic character of episcopal teaching was due to the exigencies of the Gnostic conflict. Irenaeus (*op. cit.* iii. 3, iv. 26, 33, v. 20), Tertullian (*op. cit.,* 32) and Hippolytus (*Philosophumena,* bk. i., preface) are about our earliest witnesses to it, and Cyprian sets it forth quite clearly in his epistles. The Church was thus in possession not only of authoritative apostolic doctrine, but also of a permanent apostolic office, to which alone belonged the right to determine what that

doctrine is. The combination of this idea with that of clerical sacerdotalism completed the Catholic theory of the Church and the clergy. Saving grace is recognized as apostolic grace, and the bishops as successors of the apostles become its sole transmitters. Bishops are therefore necessary to the very being of the Church, which without them is without the saving grace for the giving of which the Church exists (*cf.* Cyprian, *Ep.* 33, "ecclesia super episcopos constituitur"; 66, "ecclesia in episcopo"; also *Ep.* 59, and *De unitate ecclesiae* 17).

These bishops were originally not diocesan but congregational, that is, each church, however small, had its own bishop. This is the organization testified to by Ignatius, and Cyprian's insistence upon the bishop as necessary to the very existence of the Church seems to imply the same thing. Congregational episcopacy was the rule for a number of generations. But after the middle of the 3rd century diocesan episcopacy began to make its appearance here and there, and became common in the 4th century under the influence of the general tendency toward centralization, the increasing power of city bishops, and the growing dignity of the episcopate (*cf.* canon 6 of the council of Sardica, and canon 57 of the council of Laodicea; and see Harnack, *Mission und Ausbreitung,* pp. 319 *seq.*). This enlargement of the bishop's parish and multiplication of the churches under his care led to a change in the functions of the presbyterate. So long as each church had its own bishop the presbyters constituted simply his council, but with the growth of diocesan episcopacy it became the custom to put each congregation under the care of a particular presbyter, who performed within it most of the pastoral duties formerly discharged by the bishop himself. The presbyters, however, were not independent officers. They were only representatives of the bishop, and the churches over which they were set were all a part of his parish, so that the Cyprianic principle, that the bishop is necessary to the very being of the Church, held good of diocesan as well as of congregational episcopacy.

The belief in the unity of the entire Church had existed from the beginning. Though made up of widely scattered congregations, it was thought of as one body of Christ, one people of God. This ideal unity found expression in many ways. Intercommunication between the various Christian communities was very active. Christians upon a journey were always sure of a warm welcome and hospitable entertainment from their fellow-disciples. Messengers and letters were sent freely from one church to another. Documents of various kinds, including gospels and apostolic epistles, circulated widely. Thus in various ways the feeling of unity found expression, and the development of widely separated parts of Christendom conformed more or less closely to a common type. It was due to agencies such as these that the scattered churches did not go each its own way and become ultimately separate and diverse institutions. But this general unity became official, and expressed itself in organization, only with the rise of the conciliar and metropolitan systems. Already before the end of the 2nd century local synods were held in Asia Minor to deal with Montanism, and in the 3rd century provincial synods became common, and by the council of Nicaea (canon 5) it was decreed that they should be held twice every year in every province. Larger synods representing the churches of a number of contiguous provinces also met frequently; for instance, in the early 4th century at Elvira, Ancyra, Neo-Caesarea and Arles, the last representing the entire Western world. Such gatherings were specially common during the great doctrinal controversies of the 4th century. In 325 the first general or oecumenical council, representing theoretically the entire Christian Church, was held at Nicaea. Other councils of the first period now recognized as oecumenical by the Church both East and West are Constantinople I. (381), Ephesus (431), Chalcedon (451), Constantinople II. (553). All these were called by the emperor, and to their decisions he gave the force of law. Thus the character of the Church as a State institution voiced itself in them (*see* COUNCIL).

The theory that the bishops are successors of the apostles, and as such the authoritative conservators and interpreters of apostolic truth, involves of course the solidarity of the episcopate, and the assumption that all bishops are in complete harmony and bear witness to the same body of doctrine. This assumption, however, has not always been sustained by the facts. Serious disagreements even on important matters developed frequently. As a result the oecumenical council came into existence especially for the purpose of settling disputed questions of doctrine, and giving to the collective episcopate the opportunity to express its voice in a final and official way. At the council of Nicaea, and at the oecumenical councils which followed, the idea of an infallible episcopate giving authoritative and permanent utterance to apostolic and therefore divine truth, found clear expression, and has been handed down as a part of the faith of the Catholic Church both East and West.

Meanwhile the Roman episcopate developed into the papacy, which claimed supremacy over the entire Christian Church, and actually exercised it increasingly in the West from the 5th century on. This development was forwarded by Augustine, who in his famous work *De civitate Dei* identified the Church with the Kingdom of God, and claimed that it was supreme over all the nations of the earth, which make up the *civitas terrena* or earthly state. Augustine's theory was ultimately accepted everywhere in the West, and thus the Church of the middle ages was regarded not only as the sole ark of salvation, but also as the ultimate authority, moral, intellectual and political. Upon this doctrine was built, not by Augustine himself but by others who came after him, the structure of the papacy, the bishop of Rome being finally recognized as the head under Christ of the *civitas Dei,* and so the supreme organ of divine authority on earth (*see* PAPACY and POPE).

B. THE CHRISTIAN CHURCH IN THE MIDDLE AGES

The middle ages came into being at the time when the political structure of the world, based upon the conquests of Alexander the Great and the achievements of Julius Caesar, began to disintegrate. They were present when the believers in Mohammed held sway in provinces which Alexander had brought under the influence of Hellenism; while the Lombards, the West Goths, the Franks and the Anglo-Saxons had established kingdoms in Italy, Spain, Gaul and Britain.

The East.—Ancient and mediaeval times were not separated by so deep a gulf in the East as in the West; for in the East the Empire continued to exist, although within narrow limits, until towards the end of the middle ages. Constantinople only fell in 1453. Ecclesiastical Byzantinism is therefore not a product of the middle ages; it is the outcome of the development of the eastern half of the empire from the time of Constantine the Great. Imperial power extended equally over State and Church. Since the emperor ruled the Church there was no longer any question of independence for the bishops.

The *orthodoxy* of the Eastern Church was also a result of the Church's development after the time of Constantine. In the long strife over dogma the old belief of the Greeks in the value of knowledge had made itself felt, and this faith was not extinct in the Eastern Church. But the strife over dogma ended with the 7th century. After the termination of the Monothelite controversy (638–680), creed and doctrines were complete; it was only necessary to preserve them intact. Theology, therefore, now resolved itself into the collection and reproduction of the teaching of ancient authorities. The great dogmatist of the Eastern Church, John of Damascus (*c.* 699–753), who stood on the threshold of the middle ages, formulated clearly and precisely his working principle: to put forward nothing of his own, but to present the truth according to the authority of the Bible and of the Fathers of the Church.

In the Eastern Church the religious interest concerned itself more keenly with the mystic rites of divine worship than with dogma. Here was more than knowledge; here were representations of a mystic sensuousness, solemn rites, which brought the faithful into immediate contact with the Divine, and guaranteed to them the reception of heavenly powers. We may gauge the energy with which the Greek intellect turned in this direction if we call to mind that the controversy about dogma was replaced by the controversy about images. This raged in the Eastern Church for more than a century (726–843), and only sank to rest when the

worship of images was unconditionally conceded. In this connection the image was not looked upon merely as a symbol, but as the vehicle of the presence and power of that which it represented.

Consistent with this circle of ideas is the cultivation of religious experience. A beginning had been made, in the 5th century, by the Neo-platonic Christian who addressed his contemporaries under the mask of Dionysius the Areopagite. He is the first of a series of theological mystics which continued through every century of the middle ages. It is this striving after religious experience that gives to the Oriental *monasticism* (*q.v.*) of the middle ages its peculiar character; in it the old Hellenic ideal of the wise man who has no wants, *αὐτάρκεια*, was from the first fused with the Christian conception of unreserved self-surrender to God as the highest aim and the highest good.

The Eastern Church, then, throughout the middle ages, remained true in every particular to its ancient character. It did not develop as did the Western Church during this period, but room for *expansion* was found in the new nations which had sprung into existence since the beginning of the middle ages: the Bulgarians, the Serbians, and the multifarious peoples grouped under the name of Russians. One outcome of this expansion was the impossibility of continuing to share the life of the Western Church. Neither in the East nor in the West was a *separation* desired; but it was inevitable, since the lives of East and West were moving in different directions.

Since the time when the church of eastern Syria had decided, in opposition to the church of the Empire, to cling to the ancient views of Syrian theologians—therefore also to the teaching and person of Nestorius—her relations were broken off with the church in western Syria and in Greek and Latin countries; but the power of *Nestorian* Christianity was not thereby diminished. Separated from the West, it directed its energies towards the East, and here its nearest neighbour was the Persian church. The latter followed, almost without opposition, the impulse received from Syria; from the rule of the patriarch Babaeus (498–503) it may be considered definitely Nestorian. Thus there survived in mid-Asia a widely-scattered remnant, which, although out of touch with the ancient usages of Christian civilization, yet in no way lacked higher culture. Nestorian philosophers and medical practitioners became the teachers of the great Arabian natural philosophers of the middle ages, and the latter obtained their knowledge of Greek learning from Syriac translations of the works of Greek thinkers.

Political conditions at the beginning of the middle ages favoured the Nestorian church, and the fact that the Arabs had conquered Syria, Palestine and Egypt, made it possible to exert an influence on the Christians in these countries. Of still more importance was the brisk commercial intercourse between central Asia and the countries of the Far East; for this led the Nestorians into China. But with the consolidation of Mohammedan power the greater part of Nestorian Christendom was swallowed up by Islam, and only remnants of this once extensive church have survived until modern times. The middle ages were even more disastrous for *Monophysite* Christianity; in their case there was no alternation of rise and decline, and there is only a long period of gradual exhaustion to chronicle, alike in Syria and in Egypt.

The West.—(i.) During the *early middle ages* the central fact in the history of the Church is the influence of the foundation of the Teutonic States. While the Eastern Church was stereotyping those peculiar characteristics which made her a thing apart, the Church of the West was brought face to face with the greatest revolution that Europe has ever experienced. At the end of the 6th century all the provinces of the Empire had become independent kingdoms, in which conquerors of Germanic race formed the dominant nationality. This is the great fact which stands out at the beginning of the history of the Church in the middle ages. The continuity of the political history of Europe was violently interrupted by the Germanic invasion, but not that of the history of the Church. Creed and dogma, above all, remained unchanged. The doctrinal decisions of the ancient Church remained the indestructible canon of belief, and what the theologians of the ancient Church had taught was reverenced as beyond improvement. The entire form of divine worship remained therefore unaltered. Even where the Latin tongue was not understood by the people, the Church preserved it in the mass and in the administration of the sacraments, in her exorcisms and in her benedictions. The organization of ecclesiastical offices; and the property and social status of the Church and of the hierarchy, remained unchanged.

Nevertheless, the new conditions did exercise the strongest influence upon the character of the Church. The churches of the Lombards, West Goths, Franks and Anglo-Saxons, all counted themselves parts of the Catholic Church; but the Catholic Church had altered its condition; it lacked the power of organization, and split up into territorial churches. Under the Empire the oecumenical council had been looked upon as the highest representative organ of the Catholic Church; but the earlier centuries of the middle ages witnessed the convocation of no oecumenical councils. Under the Empire the bishop of Rome had possessed in the Church an authority recognized and protected by the State; among the new territorial churches, respect for Rome and for the successor of Peter was not forgotten but had altered in character; legal authority had become merely moral authority; its wielder could exhort, warn, advise, but could not command. The bishops continued to meet in synods as before, but the councils became territorial synods; they were called together at irregular intervals by the king, and their decisions obtained legal effect only by royal sanction.

In the middle ages *the civilizing task of the Church* was first approached in England. Aldhelm (d. 709) and the Venerable Bede (d. 735) were the first scholars of the period. England was also the home of Winfrid Bonifatius (St. Boniface, d. *c.* 757), who, in co-operation with the bishops of Rome, began the reorganization of the Frankish church, which had fallen into confusion and decay during the political disorders of the last years of the Merovingians. It was Boniface, too, who, with the aid of numerous English priests, monks and nuns, introduced the literary culture of England into Germany.

Charlemagne (d. 814) built on the foundations laid by St. Boniface. The importance of Charlemagne's work, from the point of view of the Church, consists in his having led back the Frankish Church to the fulfilment of her functions as a religious and civilizing agent. This was the purpose of his ecclesiastical legislation. The principal means to this end taken by him was the raising of the status of the clergy. For the purpose of carrying out his ideas Charlemagne gathered round him the best intellects of Europe. None was more intimately associated with him than the Anglo-Saxon Alcuin (d. 804); but he was only one among many. Under this guidance theology flourished in the Frankish empire. It was as little original as that of Bede; for on the continent, too, scholars were content to think what those of old had thought before them. But in so doing they did not only repeat the old formulae; the ideas of the men of old sprang into new life. This is shown by the searching discussions to which the Adoptionist controversy gave rise. At the same time, the controversy with the Eastern Church over the adoration of images shows that the younger Western theology felt itself equal, if not superior to the Greek.

The second generation of Frankish theologians did not lag behind the first. Hrabanus of Fulda (who died archbishop of Mainz in 856) was in the range of his knowledge undoubtedly Alcuin's superior. He was the first learned theologian produced by Germany. His disciple, Abbot Walafrid Strabo of Reichenau (d. 849), was the author of the *Glossa Ordinaria*, a work which formed the foundation of biblical exposition throughout the middle ages. France was still more richly provided with theologians in the 9th century: her most prominent names are Hincmar, archbishop of Reims (d. 882), Bishop Prudentius of Troyes (d. 861), the monks Servatus Lupus (d. 862), Radbert Paschasius (d. *c.* 860), and Ratramnus (d. after 868); and the last theologian who came into France from abroad, Johannes Scotus Erigena (d. *c.* 880). The real strength of Erigena was in the field of speculative metaphysics; the controversy about

predestination, which, in the 9th century, Hincmar and Hrabanus fought out with the monk Gottschalk of Fulda, as well as the discussions that arose from the definition of the doctrine of transubstantiation by Radbert, enable us to gauge the intellectual energy with which theological problems were being handled.

Charlemagne followed his father's policy in carrying out his ecclesiastical measures in close association with the bishops of Rome. The relation was one of co-operation, without supremacy on either side. There were, indeed, forces tending in the contrary direction; and these were present in the Frankish empire. Evidence of this is given by the canon law forgeries of the 9th century: especially the great collection of the Pseudo-Isidorian Decretals (*see* DECRETALS), the fundamental idea being that all lay control in ecclesiastical affairs is wrong. For the moment, however, this party met with no success. Of more importance was the fact that at Rome the old conditions, the old claims, and the old law were unforgotten. For example, Nicholas I. (858–867) drew a picture of the divine right and unlimited power of the bishop of Rome, which anticipated all that the greatest of his successors were, centuries later, actually to effect. The time had not, however, yet come for the establishment of the papal world-dominion. For, while the power of Charlemagne's successors was decaying, the papacy itself became involved in the confusion of the party strife of Italy and of the city of Rome, and was plunged in consequence into such an abyss of degradation (the so-called Pornocracy), that it was in danger of forfeiting every shred of its moral authority over Christendom.

(ii.) During the central period of the Middle Ages the antagonism between the German conception of ecclesiastical affairs and Roman views of ecclesiastical law found inevitable expression. This was most obvious in the matter of appointment to bishoprics. At Rome canonical election was alone regarded as lawful; in Germany, on the other hand, developments since the time of Charlemagne had led to the actual appointment of bishops being in the hands of the king, although the form of ecclesiastical election was preserved.

The practice customary in Germany was finally transferred to Rome itself. The desperate position of the papacy in the 11th century obliged Henry III. to intervene. When, in Dec. 1046, after three rival popes had been set aside, he nominated Suidgar, bishop of Bamberg, as bishop of Rome before all the people in St. Peter's, the papacy was bestowed in the same way as a German bishopric; and what had occurred in this case was to become the rule. By procuring the transference of the patriciate from the Roman people to himself Henry assured his influence over the appointment of the popes, and accordingly also nominated the successors of Clement II.

His intervention saved the papacy. For the popes nominated by him, Leo IX. in particular, were men of high character, who exercised their office in a loftier spirit than their corrupt predecessors. They placed themselves at the head of the movement for ecclesiastical reform. But it was not possible for the relation between Empire and Papacy to remain what Henry III. had made it.

The original sources of this reform movement lay far back, in the time of the Carolingians. It has been pointed out how Charlemagne pressed the monks into the service of his civilizing aims; but he thereby alienated monasticism from its original ideals. These, however, had far too strong a hold upon the Roman world for a reaction against the new tendency to be long avoided. This reaction began with the reform of Benedict of Aniane (d. 821), the aim of which was to bring the Benedictine order back to the principles of its original rules. In the next century the reform movement acquired a fresh centre in the Burgundian monastery of Cluny. A large number of the reformed monasteries attached themselves to the congregation of Cluny, thus assuring the influence of reformed monasticism upon the Church, and securing likewise its independence of the diocesan bishops, since the abbot of Cluny was subordinate of the pope alone (*see* CLUNY, BENEDICTINES, and MONASTICISM). Everywhere the object was the same: the supreme obligation of the Rule, the renewal of discipline, and also the economic improvement of the monasteries. The reform movement had originally no connection with ecclesiastical politics; but that came later when the leaders turned their attention to the abuses prevalent among the clergy, to the conditions obtaining in the Church in defiance of the ecclesiastical law. "Return to the canon law!" was now the battle-cry. The programme of reform thus included the freeing of the Church from the influence of the State, the recovery of her absolute control over all her possessions, the liberty of the Church and of the hierarchy.

As a result, the party of reform placed itself in opposition to those ecclesiastical conditions which had arisen since the conversion of the Teutonic peoples. It was, then, a fact pregnant with the most momentous consequences that Leo IX. attached himself to the party of reform. For, thanks to him and to the men he gathered round him (Hildebrand, Humbert and others), their principles were established in Rome, and the pope himself became the leader of ecclesiastical reform. But the carrying out of reforms led at once to dissensions with the civil power, the starting-point being the attack upon simony, this term covering all transferences by laymen of ecclesiastical offices or benefices, even though no money changed hands in the process. Thus the lord who handed over a living was a simonist, and so too was the king who invested a bishop. The Church at first concentrated her attack upon investiture. In 1059 the new system of papal election introduced by Nicholas II. (*see* CONCLAVE) ensured the occupation of the Holy See by a pope favourable to the party of reform; and in 1078 Gregory VII. issued his prohibition of lay investiture. In the years of conflict that followed Gregory looked far beyond this point; he set his aim ever higher, until, in the end, his idea was to concentrate all ecclesiastical power in the hands of the pope, and to raise the papacy to the dominion of the world. Thus was to be realized the old dream of Augustine: that of a Kingdom of God on earth under the rule of the Church. But it was not given to Gregory to reach this goal, and his successors had to return again to the strife over investiture; and the long struggle ended in a compromise by the Concordat of Worms (1122), the essential part of which was that the Empire accepted the canonical election of bishops, while the Church acknowledged that the bishop held his temporal rights from the Empire, and was therefore to be invested with them by a touch from the royal sceptre. A similar solution was arrived at in England. In France the demands of the Church were successful to the same degree as in England and Germany, but without any conflict. Thus the Germanic element in the law regarding appointment to bishoprics was eliminated. Somewhat later it disappeared also in the case of the churches of less importance, patronal rights over these being substituted for the former absolute ownership. The pontificate of Alexander III. (1159–81) decided this.

The Teutonic peoples had been taking the lead in the expansion of Christianity; but the spirit of the Latin races now began to assert itself. Scholasticism, the new theology, had its home in the Latin countries. Reason as well as authority had been appealed to as the foundation of theology; but for the theologians of the 9th and 10th centuries, whose method had been merely that of restatement, *ratio* and *auctoritas* were in perfect accord. Then Berengar of Tours (d. 1088) ventured to set up reason against authority: by reason the truth must be decided. This involved the question of the relation in theology of authority and reason, and of whether the theological method is authoritative or rational. To these questions Berengar gave no answer; he was ruined by his opposition to Radbert's doctrine of transubstantiation. The Lombard Anselm (d. 1109), archbishop of Canterbury, was the first to deal with the subject. He took as his starting-point the traditional faith; but he was convinced that whoever has experience of the truths of the faith would be able to understand them, by the exercise of his natural reason.

It was a bold conception—too bold for the mediaeval world, for which faith was primarily the obligation to believe. It was easy, therefore, to understand why Anselm's method did not become the dominant one in theology. Not he, but the Frenchman Abelard (d. 1142), was the creator of the scholastic method. Abelard, too, started from tradition; but he discovered that the statements of

the various authorities are very often in the relation of *sic et non*, yes and no. Upon this fact he based his pronouncement as to the function of theology: it must employ the dialectic method to reconcile the contradictions of tradition, and thus to shape the doctrines of the faith in accordance with reason. By teaching this method Abelard created the implements for the erection of the great theological systems of the schoolmen of the 12th and 13th centuries: Peter Lombard (d. 1160), Alexander of Hales (d. 1245), Albertus Magnus (d. 1280) and Thomas Aquinas (d. 1275). They adventured a complete exposition of Christian doctrine that should be altogether ecclesiastical and at the same time altogether rational. In so doing they set to work to complete the development of ecclesiastical dogma; the formulation of the Catholic doctrine of the Sacraments was the work of scholasticism.

Canon law is the twin-sister of scholasticism. At the very time when Peter Lombard was shaping his Sentences, the monk Gratian of Bologna was making a new collection of laws. It was not only significant that in the *Concordia discordantium canonum* ecclesiastical laws, whether from authentic or forged sources, were gathered together without regard to the existing civil law; of even greater eventual importance was the fact that Gratian taught that the contradictions of the canon law were to be reconciled by the same method as that used by theology to reconcile the discrepancies of doctrinal tradition. Thus Gratian became the founder of the science of canon law, a science which, like the scholastic theology, was entirely ecclesiastical and entirely rational (*see* CANON LAW).

Like the new theology and the new science of law, the new monasticism was also rooted in Latin soil. The duty of the priest-monk is not only to work out his own salvation, but, by preaching and cure of souls, to labour for others. This was the dominant idea of the order of friars preachers founded in 1216 by St. Dominic (*see* DOMINIC, SAINT; DOMINICANS). It was also the basis of the order of friars minor, founded in 1210 (*see* FRANCIS OF ASSISI, ST.; FRANCISCANS). This alone would serve to indicate the remarkable deepening of the religious life that had taken place in the Latin countries. In the 12th century the most influential exponent of this new piety was Bernard (*q.v.*) of Clairvaux, who taught men to find God by leading them to Christ. Contemporary with him were Hugh of St. Victor (*q.v.*) and his pupil Richard of St. Victor (*q.v.*), both monks of the abbey of St. Victor at Paris, the aim of whose teaching was a mystical absorption of thought in the Godhead and the surrender of self to the Eternal Love. Under the influence of these ideas, in part purely Christian and in part Neoplatonic, piety gained in warmth and depth and became more personal; and though at first it flourished in the monasteries, and in those of the mendicant orders especially, it penetrated far beyond them and influenced the laity everywhere. The new piety did not set itself in opposition either to the hierarchy or to the institutions of the Church, such as the sacraments and the discipline of penance, nor did it reject those foreign elements (asceticism, worship of saints and the like) which had passed of old time into Christianity from the ancient world. Its temper was not critical, but aggressively practical.

All this meant a mighty exaltation of the Church, which ruled the minds of men as it had hardly ever done before. Nor was it possible that the position of the bishop of Rome, the supreme head of the Western Church, should remain unaffected by it. Two of the most powerful of the German emperors, Frederick I. and his son Henry VI., struggled to renew and to maintain the imperial supremacy over the papacy. But when at the peace of Venice (1177) Frederick recognized Alexander III. as pope, he relinquished the hope of carrying out his Italian policy; while Henry died at the early age of thirty-two (1197), before his far-reaching schemes had been realized.

The field was thus cleared for the full development of papal power. This had greatly increased since the Concordat of Worms, and reached its height under Innocent III. (1198–1216). Innocent believed himself to be the representative of God, and as such the supreme possessor of both spiritual and temporal power. He therefore claimed in both spheres the supreme administrative, legislative and judicial authority. The bishops described themselves as holding office "by grace of the Apostolic See," for they administered their dioceses as plenipotentiaries of the pope; and even the criminal jurisdiction of the church (*see* INQUISITION) became more and more concentrated in his hands. And just as he considered himself entitled to appoint to all ecclesiastical offices, so also he invested the emperor with his empire and kings with their kingdoms. Not only did he despatch his decretals to the universities to form the basis of the teaching of the canon law and of the decisions founded upon it, but he considered himself empowered to annul civil laws. Thus he annulled the Great Charter in 1215. Just as the Curia was the supreme court of appeal in ecclesiastical causes, so also the pope threatened disobedient princes with deposition, *e.g.*, the emperor Otto IV. in 1210, and John of England in 1212. But the papal claim to supreme temporal authority proved impossible to maintain, although Innocent III. had apparently enforced it. The long struggle against Frederick II., carried on by Gregory IX. (1227–41) and Innocent IV. (1243–54), did not result in victory; no papal sentence, but only death itself, deprived the emperor of his dominions; and when Boniface VIII. (1294–1303), who gave the papal claims to universal dominion their classical form, quarrelled with Philip IV. of France about the extension of the royal power, he could not but perceive that the national monarchy had become a force which it was impossible for the papacy to overcome.

(iii.) At the close of the middle ages we come to a period of disintegration. While the Church was yet at the height of her power began the great revolution which was to end in the disruption of that union between the Temporal and the Spiritual which, under her dominion, had characterized the life of the West. The Temporal now claimed its proper rights. The political power of the Empire, indeed, had been shattered; but this left all the more room for the vigorous development of national states, notably of France and England. At the same time intellectual life was enriched by a wealth of fresh views and new ideas, partly the result of the busy intercourse with the East to which the Crusades had given the first impetus, and which had been strengthened and extended by lively trade relations, partly of the revived study, eagerly pursued, of ancient philosophy and literature (*see* RENAISSANCE). The life of the Church, moreover, was affected by the economic changes due to the rise of the power of money as opposed to the old economic system based upon land.

The effects of these changes made themselves felt on all sides, in no case more strongly than in that of the papal claims to the supreme government of the world. Theoretically they were still unwaveringly asserted; but after Boniface VIII. no pope seriously attempted to realize them; to do so had in fact become impossible, for from the time of their residence at Avignon (1305–77) the popes were in a state of complete dependence upon the French crown. In France Philip IV.'s jurists maintained that the temporal power was independent of the spiritual. In Italy, a little later, Dante championed the divine right of the emperor (*De Monarchia*, 1311). In Germany, Marsiglio of Padua and Jean of Jandun, the literary allies of the emperor Louis IV., ventured to define anew the nature of the civil power from the standpoint of natural law, and to assert its absolute sovereignty (*Defensor pacis, c.* 1352); while the Franciscan William of Occam (d. 1349) examined, also in Louis' interests, into the nature of the relation between the two powers. He too concluded that the temporal power is independent of the spiritual, and is even justified in invading the sphere of the latter in cases of necessity.

While these thoughts were filling men's minds, opposition to the papal rule over the Church was also gaining continually in strength. The reasons for this were numerous, first among them being the abuses of the papal system of finance, which had to provide funds for the vast administrative machinery of the Curia. There was also the boundless abuse and arbitrary exercise of the right of ecclesiastical patronage; and further the ever-increasing traffic in dispensations, the abuse of spiritual punishments for worldly ends, and so forth. No means, however, existed of enforcing any remedy until the papal schism occurred in 1378. Such a schism as this, so intolerable to the ecclesiastical sense of the

middle ages, necessitated the discovery of some authority superior to the rival popes, and therefore able to put an end to their quarrelling. General councils were now once more called to mind; but these were no longer conceived as mere advisory councils to the pope, but as the highest representative organ of the universal Church, and as such ranking above the pope, and competent to demand obedience even from him. The council of Constance (1414–18) did actually put an end to the schism; but the reforms begun at Constance and continued at Basel (1431–49) proved insufficient. Above all, the attempt to set up the general council as an ordinary institution of the Catholic Church failed; and the Roman papacy, restored at Constance, preserved its irresponsible and unlimited power over the government of the Church (*see* PAPACY; CONSTANCE, COUNCIL OF; and BASEL, COUNCIL OF). Neither France nor Germany, however, was prepared to forgo the reforms passed by the council. France secured their validity, as far as she herself was concerned, by the Pragmatic Sanction of Bourges (July 7, 1438); Germany followed with the Acceptation of Mainz (March 26, 1439). The theory of the papal supremacy held by the Curia was thus at least called in question.

The antagonism of the opposition parties was even more pronounced. The tendencies which they represented had been present when the middle ages were yet at their height; but the papacy, while at the zenith of its power, had succeeded in crushing the attacks made upon the creed of the Church by its most dangerous foes, the dualistic Cathars (*q.v.*), Waldenses (*q.v.*) and kindred enthusiasts, who everywhere kept alive mistrust of the temporal power of the Church, of her priesthood and her hierarchy. In England the hierarchy was attacked by Wycliffe (d. 1384), its greatest opponent before Luther. Starting from Augustine's conception of the Church as the community of the elect, he protested against a church of wealth and power, a church that had become a political institution instead of a school of salvation; and against its head, the bishop of Rome. Wycliffe's ideas, conveyed to the continent, precipitated the outbreak of the Hussite storm in Bohemia (*see* HUSS; WYCLIFFE; LOLLARDS). This was open opposition; but there was besides another opposing force which, though it raised no noise of controversy, was far more widely severed from the views of the Church than either Wycliffe or Huss, namely the Renaissance, which began its reign in Italy during the 14th century. The Renaissance meant the emancipation of the secular world from the domination of the Church, and it contributed in no small measure to the rupture of the educated class with ecclesiastical tradition. Beauty of form alone was at first sought, and found in the antique; but, with the form, the spirit of the classical attitude towards life was revived. The men of the Renaissance wished to enjoy the earth by means of secular education and culture, and an impassable gulf yawned between their views of religion and morality and those of the Church. Theology could no longer provide a reconciliation. Since the time of Duns Scotus (d. 1308) theologians had been conscious of the discrepancy between Aristotelianism and ecclesiastical dogma. Faith in the infallibility of the scholastic system was thus shaken, and the system itself was destroyed by the revival of philosophic nominalism, which had been discredited in the 11th century by the realism of the great schoolmen. It now found a courageous supporter in William of Occam, and through him became widely accepted. But nominalism was powerless to inspire theology with new life; on the contrary, its intervention only increased the inextricable tangle of the hairsplitting questions with which theology busied itself.

In the meantime the Roman claim to the supreme government of the Church was steadily maintained. In 1512 Julius II. called together the 5th Lateran general council, which expressly recognized the subjection of the councils to the pope and also declared the constitution of Boniface VIII. (*see* above) valid in law. But the papacy that sought to win back its old position was no longer the same as of old. Eugenius IV.'s successor, Nicholas V. (1447–55), was the first of the Renaissance popes. Under his successors the views which prevailed at the secular courts of the Italian princes came likewise into play at the Curia: the papacy became an Italian princedom. Innocent VIII., Alexander VI., Julius II. were in many respects remarkable men, but they were scarcely affected by the convictions of the Christian faith. The terrible tragedy which was consummated on May 23, 1498, before the Palazzo Vecchio, in Florence, casts a lurid light upon the irreconcilable opposition in which the wearers of the papal dignity stood to mediaeval piety; for Savonarola was in every fibre a loyal son of the mediaeval Church.

Twenty years after Savonarola's death Luther made public his theses against indulgences. The Reformation which thus began brought the disintegrating process of the middle ages to an end, and at the same time divided Western Catholicism in two. Yet we may say that this was its salvation; for the struggle against Luther drove the papacy back to its ecclesiastical duties, and the council of Trent established mediaeval dogma as the doctrine of modern Catholicism in contradistinction to Protestantism.

C. THE MODERN CHURCH

The issue in 1564 of the canons of the council of Trent marks a very definite epoch in the history of the Christian Church. Up till that time, in spite of the schism of East and West and of innumerable heresies, the idea of the Church as Catholic, not only in its faith but in its organization, had been generally accepted. From this conception the Reformers had, at the outset, no intention of departing. Their object had been to purify the Church of mediaeval accretions, and to restore the primitive model in the light of the new learning; the idea of rival "churches," differing in their fundamental doctrines and in their principles of organization, existing side by side, was as abhorrent to them as to the most rigid partisan of Roman centralization. The actual divisions of Western Christendom are the outcome, less of the purely religious influences of the Reformation period than of the political forces with which they were associated and confused. Thus over a great part of Europe the Catholic Church was split up into territorial or national churches, which, whatever the theoretical ties which bound them together, were in fact separate organizations, tending ever more and more to become isolated and self-contained units with no formal intercommunion, and, as the rivalry of nationalities grew, with increasingly little even of intercommunication.

It was not, indeed, till the settlement of Westphalia in 1648, after the Thirty Years' War, that this territorial division of Christendom became stereotyped, but the process had been going on for 100 years previously; in some States, as in England and Scotland, it had long been completed; in others, as in S. Germany, Bohemia and Poland, it was defeated by the political and missionary efforts of the Jesuits and other agents of the counter-Reformation. In any case, it received a vast impetus from the action of the council of Trent. With the issue of the Tridentine canons, all hope even of compromise between the "new" and the "old" religions was definitely closed. Considered from the standpoint of the world outside, the Roman Church is, no less than the Protestant communities, merely one of the sects into which Western Christendom has been divided—the most important and widespread, it is true, but playing in the general life and thought of the world a part immeasurably less important than that filled by the Church before the Reformation, and one in no sense justifying her claim to be considered as the sole inheritor of the tradition of the pre-Reformation Church.

If this be true of the Roman Catholic Church, it is still more so of the other great communities and confessions which emerged from the controversies of the Reformation. Of these the Anglican Church held most closely to the tradition of Catholic organization; but she has never made any higher claim than to be one of "the three branches of the Catholic Church," a claim repudiated by Rome and never formally admitted by the Church of the East. The Protestant churches established on the continent, even where —as in the case of the Lutherans—they approximate more closely than the official Anglican Church to Roman doctrine and practice, make no such claim. The Bible is for them the real source of authority in doctrine; their organization is part and parcel of that of the State. They are, in fact, the State in its religious aspect, and as such are territorial or national, not Catholic. This tendency has been common in the East also, where with the growth

of racial rivalries the Orthodox Church has split into a series of national churches, holding the same faith but independent as to organization.

A yet further development, of comparatively recent growth, has been the formation of what are now commonly called in England the "free churches." These represent a theory of the Church practically unknown to the Reformers, and only reached through the necessity for discovering a logical basis for the communities of conscientious dissidents from the established churches. According to this the Catholic Church is not a visibly organized body, but the sum of all "faithful people" throughout the world, who group themselves in churches modelled according to their convictions or needs. For the organization of these churches no divine sanction is claimed, though all are theoretically modelled on the lines laid down in the Scriptures. It follows that, while in the traditional Church, with its claim to an unbroken descent from a divine original, the individual is subordinate to the Church, in the "free churches" the Church is in a certain sense secondary to the individual. The believer may pass from one community to another without imperilling his spiritual life, or establish a new church without necessarily incurring the reproach of schism. From this theory, powerful in Great Britain and her colonies, supreme in the United States of America, has resulted an enormous multiplication of sects.

Hence, from the period of the Reformation onward, no historical account of the Christian Church as a whole, and considered as a definite institution, is possible. The stream of continuity has been broken, and divides into innumerable channels. The only possible synthesis is that of the Christianity common to all; as institutions, they are divided, though they possess many features in common. The history of the various branches of the Christian Church since the Reformation will therefore be found under their several titles: ROMAN CATHOLIC CHURCH; ENGLAND, CHURCH OF; PRESBYTERIANISM; CONGREGATIONALISM; METHODISM; and others. The references given under the titles CHRISTIANITY, HERESY, and REUNION, CHURCH, may be mentioned here also.

The first real Church History was written by Eusebius of Caesarea in the early part of the 4th century. His work was continued in the 5th century by Philostorgius, Socrates, Sozomen and Theodoret, and later by Evagrius, Theophanes and others. In the West the history of Eusebius was translated into Latin by Rufinus and continued to the end of the 4th century. In the 6th century Cassiodorus had a translation made of the histories of Socrates, Sozomen and Theodoret, and brought down to 518. It was called *Historia Ecclesiastica Tripartita,* and during the middle ages was the principal textbook of Church History in the West. During the 5th, 6th and following centuries numerous works were produced containing more or less ecclesiastical material: biographies, chronicles, cloister annals and especially many local and territorial histories such as Gregory of Tours, *History of the Franks,* and Bede's *Ecclesiastical History of England.* The Protestant Reformation led to a new development of historical writing. In 1559 and following years a number of Protestant scholars published the *Magdeburg Centuries* to prove the primitive character of Protestantism, and were followed by Baronius (*Annales Ecclesiastici,* 1588 ff.) on the Roman Catholic side. Both works became the model for many others.

Church history began to be written in a genuinely scientific spirit in the 18th century under the leadership of Mosheim, whose most important work is his *Institutiones Historiae Ecclesiasticae* (1755), and was carried further through the new historical spirit of the 19th century in a series of works of which the most important are those of Gieseler, *Lehrbuch der Kirchengeschichte* (1826 ff. Eng. tr. by H. B. Smith), with copious citations from the sources, and still valuable; Neander, *Allgemeine Geschichte der Christlichen Religion und Kirche* (1825 ff., Eng. tr. by Torrey), with special stress on the religious side of the subject (*cf.* also Schaff, *History of the Christian Church,* 5th ed. 1889 ff.); Ferdinand Christian Baur of Tübingen (*Das Christenthum und die christliche Kirche,* 1853 ff.) whose many historical works were dominated by the principles of the Hegelian philosophy and exhibit both the merits and defects of that school; and Albrecht Ritschl (*Entstehung der alt katholischen Kirche,* 2nd ed. 1857), who broke away from the Tübingen school and built up new points of view. Among many more recent books may be mentioned that of W. Moeller, *Lehrbuch der Kirchengeschichte* (1889 ff., 2nd ed. by von Schuberth, 1898 ff., enlarged and improved), the translation of the latter being still the most useful textbook in English. Many references to historical works on specific branches of the subject will be found in the relative articles.

There are many editions of the works of the Fathers in the original, the most convenient, in spite of its defects, being that of J. P. Migne (*Patrologia Graeca,* 166 vols., Paris, 1857 ff.; *Patrologia Latina,* 221 vols., 1844 ff.). Of modern critical editions, besides those containing the works of one or another individual, the best are the Berlin edition of the early Greek Fathers (*Die griechischen christlichen Schriftsteller der ersten drei Jahrhunderte,* 1897 ff.), and the Vienna edition of the Latin Fathers (*Corpus scriptorum ecclesiasticorum Latinorum,* 1867 ff.), both of first-rate importance. There is a convenient English translation of most of the writings of the ante-Nicene Fathers by Roberts and Donaldson (*Ante-Nicene Christian Library,* 25 vols., Edinburgh, 1868 ff., American reprint, 9 vols., 1886 ff.). A continuation of it, containing selected works of the Nicene and post-Nicene period, was edited by Schaff and others under the title *A Select Library of Nicene and post-Nicene Fathers* (series 1 and 2; 28 vols., Buffalo and N.Y., 1886 ff.).

On early Christian literature, in addition to the works on Church history, see especially the monumental *Geschichte der altchristlichen Litteratur bis Eusebius,* by Harnack (1893 ff.). The brief *Geschichte der altchristlichen Litteratur in den ersten drei Jahrhunderten,* by G. Krüger (1895, English translation, 1897) is a very convenient summary. Bardenhewer's *Patrologie* (1894) and his *Geschichte der altkirchlichen Litteratur* (1902 ff.) should also be mentioned. Upon the spread of the Church during the early centuries see especially Harnack, *Mission und Ausbreitung des Christenthums in den ersten drei Jahrhunderten,* Eng. tr. *The Mission and Expansion of Christianity* (1907). An interesting parallel to the spread of Christianity in the Roman empire is afforded by the contemporary Mithraism; *see* Cumont's *Les Mystères de Mithra* (1900, Eng. tr., 1903). *See* also Hatch, *Influence of Greek Ideas and Usages upon the Christian Church,* 1890; Anrich, *Das antike Mysterienwesen in seinem Einfluss auf das Christentum,* 1894, Wobbermin, *Religionsgeschichtliche Studien zur Frage der Beeinflussung des Urchristentums durch das antike Mysterienwesen,* 1896; and for the organization of the early church, Harnack, *Mission und Ausbreitung des Christenthums,* pp. 337 *seq.,* and to the same writer's *Texte und Untersuchungen,* ii. 5 (Eng. tr. *Sources of the Apostolic Canons,* 1895); Fulbert Cayré, A.A.; *Precis de Patralogie,* French 1930, 1931; English 1936, 1940. (A. C. McG.; A. Hk.; W. A. P.; X.)

CHURCHILL, CHARLES (1731–1764), English poet and satirist, was born in Westminster, in Feb. 1731. His father, a clergyman, destined his son for the Church, and Charles was ordained in 1756. He was married at the age of 18, but his married life was unhappy and in 1761 he separated from his wife. He had lived a poverty-stricken life until that year, when he published, anonymously and without advertisement, the *Rosciad* at the price of a shilling. This brilliant but merciless satire described one by one the faults and eccentricities of the leading actors and actresses of the London stage, David Garrick almost alone escaping censure. It lay but a few days unnoticed in the bookshops; it was soon taken up with enthusiasm and the secret of its authorship publicly debated. It was attributed to Robert Lloyd, an amiable Welsh poet who, on Churchill's acknowledging the authorship, became his great friend. Churchill followed up the *Rosciad* with the *Apology,* in which his strictures were repeated and even Garrick was threatened. The actor sent through Lloyd an anxious and alarmed letter which flattered the poet by showing the fear which he already inspired. More, perhaps, even than his new-found power, Churchill enjoyed the wealth which his poems brought him. He paid his debts, made an allowance to his wife and started on a career of loose living and dandiacal dressing, which led, in 1763, after protests from his parishioners

and his bishop, to his being forced to resign his living. He defended in 1761 his method of life in a poem called *Night*, of which Smollett's *Critical Review* said in Dec. 1761, not unfairly, "This Night, like many others at this time of the year, is very cold, long, dark and dirty." With Sir Francis Dashwood and John Wilkes (*q.v.*) he drank wine in the globe at the top of West Wycombe church, and indulged in even less seemly pranks; he may even have been one of the famous Medmenham monks.

He became, in 1762, along with Lloyd, a close ally of Wilkes and assistant editor of the *North Briton* throughout its career, assisting its furious political campaign by rhymed satires which were almost equally feared: *The Prophecy of Famine* (1763), an attack on Lord Bute and the Scots, an *Epistle to William Hogarth* (1763), a reply to Hogarth's attack on Temple and Pitt; *The Duellist* (1763), an attack on Samuel Martin, M.P., who had attempted to kill Wilkes, and *The Candidate* (1764), an exposure of "Jemmy Twitcher," Lord Sandwich, Wilkes' chief enemy. His other completed works are *The Ghost, The Conference, The Author* (1763), *The Farewell, Independence, The Times* and *Gotham* (1764), of which the last is perhaps the best. He died of a fever on a visit to Wilkes in exile at Boulogne on Nov. 4, 1764.

Churchill was elephantine in figure: he has drawn his own picture in *Independence:*—

> Vast were his bones, his muscles twisted strong;
> His face was short, but broader than 'twas long;
> His features, though by nature they were large,
> Contentment had contrived to overcharge,
> And bury meaning, save that we might spy
> Sense lowering in the penthouse of his eye;
> His arms were two twin oaks; his legs so stout
> That they might bear a Mansion House about;
> Nor were they, look but at his body there,
> Designed by fate a much less weight to bear.

Churchill excelled in invective and malicious portraiture, as of Warburton, the pedantic and ambitious bishop of Gloucester:—

> Who was so proud, that should he meet
> The Twelve Apostles in the street,
> He'd turn his nose up at them all
> And shove his Saviour from the wall.
> (*The Duellist.*)

In his lifetime he was grossly overpraised and his death was lamented as a privation equal to the loss of Hogarth. Since then he has suffered an almost total eclipse. But he possesses great merits: his English is clear and vigorous, his wit and talent for invective are undoubted, and his poetic genius, of a Juvenalian character, much above the average. But it requires a great knowledge of 18th century politics and an equally great interest to appreciate his merits, and for that reason he is never again likely to be widely read.

See his *Collected Poems*, edited by W. Tooke with a biography and letters (1804), and re-edited by J. L. Hannay (1892), and the books cited under WILKES, JOHN. (R. W. P.)

CHURCHILL, LORD RANDOLPH HENRY SPENCER (1849–1895), English statesman, third son of John, 7th duke of Marlborough, by Frances, daughter of the third marquess of Londonderry, was born at Blenheim palace, on Feb. 13, 1849. He was educated at Eton and at Merton college, Oxford. In 1874 he was elected to parliament in the Conservative interest for Woodstock.

In 1878 he forced himself into public notice as the exponent of a species of independent Conservatism. He directed a series of furious attacks against some of the occupants of the front Ministerial bench. Sclater-Booth (afterwards 1st Lord Basing), president of the Local Government Board, was a special object of attack, and denounced as the "crowning dishonour to Tory principles." In the new parliament of 1880, Churchill began to play a more notable rôle. With the assistance of Sir Henry Drummond Wolff, Sir John Gorst and occasionally of Arthur Balfour, and one or two others, he constituted himself at once the audacious opponent of the Liberal Administration and the unsparing critic of the Conservative front bench. The "fourth party," as it was nicknamed, was effective in awakening the Opposition from the apathy which had fallen upon it after its defeat at the polls. Churchill roused the Conservatives and gave them a fighting issue, by putting himself at the head of the resistance to Charles Bradlaugh, the member for Northampton, who, though an avowed atheist or agnostic, was prepared to take the parliamentary oath. He continued to play a conspicuous part throughout the parliament of 1880–85, dealing his blows with almost equal vigour at Gladstone and at the Conservative front bench, some of whose members, and particularly Sir Richard Cross and W. H. Smith, he assailed with extreme virulence.

From the beginning of the Egyptian imbroglio Lord Randolph emphatically opposed almost every step taken by the Government. He declared that the suppression of Arabi Pasha's rebellion was an error, and the restoration of the khedive's authority a crime. He was equally severe on the domestic policy of the Administration, and was particularly bitter in his criticism of the Kilmainham Treaty and the *rapprochement* between the Gladstonians and the Parnellites. It is true that for some time before the fall of the Liberals in 1885 he had considerably modified his attitude towards the Irish question, and was himself cultivating friendly relations with the Home Rule members, and even obtained from them the assistance of the Irish vote in the English constituencies in the general election. By this time he had definitely formulated the policy of progressive Conservatism which was known as "Tory democracy." He declared that the Conservatives ought to adopt, rather than oppose, reforms of a popular character, and to challenge the claims of the Liberals to pose as the champions of the masses. His views were to a large extent accepted by the official Conservative leaders in the treatment of the Gladstonian Franchise bill of 1884. Lord Randolph insisted that the principle of the bill should be accepted by the Opposition, and that resistance should be focussed upon the refusal of the Government to combine with it a scheme of redistribution. The prominent, and on the whole judicious and successful, part he played in the debates on these questions, still further increased his influence with the rank and file of the Conservatives in the constituencies. At the same time he was actively spreading the gospel of democratic Toryism in a series of platform campaigns. In 1883 and 1884 he invaded the Radical stronghold of Birmingham itself, and in the latter year took part in a Conservative garden party at Aston Manor, at which his opponents paid him the compliment of raising a serious riot. He gave constant attention to the party organization, and was an active promoter and first member of the Primrose League, which owed its origin to the happy inspiration of one of his own "fourth party" colleagues.

In 1884 the struggle between stationary and progressive Toryism ended in favour of the latter. At the conference of the Central Union of Conservative Associations, Lord Randolph was nominated chairman, notwithstanding the strenuous opposition of the parliamentary leaders of the party. The split was averted by Lord Randolph's voluntary resignation; but the episode had confirmed his title to a leading place in the Tory ranks. It was further strengthened by the prominent part he played in the events immediately preceding the fall of the Liberal Government in 1885; and when Childers's budget resolutions were defeated by the Conservatives, aided by about half the Parnellites, Lord Randolph Churchill's admirers were justified in proclaiming him to have been the "organizer of victory." Owing to Lord Randolph's refusal to serve under Sir S. Northcote's leadership, Lord Salisbury had great difficulty in forming a cabinet in June 1885. Finally a way out of the *impasse* was found by elevating Northcote to the peerage (as earl of Iddesleigh) and giving the leadership in the House of Commons to Sir M. Hicks Beach. Lord Randolph was given the India Office, where "the India Council would be a check on him." (*Letters of Queen Victoria,* second series, vol. iii., p. 663.) During the few months of his tenure of this great post the young free-lance of Tory democracy attended to his departmental duties and mastered the complicated questions of Indian administration. In the autumn election of 1885 he contested Central Birmingham against Bright, and though defeated here, was at the same time returned by a very large ma-

jority for South Paddington. In the Home Rule controversy, both in and out of parliament, Lord Randolph again bore a conspicuous part. He was now the recognized Conservative champion in the lower chamber, and when the second Salisbury Administration was formed after the general election of 1886 he became chancellor of the exchequer and leader of the House of Commons. His management of the House was on the whole successful, and was marked by tact, discretion and temper. But he had never really reconciled himself with some of his colleagues, and there was a good deal of friction in his relations with them, which ended with his sudden resignation on Dec. 20, 1886. Various motives influenced him in taking this step; but the only ostensible cause was that put forward in his letter to Lord Salisbury, read in the House of Commons on Jan. 27, in which he stated that his resignation was due to his inability, as chancellor of the exchequer, to concur in the demands made on the Treasury by the ministers at the head of the naval and military establishments and that a better foreign policy might obviate the necessity for such demands. Although he himself refrained from offering any public explanation of his conduct, nor in any way sought to bring about a reconciliation with Salisbury, Lord Randolph Churchill's prestige was so great that a reconstruction of the cabinet proved a task of great difficulty. At length Goschen was induced to accept the chancellorship, and Churchill disappeared from any effective part in the leadership of the Conservative Party.

He continued, for some years longer, to give a general, though decidedly independent, support to the Unionist Administration. On the Irish question he was a very candid critic of Balfour's measures, and one of his later speeches, which recalled the acrimonious violence of his earlier period, was that which he delivered in 1890 on the report of the Parnell commission. He also fulfilled the promise made on his resignation by occasionally advocating the principles of economy and retrenchment in the debates on the naval and military estimates. In April 1889, on the death of Bright, he was asked to stand for the vacant seat in Birmingham, and the result was a rather angry controversy with Chamberlain, terminating in the so-called "Birmingham compact" for the division of representation of the Midland capital between Liberal Unionists and Conservatives. But his health was already precarious, and he bestowed much attention on society, travel and sport. He was an ardent supporter of the turf, and in 1889 he won the Oaks with a mare named the Abbesse de Jouarre. In 1891 he went to South Africa, in search both of health and relaxation. He travelled for some months through Cape Colony, the Transvaal and Rhodesia, and recorded his impressions in a book entitled *Men, Mines and Animals in South Africa.*

In the general election of 1892 he once more flung himself, with his old vigour, into the strife of parties. His seat at South Paddington was uncontested, and when parliament met he returned to the Opposition front bench to take a leading part in debate, attacking Gladstone's second Home Rule bill with especial energy. He died in London on Jan. 24, 1895.

Lord Randolph Churchill married, in Jan. 1874, Jennie, daughter of Leonard Jerome of New York, U.S.A., by whom he had two sons. In 1900 Lady Randolph Churchill married G. Cornwallis-West.

An authoritative biography of Lord Randolph, by his son Winston appeared in 1906; and a brief and intimate appreciation by Lord Rosebery, inspired by this biography, was published a few months later. Lord Randolph's earlier speeches were edited, with an introduction and notes, by Louis Jennings (2 vols., 1889). *See* also H. W. Lucy, *Diary of Two Parliaments* (1892); and Mrs. Cornwallis-West, *The Reminiscences of Lady Randolph Churchill,* (*i.e.,* of the author) (1908); *The Letters of Queen Victoria,* second series, 3 vols. (1926–28).

CHURCHILL, WINSTON (1871–), American writer, was born in St. Louis, Mo., Nov. 10 1871. He graduated from the United States naval academy in 1894, soon devoting himself to writing. His first novel, *The Celebrity,* appeared in 1898. His next *Richard Carvel* (1899), a novel of Maryland in the time of the Revolution, had a sale of nearly 1,000,000 copies. Then followed *The Crisis* (1901), the heroine of which is a descendant of his former hero, Richard Carvel; and *The Crossing* (1904). His other works include: *Coniston* (1906); *Mr. Crewe's Career* (1908); *A Modern Chronicle* (1910); *The Inside of the Cup* (1913); *The Dwelling Place of Light* (1917); *The Uncharted Way* (1941). Although his later work consisted chiefly of problem novels, his romantic tales of America's past were most popular. He took an active part in state politics. From 1903 to 1905 he was a member of the New Hampshire legislature, and in 1913 he was a candidate for the governorship as a Progressive.

CHURCHILL, WINSTON LEONARD SPENCER (1874–), British statesman, elder son of Lord Randolph Churchill and Jennie, daughter of Leonard Jerome, of New York, U.S.A., was born on Nov. 30, 1874, at Blenheim palace, Oxfordshire. He was educated at Harrow and Sandhurst. Entering the army in 1895, his principal war service was with the Malakand field force (1897) and the Tirah expeditionary force (1898); these campaigns gave him material for two brilliant books, *The Story of the Malakand Field Force* (1898) and *The River War* (1899). During the South African War (1899–1902) he was correspondent for the *Morning Post* and wrote an account of his experiences as *London to Ladysmith via Pretoria* (1900). He was taken prisoner by the Boers, but escaped.

Churchill was elected Conservative M.P. for Oldham in 1900, and immediately made his mark in a House which expected great things from his father's son. He excelled in the set speech elaborately prepared on the classic models, but was not at first a ready speaker. Lord Balfour once said of him that he carried "heavy but not very mobile guns," and it was only later that he became a master in the cut and thrust of debate. He had a filial reverence for the political memory of his father and his *Life of Lord Randolph Churchill* (1906) is one of the most interesting political biographies in the language.

In his first session Churchill opposed the Brodrick scheme of army reorganization mainly on financial grounds, and when Joseph Chamberlain began his tariff reform campaign he threw himself into the ranks of the Free Traders with uncompromising vehemence. He then joined the Liberal party, and fought a severely contested election at North-West Manchester at the general election of 1906. He was under-secretary for the colonies in Sir Henry Campbell-Bannerman's Govt. (1905–08), and the spokesman of his department in the House of Commons. Even at the time of the South African War he had held liberal views about the treatment of the Dutch. As under-secretary, he expounded Sir Henry Campbell-Bannerman's policy of self-government for the Transvaal and Orange River colonies, leading up to the federation of South Africa, with such skill and authority that his position in the House of Commons was much advanced. Place was made for him (1908) in the cabinet as president of the Board of Trade. There, and later at the Home Office, he showed a keen interest in social legislation. He carried a Trade Boards Act establishing a minimum wage in certain sweated industries, an act setting up labour exchanges, and a Shops Act. It may fairly be said that these three measures reorganized those trades which were then unorganized or feebly organized; the Trade Boards Act, developed and expanded, removed a dark blot on English industrial life. The Old Age Pensions Act and other social measures, for which he was not immediately responsible, found in him a brilliant advocate.

By 1909 Churchill had become a great power in the Liberal Party. His platform oratory had a vivacity, a boldness and an epigrammatic quality that stirred popular gatherings. Into the conflict that followed the rejection of the Lloyd George budget by the House of Lords, he threw himself with characteristic impetuosity. As president of the Budget League he was a driving force in the campaign against the Lords' veto on finance. On the question of Irish Home Rule he had also made a definite advance. During the Ulster agitation in 1912 against the Home Rule Bill Churchill was announced to speak in favour of the Bill at the Ulster hall, Belfast. On Jan. 16, the Ulster Unionist Council declared that he should not be allowed to speak there. He was not the man to be intimidated, and the meeting took place on Feb. 8 on a Nationalist club football ground. At that

meeting he defined his position in the words "that any plan for Home Rule put forward would be an integral part of parliamentary devolution, and would not be inconsistent with the design of the ultimate federation of the empire."

But events on a larger stage were shaping themselves to give a new direction to Churchill's career. In July 1911 Great Britain came into dangerous clash with Germany over the Agadir incident (*See* EUROPE: *History*). A conflict was avoided, but the German menace now loomed as a reality. Churchill was transferred from the Home Office to the Admiralty, with explicit injunctions laid upon him by Asquith, to "put the fleet into a state of instant and constant readiness for war in case we were attacked by Germany"—a disclosure made at Dundee by Churchill in June, 1915. The reason for Churchill's appointment to the Admiralty was that a serious disagreement had arisen between the War Office and the Admiralty concerning the strategy to be adopted in the event of war, and Haldane had told Asquith that he would resign from the War Office unless the Admiralty worked in accordance with the War Office plans and a naval war staff was created. To that the existing admiralty board and McKenna were opposed and it was therefore one of Churchill's first duties to make a new board. "He is knocking over the admirals like ninepins," it was said at the time. The formation of a naval war staff was less easy and some years were necessary before it could do its work adequately. He was, at this time, in constant communication, though not always in agreement, with Lord Fisher; but he did not recall him to the Admiralty. In addition to the creation of a naval war office Churchill carried out many major reforms in the navy and its administration. His tenure of office saw the introduction of the 15 in. gun, the development of the light cruiser type and the creation of a famous division of fast battleships ("Queen Elizabeth" type). In the personnel of the navy changes were effected; Sir John Jellicoe was his second sea lord (1912–14), and at the outbreak of war was placed by a strong decision of the Admiralty in command of the Grand Fleet, while Sir David Beatty was in close touch with Churchill as his naval secretary (1912), and was given the command of the 1st Battle Cruiser Squadron in the same year.

Gradually a rift appeared between Churchill and Lloyd George, for Churchill was convinced that war was coming, whereas Lloyd George, despite his speech at the Mansion House on the Agadir crisis, was not. When World War I came it found the fleet, owing to the coincidence of the manoeuvres, on a war footing. Churchill had done important work in preparing the fleet for war, but the operations of the navy in the first few months of the struggle suffered from the lack of clear and consistent direction which a naval war staff would have supplied. Nevertheless, at the outset of the war troops were safely transported, the outer oceans cleared and the German High Seas fleet contained. Churchill presently found himself the leader of a minority and opposition school of war strategy of which the Antwerp expedition and the Dardanelles enterprise were the main projects. In both cases the strategical conception was not only sound but brilliant, but the forces required for their success were not forthcoming, and Churchill's own impatience contributed to their failure. Lord Fisher in particular, who had been recalled to the Admiralty (Oct. 1914), disliked the Dardanelles enterprise, and his resignation in May, 1915, was one of the causes of the downfall of the Liberal Government. Churchill suffered a great blow. He was succeeded at the Admiralty by Balfour. For a few months he remained in office as chancellor of the duchy of Lancaster, but resigned on Nov. 13 on the ground of his non-inclusion in the new war committee of the cabinet.

This step was followed by a lengthy and vigorous speech of personal explanation and vindication in the House of Commons, which was a performance of great power. Denying an improper usurpation of authority while at the Admiralty, Churchill described the Dardanelles adventure as a legitimate war gamble. He blamed Lord Fisher for not speaking out in the War Council if he did not approve the operation, declaring at the same time that he had not received from the first sea lord either the clear guidance before the event or the firm support after that he was entitled to expect. After this Churchill went on active service in France, where he commanded the 6th Royal Scots Fusiliers.

Lloyd George recalled him to high office. He was again on the Treasury bench in 1917 as minister of munitions and then as secretary for war and air minister (1918–21). He supervised the return of the army to a voluntary basis. Apart from his conspicuous part in the Irish settlement he began to be less in agreement with the premier. Lloyd George disliked his Russian policy and the expensive campaigns conducted against the Bolshevists under his inspiration. The outward sign of this estrangement was the appointment of Sir Robert Horne instead of Churchill to the chancellorship of the exchequer left vacant by the retirement of Bonar Law. This was one of the temporary disappointments of Churchill's career. Churchill went to the Colonial Office (1921–22). Less in favour with Lloyd George and still unpopular with the Conservatives, he seemed to be drifting into extreme insecurity and isolation.

The downfall of the Coalition which seemed likely to complete his political ruin was in fact his salvation. After his rejection by Dundee (1922), Churchill had a period of retirement, during which he devoted himself to writing, painting and other pursuits. He now wrote the first volume of *The World Crisis 1916–18* (four volumes, 1923–29), in which he declared that the great Allied offensives of 1915, 1916 and 1917 were wrongly conceived and costly operations, and maintained his "Eastern front" thesis.

Elected to the house of commons from the Epping division in 1924, Churchill was called to be chancellor of the exchequer in the second Baldwin administration (Nov. 1924). He applied his customary energy to budgetary problems for almost five years, and when he left office in June 1929 he remained a powerful political influence. From 1929 to 1932 he was lord rector of Edinburgh university. His *Marlborough* was published in 4 vols., 1933–38.

As crisis after crisis unfolded in Britain's relationships with Nazi Germany and Italy, Churchill became an outspoken opponent of Prime Minister Neville Chamberlain's attempts to appease the dictators. In the summer of 1939 there was an increasing demand that Churchill be appointed to the cabinet, and on September 3, a few hours after Britain's declaration of war, he was in his old office as first lord of the admiralty. As the criticism of Chamberlain's conduct of the war mounted, so grew his onetime opponent's influence in the war cabinet. On May 10, 1940, the day German troops marched into the Low Countries, Churchill was appointed prime minister. In his first speech as head of the government he addressed parliament in the memorable words: "I have nothing to offer but blood, toil, tears and sweat." Confidence in Churchill's government was sustained during the ensuing defeats in Europe and the Pacific, and throughout the later Allied victories which were climaxed by the surrender of Germany in May 1945. Increasing opposition to his domestic policies, however, especially among members of the Labour party, culminated in the Labour party landslide in the election of July 1945, which swept Churchill out of office.

CHURCHILL (Missinnippi or English), the name of a river of the province of Saskatchewan and district of Keewatin, Canada. It rises in La Loche (or Methy) lake, a small lake in 56° 30′ N. and 109° 30′ W., at an altitude of 1,577ft. above the sea, and flows east-north-east to Hudson's Bay, passing through a number of lake expansions. Its principal tributaries are the Beaver (350m. long), Sandy and Reindeer rivers. Between Frog and Methy portages (480m.) it formed part of the old *voyageur* route to the Peace, Athabasca and Mackenzie. It is still navigated by canoes, but has many rapids. The Churchill is 925 mi. long. Churchill, at its mouth, is the best harbour in the southern portion of Hudson's Bay. It is to be the terminus of the Hudson's Bay railway, and not Port Nelson as originally planned. The river has enormous undeveloped water powers.

CHURCHING OF WOMEN, the Christian ceremony of thanksgiving on the part of mothers shortly after the birth of their children. Unlike the Mosaic ceremony (Lev. xii), it is not a rite of purification from uncleanness. In ancient times the ceremony was usual but not obligatory in England. In the Greek and Roman Catholic Churches today it is encouraged. No ancient

form of service exists, and that which figures in the English Prayer Book of to-day dates only from the middle ages. In the Prayer Book of 1549 the rite was called the Purification of Women; but this was altered in 1552 to the present form, Thanksgiving of Women after Childbirth. (*See* Hooker, *Eccl. Pol.* V. lxxiv.) Custom differs, but the usual date of churching was the fortieth day after confinement, in accordance with the Biblical date of the presentment of the Virgin Mary and the Child Jesus at the Temple. It was formerly regarded as unlucky for a woman to leave her house to go out at all after confinement till she went to be churched. It was not unusual for the churching service to be said in private houses. In some parishes there was a special pew known as "the churching seat." The words in the rubric requiring the woman to come "decently [*i.e.,* suitably] apparelled" refer probably to the custom of wearing a veil upon the head.

In the *Roman Ritual* (tit. vii, c. 3), the rite is called "The Blessing of a Woman after Childbirth." The mother is to kneel at the church door (more commonly today at the altar rail), holding a lighted candle. The priest, vested in surplice and white stole (symbolizing gladness), sprinkles her with holy water and recites Psalm 23 (R.V. 24). Then, offering her the end of the stole that hangs to his left, he leads her into the church, saying in Latin: "Enter into the temple of God, adore the Son of Blessed Mary the Virgin, who has granted thee [the grace of] the birth of a child." The mother "kneels before the altar and prays, thanking God for the gifts given her"; and the priest utters a prayer for her temporal and eternal happiness and that of her child. Finally, he invokes upon her the abiding "peace and blessing" of the Trinity.

CHURCH OF THE BRETHREN: *see* GERMAN BAPTIST BRETHREN.

CHURCH RATE, the name of a tax formerly levied in each parish in England and Ireland for the benefit of the parish church. Out of this rate were defrayed the expenses of carrying on divine service, repairing the fabric of the church, and paying the salaries of the officials connected with it. The church rate was made by the churchwardens, together with the parishioners duly assembled after proper notice in the vestry or the church, and was a personal charge imposed on the occupier of land or of a house in the parish. Though it was compulsory, much difficulty was found in effectually applying the compulsion. This was especially so in the case of Nonconformists, who had conscientious objections to supporting the Established Church; and in Ireland, where the population was preponderatingly Roman Catholic, the grievance was specially felt and resented. The agitation against church rates led in 1868 to the passing of the Compulsory Church Rate Abolition act. By this act church rates are no longer compulsory on the person rated, but are merely voluntary, and those who are not willing to pay them are excluded from inquiring into, objecting to, or voting in respect of their expenditure (s. 8).

CHURCH STRETTON, urban district, Shropshire, England, situated on a low watershed in a narrow longitudinal valley between the Longmynd and the Caradoc ranges. (Pop., 1938, 2,223. Area 9.5 sq.mi.) It takes its name ("Street Town") from the Roman road joining Viroconium and Caerleon, on which it lies. The Great Western railway from Shrewsbury to Ludlow and the main road parallel to it make use of this gap, where the railway reaches a height of 600 ft. As a market town Church Stretton serves the hilly country between Wenlock Edge and Longmynd, but the area is limited by hill barriers and much trade drifts to Shrewsbury on the north and Craven Arms and Ludlow on the south. The hill ponies of the Longmynd are sold at an annual autumn fair. The neighbourhood has numerous prehistoric camps and barrows, while a remarkable ridgeway or "Portway" runs along the summit of the Longmynd.

CHURCHWARDEN, in England, the guardian or keeper of a church, and representative of the body of the parish. The office dates from the 14th century, when the responsibility of providing for the repairs of the nave, and of furnishing the utensils for divine service, was imposed on the parishioners. Resident lay householders of a parish are those primarily eligible as churchwardens, but non-resident householders who are habitually occupiers are also eligible, while there are a few classes of persons who are either ineligible or exempted. The appointment of churchwardens is regulated by the 89th canon, which requires that the churchwardens shall be chosen by the joint consent of the ministers and parishioners, if it may be; but if they cannot agree upon such a choice, then the minister is to choose one, and the parishioners another. If, however, there is any special custom of the place, the custom prevails, and the most common custom is for the minister to appoint one, and the parishioners another, and this has been established by English statute, in the case of new parishes, by the Church Building and New Parishes acts 1818–84. There are other special customs recognized in various localities; *e.g.,* in some of the larger parishes in the north of England a churchwarden is chosen for each township of the parish; in the old ecclesiastical parishes of London both churchwardens are chosen by the parishioners; in some cases they are appointed by the select vestry, or by the lord of the manor, and in a few exceptional cases are chosen by the outgoing churchwardens. Each churchwarden after election subscribes before the ordinary a declaration that he will execute his office faithfully.

The duties of churchwardens comprise the provision of necessaries for divine service; the keeping of order during the divine service and the giving of offenders into custody; the assignment of seats to parishioners; and the presentment of offenses against ecclesiastical law: but by the Parochial Church Councils (Powers) measure, 1921, No. 1 made under the Church of England Assembly (Powers) act, 1919, c. 76, all powers, duties and liabilities of the churchwardens relating to (a) the financial affairs of the church; (b) the maintenance and insurance of the fabric, goods and ornaments; (c) the maintenance of the churchyard (even when closed) were transferred to the new parochial church councils. The property in the movable goods and ornaments remains in the churchwardens.

In the Protestant Episcopal Church in the United States churchwardens discharge much the same duties as those performed by the English officials; their duties, however, are regulated by canons of the diocese, not by canons general. In the United States, too, the usual practice is for the parishes to elect both the churchwardens.

See J. H. Blunt, *Book of Church Law* (7th ed., 1894); C. G. Prideaux, *Churchwarden's Guide* (16th ed., 1895); J. Steer, *Parish Law* (6th ed., 1899).

CHURCHYARD, THOMAS (*c.* 1520–1604), English author, was born at Shrewsbury. He served in the household of Henry Howard, earl of Surrey, and in 1541 became a soldier of fortune. During the next 30 years he fought in almost every campaign in Ireland, Scotland and the Low Countries, now in the service of the Emperor Charles V, now in the English service, at last under the prince of Orange. His last campaign was the defence of Zutphen in 1572.

Churchyard was employed to devise a pageant for the queen's reception at Bristol in 1574, and again at Norwich in 1578. He had published in 1575 *The firste parte of Churchyarde's Chippes,* the modest title which he gives to his works. No second part appeared, but there was a much enlarged edition in 1578. A passage in *Churchyarde's Choise* (1579) gave offense to Elizabeth, and the author fled to Scotland, where he remained for three years. He was only restored to favour about 1584, and in 1593 he received a small pension from the queen. The affectionate esteem with which he was regarded by the younger Elizabethan writers is expressed by Thomas Nashe, who says (*Foure Letters Confuted*) that Churchyard's aged muse might well be "grandmother to our grandiloquentest poets at this present."

His writings, with the exception of his contributions to the *Mirror for Magistrates,* are chiefly autobiographical in character, or deal with the wars in which he had a share. They are very rare, and have never been completely reprinted. Churchyard lived right through Elizabeth's reign, and was buried in St. Margaret's church, Westminster, on April 4, 1604.

BIBLIOGRAPHY.—The extant works of Churchyard, exclusive of commendatory and occasional verses, include:—*A lamentable and pitifull Description of the wofull warres in Flanders* (1578); *A gen-*

eral rehearsall of warres, called Churchyarde's Choise (1579), really a completion of the *Chippes*, and containing, like it, a number of detached pieces; *A light Bondel of livelie Discourses, called Churchyarde's Charge* (1580); *The Worthines of Wales* (1587), a valuable antiquarian work in prose and verse, anticipating Michael Drayton; *Churchyard's Challenge* (1593); *A Musicall Consort of Heavenly harmonie . . . called Churchyard's Charitie* (1595); *A True Discourse Historicall, of the succeeding Governors in the Netherlands* (1602).

The chief authority for Churchyard's biography is his own "Tragicall Discourse of the unhappy man's life" (*Churchyarde's Chippes*). George Chalmers published (1817) a selection from his works relating to Scotland, for which he wrote a useful life. *See* also an edition of the *Chippes* (ed. J. P. Collier, 1870), of the *Worthines of Wales* (Spenser Soc., 1876) and a notice of Churchyard by H. W. Adnitt (*Transactions* of the Shropshire Archaeological and Nat. Hist. Soc., reprinted separately 1884).

CHURCHYARD, a piece of consecrated ground attached to a parochial church, and used as a burial place. It is distinguished from a cemetery (*q.v.*), which is also a place of burial, but is separate and apart from any parochial church. (*See* BURIAL.)

CHURL. In Old English law the word *ceorl* denoted the ordinary free man, who formed the basis of Anglo-Saxon society. In the course of time he lost much of his original independence, and after the Norman Conquest became included within the great class of villeins (*see* VILLEINAGE) who were regarded in law as personally unfree. It is largely owing to this depression that the word "churl" came to bear a derogatory sense. Nevertheless, even in Anglo-Norman law the *ceorl* had not wholly sunk into a servile position; he retained the wergild of a free man until the whole system of wergilds became obsolete, and he was long subject to the duty of attending public courts such as that of the Hundred (*q.v.*). His depression was due essentially to economic causes; men of his class suffered heavily in the wars of the 10th and 11th centuries and the lawyers of a later time who regarded their descendants as legally dependent upon their lords were only recognizing accomplished facts.

CHURN: *see* DAIRY MACHINERY AND EQUIPMENT.

CHURRIGUERESQUE, in architecture, the late, luxuriant, Spanish baroque style, so called from its most famous architect, Don José Churriguera (d. 1725). *See* ARCHITECTURE; RENAISSANCE ARCHITECTURE.

CHURUBUSCO, a village of Mexico on the river of the same name, about six miles south of the capital. It contains a massive stone convent. It was here that Major General Winfield Scott in his brilliant southern campaign of the war between Mexico and the United States (1846–48) fought the battle of that name as an aftermath of the action at Contreras the same day (August 20, 1847). Brigadier General Worth, who had been acting as rear guard at San Agustín, moved forward toward San Antonio to find, after trying a turning movement, that, on account of the victory at Contreras, the strong fortifications before him had been evacuated by General Santa Anna's Mexicans. Worth pressed on to meet stout and unexpected resistance at the bastioned bridgehead of Churubusco. Scott, taking charge of Pillow's and Twiggs' troops, a part of whom he sent to reinforce Worth, decided upon a turning movement. Sending Pierce and Shields over a road around Santa Anna's right flank, he ordered them to strike the Mexican general in rear. Though the untrained militia making the detour did not at first acquit themselves well, Worth stubbornly pressed in front and, after severe charging in which his troops succeeded in turning Santa Anna's left flank, was able to take the bridgehead and the well fortified convent beyond. The pursuit continued for over two miles. In addition to the guns and ammunition taken, the Mexican losses probably mounted to 10,000. The Americans lost about 950.

BIBLIOGRAPHY.—Justin H. Smith, The *War with Mexico,* Vol. I. (1919); George B. McClellan, *The Mexican War Diary* (1917); C. M. Wilcox, *History of the Mexican War* (1892); W. A. Ganoe, *The History of the United States Army* (1924); Original Correspondence and Reports in Old Files Section, Adjutant General's Office, Washington, D.C. (W. A. G.)

CHUSAN, an island archipelago off the Chinese coast. It represents the submerged terminus of the Tayu-ling, the dominating range of Chekiang, which is linked on south-westwards with the high ranges along the Fukien-Kiangsi border. The outermost islands of the archipelago lie across the entrance to Hangchow bay. Their shores are becoming choked with silt from the Yangtze estuary, which opens out just to the north of them, in perhaps the same way as at an earlier period the hills along the E. side of the Tai-hu became linked together by stretches of alluvium. If this interpretation is correct, the shallow Hangchow bay may in time become a second Tai-hu. By reason of its character as a rocky island and of its proximity to the Yangtze estuary, Chusan island, the largest of the archipelago, was during the Ming Dynasty (1368–1644) an entrepôt for trade with Japan. Until the modern development of Japan, Japanese relations with China were naturally most intimate in the neighbourhood of the Yangtze estuary. The Japanese use of Chusan at that time is somewhat comparable to the British use of Hongkong at a later period.

CHUTE, a channel or trough, artificial or natural, down which objects, such as timber, coal or grain may slide, identical in meaning and pronunciation with "shoot." A channel cut in a dam on a river for the passage of floating timber, and in Louisiana and on the Mississippi a channel at the side of a river or narrow way between an island and the shore. The "water-chute," a steep wooden slope terminating in a shallow lake down which run flat-bottomed boats, is a Canadian pastime, which has been popular in London and elsewhere.

CHUTNEY, a sweet pickle or relish prepared from sweet fruits such as mangoes, raisins, etc., with acid flavouring from tamarinds, lemons, limes and sour herbs, and with a hot seasoning of chillies, cayenne pepper and spices. The word is an anglicized form of the Hindustani *chatni.*

CHUVASH, an A.S.S.R. in the Russian Soviet Federated Socialist Republic, created as an autonomous area by decree in June 1920, and declared an autonomous republic in April 1925. Area 6,911 sq.mi. Its boundaries are west, Gorky (formerly Nizhegorod); south, Ulianovsk; east, Tatar A.S.S.R.; north, Marii A.S.S.R. East of the Gorky province, from the junction of the Sura river with the Volga river, begins the forest area in which many Finno-Turkish tribes maintained their linguistic and racial individuality against the advancing waves of Slav colonization. Of these tribes the Chuvash occupy the area between the right bank of the Sura and Volga and are thus nearest to Moscow. The population (1939) 1,077,614 (urban, 131,533, rural 946,081), includes Chuvash 80%, Great Russians 18%, Tatars and Marii (Cheremiss). The urban population is 85% Great Russians. In the south and west the republic is forested, but towards the north and east the forest only remains in patches. Deforestation is progressing rapidly; 70% of the timber annually cut is not replaced. From ancient times lumbering, sawmilling and the making of wooden articles, *e.g.,* furniture, oak rivets, barrels, wagons, shovels, have been the chief occupation of the Chuvash, and 94% of the koustar (peasant) industries are of this nature. The Alatyr district is noted for its koustar furniture industry. Agriculture is poorly developed, owing to poor soils and climatic conditions and to the primitive methods adopted. The soils are podzolized or degraded soils and liched black soils (*see* RUSSIA: *Soils and Their Influence*). The climate is severe; snow lies from October to April, and the rivers are frozen. There are fierce storms in winter and spring and in June and July thunderstorms are frequent. The prevailing winds are S.W. and in the hot summer they bring sand from the steppe, so that the crops are covered with dust. In 1924–25 the extent of ploughed land was 43.3%, and of forest 35.1%. Oats and rye occupy 85% of the sown area and wheat only 2.2%; other small crops are spelt, buckwheat, barley, millet, peas, lentils, flax, hemp and potatoes, but there was a serious deterioration in agriculture during the 1914–21 period. Even the 1925 harvest was 40% less than in pre-World War I times. The Chuvash suffered very severely during the Civil War and in the 1920–21 famine: the population fell from 745,000 in 1914 to 201,000 in 1920, and the effects of the hardships of that terrible time are still evident in the survivors, and in the lack of horses, working cattle and farm implements.

The chief agricultural exports are oats by waterway to Leningrad and by rail to Moscow, and eggs and poultry. Small quantities of honey, apples and hops are also exported. Though Chuvash horses, cattle, sheep and pigs are underfed and undersized,

cattle, meat, wool and hides are exported. The standard of living is low and the imports are mainly salt, kerosene and iron goods, but in spite of the few cultural needs of the people there are 65 bazaar centres and four annual fairs. Cheboksari, on the Volga river, the administrative centre, is a river port with an electric plant and a radio station, and its fair is the most important. It also has sawmills, printing works, dried fruit, starch and syrup industries. The only other industrial concern is the Yadrinsk oil-pressing factory, which employed 2,000 men in normal times. Distilling, leather work, flour milling, hemp, fulling and metal industries of a koustar and semi-koustar type are carried on, and there are six steam flour mills. The Volga and Sura rivers provide navigable waterways in the summer. The Kazan to Kanash railway, linking through Arzamas in the Gorky province, is the shortest route to Moscow. Kanash (formerly Shikhran) is an important timber and grain centre and from it a branch line goes southwest through Alatyr, also a grain and timber centre, with an elevator. Plans for the development of the republic include the linking of Kanash to Cheboksari, and the development of a peat industry.

The percentage of illiteracy is high; in 1920 only 23.2% of the population could read and write. The soviet government has inaugurated a policy of instruction in the vernacular, which belongs to the Tatar or Turkish group, but has many Finno-Ugrian idioms. A Chuvash daily paper is issued and in Cheboksari a Chuvash theatre and museum have been established; literacy is greatly increasing. The Chuvash are of Finno-Tatar origin, round-headed, flat-featured and light-eyed; they are thought by some to be the descendants of the ancient Bolgars. Their preferences at present are for agriculture of a somewhat primitive type, and for small peasant industries, rather than for industrial occupations. The rapid deforestation of the area, its proximity to Moscow and the central productive region, combined with the effects of improved communications, will inevitably alter their outlook.

CHUVASHES, a tribe found in east Central Russia, in the Kazan province and throughout the Ulianovsk province and the regions of Kuibyshev, Saratov, Chkalov and Perm. Some think they are the descendants of the ancient Bolgars. In general, like the Finns they are round-headed, flat-featured and light-eyed, but have been affected by Tatar elements. They are nominally Christians, but cling to many Shamanistic practices. Their language belongs to the Turkish group, but has been strongly influenced by the Finno-Ugrian idioms spoken round it.

See Schott, *De Lingua Tschuwaschorum* (Berlin, 1841).

CHWANA, a collective name applied to a number of Bantu-speaking tribes inhabiting the interior plain of South Africa north of the Orange river. The most important are the baMangwato, baKwena, baHurutshe, baNgwaketse, baTlapin and baRolong. They all live by pastoralism combined with agriculture. They are organized socially into large totemic groups which are not exogamous. Marriage is legalized by the payment of a bride-price; and in some of the tribes ortho-cousin marriage is permitted. Their religion is mainly ancestor-worship, with strong traces of monotheism associated with a supreme being known as *Modimo.* Formerly there also appears to have been a certain degree of totemic ritual.

See J. T. Brown, *Among the Bantu Nomads* (1926).

CHWANBEN: *see* KHAM.

CIALDINI, ENRICO (1811–1892), Italian soldier, politician and diplomatist, was born in Castelvetro, Modena. In 1831 he took part in the insurrection at Modena, fleeing afterwards to Paris, whence he proceeded to Spain to fight against the Carlists. Returning to Italy in 1848, he commanded a regiment at the battle of Novara. In 1859 he organized the Alpine brigade, fought at Palestro at the head of the 4th Division, and in the following year invaded the marches, won the battle of Castelfidardo, took Ancona, and subsequently directed the siege of Gaeta. In 1861 his intervention envenomed the Cavour-Garibaldi dispute. Placed in command of the troops sent to oppose the Garibaldian expedition of 1862, he defeated Garibaldi at Aspromonte. Between 1862–66 he held the position of lieutenant-royal at Naples, and in 1864 was created senator. On the outbreak of the war of 1866 he resumed command of an army corps, but dissensions between him and La Marmora contributed to the defeat of Custozza. In 1867 he attempted unsuccessfully to form a cabinet sufficiently strong to prevent the threatened Garibaldian incursion into the papal States, and two years later failed in a similar attempt, through disagreement with Lanza concerning the army estimates. On Aug. 3, 1870, he pleaded in favour of Italian intervention in aid of France, a circumstance which enhanced his influence when in July 1876 he replaced Nigra as ambassador to the French republic. This position he held until 1882, when he resigned on account of the publication by Mancini of a dispatch in which he had complained of arrogant treatment by M. Waddington. He died at Leghorn, on Sept. 8, 1892.

See G. Marcotti, *Il Generale Enrico Cialdini* (Florence, 1892); N. Nisco, *Il Generale Cialdini e i suoi tempi* (Naples, 1893); Prince Adam Wiszniewski, *Le Général Cialdini,* etc. (1913).

CIAMICIAN, GIACOMO LUIGI (1857–1922), Italian chemist, was born at Trieste on Aug. 22, 1857; his father was of American origin. He was educated at Trieste and Vienna but took his doctorate in 1880 at the University of Giessen. He became assistant and later reader in the institute of general chemistry of the University of Rome. In 1887 he was appointed professor of general chemistry in the University of Padua and in 1889 accepted the chair of chemistry at the University of Bologna, retaining this appointment until his death on Jan. 2, 1922. From 1910–22 he was a member of the Italian senate, concerning himself mainly with education and the chemical industry.

Ciamician's most important researches were in organic chemistry. He stressed its application to biological chemistry rather than the discovery of new compounds. An investigation on the compounds in animal tar led him, early in his career, to the important researches on pyrrole. A monograph, *Il Pirralo e i suoi Derivati* (1888), gained the royal prize of the Accademia dei Lincei. Ciamician was also a pioneer in the chemistry of vegetable products. At first he worked on organic compounds of vegetable origin and later became interested in the chemistry of the substances in the living plant and their biological significance. The essential oil of celery was the subject of an important early investigation, and later he inoculated plants and seeds with alkaloids and with their constituents. His researches on the chemical action of light, many of them carried out in conjunction with Dr. Silber of Rome, are noteworthy.

In addition there are a number of investigations by Ciamician on physical chemistry. Some of his earliest work was on the spectra of homologous elements; later researches were on theory of electrolytic dissociation, on the nature of chemical affinity and on the valency of atoms.

CIANO, GALEAZZO (1903–1944), Italian statesman, was the son of Count Costanzo Ciano (1876–1939), naval hero of World War I and a long-time legislative aide of Mussolini. The son entered diplomatic service in a South American embassy and was later consul-general at Shanghai. In 1930 he married Mussolini's daughter Edda. In 1934 he became minister of propaganda, and during the conquest of Abyssinia he led a squadron of bombing planes. He was a member of the grand fascist council and in 1936 became minister of foreign affairs, a post he held until Jan. 1943, when Mussolini took over the ministry of foreign affairs himself, at the same time appointing Ciano ambassador to the Vatican. Ciano retained this position only six months, resigning in July 1943. On Jan. 11, 1944, Ciano and four other former members of the grand fascist council, all of whom had previously been convicted by a special fascist tribunal of high treason for plotting the overthrow of Mussolini, were executed in Verona by a firing squad.

CIBBER (or CIBERT), **CAIUS GABRIEL** (1630–1700), Danish sculptor, was born at Flensburg. He was the son of the king's cabinet-maker, and was sent to Rome at the royal charge while yet a youth. He came to England during the Protectorate, or during the first years of the Restoration. Besides the famous statues of Melancholy and Raving Madness ("great Cibber's brazen brainless brothers"), now in the Guildhall, London, Cibber produced the bas-reliefs round the Monument on Fish street hill. The several kings of England and the Sir Thomas Gresham, exe-

cuted by him for the Royal Exchange, were destroyed with the building itself in 1838. Cibber was long employed by the fourth earl of Devonshire, and many fine specimens of his work are to be seen at Chatsworth. Under that nobleman he took up arms in 1688 for William of Orange, and was appointed, in return, carver to the king's closet. He died rich, and, according to Horace Walpole, built the Danish church in London, where he lies buried beside his second wife, to whom he erected a monument. She was a Miss Colley, of Glaiston, granddaughter of Sir Anthony Colley, and the mother of Colley Cibber.

CIBBER, COLLEY (1671–1757), English actor and dramatist, was born in London on Nov. 6, 1671, the eldest son of Caius Gabriel Cibber, the sculptor. Sent in 1682 to the free school at Grantham, Lincolnshire, the boy distinguished himself by an aptitude for writing verse. He was removed from school in 1687 on the chance of election to Winchester college. His father, however, had not then presented that institution with his statue of William of Wykeham, and the son was rejected, although through his mother he claimed to be of "founder's kin." The boy went to London, and indulged his passion for the theatre. He was on his way to Chatsworth, the seat of William Cavendish, earl (afterwards duke) of Devonshire, for whom his father was then executing commissions, when the news of the landing of William of Orange was received; father and son met at Nottingham, and Colley Cibber was taken into Devonshire's company of volunteers. Afterwards he enrolled himself (1690) as an actor in Betterton's company at Drury Lane. On his more than meagre earnings, which rose to £1 per week, supplemented by an allowance of £20 a year from his father, he contrived to live with his wife and family—he had married in 1693—and to produce a play, *Love's Last Shift, or the Fool in Fashion* (1696). Of this comedy Congreve said that it had "a great many things that were like wit in it"; and Vanbrugh honoured it by writing his *Relapse* as a sequel. Cibber played the part of Sir Novelty Fashion, and his performance as Lord Foppington, the same character renamed, in Vanbrugh's piece established his reputation as an actor. In 1698 he was assailed with other dramatists, by Jeremy Collier in the *Short View*. In Nov., 1702, he produced, at Drury Lane, *She Wou'd and She Wou'd Not; or the Kind Impostor,* one of his best comedies; and in 1704, for himself and Mrs. Oldfield, *The Careless Husband,* which Horace Walpole classed, with Cibber's *Apology,* as "worthy of immortality." In 1706 Cibber left Drury Lane for the Haymarket, but when the two companies united two years later he rejoined his old theatre through the influence of his friend Colonel Brett, a shareholder. Brett made over his share to Wilks, Estcourt and Cibber. Complaints against the management of Christopher Rich led, in 1709, to the closing of the theatre by order of the crown, and William Collier obtained the patent. After a series of intrigues Collier was bought out by Wilks, Doggett and Cibber, under whose management Drury Lane became more prosperous than it ever had been. In 1715 a new patent was granted to Sir Richard Steele, and Barton Booth was also added to the management. In 1717 Cibber produced the *Nonjuror,* an adaptation from Molière's *Tartuffe;* the play, for which Nicholas Rowe wrote an abusive prologue, ran eighteen nights, and the author received from George I., to whom it was dedicated, a present of two hundred guineas. Tartuffe became an English Catholic priest who incited rebellion, and there is little doubt that the Whig principles expressed in the *Nonjuror* led to Cibber's appointment as poet laureate (1730). It also provoked the animosity of the Jacobite and Catholic factions, and was possibly one of the causes of Pope's hostility to Cibber. Numerous "keys" to the *Nonjuror* appeared in 1718. In 1726 Cibber pleaded the cause of the patentees against the estate of Sir Richard Steele before Sir Joseph Jekyll, master of the rolls, and won his case. In 1730 Mrs. Oldfield died, and her loss was followed in 1732 by that of Wilks; Cibber now sold his share in the theatre, appearing rarely on the stage thereafter. In 1740 he published *An Apology for the Life of Colley Cibber, Comedian . . . with an Historical View of the Stage during his Own Time,* which gives the best account there is of Cibber's contemporaries on the London stage.

In 1742 Cibber was substituted for Theobald as the hero of Pope's *Dunciad.* Cibber had introduced some gag into the *Rehearsal,* in which he played the part of Bayes, referring to the ill-starred farce of *Three Hours after Marriage* (1717). This play was nominally by Gay, but Pope and Arbuthnot were known to have had a hand in it. Cibber refused to discontinue the offensive passage, and Pope revenged himself in sarcastic allusions in his printed correspondence, in the *Epistle to Dr. Arbuthnot* and in the *Dunciad.* To these Cibber replied with *A Letter from Mr. Cibber to Mr. Pope, inquiring into the motives that might induce him in his satirical works to be so frequently fond of Mr. Cibber's name* (1742). Cibber scored with an "idle story of Pope's behaviour in a tavern" inserted in this letter, and gives an account of the original dispute over the *Rehearsal.* By the substitution of Cibber for Theobald as hero of the *Dunciad* much of the satire lost its point. Cibber's faults certainly did not include dullness. A new edition contained a prefatory discourse, probably the work of Warburton, entitled "Ricardus Aristarchus, or the Hero of the Poem," in which Cibber is made to look ridiculous from his own *Apology.* Cibber replied in 1744 with *Another Occasional Letter . . . ,* and altogether he had the best of the argument. When he was 74 years old he made his last appearance on the stage as Pandulph in his own *Papal Tyranny in the Reign of King John* (Covent Garden, Feb. 15, 1745), a miserable paraphrase of Shakespeare's play. He died on Dec. 11, 1757.

Cibber's reputation has suffered unduly from the depreciation of Pope and Johnson. "I could not bear such nonsense" said Johnson of one of Cibber's odes, "and I would not let him read it to the end." Fielding attacked Cibber's style and language more than once in *Joseph Andrews,* and elsewhere. Nevertheless, Cibber possessed wit, unusual good sense and tact; and in the *Apology* he showed himself the most delicate and subtle critic of acting of his time. He was frequently accused of plagiarism, and did not scruple to make use of old plays, but he is said to have been ashamed of his Shakespearian adaptations, one of which, however, *Richard III.* (Drury Lane, 1700), kept its place as the acting version until 1821. Cibber is rebuked for his mutilation of Shakespeare by Fielding in the *Historical Register for 1736,* where he figures as Ground Ivy.

CHARLOTTE, Colley Cibber's youngest daughter, married Richard Charke, a violinist, from whom she was soon separated. She began as an understudy to actresses in leading parts, but quarrelled with her manager, Charles Fleetwood, on whom she wrote a one-act skit, *The Art of Management* (1735). She also wrote two comedies and two novels of small merit, and an untrustworthy, but amusing, *Narrative of Life of . . . Charlotte Charke, . . . by herself* (1755), reprinted in Hunt and Clarke's *Autobiographies* (1822).

The *Apology* was edited in 1822 by E. Bellchambers and in 1889 by R. W. Lowe, who printed with it other valuable theatrical books and pamphlets. It is also included in Hunt and Clarke's *Autobiographies* (1826, etc.). Cibber's *Dramatic Works* were published in 1760, with an account of the life and writings of the author, and again in 1777. Besides the plays already mentioned, he wrote *Woman's Wit, or the Lady in Fashion* (1697), which was altered later (1707) into *The Schoolboy, or the Comical Rivals; Xerxes* (1699), a tragedy acted only once; *The Provoked Husband* (acted 1728), completed from Vanbrugh's unfinished *Journey to London; The Rival Queens, with the Humours of Alexander the Great* (acted 1710), a comical tragedy; *Damon and Phyllida* (acted 1729), a ballad opera; and adaptations from Beaumont and Fletcher, Dryden, Molière and Corneille. A bibliography of the numerous skits on Cibber is to be found in Lowe's *Bibliographical Account of English Theatrical Literature.*

CIBBER, SUSANNAH MARIA (1714–1766), wife of T. Cibber, was an actress of distinction. She was the daughter of a Covent Garden upholsterer, and sister of Dr. Arne (1710–78) the composer. Mrs. Cibber had a beautiful voice and began her career in opera. She was the original Galatea in Handel's *Acis and Galatea,* and the contralto arias in the *Messiah* are said to have been written for her. She played Zarah in Aaron Hill's version of Voltaire's *Zaïre* in 1736, and it was as a tragic actress, not as a singer, that her greatest triumphs were won. From Colley Cibber she learned a sing-song method of declamation. Her mannerisms, however, did not obscure her real genius, and she freed herself from them entirely when she began to act with Garrick, with whom she

was associated at Drury Lane from 1753. She died on Jan. 30, 1766. She married Theophilus Cibber in 1734, but soon separated from him. Appreciations of Mrs. Cibber's fine acting are to be found in many contemporary writers, one of the most discriminating being in the *Rosciad* of Charles Churchill.

CIBBER, THEOPHILUS (1703–1758), Colley Cibber's son; also an actor and playwright, was born on Nov. 26, 1703. In 1734 he was acting-manager at the Haymarket, and later played at Drury Lane, Lincoln's Inn Fields and Covent Garden. His best impersonation was as Pistol, but he also distinguished himself in some of the fine-gentleman parts affected by his father. He was one of the ringleaders in the intrigues against John Highmore, who had bought a share in the patent of Drury Lane from Colley Cibber. Theophilus Cibber, with a number of other actors, seceded from Drury Lane, and in thus depreciating the value of the patent, for which his father had received a considerable sum, acted with doubtful honesty.

In 1753 appeared *An Account of the Lives of the Poets of Great Britain and Ireland,* with the name of "Mr. Cibber" on the title page. The five volumes of *Lives* are chiefly based on the earlier works of Gerard Langbaine and Giles Jacob and the ms. collections of Thomas Coxeter (1689–1747). The book is said to have been largely written by Robert Shiels, Dr. Johnson's amanuensis. Theophilus Cibber perished by shipwreck on his way to Dublin to play at the Theatre Royal.

CIBORIUM, in classical Latin a drinking-vessel (Gr. *κιβώριον,* the cup-shaped seed-vessel of the Egyptian water-lily, and hence a cup). In the early Christian church the ciborium was a canopy over the altar (*q.v.*), supported on columns, and from it hung the dove-shaped receptacle in which was reserved the consecrated Host. The name was early transferred to the receptacle, and in the Western church the canopy was known as a baldachin (Ital. *baldacchino,* from *Baldacco,* Bagdad, whence came the rich brocade used for canopies, etc.). At the present day in the Roman church the term "pyx" (*πύξις,* a boxwood vessel) is used for the receptacle in which the viaticum is carried to the sick or dying. Mediaeval pyxes and ciboria are often beautiful examples of the goldsmith's, enameller's and metal-worker's craft. They usually take the shape of a covered chalice or of a cylindrical box with cover surmounted by a cross. An exquisite ciborium, probably of English 13th century make, fetched £6,000 at Christie's in 1908: copper-gilt, ornamented with champlevé enamels, with Biblical subjects in medallions on the outside (coloured illustration in catalogue of Burlington Fine Arts Club Exhibition, 1897).

CIBRARIO, LUIGI, Count (1802–1870), Italian statesman and historian, was born in Usseglia. His verses to King Charles Albert, then prince of Carignano, on the birth of his son Victor Emmanuel, led to a long friendship. He entered the Sardinian civil service, and in 1824 was appointed lecturer on canon and civil law. He was sent to search the archives of Switzerland, France and Germany for charters relating to the history of Savoy. During the war of 1848, after the expulsion of the Austrians from Venice, Cibrario was sent to that city with Colli on an abortive mission to secure its union with Piedmont. After the battle of Novara (1849) and the abdication of Charles Albert he visited the ex-king at Oporto on behalf of the Senate. In May 1852 he became minister of finance in the reconstructed d'Azeglio cabinet, and later minister of education in that of Cavour. He strongly supported Cavour's Crimean policy (1855), and, as minister for foreign affairs during the war, he seconded Cavour in procuring the admission of Piedmont to the congress of Paris on an equal footing with the great powers. On retiring from the foreign office Cibrario was created count. After the war of 1866 by which Austria lost Venetia, Cibrario negotiated the restitution of state papers and art treasures removed by the Austrians from Lombardy and Venetia to Vienna. He died in Oct. 1870, near Salò, on the lake of Garda. His most important work was his *Economia politica del medio evo* (Turin, 1839), popular then, but now of little value. His *Schiavitù e servaggio* (Milan, 1868–69) gave an account of the development and abolition of slavery and serfdom.

His biography has been written by F. Odorici, *Il Conte L. Cibrario* (Florence, 1872).

CICADA (Cicadidae), insects of the homopterous division of the Hemiptera (*q.v.*), generally of large size with the femora of the forelegs spined below, two pairs of large membranous wings and prominent eyes. Cicadas are remarkable for the shrill noise emitted by the males, which has been variously compared to a knife-grinder, scissors-grinder or even a railway whistle, and may be heard in concert at a distance of a quarter of a mile or more. The sound-producing organs are a kind of drum on each side of the base of the abdomen. These drums vibrate by the action of powerful muscles and the sound can be modified by the so-called mirrors or sounding boards. Although no auditory organs are known in the females, the song of the males is regarded as a sexual call.

One of the best-known species is the periodical cicada (*Magicicada septendecim*) of eastern N. America, often known as the 17-year "locust" which appears in great numbers and often causes much concern. It has two races, a 13-year race in the southeastern United States which requires 13 years from egg to adult and a 17-year race in the northeastern United States which requires 17 years from egg to adult. There are 17 different broods of the 17-year race in different parts of the United States and 13 different broods of the 13-year race. Since there is some overlapping of the different broods, some confusion has arisen in the minds of some people in regard to the regularity of this insect. By means of a saw-like instrument the eggs are laid in the twigs of trees, and the nymphs, upon hatching, drop to the ground, where they bury themselves. They feed by sucking juices from the roots of forest and fruit trees and finally change into the so-called "pupae." In the latter stage the insect crawls from the ground, grasps a suitable support and emerges as a full-fledged cicada. In some cases these "pupae" construct curious earthen chimneys wherein they live before turning into adults. The life-histories of cicadas are all very similar. Other common North American species seem to require from one to five years to complete their life histories with a few adults emerging every year. Over 2,000 kinds are known and they are most abundant in the tropics. One species occurs in the southern counties of England, but is rare; 170 species are known in the United States. *See* J. G. Myers, *Insect Singers: a Natural History of the Cicadas* (1929). (Z. P. M.)

CICELY, *Myrrhis odorata* (family Umbelliferae), a perennial herb with a leafy hollow stem, 2 to 3 ft. high, much divided leaves, whitish beneath, a large sheathing base, and terminal umbels of small white flowers, the outer ones only of which are fertile. The fruit is dark brown, long (¾ to 1 in.), narrow and beaked. The plant is a native of central and southern Europe, and is found in parts of England and Scotland in pastures, usually near houses. It has aromatic and stimulant properties and was formerly used as a pot-herb.

CICERO, the name of two families of ancient Rome. It may perhaps be derived from *cicer* (pulse), in which case it would be analogous to such names as *Lentulus, Tubero, Piso.* Of one family, of the plebeian Claudian *gens,* only a single member, Gaius Claudius Cicero, tribune in 454 B.C., is known. The other family was a branch of the Tullii, settled from an ancient period at Arpinum. This family, four of whose members are noticed specially below, did not achieve more than municipal eminence until the time of M. Tullius Cicero, the great orator.

(1) Marcus Tullius Cicero (106–43 B.C.), Roman orator and politician, was born at Arpinum on Jan. 3, 106 B.C. His mother, Helvia, is said to have been of good family. His father was by some said to have been descended from Attius Tullius, the Volscian host of Coriolanus, while spiteful persons declared him to have been a fuller; in any case he was a Roman knight with property at Arpinum and a house in Rome. His health was weak, and he generally lived at Arpinum, where he devoted himself to literary pursuits. Cicero spent his boyhood partly in his native town and partly at Rome. The poet Archias, he says, first inspired him with the love of literature. He was much impressed by the teaching of Phaedrus, the Epicurean, at a period before he assumed the *toga virilis;* he studied dialectic under Diodotus the Stoic, and in 88 B.C. attended the lectures of Philo, the head of the Academic school, whose devoted pupil he became.

He studied rhetoric under Molo (Molon) of Rhodes, and law under the guidance of Q. Mucius Scaevola, the augur and jurisconsult. After the death of the augur, he transferred himself to the care of Q. Mucius Scaevola, the *pontifex maximus,* a still more famous jurisconsult, nephew of the augur. His literary education at this period consisted largely of verse-writing and making translations from Greek authors. We hear of an early poem named *Pontius Glaucus* the subject of which is uncertain, and of translations of Xenophon's *Oeconomica* and the *Phenomena* of Aratus. Considerable fragments of the latter work are still extant. To this period also belongs his *de Inventione rhetorica,* of which he afterwards spoke lightly (*de Orat.* i. 5), but which enjoyed a great vogue in the middle ages. Cicero also, according to Roman practice, received military training. At the age of 17 he served in the social war successively under Pompeius Strabo and Sulla (89 B.C.). In the war between Marius and Sulla his sympathies were with Sulla, but he did not take up arms (*Sext. Rosc.* 136, 142).

His forensic life begins in 81 B.C., at the age of 25. A speech delivered in this year, *pro Quinctio,* is still extant; it is concerned with a technical point of law and has little literary merit. In the following year he made his celebrated defence of Sextus Roscius on a charge of parricide. He subsequently defended a woman of Arretium, whose freedom was impugned on the ground that Sulla had confiscated the territory of that town. He then left Rome on account of his health, and travelled for two years in the East. He studied philosophy at Athens under various teachers, notably Antiochus of Ascalon, founder of the Old Academy, a combination of Stoicism, Platonism and Peripateticism. In Asia he attended the courses of Xenocles, Dionysius and Menippus, and in Rhodes those of Posidonius, the famous Stoic. In Rhodes also he studied rhetoric once more under Molo, to whom he ascribes a decisive influence upon the development of his literary style. He had previously affected the florid, or Asiatic, style of oratory then current in Rome. The chief faults of this were excess of ornament, antithesis, alliteration and assonance, monotony of rhythm, and the insertion of words purely for rhythmical effect. Molo, he says, rebuked his youthful extravagance and he came back "a changed man."

He returned to Rome in 77 B.C., and appears to have married at this time Terentia, a rich woman with a domineering temper, to whom many of his subsequent embarrassments were due.[1] He engaged at once in forensic and political life. He was quaestor in 75, and was sent to Lilybaeum to supervise the corn supply. His connection with Sicily let him to come forward in 70 B.C., when curule-aedile elect, to prosecute Gaius Verres, who had oppressed the island for three years. Cicero seldom prosecuted, but it was the custom at Rome for a rising politician to win his spurs by attacking a notable offender (*pro Caelio,* 73). In the following year he defended Marcus Fonteius on a charge of extortion in Gaul, using various arguments which might equally well have been advanced on behalf of Verres himself.

In 68 B.C. his letters begin, from which (and especially those to T. Pomponius Atticus, his "second self") we obtain wholly unique knowledge of Roman life and history. In 66 B.C. he was praetor, and was called upon to hear cases of extortion. In the same year he spoke on behalf of the proposal of Gaius Manilius to transfer the command against Mithridates from Lucullus to Pompey (*de Lege Manilia*), and delivered his clever but disingenuous defence of Aulus Cluentius (*pro Cluentio*). At this time he was a prospective candidate for the consulship, and was obliged by the hostility of the nobles towards "new men" to look for help wherever it was to be found. In 65 B.C. he even thought of defending Catiline on a charge of extortion, and delivered two speeches on behalf of Gaius Cornelius, tribune in 67 B.C., a leader of the democratic party. In 64 B.C. he lost his father and his son Marcus was born. The optimates finally decided to support him for the consulship in order to keep out Catiline, and he eagerly embraced the "good cause," his affection for which from this time onward never varied, though his actions were not always consistent.

The public career of Cicero henceforth is largely covered by the article on ROME: *Ancient History.* The year of his consulship (63) was one of amazing activity, both administrative and oratorical. Besides the three speeches against Publius Rullus and the four against Catiline, he delivered a number of others, among which that on behalf of Gaius Rabirius is especially notable. The charge was that Rabirius (*q.v.*) had killed Saturninus in 100 B.C., and by bringing it the democrats challenged the right of the senate to declare a man a public enemy. Cicero, therefore, was fully aware of the danger which would threaten himself from his execution of the Catilinarian conspirators. He trusted, however, to receive the support of the nobles. In this he was disappointed. They never forgot that he was a "new man," and were jealous of the great house upon the Palatine which he acquired at this time. Caesar had made every possible effort to conciliate Cicero,[1] but, when all overtures failed, allowed Publius Clodius to attack him. Cicero found himself deserted, and on the advice of Cato went into exile to avoid bloodshed. He left Rome at the end of March 58, and arrived on May 23 at Thessalonica where he remained in the deepest dejection until the end of November, when he went to Dyrrhachium (Durazzo) awaiting his recall. He left for Italy on Aug. 4, 57, and on arriving at Brundisium (Brindisi) found that he had been recalled by a law passed by the *comitia* on the very day of his departure. On his arrival at Rome he was received with enthusiasm by all classes, but did not find the nobles at all eager to give him compensation for the loss of his house and villas, which had been destroyed by Clodius. He was soon encouraged by the growing coolness between Pompey and Caesar to attack the acts of Caesar during his consulship, and after his successful defence of Publius Sestius on March 10 he proposed on April 5 that the senate should on May 15 discuss Caesar's distribution of the Campanian land. This brought about the conference of Luca (Lucca). Cicero was again deserted by his supporters and threatened with fresh exile. He was forced to publish a "recantation," probably the speech *de Provinciis Consularibus,* and in a private letter says frankly, "I know that I have been a regular ass." His conduct for the next three years teems with inconsistencies which we may deplore but cannot pass over. He was obliged to defend in 54 Publius Vatinius whom he had fiercely attacked during the trial of Sestius; also Aulus Gabinius, one of the consuls to whom his exile was due; and Rabirius Postumus, an agent of Gabinius. On the other hand, he made a violent speech in the senate in 55 against Lucius Piso, the colleague of Gabinius in 58. We know from his letters that he accepted financial aid from Caesar, but that he repaid the loan before the outbreak of the civil war. There is no doubt that he was easily deceived. He was always an optimist, and thought that he was bringing good influence to bear upon Caesar as afterwards upon Octavian. His actions, however, when Caesar's projects became manifest, sufficiently vindicated his honesty. During these unhappy years he took refuge in literature. The *de Oratore* was written in 55 B.C., the *de Republica* in 54, and the *de Legibus* at any rate begun in 52. The latter year is famous for the murder of Clodius by T. Annius Milo on the Appian Way (on Jan. 18), which brought about the appointment of Pompey as sole consul and the passing of special laws dealing with rioting and bribery. Cicero took an active part in the trials which followed both as a defender of Milo and his adherents and as a prosecutor of the opposite faction. At the close of the year, to his annoyance, he was sent to govern Cilicia under the provisions of Pompey's law (*see* POMPEY and ROME: *Ancient History*). His reluctance to leave Rome, already shown by his refusal to take a province, after his praetorship and consulship, was increased by the inclination of his daughter Tullia, then a widow, to marry again.

[1] According to Plutarch she urged her husband to take vigorous action against Catiline, who had compromised her half-sister Fabia, a vestal virgin; also to give evidence against Clodius, being jealous of his sister Clodia.

[1] Caesar, at one time, offered him a place on the coalition, which on his refusal became a triumvirate (*Att.* ii. 3. 3; *Prov. Cons.* 41), and afterwards a post on his commission for the division of the Campanian land, or a *legatio libera.*

During his absence she married the profligate spendthrift, P. Cornelius Dolabella.

The province of Cilicia was a large one. It included, in addition to Cilicia proper, Isauria, Lycaonia, Pisidia, Pamphylia and Cyprus, as well as a protectorate over the client kingdoms of Cappadocia and Galatia. There was also danger of a Parthian inroad. Cicero's legate was his brother Quintus Cicero (below), an experienced soldier who had gained great distinction under Caesar in Gaul. The fears of Parthian invasion were not realized, but Cicero, after suppressing a revolt in Cappadocia, undertook military operations against the hill-tribes of the Amanus and captured the town of Pindenissus after a siege of 46 days. A *supplicatio* in his honour was voted by the senate. The early months of 50 were occupied by the administration of justice, chiefly at Laodicea, and by various attempts to alleviate the distress in the province caused by the exactions of his predecessor, Appius Claudius. He had to withstand pressure from influential persons (*e.g.*, M. Brutus, who had business interests in his province), and refused to provide his friends with wild beasts for their games in Rome. Leaving his province on the earliest opportunity, he reached Brundisium on Nov. 24, and found civil war inevitable. He went to Rome on Jan. 4, but did not enter the city, since he aspired to a triumph for his successes. After the outbreak of war he was placed by Pompey in charge of the Campanian coast. After much irresolution he refused Caesar's invitations and resolved to join Pompey's forces in Greece. He was shocked by the ferocious language of his party, and himself gave offence by his bitter jests (Plut. *Cic.* 38). Through illness he was not present at the battle of Pharsalus, but afterwards was offered the command by Cato the Younger at Corcyra, and was threatened with death by the young Cn. Pompeius when he refused to accept it. Thinking it useless to continue the struggle, he sailed to Brundisium, where he remained until Aug. 12, 47, when, after receiving a kind letter from Caesar, he went to Rome. Under Caesar's dictatorship Cicero abstained from politics. His voice was raised on three occasions only: once in the senate in 46 to praise Caesar's clemency to M. Claudius Marcellus (*pro Marcello*), to plead in the same year before Caesar for Quintus Ligarius, and in 45 on behalf of Deiotarus, tetrarch of Galatia, also before Caesar. He suffered greatly from family troubles at this period. In 46, he divorced Terentia, and married his young and wealthy ward, Publilia. Then came the greatest grief of his life, the death of Tullia, his beloved daughter. He shortly afterwards divorced Publilia, who had been jealous of Tullia's influence and proved unsympathetic. To solace his troubles he devoted himself wholly to literature. To this period belong several famous rhetorical and philosophical works, the *Brutus, Orator, Partitiones Oratoriae, Paradoxa, Academica, de Finibus, Tusculan Disputations,* together with other works now lost, such as his *Laus Catonis, Consolatio* and *Hortensius.*

His repose was broken by Caesar's murder on March 15, 44, to which he was not a party. On March 17 he delivered a speech in the senate urging a general amnesty like that declared in Athens after the expulsion of the Thirty Tyrants. When it became apparent that the conspirators had removed only the despot and left the despotism, he again devoted himself to philosophy, and in an incredibly short space of time produced the *de Natura Deorum, de Divinatione, de Fato, Cato maior* (or *de Senectute*), *Laelius* (or *de Amicitia*), and began his treatise *de Officiis.* To this period also belongs his lost work *de Gloria.* He then projected a journey to Greece in order to see his son Marcus, then studying at Athens, of whose behaviour he had heard unfavourable reports. He reached Syracuse on Aug. 1, having during the voyage written from memory a translation of Aristotle's *Topica.* He was driven back by unfavourable winds to Leucopetra, and then, hearing better news, returned to Rome on Aug. 21. He was bitterly attacked by Marcus Antonius (Mark Antony) in the senate on Sept. 1 for not being present there, and on the next day replied in his First *Philippic.* He then left Rome and devoted himself to the completion of the *de Officiis,* and to the composition of his famous Second *Philippic,* which was never delivered, but was circulated, at first privately, after Antony had made his departure from Rome on the way to Cisalpine Gaul on Nov. 28.

Cicero returned to Rome on Dec. 9, and from that time forward led the republican party in the senate. His policy, stated briefly, was to make use of Octavian, whose name was all-powerful with the veterans, until new legions had been raised which would follow the republican commanders. Cicero pledged his credit for the loyalty of Octavian, who styled him "father" and affected to take his advice on all occasions. Cicero, an incurable optimist in politics, may have convinced himself of Octavian's sincerity. The breach, however, was bound to come, and the saying, maliciously attributed to Cicero, that Octavian was an "excellent youth who must be praised and—sent to another place," neatly expresses the popular view of the situation. Cicero was sharply criticized by M. Junius Brutus for truckling to Octavian while showing irreconcilable enmity to Antony and Lepidus (*ad Brut.* i. 16. 4, i. 15. 9); but Brutus was safe in his province, and it is difficult to see what other course was open to a politician in Rome. Whether Cicero was right or wrong, none can question his amazing energy. He delivered his long series of Philippics at Rome, and kept up a correspondence with the various provincial governors and commanders, all short-sighted and selfish, and several of them half-hearted, endeavouring to keep each man in his place and to elaborate a common plan of operations. He was naturally included in the list of the proscribed, though it is said that Octavian fought long on his behalf, and was slain near Formiae on Dec. 7, 43. He had a ship near in which he had previously attempted to flee, but being cast back by unfavourable winds he returned to his villa, saying, "Let me die in the country which I have often saved." His head and hands were sent to Rome and nailed to the rostra, after Fulvia, wife of Antony and widow of Clodius, had thrust a hairpin through the tongue.

Works.—The literary works of Cicero may be classed as (i.) rhetorical; (ii.) oratorical; (iii.) philosophical and political; (iv.) epistolary.

(i.) *Rhetorical.*—His chief works of this kind are: (*a*) *de Oratore,* a treatise in three books dedicated to his brother Quintus. The discussion is conducted in the form of a dialogue which is supposed to have occurred in 91 B.C. chiefly between the two orators L. Crassus and M. Antonius. The first book deals with the studies necessary for an orator; the second with the treatment of the subject matter; the third with the form and delivery of a speech. Cicero says of this work in a letter (*Fam.* i. 9. 23) that it "does not deal in hackneyed rules and embraces the whole theory of oratory as laid down by Isocrates and Aristotle." (*b*) *Brutus,* or *de claris oratoribus,* a history of Roman eloquence containing much valuable information about his predecessors, drawn largely from the *Chronicle* (*liber annalis*) of Atticus. (*c*) *Orator,* dedicated to M. Brutus, sketching a portrait of the perfect and ideal orator, Cicero's last word on oratory. The sum of his conclusion is that the perfect orator must also be a perfect man. Cicero says of this work that he has "concentrated in it all his taste" (*Fam.* vi. 18. 4). The three treatises are intended to form a continuous series containing a complete system of rhetorical training.

It will be convenient to mention here a feature of Ciceronian prose on which singular light has been thrown by recent inquiry. In the *de Oratore,* iii. 173 *sqq.,* he considers the element of rhythm or metre in prose, and in the *Orator* (174–226) he returns to the subject and discusses it at length. His main point is that prose should be metrical in character, though it should not be entirely metrical, since this would be poetry (*Orator,* 220). Greek writers relied for metrical effect in prose on those feet which were not much used in poetry. Aristotle recommended the paean ⏑⏑⏑–. Cicero preferred the cretic –⏑–, which he says is the metrical equivalent of the paean. Demosthenes was especially fond of the cretic. Rhythm pervades the whole sentence but is most important at the end or *clausula,* where the swell of the period sinks to rest. The ears of the Romans were almost incredibly sensitive to such points. We are told that an assembly

was stirred to wild applause by a double trochee – ∪ – ∪.[1] If the order were changed, Cicero says, the effect would be lost. The same rhythm should be found in the *membra* which compose the sentence. He quotes a passage from one of his own speeches in which any change in the order would destroy the rhythm. Cicero gives various *clausulae* which his ears told him to be good or bad, but his remarks are desultory as also are those of Quintilian, whose examples were largely drawn from Cicero's writings. It was left for modern research to discover rules of harmony which the Romans obeyed unconsciously. Other investigators had shown that Cicero's *clausulae* are generally variations of some three or four forms in which the rhythm is trochaic. Dr. Thaddaeus Zielinski of Warsaw, after examining all the *clausulae* in Cicero's speeches, finds that they are governed by a law. In every *clausula* there is a basis followed by a cadence. The basis consists of a cretic or its metrical equivalent.[2] This is followed by a cadence trochaic in character, but varying in length. The three favourite forms are (i.) – ∪ – ∪̄, (ii.) – ∪ – – ∪ ∪̄, (iii.) – ∪ – – ∪ – ∪̄. These he styles *verae* (V). Other frequent *clausulae,* which he terms *licitae* (L), are those in which a long syllable is resolved, as in verse, into two shorts, e.g., *ēssĕ vidĕātŭr.* These two classes, V and L, include 86% of the *clausulae* in the orations. Some rarer *clausulae* which he terms M (=*malae*) introduce no new principle. There remain two interesting forms, viz., S (=*selectae*), in which a spondee is substituted for a trochee in the cadence, *e.g.,* – ∪ – – – ∪̄, this being done for special emphasis, and P (= *pessimae*), where a dactyl is so used, *e.g.,* ∪ – – ∪ ∪ ∪̄, this being the *heroica clausula* condemned by Quintilian. Similar rules apply to the *membra* of the sentence, though in these the S and P forms are more frequent, harmony being restored in the *clausula.*

These results apply not only to the speeches but also to the philosophical writings and the more elaborate letters, and with modifications to other rhythmical prose, *e.g.,* that of Pliny and Seneca. Rhythm was avoided by Caesar who was an Atticist, and by Sallust, who was an archaist. Livy's practice is exactly opposite to that of Cicero, since he has a marked preference for the S forms, thereby exemplifying Cicero's saying that long syllables are more appropriate to history than to oratory (*Orator,* § 212).

(ii.) *Speeches.*—These were generally delivered before the senate or people, if political in character, and before jurors sitting in a *quaestio,* if judicial. The speech against Vatinius was an attack upon a witness under examination; that *de Domo* was made before the Pontifices; that *pro C. Rabirio perduellionis reo* in the course of a *provocatio* to the people; and those *pro Ligario* and *pro rege Deiotaro* before Caesar. The five orations composing the *Actio Secunda in Verrem* were never spoken, but written after Verres had gone into exile. The Second *Philippic* also was not delivered but issued as a pamphlet. Cicero's speech for Milo at his trial was not a success, though, as Quintilian (ix. 2. 54) quotes from it, as taken down by shorthand reporters, an example of a rhetorical figure well used, it cannot have been such a failure as is alleged by later writers. The extant speech was written by Cicero at his leisure. None of the other speeches is in the exact form in which it was delivered. Cicero's method was to construct a *commentarius* or skeleton of his speech, which he used when speaking. If he was pleased with a speech he then wrote it out for publication. Sometimes he omitted in the written speech a subject on which he had spoken. A record of this is sometimes preserved: *e.g.,* "de Postumi criminibus" (*Mur.* 51), "de teste Fufio" (*Cael.* 19). These *commentarii* were published by his freedman Tiro and are quoted by Asconius (*ad Orat. in Toga Candida,* p. 87).

Cicero in his speeches must be given all the privileges of an advocate. Sometimes he had a bad client; he naïvely confesses the straits to which he was put when defending Scamander (*Clu.* 51; *cf. Phil.* xiii. 26). He thought of defending Catiline, though he says that his guilt is clear as noon-day (*Att.* i. 1–2 and ii. 1). Sometimes the brief which he held at the moment compelled him to take a view of facts contrary to that which he had previously advocated. Thus in the *pro Caecina* he alleges judicial corruption against a witness, Falcula, while in the *pro Cluentio* he contends that the offence was not proved (*Caec.* 28, *Clu.* 103). He says quite openly that "it is a great mistake to suppose that statements in his speeches express his real opinions" (*Clu.* 139). It is therefore idle to reproach him with inconsistencies, though these are sometimes very singular. Thus in the *pro Cornelio* he speaks with praise of Gabinius, who, when a colleague vetoed his proposal, proceeded to depose him after the precedent set by Tiberius Gracchus (Asconius *in Cornel.* p. 71). In the *pro Cluentio,* 111, he contends that nothing is easier than for a new man to rise at Rome. In the *pro Caelio* he says that Catiline had in him undeveloped germs of the greatest virtues, and that it was the good in him that made him so dangerous (*Cael.* 12–14). He sometimes deliberately puts the case upon a wrong issue. In the *pro Milone* he says that either Milo must have lain in wait for Clodius or Clodius for Milo, leaving out of sight the truth, that the encounter was due to chance. He used to boast that he had cast dust into the eyes of the jury in the case of Cluentius (Quintil. ii. 17–21).

Cicero had a perfect mastery of all weapons wielded by a pleader in Rome. He was specially famous for his pathos, and for this reason, when several counsel were employed, always spoke last (*Orat.* 130). A splendid specimen of pathos is to be found in his account of the condemnation and execution of the Sicilian captains (*Verr.* [*Act.* ii.] v. 106–122). Much exaggeration was permitted to a Roman orator. Thus Cicero frequently speaks as if his client were to be put to death, though a criminal could always evade capital consequences by going into exile. His enemies scoffed at his "tear-drops." He indulged in the most violent invective, which, though shocking to a modern reader, *e.g.,* in his speeches against Vatinius and Piso, was not offensive to Roman taste (*de Orat.* ii. 216–290). He was much criticized for his jokes, and even Quintilian (ii. 17–21) regrets that he made so many in his speeches. He could never resist the temptation to make a pun. It must be remembered, however, that he was the great wit of the period. Caesar used to have a collection of Cicero's *bons mots* brought to him. Cicero complains that all the jokes of the day were attributed to himself, including those made by very sorry jesters (*Fam.* vii. 32. 1). A fine specimen of sustained humour is to be found in his speech *pro Murena,* where he rallies the jurisconsults and the Stoics. He was also criticized for his vanity and perpetual references to his own achievements. His vanity, however, as has been admirably remarked, is essentially that of "the peacock, not of the gander," and is redeemed by his willingness to raise a laugh at his own expense (Strachan-Davidson, p. 192). Some critics have impugned his legal knowledge, but probably without justice. It is true that he does not claim to be a great expert, though a pupil of the Scaevolas, and when in doubt would consult a jurisconsult; also, that he frequently passes lightly over important points of law, but this was probably because he was conscious of a flaw in his case.

(iii.) *Political and Philosophical Treatises.*—These are generally written in the form of dialogues, in which the speakers sometimes belong to bygone times and sometimes to the present. The first method was known as that of Heracleides, the second as that of Aristotle (*Att.* xiii. 19. 4). There is no reason to suppose that the speakers held the views with which Cicero credits them, or had such literary powers as would make them able to express such views (*ib.,* xiii. 12. 3). The political works are *de Republica* and *de Legibus.* The first was a dialogue in six books concerning the best form of constitution, in which the speakers are Scipio Africanus Minor and members of his circle. He tells us that he drew largely from Plato, Aristotle, Theophrastus and writings of the Peripatetics. The famous "Dream of Scipio" recalls the "Vision of Er" in Plato's *Republic* (Book x. *ad fin.*). The *de*

[1] *Orator,* § 214: "'patris dictum sapiens temeritas fili cōmprŏbāvit'—hoc dichoreo tantus clamor contionis excitatus est ut admirabile esset. Quaero, nonne id numerus efficerit? Verborum ordinem immuta, fac sic: 'Comprobavit fili temeritas' jam nihil erit."

[2] This theory is partly anticipated by Terentianus Maurus (*c.* A.D. 290), who says of the cretic (v. 1440 *sqq.*):—

"Plurimum orantes decebit quando paene in ultimo
Obtinet sedem beatam, terminet si clausulam
Dactylus spondeus imam, nec trochaeum respuo;
Plenius tractatur istud arte prosa rhetorum."

Legibus, a sequel to this work in imitation of Plato's *Laws,* is drawn largely from Chrysippus.

Cicero as a philosopher belonged to the New Academy. The followers of this school were free to hear all arguments for and against, and to accept the conclusion which for the moment appeared most probable (*Acad.* ii. 131). Thus in the *Tusculan Disputations* v. he expresses views which conflict with *de Finibus* iv., and defends himself on the ground that as an Academic he is free to change his mind. He was much fascinated by the Stoic morality, and it has been noticed that the *Tusculan Disputations* and *de Officiis* are largely Stoic in tone. He has nothing but contempt for the Epicureans, and cannot forgive their neglect of literary style. As Cicero's philosophical writings have been severely attacked for want of originality, it is only fair to recollect that he resorted to philosophy as an anodyne when suffering from mental anguish, and that he wrote incredibly fast. He issued two editions of his *Academica.* The first consisted of two books, in which Catulus and Lucullus were the chief speakers. He then rewrote his treatise in four books, making himself, Varro and Atticus the speakers. His works are confessedly in the main translations and compilations (*Att.* xii. 52. 3); all that he does is to turn the discussion into the form of a dialogue, to adapt it to Roman readers by illustrations from Roman history, and to invent equivalents for Greek technical terms. This is equally true of the political treatises. Thus, when Atticus criticized a strange statement in *de Republ.* ii. 8, that all the cities of the Peloponnese had access to the sea, he excuses himself by saying that he found it in Dicaearchus and copied it word for word (*Att.* vi. 2. 3). In the same passage he used an incorrect adjective, *Phliuntii* for *Phliasii;* he says that he had already corrected his own copy, but the mistake survives in the single palimpsest in which this work has been preserved. The only merits, therefore, which can be claimed for Cicero are that he invented a philosophical terminology for the Romans, and that he produced a series of manuals which from their beauty of style have had enduring influence upon mankind.

The most famous of these treatises are the following:

De Finibus, on the Supreme Good. In Book i. L. Manlius Torquatus explains the Epicurean doctrine, which is refuted in ii. by Cicero. In iii. and iv. M. Porcius Cato sets forth the doctrine of the Stoics which is shown by Cicero to agree with that of Antiochus of Ascalon; in v. M. Pupius Piso explains the views of the Academics and Peripatetics.

Tusculanae Disputationes, so called from Cicero's villa at Tusculum in which the discussion is supposed to have taken place. The subjects treated are:—in Book i., the nature of death and the reasons for despising it; Book ii., the endurance of pain; pain is not an evil; Book iii., wisdom makes a man insensible to sorrow; Book iv., wisdom banishes all mental disquietude; Book v., virtue is sufficient to secure happiness. The materials are drawn largely from works of Dicaearchus.

De Deorum Natura.—The dialogue is placed in 77 B.C. In Book i. Velleius attacks other philosophies and explains the system of Epicurus. He is then refuted by Cotta. In Book ii. Balbus, speaking as a Stoic, discusses the existence of the gods, nature, the government of the world and providence. In Book iii. Cotta criticizes the views of Balbus. The statement of the Epicurean doctrine is drawn from the work of Phaedrus, *περὶ θεῶν* the criticism of this from Posidonius. The Stoic teaching is derived from Cleanthes, Chrysippus and Zeno, and is criticized from the writings of Carneades and Clitomachus.

De Officiis, addressed to his son Marcus. In this the form of dialogue was not employed. The material is chiefly drawn from Stoic sources, *e.g.,* works of Panaetius in Books i. and ii., of Posidonius and Hecato in Book iii.

The *Academica,* as they have come down to us, are a conflation from the two editions of this work. They consist of the second book from the first edition, and a portion of the first book from the second edition.

Cato maior, or *de Senectute,* a dialogue placed in 150 B.C., in which Cato, addressing Scipio and Laelius, set forth the praises of old age. The idea is drawn from Aristo of Chios, and the materials largely derived from Xenophon and Plato.

Laelius, or *de Amicitia,* a dialogue between Laelius and his sons-in-law, in which he sets forth the theory of friendship, speaking with special reference to the recent death of Scipio. Cicero here draws from a work of Theophrastus on the same subject and from Aristotle.

(iv.) *Letters.*—Those preserved are (1) *ad Familiares,* i.–xvi.; (2) *ad Atticum,* i.–xvi.; (3) *ad Quintum,* i.–iii., *ad Brutum,* i.–ii. Some 35 other books of letters were known to antiquity, *e.g.,* to Caesar, to Pompey, to Octavian and to his son Marcus.

The collection includes nearly 100 letters written by other persons. Thus, the eighth Book *ad Fam.* consists entirely of letters from Caelius to Cicero when in Cilicia. When writing to Atticus Cicero frequently sent copies of letters which he had received. There is a great variety in the style not only of Cicero's correspondents, but also of Cicero himself. Caelius writes in a breezy, school-boy style; the Latinity of Plancus is Ciceronian in character; the letter of Sulpicius to Cicero on the death of Tullia is a masterpiece of style; Matius writes a most dignified letter justifying his affectionate regard for Caesar's memory. Several of his correspondents are indifferent stylists. Cato labours to express himself in an awkward and laconic epistle, apologizing for its length. Metellus Celer is very rude, but gives himself away in every word. Antony writes bad Latin, while Cicero himself writes in various styles. We have such a *cri de coeur* as his few words to one of the conspirators after Caesar's murder, "I congratulate you. I rejoice for myself. I love you. I watch your interest; I wish for your love and to be informed what you are doing and what is being done" (*Fam.* vi. 15). When writing to Atticus he eschews all ornamentation, uses short sentences, colloquial idioms, rare diminutives and continually quotes Greek. This use of Greek tags and quotations is also found in letters to other intimate friends, *e.g.,* Paetus and Caelius; also in letters written by other persons, *e.g.,* Cassius to Cicero; Quintus to Tiro, and subsequently in those of Augustus to Tiberius. It is a feature of the colloquial style and often corresponds to the modern use of "slang." Other letters of Cicero, especially those written to persons with whom he was not quite at his ease or those meant for circulation, are composed in his elaborate style with long periods, parentheses and other devices for obscuring thought. These are throughout rhythmical in character, like his speeches and philosophical works.

We know from Cicero's own statement (*Att.* xvi. 5. 5) that he thought of publishing some of his letters during his lifetime. On another occasion he jestingly charges Tiro with wishing to have his own letters included in the "volumes" (*Fam.* xvi. 17. 1). It is obvious that Cicero could not have meant to publish his private letters to Atticus in which he makes confessions about himself, or those to Quintus in which he sometimes outsteps the limits of brotherly criticism, but was thinking of polished productions such as the letters to Lentulus Spinther or that to Lucceius which he describes as "very pretty" (*Att.* iv. 6. 4).

It is universally agreed that the letters *ad Familiares* were published by Tiro, whose hand is revealed by the fact that he suppresses all letters written by himself, and modestly puts at the end those written to him. That Cicero kept copies of his letters, or of many of them, we know from a passage in which, when addressing a friend who had inadvertently torn up a letter from him, he says that there is nothing to grieve about; he has himself a copy at home and can replace the loss (*Fam.* vii. 25. 1). Tiro may have obtained from Terentia copies of letters written to her. It has been suggested that he may also have edited the letters to Quintus, as he could obtain them from members of the family. The letters *ad Familiares* were generally quoted in antiquity by books, the title being taken from the first letter, *e.g., Cicero ad Varronem epistula Paeti.*

While the letters *ad Familiares* were circulated at once, those to Atticus appear to have been suppressed for a considerable time. Cornelius Nepos (*Att.* 16) knew of their existence but distinguishes them from the published letters. Asconius (p. 87), writing under Claudius, never quotes them, though, when discussing Cicero's projected defence of Catiline, he could hardly have

failed to do so, if he had known them. The first author who quotes them is Seneca. It is, therefore, probable that they were not published by Atticus himself, who died 32 B.C., though his hand may be seen in the suppression of all letters written by himself, but that they remained in the possession of his family and were not published until about A.D. 60. At that date they could be published without expurgation of any kind, whereas in the letters *ad Familiares* the editor's hand is on one occasion (iii. 10. 11) manifest. Cicero is telling Appius, his predecessor in Cilicia, of the measures which he is taking on his behalf. There then follows a lacuna. It is obvious that Tiro thought the passage compromising and struck it out. In the letters to Atticus, on the other hand, we have Cicero's private journal, his confessions to the director of his conscience, the record of his moods from day to day, without alterations of any kind.

Cicero's letters are the chief and most reliable source of information for the period. It is due to them that the Romans of the day are living figures to us, and that Cicero, in spite of, or rather in virtue of his frailties, is intensely human and sympathetic. The letters to Atticus abound in the frankest self-revelation, though even in the presence of his confessor his instinct as a pleader makes him try to justify himself. The historical value of the letters, therefore, completely transcends that of Cicero's other works. It is true that these are full of information. Thus we learn much from the *de Legibus* regarding the constitutional history of Rome, and much from the *Brutus* concerning the earlier orators. The speeches abound in details which may be accepted as authentic, either because there is no reason for misrepresentation or on account of their circumstantiality. Thus the *Verrines* are our chief source of information for the government of the provinces, the system of taxation, the powers of the governor. They tell us of the monstrous system by which the governor could fix upon a remote place for the delivery of corn, and so compel the farmer to compound by a payment in money which the orator does not blame, on the ground that it is only proper to allow magistrates to receive corn wherever they wish (iii. 190). From the speech *pro Cluentio* (145–154) we gain unique information concerning the condition of society in a country town, the extraordinary exemption of *equites* from prosecution for judicial corruption, the administration of domestic justice in the case of slaves examined by their owner (*ib.*, 176–187). But we have always to be on our guard against misrepresentation, exaggeration and falsehood. The value of the letters lies in the fact that in them we get behind Cicero and are face to face with the other *dramatis personae;* also that we are admitted behind the scenes and read the secret history of the times. One of the most interesting documents in the correspondence is a despatch of Caesar to his agent Oppius, written in great haste and in disjointed sentences. It runs as follows: "On the 9th I came to Brundisium. Pompey is at Brundisium. He sent Magius to me to treat of peace. I gave him a suitable answer" (*Att.* ix. 13, A). In the *de Bello civili,* on the other hand, Caesar who wishes to show that he did his best to make peace, after stating that he sent his captive Magius to negotiate, expresses mild surprise at the fact that Pompey did not send him back (*Bell. Civ.* i. 26). We hear of the extraordinary agreement made by two candidates for the consulship in Caesar's interest with the sitting consuls of 54 B.C., which Cicero says he hardly ventures to put on paper. Under the terms of this the consuls, who were *optimates,* bound themselves to betray their party by securing, apparently fraudulently, the election of the candidates while they in turn bound themselves to procure two ex-consuls who would swear that they were present in the senate when supplies were voted for the consular provinces, though no meeting of the senate had been held, and three augurs who would swear that a *lex curiata* had been passed, though the *comitia curiata* had not been convened (*Att.* iv. 18. 2). But perhaps the most singular scene is the council of three great ladies presided over by Servilia at Antium, which decides the movements of Brutus and Cassius in June 44 B.C., when Cassius "looking very fierce—you would say that he was breathing fire and sword"—blustered concerning what he considered an insult, viz., a commission which had been laid upon him to supply corn. Servilia calmly remarks she will have the commission removed from the decree of the senate (*Att.* xv. 11. 2).

(v.) *Miscellaneous.*—It is not necessary to dwell upon the other forms of literary composition attempted by Cicero. He was a fluent versifier, and would write 500 verses in one night. Considerable fragments from a juvenile translation of Aratus have been preserved. His later poems upon his own consulship and his exile were soon forgotten except for certain lines which provoked criticism, such as the unfortunate verse:

"O fortunatam natam me consule Romam."

He wrote a memoir of his consulship in Greek and at one time thought of writing a history of Rome. Nepos thought that he would have been an ideal historian, but as Cicero ranks history with declamation and on one occasion with great *naïveté* asks Lucius Lucceius (*q.v.*), who was embarking on this task, to embroider the facts to his own credit, we cannot accept this criticism (*Fam.* vi. 2. 3).

(vi.) *Authenticity.*—The genuineness of certain works of Cicero has been attacked. It was for a long time usual to doubt the authenticity of the speeches *post reditum* and *pro Marcello.* Recent scholars consider them genuine. As their rhythmical structure corresponds more or less exactly with the canon of authenticity formed by Zielinski from the other speeches, the question may now be considered closed. Absurd suspicion has been cast upon the later speeches *in Catilinam* and that *pro Archia.* An oration *pridie quam in exsilium iret* is certainly a forgery, as also a letter to Octavian. There is a "controversy" between Cicero and Sallust which is palpably a forgery, though a quotation from it occurs in Quintilian (iv. 1. 68). Suspicion has been attached to the letters to Brutus, which in the case of two letters (i. 16 and 17) is not unreasonable since they somewhat resemble the style of *suasoriae,* or rhetorical exercises, but the latest editors, Tyrrell and Purser, regard these also as genuine.

After Cicero's death his character was attacked by various detractors, such as the author of the spurious *Controversia* put into the mouth of Sallust, and the calumniator from whom Dio Cassius (xlvi. 1–28) draws the libellous statements which he inserts into the speech of Q. Fufius Calenus in the senate. Of such critics, Asconius (in *Tog. Cand.* p. 95) well says that it is best to ignore them. His prose style was attacked by Pollio as Asiatic, also by his son, Asinius Gallus, who was answered by the emperor Claudius (Suet. 41). The writers of the silver age found fault with his prolixity, want of sparkle and epigram and monotony of his *clausulae.* A certain Largius Licinius gained notoriety by attacking his Latinity in a work styled *Ciceromastix.* His most devoted admirers were the younger Pliny, who reproduced his oratorical style with considerable success, and Quintilian (x. 1. 112), who regarded him as the perfect orator, and draws most of his illustrations from his works. At a later period his style fascinated Christian writers, notably Lactantius, the "Christian Cicero," Jerome and St. Augustine, who drew freely from his rhetorical writings.

(2) QUINTUS TULLIUS CICERO, brother of the orator and brother-in-law of T. Pomponius Atticus, was born about 102 B.C. He was aedile in 67, praetor in 62, and for the three following years propraetor in Asia, where, though he seems to have abstained from personal aggrandizement, his ill-temper gained him an evil notoriety. After his return to Rome, he heartily supported the attempt to secure his brother's recall from exile, and was nearly murdered by gladiators in the pay of Clodius. He distinguished himself as one of Julius Caesar's legates in the Gallic campaigns, served in Britain, and afterwards under his brother in Cilicia. On the outbreak of the Civil War between Pompey and Caesar, Quintus, like Marcus, supported Pompey, but after Pharsalus he deserted and made peace with Caesar, largely owing to the intercession of Marcus. Both the brothers fell victims to the proscription which followed Caesar's death, Quintus being put to death in 43, some time before Marcus. His marriage with Pomponia was very unhappy, and he was much under the influence of his freedman Statius. Though trained on the same lines as Marcus he never spoke in public, and even said,

"One orator in a family is enough, nay even in a city." Though essentially a soldier, he took considerable interest in literature, wrote epic poems, tragedies and annals, and translated plays of Sophocles. There are extant four letters written by him (one to his brother Marcus, and three to his freedman Tiro) and a short paper, *de Petitione Consulatus* (on canvassing for the consulship), addressed to his brother in 64. A few hexameters by him on the 12 signs of the zodiac are quoted by Ausonius.

(3) MARCUS TULLIUS CICERO, only son of the orator and his wife Terentia, was born in 65 B.C. At the age of 17 he served with Pompey in Greece and commanded a squadron of cavalry at the battle of Pharsalus. In 45 he was sent to Athens to study rhetoric and philosophy, but abandoned himself to a life of dissipation. It was during his stay at Athens that his father dedicated the *de Officiis* to him. After the murder of Caesar (44) he attracted the notice of Brutus, by whom he was offered the post of military tribune, in which capacity he rendered good service to the Republican cause. After the battle of Philippi (42), he took refuge with Sextus Pompeius in Sicily, where the remnants of the Republican forces were collected. He took advantage of the amnesty granted by the Treaty of Misenum (39) to return to Rome, where he took no part in public affairs, but resumed his former dissipated habits. In spite of this, he received signal marks of distinction from Octavian, who not only nominated him augur, but accepted him as his colleague in the consulship (30). He had the satisfaction of carrying out the decree which ordered that all the statues of Antony should be demolished, and thus "the divine justice reserved the completion of Antony's punishment for the house of Cicero" (Plutarch). He was subsequently appointed proconsul of Asia or Syria, but nothing further is known of his life. In spite of his debauchery, there is no doubt that he was a man of considerable education and no mean soldier, while Brutus, in a letter to his father (*Epp. ad Brutum*, ii. 3), even goes so far as to say that the son would be capable of attaining the highest honours without borrowing from the father's reputation.

(4) QUINTUS TULLIUS CICERO (*c.* 67–43 B.C.), son of Quintus Tullius Cicero (brother of the orator). He accompanied his uncle Marcus to Cilicia, and, in the hope of obtaining a reward, repaid his kindness by informing Caesar of his intention of leaving Italy. After the battle of Pharsalus he joined his father in abusing his uncle as responsible for the condition of affairs, hoping thereby to obtain pardon from Caesar. After the death of Caesar he attached himself to Mark Antony, but, owing to some fancied slight, he deserted to Brutus and Cassius. He was included in the proscription lists, and was put to death with his father in 43. In his last moments he refused under torture to disclose his father's hiding-place. His father, who in his concealment was a witness of what was taking place, thereupon gave himself up, stipulating that he and his son should be executed at the same time.

BIBLIOGRAPHY.—It is impossible to mention more than a few works as the literature is so vast. (1) *Historical.*—J. L. Strachan-Davidson, *Cicero and the Roman Republic* (Heroes of the Nations series, 1894); G. Boissier, *Cicéron et ses amis* (1865); W. Warde Fowler, *Social Life at Rome* (1908); introduction to R. Y. Tyrrell and L. C. Purser's edition of the letters (1904–18); Th. Zielinski, *Cicero im Wandel der Jahrhunderte* (3rd ed., Leipzig, 1912). (2) *Literary.*—M. Schanz, *Geschichte der römischen Literatur*, i., 194–274 (München, 1890). (3) *Linguistic.*—H. Merguet, *Lexikon zu den Schriften Ciceros* (Jena, 1887–94); J. Le Breton, *Études sur la langue et la grammaire de Ciceron* (1901); E. Norden, *Die antike Kunstprosa* (Leipzig, 1898); Th. Zielinski, "Das Clauselgesetz in Ciceros Reden" in *Philologus* (Leipzig, 1904); L. Laurand, *Études sur le style des discours de Cicéron* (1907). Much information on points of Ciceronian idiom and language will be found in J. S. Reid's *Academica* (London, 1885), *de Finikus*, i.–ii. (Cambridge, 1925) and G. Landgraf's *Pro Sext. Roscio* (Erlangen, 1884). (4) *Legal.*—A. H. J. Greenidge, *The Legal Procedure of Cicero's Time* (Oxford, 1901). (5) *Philosophical.*—An excellent account of Cicero as a philosopher is given in the preface to Reid's editions of the *Academica*. (6) *Editions* (critical) of the complete texts.—Baiter-Halm (1845–61); C. F. W. Müller (1880–96); Oxford Classical Texts. (A. C. C.)

CICERO, a town of Cook county (Ill.), U.S.A., 7m. W. of the "Loop," and bounded by Chicago on the north, east, and south. It is served by the Burlington, the Baltimore and Ohio Chicago Terminal, the Belt of Chicago and the Manufacturers' Junction railways. In 1900 the population was 16,310; in 1920 it was 44,995 (34·4% foreign-born white), and in 1940 it was 64,712 by federal census.

Cicero is an important industrial centre, manufacturing electrical equipment, pumps, engines, windmills, malleable iron castings and enamelled ware. The aggregate factory product in 1937 was valued at $146,326,019. Cicero was settled about 1849, and was incorporated in 1867.

CICERONE, a guide, one who conducts visitors to museums, galleries, etc., and explains matters of historic or artistic interest. The word is presumably taken from Marcus Tullius Cicero as a type of learning and eloquence. According to a quotation (1762) cited by the *New English Dictionary* the word seems first to have been applied to "learned antiquarians who show and explain to foreigners the antiquities and curiosities of the country."

CICHLID. The fishes of the family Cichlidae are perches with a single nostril on each side and with the lower pharyngeals coalesced or united by suture. They are found in lakes, rivers and brackish lagoons of Central and South America, Africa and Syria, Madagascar and India. This distribution was formerly considered to favour the idea of the persistence of the connection between South America and Africa into the Eocene, but the value of the Cichlids in this relation is discounted by the fact that many species enter brackish water and some the sea. Their presence in Madagascar, where none of the true freshwater African families is represented, indicates that their dispersal has been accomplished in a manner different from these.

The American species number about 250, the African 400; none of the genera is common to the two continents. The Indian *Etroplus* is an isolated genus, related only to *Paretroplus* of Madagascar, in which island the genera are peculiar, the two others being related to African genera. In the African Cichlid fauna an extraordinary diversity and specialization is attained in the great lakes, Tanganyika having 100 species, nearly all belonging to genera found only in the lake, and Nyassa having nearly as many endemic species, some of which have evolved on parallel lines to those of Tanganyika. The lacustrine genera differ from each other, especially in modifications of the mouth and teeth, enabling these fishes to make use of every kind of animal and vegetable food available in the lakes. Many Cichlids are beautifully coloured, and are favourite aquarium fishes. *Herichthys cyanoguttatus* of Mexico, covered with bright blue spots, is one of the really handsome species. *Pterophyllum scalare* of the Amazon has the body very deep and strongly compressed and the dorsal and anal fins high. *Tilapia nilotica*, the bolti of the Nile, reaches a length of 18 inches.

In many Cichlids the female fish keeps the eggs in her mouth until they hatch, and for a time swims with her brood, opening her mouth for the little fishes to swim in when danger threatens. In other species the eggs are laid in a hollow scooped out by the male; both parents guard the nest until the eggs hatch, when the mother takes the young into her mouth. (C. T. R.)

CICISBEO (chĭ-chĭs-bā′ō), the term in Italy (17th century onwards) for a dangler about women. The cicisbeo was the professed gallant of a married woman, who attended her at all public entertainments, it being considered unfashionable for the husband to be her escort.

CICOGNARA, LEOPOLDO, COUNT (1767–1834), Italian archaeologist and writer on art, was born at Ferrara. A residence of some years at Rome, devoted to the study of the antiquities and galleries, was followed by visits to Naples and Sicily. He then visited Florence, Milan, Bologna and Venice, acquiring a complete archaeological knowledge of these and other cities. In 1795 he took up his abode at Modena, and was for 12 years engaged in politics, becoming minister plenipotentiary of the Cisalpine Republic at Turin. Napoleon decorated him with the Iron Crown; and in 1808 he was made president of the Academy of the Fine Arts at Venice. In 1808 appeared his treatise *Del bello ragionamenti.* This was followed (1813–18) by his *magnum opus*, the *Storia della scultura dal suo risorgimento in Italia al*

secolo di Napoleone. The book was designed to complete the works of Winckelmann and D'Agincourt, and is illustrated with 180 plates in outline. His *Fabbriche più cospicue di Venezia,* two superb folios, containing some 150 plates, was published (1815–20) under the auspices of Francis I. of Austria. Charged by the Venetians with the presentation of their gifts to the Empress Caroline at Vienna, Cicognara added to the offering an illustrated catalogue of the objects it comprised; this book, *Omaggio delle Provincie Venete alla maestà di Carolina Augusta,* has since become of great value to the bibliophile. In 1821 he published at Pisa a *catalogue raisonné,* rich in bibliographical lore, of his fine library, the result of 30 years of loving labour, which in 1824 was purchased *en bloc* by Pope Leo XII., and added to the Vatican library. Cicognara's work in the academy at Venice, of which he became president in 1808, led to the foundation of a gallery for the reception of Venetian pictures.

See Zanetti, *Cenni biografici di Leopoldo Cicognara* (Venice, 1834); Malmani, *Memorie del conte Leopoldo Cicognara* (Venice, 1888).

CICONIIDAE: *see* JABIRU; STORK.

CID, THE (sĭd, Spanish thēth), Diaz de Bivar (d. 1099), the favourite hero of Spain, and the most prominent figure in her literature. The name, however, is so obscured by fable as scarcely to belong to history. The Jesuit Masdeu denies that he existed, and this heresy has not wanted followers even in Spain. The truth of the matter has been expressed by Cervantes, through the mouth of the Canon in Don Quixote: "There is no doubt there was such a man as the Cid but much doubt whether he achieved what is attributed to him."

The Cid of history is still the foremost man of the heroical period of Spain—the greatest warrior of the long struggle between Christian and Muslim, and the perfect type of the Castilian of the 12th century. Rodrigo Diaz, called de Bivar, from the place of his birth, better known by the title given him by the Arabs as the *Cid* (*El Seid,* the lord) and *El Campeador,* the champion, was born of a noble family about 1040, being first mentioned (as Rodrigo Díaz de Vivar) in a charter of Ferdinand I. of 1064. He rose to great distinction in the war between Sancho of Castile and Sancho of Navarre, in which he won his name of *Campeador* by slaying the enemy's champion in single combat. In the quarrel between Sancho and his brother Alphonso, he espoused the cause of the former, and suggested the perfidious stratagem by which Sancho eventually obtained possession of León. Sancho having been slain in 1072, while engaged in the siege of Zamora, the exiled Alphonso returned and occupied the vacant throne. The Cid accepted the new monarch, was entrusted with high commissions of State, and in 1074 married Ximena, daughter of the count of Oviedo, and granddaughter of Alphonso V. Some time afterwards he was sent to collect tribute from Motamid, the king of Seville, who was at war with Abdullah, the king of Granada. During the battle which ensued under the walls of Seville, Abdullah and his auxiliaries were routed, the Cid returning to Burgos with many prisoners and a rich booty. Garcia Ordoñez then accused him to Alphonso of keeping part of the tribute, and the king took advantage of the Cid's absence on a raid against the Moors to banish him from Castile in 1081.

Henceforth Rodrigo Diaz lived that life of a soldier of fortune which has made him famous, sometimes fighting with the Christians, sometimes with the Moors, but always for his own hand. At the head of 300 free lances he offered his services to the count of Barcelona; then, failing him, to Moktadir, the Arab king of Saragossa, under whose successors he fought for nearly eight years, against Mohammedan and Christian, being admitted almost to a share of their royal authority. His overtures towards Alphonso being rejected, he extended the Arab dominions at the expense of the Christian States of Aragon and Barcelona, and harried even the borders of Castile. Among the enterprises of the Cid the most famous was that against Valencia, where he appeared at the head of 7,000 men, chiefly Mohammedans. In defiance of a relief army, under Yusuf the Almoravide, the Cid took Valencia after a siege of nine months, on June 15, 1094—the richest prize which had been recovered from the Moors. The conditions of the surrender were all violated—the cadi Ibn Djahhaff burnt alive, many citizens slaughtered, and the possessions divided among the Cid's companions. The Cid ruled his kingdom, which now embraced nearly the whole of Valencia and Murcia, for four years, with vigour and justice. At length the Almoravides defeated him at Cuenca, and the blow led to his death in July, 1099. His widow maintained Valencia against the Moors till 1102, when she evacuated the city, taking with her the body of the Cid to be buried in the monastery of San Pedro at Cardeña, near Burgos. The bones have since been removed to the town hall of Burgos.

The Cid of romance is not the historical rebel, the consorter with infidels and the enemies of Spain. He is the type of knightly virtue, the mirror of patriotic duty, the flower of all Christian grace, the Roland, the King Arthur, and Bayard in one. In a barbarous Latin poem, written in celebration of the conquest of Almeria by Alphonso VII. in 1147, the bard sings of the supereminence of the Cid among his country's heroes:—

> Ipse Rodericus *Mio Cid* semper vocatus,
> De quo cantatur quod ab hostibus haud superatus,
> Qui domuit Mauros, comites domuit quoque nostros.

The *Poema del Cid,* of the latter half of the 12th century, the oldest extant Spanish epic, written in a barbarous style, in rugged assonant rhymes, and a rude Alexandrine measure, full of a noble simplicity and a true epic grandeur, is invaluable as a living picture of the age, though it is silent about the Cid's cruelties. The ballads relating to him number nearly 200, most of which date from the 16th century and are of inferior merit. They all take very great liberties with history. Such of the ballads as are not genuine relics of the 12th century are either poetical versions of episodes in the hero's life as contained in the *Chronicle,* which itself was composed out of still earlier legends, or later inventions inspired by the romance of chivalry. In these last the ballad-mongers, not to let their hero be outdone by Amadis of Gaul and the other heroes of romance, engage him in the most extravagant adventures—making war upon the king of France and upon the emperor, receiving embassies from the soldan of Persia, or bearding the pope. The last and the worst of the Cid ballads are those which betray by their frigid conceits and feeble mimicry of the antique the false taste and unheroic spirit of the age of Philip II. The influence of the Spanish Cid cycle in France first appeared in Du Périer's novel: *La Hayne et l'Amour d'Arnoul et de Clairemonde* (1600), and more notably in Corneille's *Cid* (1636), which was greatly indebted to the drama by Guillen de Castro, *Las Mocedades del Cid* (1614?).

BIBLIOGRAPHY.—The chief sources for the story of the Cid are the Latin chronicle discovered by Risco in the convent of San Isidro at León, which appears, from internal evidence, to date from before 1258; the *Cronica General,* composed by Alphonso X. (d. 1284), partly (so far as relates to the Cid) from the above, partly from contemporary Arab histories, partly from tradition; the *Crónica particular del Cid* (first pub. 1512 by Juan de Velorado), a compilation from the last, interlarded with pious fictions; lastly, various early Arabic manuscripts, discussed in Dozy's *Recherches sur l'histoire politique et littéraire de l'Espagne pendant le moyen âge,* vol. ii. (Leyden, 1849). The *Chronicle* was translated into Eng. by R. Markham (1883), and with elaborations by Robt. Southey (1883). The last edition and translation of the *Poem of the Cid* is by A. M. Huntington (The Hispanic Socy. of America, 1921). The largest collection of the Cid ballads is that of Duran in the *Romancero general,* vol. x., xvi. of Rivadeneyra's *Biblioteca de autores españoles* (1849–51). Huber, Müller, and F. Wolf are among the authorities for the history and literature of the Cid. *See* also J. Fitzmaurice-Kelly, *History of Spanish Literature* (1926); H. Butler Clarke, *The Cid Campeador* (1897); Hämel, *Der Cid im Spanischen Drama* (1910).

CIDER or **CYDER,** as made outside of the United States, is an alcoholic beverage made from apples. It is produced by the vinous fermentation of the expressed juice of the fruit. Although any kind of apples can be used for the purpose, special vintage varieties distinguished by chemical and other characters which render them unsuited for the most part for table use are required for a beverage of fine quality. The making of cider has been attempted wherever the apple is grown extensively, but a flourishing commercial industry has hitherto been established only in those countries where true vintage fruit can be obtained.

The Cider Districts.—The cider apple orchards of the world are mainly confined to certain districts of France and England.

The former country possesses the largest acreage and ranks as the chief producing centre, its average annual output of fruit being sufficient to permit of a considerable export trade to adjacent countries after home requirements have been satisfied. The cider orchards of France are chiefly concentrated in Normandy and Brittany, where the soil and other local conditions are particularly well suited to produce fruit of a high order of vintage quality. The average annual output of cider in France for the years 1915–24 was 18·4 million hectolitres. In England, where the acreage under cider fruit is also extensive, the orchards are almost entirely confined to the western and south-western counties. The belt of country extending from the counties of Hereford and Worcester in the north and passing through Gloucester and Monmouth to Somerset and Devon in the south contains by far the greatest number of orchards. In that area, according to the returns of the Ministry of Agriculture and Fisheries, the extent of grass orcharding is approximately 100,000 ac., of which the major part is planted with cider apple trees. Cider fruit growing has also spread into the counties bordering that area. In other parts of Great Britain the cider industry is limited to a few scattered localities, of which parts of Norfolk, Suffolk and Kent are the most important. Efforts have been made to develop the industry in Ireland with some success, but in this case the quantity of fruit grown specially for the purpose is small. The cider-making industry in Germany has attained considerable dimensions, but it has been in the past to some extent dependent on supplies of imported French fruit. Of the other European countries Spain and Switzerland have obtained some repute as cider producers.

Farm Cider and Factory Cider.—While in France and Germany the cider industry has long been of considerable commercial importance and the manufacture of the beverage has been carried on in factories of some magnitude, in England prior to the beginning of the present century cider making was chiefly confined to the farms upon which the fruit was grown. The product was mainly consumed on the farm and the surplus disposed of in the immediate locality. Except for the ouput of a few old-established factories the distribution and consumption of cider were confined almost exclusively to the west of England. Since then there has been a remarkable change. The introduction of improved methods of making as the result of research and education has led to a marked improvement in the quality of the article placed upon the market, which has been followed by the widespread adoption of cider as a popular beverage throughout the country generally. Many new factories in the cider-making area have been established and a large part of the fruit which used to be made into cider on the farms is now sold by the farmers to the factories. There has been a gradual elimination of making on farms where the product used to be indifferently prepared, and on many of the farms where making is still practised the process now receives the skilled attention necessary.

Legal Standards.—As a commercial article English cider has been handicapped by its extreme variability in character. No legal definitions or standards have been imposed and a wide variety of types has therefore been placed upon the market. In France, where hitherto the industry has been of much greater commercial importance, cider has to conform to a series of regulations defining the respective standards of the beverage to which the name may be applied. These regulations, which came into force in 1908, lay down that no beverage may be offered for sale under the name of cider unless produced exclusively by the fermentation of the juice from fresh apples, or a mixture of fresh apples and pears extracted with or without the addition of pure water. The term *Cidre pur juice* is reserved for cider made without addition of water. The name *Cidre* may only be applied to a beverage containing at least 3·5% by volume of alcohol, actual or potential, 12 grams of dry extract at 100° C (sugar not included) per litre, and 1·2 grams of mineral matter (ash) per litre. All ciders containing smaller quantities of alcohol, extract and ash than those limits or any of them must be designated as *petite cidre*. In England, though no corresponding regulations exist, the application of the name of cider to beverages other than those of which apple juice is the basis is an offence under the Merchandise Marks Acts, as illustrated by cases where legal proceedings have been taken successfully against the use of the name for synthetic aerated drinks flavoured with artificial apple essence. The above legal standards do not apply to the United States.

Constituents of Cider.—Even in the most strictly restricted class, that for "pure juice" cider, the French regulations permit a great elasticity in the nature of the beverage offered for sale. The primary reason for variability lies in the nature of the raw material. The more important constituents of apple juice are sugars, malic acid and tannin. Allowing for seasonal effects on composition and the kinds of apples used, and without taking account of extreme cases, the total sugar content of a freshly expressed juice may range from 6 to 20%, the acid from 0·1 to 1·25%, and the tannin from 0·05 to 0·75%. Further, since the extent of the ensuing fermentation is determined by the nitrogenous content of the juice, which also varies widely, it proceeds in some cases till the whole of the sugar is fermented (unless prevented by special treatment), and in others ceases prematurely and leaves more or less of the sugars unfermented. According to the nature of the juice used, therefore, the finished article may be sweet or dry, strongly or very lightly alcoholic, highly acid or of a very low grade of acidity, and strongly astringent and bitter or almost entirely lacking in that character.

The variations here indicated are attributable primarily to the varieties of apples from which the juice is derived. By a suitable blending of different sorts, juices of any desired standard of composition can be secured. In practice individual makers aim at definite standards suited to the taste of their customers and some degree of uniformity is thus attained: but since the predominating kinds of apples grown in different areas vary widely, and other local influences, such as those of soil and climate, come into play, the ciders of different districts tend to show marked distinctive local characters. French ciders generally are characterized by low acidity and a "bittersweet" flavour. Those of the English cider area north of Bristol are usually light and brisk as compared with the typical heavy sub-acid and bittersweet Somerset ciders and the less heavy but luscious Devon type of rather low acidity and astringency.

Classification of Cider Apples.—The varieties of cider apples are grouped into three classes, commonly termed "sharp," "sweet" and "bittersweet" respectively. The classification is based upon chemical composition. The "sharp" class includes all varieties yielding the juices which normally contain not less than 0·45% of total acid, expressed as malic acid. The latter is the predominating acid, but various other organic acids are also present in very small amounts. Varieties of the "sweet" class are characterized by juices containing normally less than 0·45% of total acid, expressed as malic acid, and also less than 0·2% of "tannin." "Bittersweet" apples contain normally in their juices acids in corresponding amount to those of the "sweet" class, and are specially characterized by a relatively large quantity of "tannin," which normally exceeds 0·2%. The term "tannin" is used comprehensively by cider makers to include a group of constituents giving an astringent and bitter flavour to the juice. Chemically they may not all be true tannins.

According to this classification all table varieties of apples, dessert and culinary, fall within the "sharp" class and form a distinct section of it characterized by an extremely low "tannin" content, which rarely exceeds 0·1% in the juice. The typical "sharp" vintage apple contains generally a substantially larger amount. This high-acid, low-tannin character of the eating apple and other features usually associated with that type of composition render it inferior for cider making. The number of varieties of cider apple occurring in the orchards of England and France is very large, certainly running into thousands. Many are of very low vintage quality and are being eliminated gradually in favour of those proved by research and experience to be worthy of more extended cultivation. A complete list of the latter is too lengthy for inclusion here, but the following selection is representative of the better English and French varieties.

English varieties: *Sharp:* Cap of Liberty, Cherry Pearmain, Kingston Black, Old Foxwhelp, Yellow Styre, Skyrme's Kernel, Backwell Red, New Foxwhelp, Ponsford and Dymock Red. *Sweet:* Woodbine, Eggleton Styre, Sweet Alford, Killerton Sweet and Sweet Coppin. *Bittersweet:* Belle Norman, Chisel Jersey, Dabinett, Royal Wilding, Strawberry Norman, Yarlington Mill Jersey, Knotted Kernel, Silver Cup, White Close Pippin and Royal Jersey. French varieties: Bedan des Parts, Binet Rouge, Reine des Pommes, Doux Amer, Ecarlatine, Frequin Rouge, Amère de Berthecourt, Reinette Obry, Muscadet, Michelin and Tardive Forestier.

Cider Making.—Modern methods of cider making differ greatly from those of a century ago. Then the fruit was crushed to a pulpy mass by heavy revolving stone rollers in a circular stone trough, similar to a mortar mill, and the pulp transferred by shovels to a clumsy wooden press worked by hand, the time occupied in milling and pressing a single lot of fruit often extending over 24 hours. The modern grater form of mill now in general use is a steel cylindrical revolving drum in which are fixed toothed knives in such fashion that their edges project about one-sixteenth of an inch above the surface of the drum. The latter is power-driven at 2,000 revolutions a minute. The fruit falling upon it is grated almost instantaneously to a very fine pulp, from which owing to its extreme state of disintegration the juice can be expressed with great ease and speed. This pulp, technically termed "pomace," is delivered from the mill direct on to the bed of the press, where it is built up into a "cheese," consisting of a series of layers, each wrapped in an open-meshed cloth or net of cotton or other strong fibre and separated from its neighbours by slatted wooden racks to facilitate the drainage of the juice. Power-driven hydraulic presses have now largely superseded the old screw-type. With machinery of this type the whole series of operations can be completed within 20 minutes after the delivery of the fruit to the mill. With fruit in good condition, a yield of juice varying from 75 to 80% of weight of the fruit can be obtained.

Juice extracted by this method is comparatively clear and free from fragments of pulp and can therefore be placed directly into fermenting vats or casks without any intervening treatment being required to remove the suspended solid matter. The operation of "keeving," formerly an important stage in the clearing of the juice, is thus no longer necessary and the risk of taint from acetic fermentation greatly reduced.

Subsequent treatment is determined by the type of cider to be produced. If a sweet cider is required, the fermenting juice must be filtered at a comparatively early stage to make it possible to retain the desired percentage of unfermented sugar. If a dry cider is wanted, fermentation is allowed to proceed till the whole or the greater part of the sugar is converted into alcohol: filtration is then required for the purpose of clarifying the liquor rather than for checking fermentation. Various types of filters are in use: they differ in constructional details rather than in principle, which consist in the forcing under pressure of the turbid liquor through a thick layer of paper pulp or other suitable fibrous material. In many cases a single filtration suffices to clear the cider to a brilliant condition: occasionally for sweet ciders a second filtration is necessary to prevent further fermentation.

After filtration the cider is fit for consumption at any time, though age, within limits, brings improvement in flavour. Made by the process here outlined, cider generally requires filtration within three months of the time of milling and is in its best condition for consumption during the summer following making. Specialized forms of treatment are sometimes practised for the production of a more fully matured article, which may require two or three years to reach prime condition.

In some factories a diffusion process, analogous to that used in the extraction of sugar from sugar-beet, is substituted for that of direct expression of the juice by pressure already described.

Cider "Disorders" and Preservatives.—Attempts have been made to eliminate the risks of various bacterial disorders by pasteurization of the freshly expressed juice and subsequent fermentation by added pure cultures of selected kinds of yeasts and some measure of success has been achieved. Most makers, however, still adhere to the older method of natural fermentation resulting from the wild yeasts naturally present on the surface of the apples and rely on strict attention to cleanliness at all stages of production to minimize the risks of disorders. The practice of washing the fruit in running water prior to milling is being increasingly adopted to ensure the maximum of cleanliness.

The chief disorders to which cider is subject are acetification, ropiness and "sickness," each due to specific micro-organisms, and discoloration, attributable generally to contamination with iron. To check fermentation and prevent the development of bacterial disorders preservatives such as salicylic acid were formerly largely used. Under the regulations relating to the use of preservatives in foods and drinks which came into force in Great Britain in 1927 no preservative other than sulphur dioxide is permissible for cider. The maximum allowed is 14 grains of free and combined sulphur dioxide per gallon. Preservatives as controlled in the United States are described below.

The wholesome properties of pure cider are widely recognized. In affections of a gouty or rheumatic nature positive benefit frequently results and regular cider drinkers are rarely troubled by stone, gravel and similar disorders. The malic acid of cider is regarded as a powerful diuretic which stimulates the kidneys and prevents accumulation of uric acid within the system.

The improved position of the cider industry and the marked developments in technique have been greatly assisted by the researches and educational work on the subject conducted in France at the *Station pomologique* at Caen, in Germany and Switzerland at the research stations of Geisenheim-am-Rhein and Wädensweil respectively, and in England at the National Fruit and Cider Institute established at Long Ashton, near Bristol, and now associated with Bristol university.

BIBLIOGRAPHY.—National Fruit and Cider Institute, Long Ashton, *Reports 1903–12* (Bath, 1905–13), continued as *The Annual Report of the Agricultural and Horticultural Research Station of the University of Bristol* (Bath, 1914, etc.); G. Warcollier, "Pomologie et cidrerie" in G. Wery, *Encyclopédie Agricole* (1920). (B. T. P. B.)

UNITED STATES

Confusion exists regarding the word "cider" applied, as it has been, to fermented and unfermented apple juices. The term is extensively used in the United States to refer to the unfermented juice, distinct from the practice in Great Britain and France. This article will not be concerned with "hard cider," which is the fermented product.

In 1935, according to the U.S. Census of Manufactures for that year, there were 125 cider-making establishments in the United States. The production was 1,240,692 gallons, not including the amount manufactured as a secondary product in other industries such as canning and preserving. The equivalent figure in 1929 was 1,444,403 gallons, in 1931, 1,499,934 gallons, and in 1933, 785,237 gallons. The annual consumption of cider in the United States is estimated to be slightly more than one quart per capita. Accurate statistics have not been compiled on the quantity of cider produced on farms, but some observers have estimated that more cider is made in the United States than any other fruit or vegetable juice. Large quantities of freshly-pressed apple juice are sold during the autumn months, and this farm industry has assumed considerable importance as an outlet for surplus fruit. The average yield of a ton of apples is 160 gallons of juice.

Although apples are grown extensively in the United States, sweet cider is virtually a seasonal product, usually consumed within a few days after the apple harvest. It is practically unobtainable after the pressing season except in small quantities sold through soda fountains and stores. This is due largely to the failure of small-scale producers of apple juice to practice pasteurizing so as to make their product available for use in a sweet condition at any season. Various chemical preservatives have been used to prevent fermentation, but are entirely unnecessary if the juice is properly pasteurized and sealed. However, benzoate of soda, under certain conditions, may be employed

under the food and drug acts.

Juice may be prepared in the natural cloudy state as obtained after straining through cloth, or it may be clarified by any one of the following three methods:

It may be filtered directly (method 1) with or without preliminary flash heating and cooling in a manner similar to flash pasteurization. Such heating flocculates the suspended insoluble solids and renders filtration more easy. The suspended solids may also be precipitated by the addition of proper amounts of gelatin and tannin solutions (method 2), or by allowing an added pectin-splitting enzyme to act on the juice under proper conditions (method 3).

In carrying out any one of these three methods, diatomaceous earth is mixed with the juice to render filtration easy. Studies of the different methods of clarification have been made by research laboratories, such as State Experiment Stations in the United States, in apple-producing areas, which supply complete directions.

Filtration is best carried out in a plate and frame type of filter using an impeller-type pump. For small-scale operation gravity may be relied upon to obtain flow. A barrel or other suitable container is elevated six or eight feet, and the juice mixed with filter aid is allowed to flow through a rubber hose into a long slender muslin bag placed in a trough supported in such manner that the clarified juice is drained off at one end. After filtration the juice is ready for pasteurization.

To prepare unfermented apple juice, select sound, well-matured, properly ripened fruit. If different varieties are available at the same time, blend to give balanced, well-flavoured cider. Wash and sort the fruit, trimming or discarding all specked or partially decayed apples; grind and press, subsequently repressing the pomace; place the juice in deep containers in a cool room over night, and allowing the settling out of the pomace, siphon off the juice from the sediment.

To pasteurize on a small scale, use an ordinary wash boiler fitted with a false bottom or rack to insure circulation. Fill the cider into clean bottles, allowing $1\frac{1}{2}$ inches of head space, and cap tightly. Place the bottles in the water on their sides and heat until a thermometer placed in an uncapped upright bottle reaches 170° F. Hold at this temperature for about 20 minutes, remove the bottles, and allow them to cool gradually while lying on their sides. Do not place on a cold surface or the bottles will break. On a larger scale, for handling jugs or carboys, a wooden box fitted with a steam coil for heating the water may be used.

Paraffined corks should be inserted at the time of removal from the bath and great care taken in cooling to prevent breakage. "Flash" pasteurization is used in commercial practice and consists of running the cider through a coil heater, cooling rapidly, and bottling directly from the apparatus.

The heating and cooling is accomplished in only a few seconds. Either bottles or cans with proper resistant enamel may be used as containers.

The number of apple varieties cultivated is so large and the various apple-growing districts differ so widely that no complete picture can be given here.

More than 150,000,000 bu. of apples are ordinarily produced in the United States annually.

Tastes vary in cider as in wine, but good cider is ordinarily pressed from the following varieties of American apples: Baldwin, Canada Red, Delicious, Golden Delicious, Golden Russet, Gravenstein, Grimes, Hubbardston, Jonathan, King, McIntosh, Newtown, Northern Spy, Rhode Island Greening, Roxbury Russet, Spitzenburg, Stayman, Wagener, Wealthy, White Pearmain, and Winesap. It is important, of course, that apples for cider-making should be neither immature or over-ripe. Among apples generally considered to be poor for cider-making when used without blending are Alexander, Ben Davis, Maiden Blush, Northwestern Greening, Red Astrachan, Rome Beauty, Stark, Wolf River, and Yellow Transparent.

Blending of two or more varieties is necessary to obtain high-grade unfermented juice, which should have a characteristic apple flavour, plus tannin, sugar and acid, in definite ratio to one another. Winesap is one of the few juices not improved by modification of the acid or sugar content. If tannin is high, as in many crab apples, the juice is harsh and astringent; if too acid, the flavour is sour; too much sugar tastes insipid, lacking in sprightliness. Furthermore, apples vary greatly in the amount of characteristic flavour they possess. Therefore, selection and blending cannot be done too carefully in order to obtain the desired result. The prospective manufacturer of cider should consult the latest government regulations, regarding State and Federal control.

CIENFUEGOS (originally Fernandina de Jagua), third largest commercial city of Cuba, on the southern coast, 192 mi. by rail S.E. of Havana in the province of Las Villas (formerly named Santa Clara province). Population of the *municipio* (1943 census), 94,810, 52,910 of whom live in Cienfuegos. Area of *municipio* 598 sq.mi. The city, located on a broad, level peninsula opposite the narrow entrance to the magnificent Bay of Jagua or Cienfuegos, is noted for its wide, straight streets, beautiful parks, attractive buildings and scenic surroundings. It is served by the United Railways of Havana, Pan American Airways, and is connected by a branch road with the Central highway of Cuba.

The fertile country which surrounds Cienfuegos produces henequen, coffee, rice, tobacco, honey, fruit (esp. mangoes and avocados), cattle and large quantities of sugar. Several of the world's largest sugar *centrales* (estates) are located within short distances of the city. Famous among these is the *central* Soledad, where Harvard university maintains botanical gardens for the purpose of conducting plant research and training students in tropical agriculture.

The site of Cienfuegos was visited by Columbus in 1494 but the Bay of Jagua and its environs attracted no permanent settlement until 1738, in which year a small fortress (enlarged in 1742 and converted into the fort of Nuestra Señora de los Angeles de Xagua in 1745) was erected at the entrance of the port. In 1817 a French colonel from Louisiana (Luis d'Clouet) presented to the captain general of Cuba (Don José Cienfuegos) a project for colonizing the Bay of Jagua. In the same year the foundation of the colony of Fernandina de Jagua was authorized by royal order. D'Clouet, accompanied by 46 colonists, arrived from Burdeos, France, on April 8, 1819, and in 1820, 282 more colonists arrived. A poll in 1824 revealed that there were 1,238 inhabitants in the settlement. After a storm had destroyed the village in 1825 it was rebuilt and named Cienfuegos in honour of the man who had participated so actively in its founding. (R. W. Rd.)

CIEZA, a town of southeastern Spain, in the province of Murcia, on the Madrid-Cartagena railway, and junction for a line to Valencia. Pop. (1940) 18,561 (mun., 23,499). Cieza stands on the right bank of the river Segura, in a narrow bend of the valley, which is enclosed on the north by mountains, providing good building stone and low timber, and on the south broadens into a fertile plain, producing grain, wine, olives, raisins, esparto, oranges and other fruits. The district greatly developed with improved communications, and Cieza became a flourishing town with flour, paper, sawmilling industries and brandy distilleries.

CIEZA DE LEÓN, PEDRO DE (*c.* 1519–1560), Spanish soldier and historian, was born at Seville. He sailed for the New World, possibly in Heredia's expedition of 1532, more probably with Duran in 1534, reaching Cartagena in November. In 1535 he went with Heredia's brother Alonzo to Darien, and in 1538 with Vadillo on an appalling journey up the valley of the Cauca; Vadillo was eventually deserted by his men, and Cieza de León later joined Jorge de Robledo, who consolidated the discoveries in the Cauca valley, and on his death served under Belalcazar, governor of Popayan, who had beheaded Robledo. It was in 1541, in the Cauca valley, that he started his diary. In 1547 the troops from Popayan marched to join President Gasca against Pizarro, a long journey, the details of which he carefully noted. In 1549 he went to look at the mines of Porco and Potosi, and then to Cuzco to confer with a surviving descendant of the Incas; in 1550 he left for Spain. The first part of his *Crónica de Perú* was published at Seville in 1553.

The scheme of his *Crónica de Perú* was as follows: part I., geography; part II., early history; part III. (lost), conquest; and

part IV (of which books 1, 2 and 3 have been found), civil wars. The first part is a minute topographical review, founded on his diary, with an account of the customs and religion of the people as he found them, given with unusual accuracy of observation and without concealing his respect for the Inca civilization. Part II., referred to inaccurately by Prescott as *Sarmiento,* gives the history of Peru under the Incas. The ms. was preserved in the Escorial library and published in 1880.

C.I.F., in commerce, a short form of "cost, insurance, freight." Thus, if an article is quoted C.I.F. London it means that the quotation is inclusive of (1) the price of the article, (2) the cost of insurance to London and (3) the cost of freight to London. In the official trade returns of the United Kingdom the import values are usually recorded by the customs statistical department at C.I.F. values.

CIGAR, originally "segar," from the Spanish cigar-shaped beetle "cicada," originated in Cuba long before advent of Columbus and the white men. Indians crudely rolled it with wrapper and inside filler only, from native West Indian tobacco. Spread of the industry to America and to Europe occurred in the 18th and 19th centuries. Introduced in the United States in 1762 by General Israel Putnam, after the British campaign to Cuba, it was 1810 before cigars were made in homes near Suffield, Connecticut. Previously, however, some "tobies" or stogies, long, thin cigars, named for pioneer Conestoga wagons, were made by Pennsylvania Dutch in 1785 in York county. New Orleans, La., too, made "Spanish" cigars in 1800, but, as this was not then American territory, the cigars were classified as foreign or "imported," like the Cuban. Cigars sold for one, two, or three cents each, although the foreign cigars brought a penny or two more. No regularity of shape or size then prevailed, and branding and boxing were unknown. The cigars were simply bundled in 100's or 500's, and packed in ordinary barrels or chests.

How Cigars Are Made.—From the first hand-made cigars the industry has expanded to machines. Hand-made cigars prevail in Cuba and in the Cuban manner, with its superior native leaf tobacco used for this purpose. Working at long benches, each hand-made cigar-maker is provided with a pad of wrappers and a few pounds of filler or inside leaf. Bunched to the necessary shape and size, the filler is cut evenly on a small, but thick, 12in. by 18in. blocked board with a half-round extremely sharp steel knife and a gauge tuck-cutter. The knife is again used in cutting the wrapper to rights and lefts.

It is extremely important, in hand-made cigars, that right hand wrappers are rolled that way for the best appearance and burn, while lefts must likewise be rolled according to direction of the veins in the tobacco, after the mid-stem, or stalk, is stripped or removed from the leaf. All the tobacco in a genuine Cuban cigar is grown upon the island—Vuelta Abajo district for the wrapper, Remedios or Partido districts for the filler.

Elsewhere, however, many local types of cigar leaf tobacco are used. In the United States, it is customary to make hand-made cigars (and some machine-made cigars, also) with Cuban, Puerto Rican, Ohio, or Pennsylvania filler, a Wisconsin or Connecticut binder (to hold the filler together in American-made cigars), and a Cuban, Connecticut shade-grown (cultivated under cheese-cloth, to neutralize sun and moisture, as in the tropics), Connecticut broadleaf, or Sumatra wrapper from the Dutch East Indies. Rolling the bunches by hand requires an apprenticeship and practice of several years. Unless the cigars are perfect in appearance and in draught they are useless. Ceaseless inspection provides that only the best in production are used for the finest sizes, selling at retail from ten cents to a dollar or more per cigar. In sealing the mouth-end, or head of the cigar, gum tragacanth is used. This is a tasteless adhesive found in Persia, but it is sometimes flavoured, slightly, with powdered licorice.

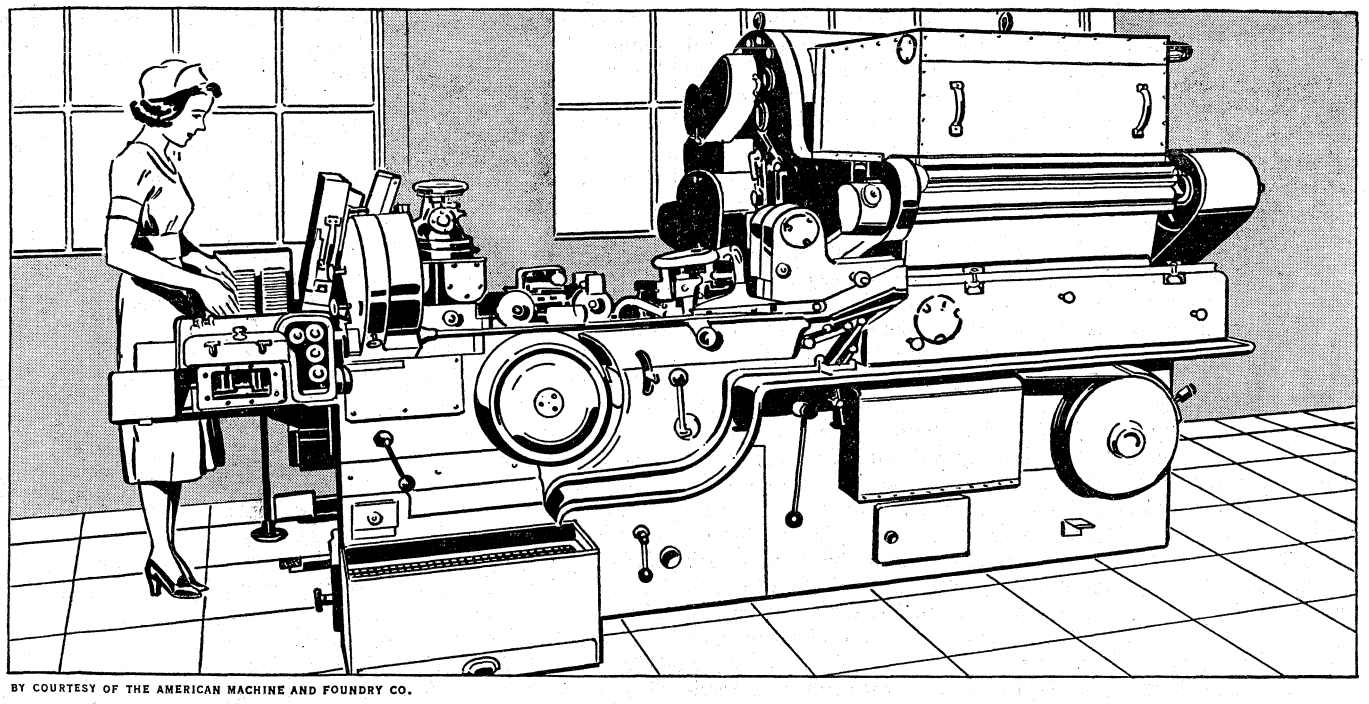
In making mould, or shaped, cigars, long, hard-wooden moulds, originally made in 1870 at Osnerbrueck, Germany, are used by the "German" or semi-hand-made method for lower cost cigars in the smaller factories catering to the five cent, or nickel, trade. These matrixes hold twenty bunches of hand prepared filler-binder. Ten moulds are prescribed for each operator. The cigars are made in innumerable shapes and sizes, to conform to numerous brand demands. Five moulds are at hand at each workman's bench, five more in the presses, waiting for the rolling of the wrapper. Working an average of eight hours daily, each cigar-maker should produce from 150 hand to 300 mould cigars. In team work, a trio of cigarmakers are employed. Two men or girls wrap, while the other "breaks" the bunches, as it requires twice the time to wrap as it does to bunch in this manner. These teams make 1,000 cigars each day.

In 1919 the first cigar machine made its appearance at Newark, N. J. It required two years to build it, but it has now reached perfection. Four women operatives at each machine make 8 cigars a minute. This is at the rate of 4,000 daily, in any size or shape, according to the machine matrix. One of the operatives feeds the filler into the hopper of the machine, another the binder, which is automatically cut to the desired size, as is the wrapper, which is also cut, rolled, and pasted.

Banding and Packing.—Modern packaging of cigars demands that bands be placed either on the cigar itself, or printed on the protective covering, usually cellophane. This preserves the natural humistatic condition of the cigar, and is quickly accomplished by a machine at the rate of 30,000 cigars daily, with band, cellophane, tin foil, or any combination of similar wrapping. One girl operates such a device.

Boxes of metal, wood, glass, paper are used for the cigars. Selectors and packers, spreading the cigars on long tables, arrange them according to perfection and colour of wrappers. To accommodate the eye to the top row of each box of flat 4-row 50's, 100's, or however the cigars may be packed, the packer selects colours of claro (light yellow), colorado claro (light red or brown), colorado (brown), colorado maduro (dark brown), maduro (deep brown), oscuro (almost black). Demand of smokers was formerly for the darker colours, and expert opinion still believes the dark wrappers to be the ripest. But modern practice makes the claro shades the more popular, although the shade of the wrapper, naturally, has nothing at all to do with the strength of the cigar. In fact, the so-called lighter colours may actually be more bitter, but the thin, elastic sheen of wrapper, especially of shade-grown Connecticut and Sumatra, actually have no strength at all, as they are neutral leaf, used for that purpose, more for beauty and service than for smoking values. As the smoking demand is for pleasing aroma and delicacy of the blend, accompanied by even burn and white ash, these factors are invariably paramount in the production of the popular brands of cigars. Millions of dollars are expended in the perfection of the blend of cigars, then in advertising them to the public. Spanish manufacturers, in Cuba, originated a multitude of brands and shapes and sizes, all under Spanish titles. Many of these titles are still used throughout the world. Imitation of the actual Cuban trade-marks is forbidden in many countries, yet similarity of names remains prevalent. Cuban cigarmakers are employed in several American cities, and their nomenclature has followed them. Original straight shapes, such as Londres or London, blunt on the tuck or lighting end, remain popular. Perfecto, pointed on both ends; concha, small perfecto; puritano, adaptation of the perfecto; panetela, long and thin; breva, short and stubby; corona, thick and straight; imperiale, long perfecto; and numerous others are all founded on Spanish language procedure.

Factory Equipment.—When the cigar industry was dependent upon hand labour for production, the equipment of the factory was limited. With the development of the machine, devices became available for the rapid manufacture of cigars. Where once hand stemming prevailed, machine stemming has stepped up the rapidity of production. Even the "casing" (conditioning the tobacco for manufacture) is now accomplished by machines. Since it is important to keep factory air at a workable point of humidification, electrostatic precipitrons keep the air clean and fresh. Machines, too, paste on boxes and packages the final internal revenue labels and stamps required by practically all Governments. Nothing is destroyed nor lost in the cigar factories. Even the stems, or stalks, are used for various purposes, in and out of the trade. Tobacco dust, also, has its market as an insect eradica-



BY COURTESY OF THE AMERICAN MACHINE AND FOUNDRY CO.

STANDARD AUTOMATIC CIGARETTE MACHINE, CAPABLE OF TURNING OUT MANY THOUSANDS OF CIGARETTES AN HOUR

tor. *Lasioderma serricone,* the small insect which lays eggs upon and damages so much tobacco, is being eliminated by entomologists: the lasioderma, which formerly punctured small holes in the leaf tobacco, and especially in the cigars after manufacture, is controlled in tobacco warehouses and factories before production starts. Soft-work cigar machines have been invented to manufacture small cigars, cheroots, and all low-cost cigars with the help of two girls at each machine. Threshed, cut, and shredded filler is prepared to size by rapid machine cutters. From the leaf tobacco in the fields to the Spanish cedar of the boxes for the cigars, the entire industry has been modernized in keeping with the demand for production on a lower cost basis.

Surprisingly, however, production has not increased in the United States. From official records of the Internal Revenue Bureau, when the first taxation was imposed July 1, 1862, for the fiscal year ending 1863, some 199,288,284 cigars paid the tax. In 1870 the production and importations increased to the first billion mark—1,139,470,774. In 1879 it was 2,019,246,764. In 1882 the figures were 3,040,975,395; while in 1890 they stood at 4,087,889,983. In 1900, there were manufactured and imported 5,316,273,561, and in 1902 the figures were 6,103,567,265. Four years later, in 1906, the total was 7,174,805,223, and the all-time high was in 1920, at 8,266,770,593, for all American production, imports included.

But since that time, manufacture and importation have declined. In 1921 the total was only 6,726,095,483, and in 1930 it was 5,893,890,418; in 1932, 4,382,722,918; 1936 showed a slight increase, 5,172,278,612. For 1938 the total was 5,138,748,434. Notwithstanding the speed-up of production it is to be noted that the total output and sales have decreased. Too, the number of cigar factories in the United States has decreased from 27,000 to less than 5,000 making cigars alone. Larger factories, employing greater numbers of employees, are supplanting the smaller factories ("buck-eyes") which once produced the bulk of the brands throughout the nation. A bare dozen large organizations account for fully 85% of the total American production, which is 94% in Class A cigars, or those sold at retail for five cents or less.

(R. R. TH.)

CIGARETTE. A cigarette is literally a little cigar—finely cut tobacco rolled in paper. In Great Britain the tobacco used in cigarettes is mostly Bright flue-cured, better known as Virginia. The leaf is properly moistened to make it pliable for stemming, *i.e.* removing the stalk or midrib. The next process is to cut the leaf into fine shreds. The cut tobacco, conditioned as a rule in large rotary drums, is then subjected to heat to remove excess moisture. Years ago, many people made their own cigarettes by hand. A person making his own cigarette takes a paper of requisite size, places on it the desired amount of tobacco, rolls the paper between his fingers, moistens one edge of the paper, and fixes the cigarette together. Hand-made cigarettes are relatively rare, but there has been developed a small "roll-your-own" machine which any person can use to make a cigarette.

Cigarette Machinery.—In factory production cigarette-making machines of the modern type will produce from 1,000 to 1,500 cigarettes per minute. The cigarette paper is put up in bobbins of definite width and is fed into a narrow trough at the side of the machine. The name of the brand is imprinted thereon at definite intervals so that it will appear an each finished cigarette. The shredded cuts of tobacco fall upon the paper which moves into a funnel shaped tube, passing a device which gums the edges, the paper then being automatically folded over the tobacco. The end of the cigarette moves under a knife which cuts it into sections of the desired length.

Packing.—In Great Britain the type of package used is much different from that used in the United States; it is known as a slide and shell package, usually containing 10 or 20 cigarettes. The cigarettes are automatically packed by modern machinery, counted, wrapped in foil, and placed in a cardboard slide. The slide is then inserted into a shell of cardboard. The machines are capable of placing an insert in the package. The packages of many of the most popular cigarettes in Great Britain are wrapped in moisture-proof cellophane in order to protect them from the varied conditions of humidity prevalent in the British Isles.

Volume of Sales.—The cigarette business in England has grown from year to year. Approximately 130,000,000lb. of tobacco are used annually in cigarettes for home consumption. Tobacco brought into England is taxed with heavy import duty, a great factor of income to the British Government. Virginia tobacco, grown in the United States, is predominantly used in cigarettes made in England; however, a great deal of tobacco (grown from seed imported from the United States) is shipped into England from various colonies of Great Britain and is used in many of the lower priced brands. Cigarettes are popular with all classes of people in England and are extensively used by women. Turkish and Egyptian cigarettes were at one time popular in the British Isles, but account now for only a very small business. Turkish tobacco, used widely in the United States, is

imported mainly from Greece and Turkey and in smaller proportion from Bulgaria, Italy, and Russia.

AMERICAN CIGARETTES

Internal Revenue figures issued by the United States Government for the year 1938 show that revenue stamps were sold for 163,758,500,000 cigarettes. Production in 1915 was 17,964,000,000; in 1919, 53,120,000,000; in 1925, 82,247,000,000. About 1917, the blended type of cigarette began to become popular with the American public and in 1939 "straight" cigarettes made from one type of tobacco such as Bright Virginia or Turkish, accounted for only a very small part of the total production. The enormous growth in manufacture may be attributed to the increase of smoking by women and to the convenience and quality of the modern cigarette.

In general, there are four types of tobaccos used in American cigarettes—*Burley*, grown mainly in Kentucky and Tennessee, but also in States in the Ohio valley: Ohio, Indiana, and West Virginia. Burley tobacco formerly was used almost exclusively for chewing and pipe tobaccos. Today the heavier-bodied types are extensively used in smoking or pipe tobaccos, while the lighter-bodied grades are used in cigarettes.

Bright Flue-cured tobacco, known to a great extent as Virginia, is grown in Virginia, North Carolina, South Carolina, Georgia, and

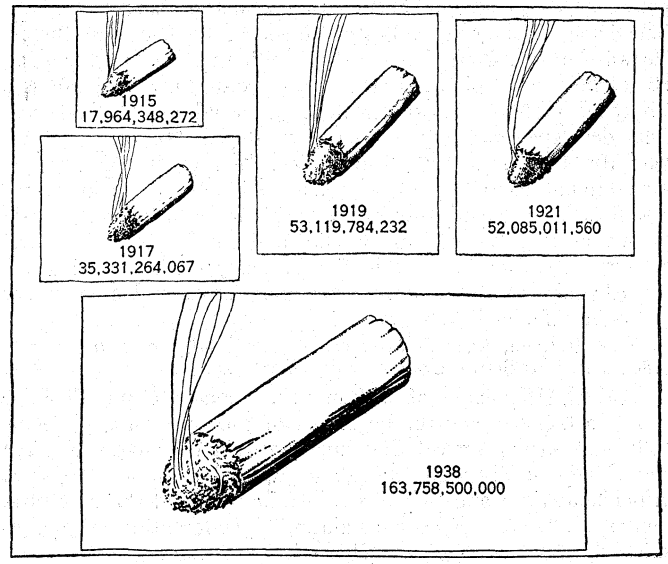


DIAGRAM SHOWING GROWTH OF MANUFACTURE OF ORDINARY SIZED CIGARETTES SINCE 1915 IN THE UNITED STATES

Florida. This type is predominant in most cigarettes manufactured in the United States, whereas in England it is used almost exclusively. This type of tobacco was first grown in the United States several hundred years ago.

Turkish tobacco, which is imported mainly from Turkey and Greece, but also from Bulgaria, Italy, and Russia, is an entirely different type from that grown in the United States, having very distinctive characteristics and aromatic flavour.

Maryland tobacco, grown in the State of Maryland, is used to a small extent in cigarettes.

The quality of tobacco used in the better cigarettes has greatly improved with advent of Government aid in educating the farmer to produce better crops. After being aged naturally in storage, the tobacco is processed in modern factories. Extensive research has helped to produce a uniform quality product. The use of high heat and ultra-violet-ray has the effect of producing a mild, mellow product.

The popular package of twenty cigarettes is first wrapped in paper-backed foil and next in a paper label. A revenue stamp seals the package, all of which is enclosed in moisture-proof cellophane, which helps to protect the cigarettes in varying climatic conditions.

CIGNANI, CARLO (1628–1719), Italian painter, was born at Bologna, where he studied under Battista Cairo, and afterwards under Francesco Albani. Though an intimate friend of the latter and his most famous disciple, Cignani was yet strongly and deeply influenced by the genius of Correggio. His greatest work, the "Assumption of the Virgin," round the cupola of the church of the Madonna della Fuoca at Forli, is in some respects one of the most remarkable works of art of the 17th century, and is obviously inspired from the more renowned fresco of Correggio in the cupola of the cathedral of Parma. He removed to Forli, where he died in 1719. His most famous pictures, in addition to the Assumption, are: the "Entry of Paul III. into Bologna"; the "François I. Touching for King's Evil"; a "Power of Love," painted under a fine ceiling by Agostino Carracci, on the walls of a room in the ducal palace at Parma; an "Adam and Eve" (at The Hague); and two of "Joseph and Potiphar's Wife" (at Dresden and Copenhagen). His son Felice (1660–1724) and nephew Paolo (1709–64) were also painters.

CIGOLI or **CIVOLI, LODOVICO CARDI DA** (1559–1613), Italian painter, architect and poet, was born at Cigoli in Tuscany. Educated under Alessandro Allori and Santi di Tito, he formed a peculiar style by the study at Florence of Michelangelo, Correggio, Andrea del Sarto and Pontormo. While in Florence he painted an "Ecce Homo," in competition with Passignani and Caravaggio, which gained the prize. This work was afterwards taken by Bonaparte to the Louvre, and was restored to Florence in 1815. Other important pictures are—a "St. Peter Healing the Lame Man," in St. Peter's at Rome; a "Conversion of St. Paul," in the church of San Paolo fuori le Mura, and a "Story of Psyche," in fresco, at the Villa Borghese; a "Martyrdom of Stephen," a "Venus and Satyr," a "Sacrifice of Isaac," and a "Stigmata of St. Francis," at Florence. He died, it is said, of grief at the failure of his last fresco (in the Roman church of Santa Maria Maggiore).

CILIA, in biology, the thread-like processes by the vibration of which many lowly organisms move through water. They are also found on certain cells of both lower and higher organisms to create a current, *e.g.* on the gill of oysters, the lining of the bronchioles of the lungs in man. The singular is cilium.

CILIATA, one of the divisions of Infusoria (*q.v.*) characterized by the permanent possession of cilia or organs derived from these (membranelles, etc.), and all parasitic. They are the most highly differentiated Protozoa (*q.v.*).

CILICIA, a district of Asia Minor, extending along the south coast between Pamphylia and Syria. Its northern limit was the crest of Mt. Taurus. It was divided into Cilicia Trachea and Cilicia Pedias.

Cilicia Trachea is a rugged mountain district formed by the spurs of Taurus, which often terminate in rocky headlands with small sheltered harbours—a feature which, in classical times, made the coast a resort of pirates, and, in the middle ages, led to its occupation by Genoese and Venetian traders. The district is watered by the Geuk Su (Calycadnus), and is covered to a large extent by forests, which supply timber to Egypt and Syria. There were several towns but no large trade centres.

Cilicia Pedias included the rugged spurs of Taurus and a large plain of rich stoneless loam. Its eastern half is studded with isolated rocky crags, which are crowned with the ruins of ancient strongholds, and broken by the low hills that border the plain of Issus. The plain is watered by the Cydnus (Tarsus Chai), the Sarus (Sihun) and the Pyramus (Jihun), and is extremely productive. Through it ran the great highway, between the east and the west, on which stood Tarsus on the Cydnus, Adana on the Sarus, and Mopsuestia (Missis) on the Pyramus. The great highway from the west, on its long rough descent from the Anatolian plateau to Tarsus, ran through a narrow pass between walls of rock called the Cilician Gate (Ghulek Boghaz). After crossing the low hills east of the Pyramus it passed through a masonry (Cilician) gate, Demir Kapu, and entered the plain of Issus. From that plain one road ran southward to Alexandretta, and thence crossed Mt. Amanus by the Syrian Gate, to Antioch and Syria; and another ran northwards and crossed Mt. Amanus by the Amanian Gate, to North Syria and the Euphrates. By the last pass, which was apparently unknown to Alexander, Darius crossed the mountains prior to the battle of Issus. Both passes are short and easy, and connect Cilicia Pedias with Syria rather than with Asia Minor. In Roman times Cilicia exported the goat's-hair cloth, *cilicium*, of which tents were made.

Under the Persian empire Cilicia was apparently governed by

tributary native kings, who bore a name or title graecized as Syennesis; but it was officially included in the fourth satrapy by Darius. Xenophon found a queen in power, and no opposition was offered to the march of Cyrus. Alexander found the gates open when he came down from the plateau in 333 B.C., and it may be inferred that the great pass was not under direct Persian control. After Alexander's death it fell to the Seleucids, who, however, never held effectually more than the eastern half. Cilicia Trachea became the haunt of pirates, who were subdued by Pompey. Cilicia Pedias became Roman territory in 103 B.C., and the whole was organized by Pompey (64 B.C.) into a province, of which at one time Cicero was governor. It was reorganized by Caesar (47 B.C.), and about 27 B.C. became part of the province Syria-Cilicia-Phoenice. Under Diocletian (*c.* A.D. 297), Cilicia, with the Syrian and Egyptian provinces, formed the Diocesis Orientis. In the 7th century it was invaded by the Arabs, who held the country until it was reoccupied by Nicephorus II in 965.

The Seljuk invasion of Armenia was followed by an exodus of Armenians southwards, and in 1080 there was founded in the Cilician Taurus a small principality, which gradually expanded into the kingdom of Lesser Armenia. This Christian kingdom—situated in the midst of Muslim states, hostile to the Byzantines, giving valuable support to the crusaders, and trading with the great commercial cities of Italy—had a stormy existence of about 300 years. When Levond V died (1342), John of Lusignan was crowned king as Gosdantin IV; but he alienated the Armenians by attempting to make them conform to the Roman Church, and at last the kingdom, a prey to internal dissensions, succumbed (1375) to the attacks of the Egyptians. Cilicia Trachea was occupied by the Osmanlis in the 15th century, but Cilicia Pedias was only added to the empire in 1515.

From 1833 to 1840 Cilicia formed part of the territories administered by Mohammed Ali of Cairo, who was compelled to evacuate it by the allied powers. By the treaty of Sèvres (*see* TURKEY) part of Cilicia was granted to France, but on Oct. 20, 1921, after unsuccessful conflicts with the Nationalist troops, the French withdrew all claim to this area.

BIBLIOGRAPHY.—Besides the general authorities for Asia Minor, see *Cambridge Ancient History*, vol. iii. (with useful bibliography); J. R. S. Sterrett, *Wolfe Expedition* (1888); G. L. Schlumberger, *Un Empereur byzantin* (1890); D. G. Hogarth and J. A. R. Munro, *Mod. and Anc. Roads in E. Asia Minor* (R.G.S. Supp. Papers, iii.) (1893); R. Heberdey and A. Wilhelm, *Reisen in Kilikien* (1896); D. G. Hogarth, *A Wandering Scholar* (1896). *See* also authorities under ARMENIA and MOHAMMED ALI.

CILLI, ULRICH, COUNT OF (1406–1456), son of Frederick II, count of Cilli, and Elizabeth Frangepan. About 1432 he married Catherine, daughter of George Brankovich, despot of Serbia.

His influence in the troubled affairs of Hungary and the empire, of which he was made a prince by the emperor Sigismund (1436) led to feuds with the Habsburgs, the overlords of Cilli. Finally he made an alliance with the Habsburg king Albert II, and after his death (1439) Alrich took up the cause of his widow, Elizabeth, and presided at the coronation of her infant son Ladislaus V. Posthumus (1440). A feud with the Hunyadis followed, embittered by John Hunyadi's attack on George Brankovich of Serbia (1444) on his refusal to recognize Ulrich's claim to Bosnia on the death of Stephen Tvrtko (1443). In 1446 Hunyadi, then governor of Hungary, harried the Cilli territories in Croatia-Slavonia; but his power was broken at Kosovo (1448), and Count Ulrich was able to lead a successful crusade, nominally in the Habsburg interest, into Hungary (1450). In 1452 he forced the emperor Frederick III to hand over the boy king Ladislaus V to his keeping, and became thus virtual ruler of Hungary, of which he was named lieutenant by Ladislaus in 1456. The Hunyadis now conspired to destroy him. On Nov. 8, in spite of warnings, he entered Belgrade with the king; the next day he was attacked by Laszlo Hunyadi and his friends, and put to death. With him died the male line of the counts of Cilli.

CILLI (Slovene *Celje*), a town of Slovenia, Yugoslavia, on a branch of the Zagreb-Fiume railway, lies picturesquely with remains of walls and towers on the river Sann, on an important road north to Marburg (Maribor) and south to Ljubljana. Pop. (1931) 7,602. The city was annexed by Germany in 1941. Probably a Celtic settlement, the Romans took it (15 B.C.) and Claudius made it a Roman municipium (A.D. 50), naming it Claudia Celeja. It prospered greatly, and its temple of Mars was widely famed. Its museum contains many Roman remains, and the Roman sewerage system was rediscovered in the second half of the 19th century and is now in use. It was incorporated with Aquileia under Constantine, and was destroyed by Slavs at the end of the 6th century. The counts of Cilli, at one time in authority in Croatia, at another in Bosnia, had their castle, Ober Cilli, on the Schlossberg (1,320 ft.), southeast of the town. Its ruins, the Cilli throne and the family tomb remain. Under the Cilli (1350–1455) the town prospered; on their extinction it became subject to Austria. The fine church (14th century) has a beautiful chapel and is justly renowned. The so-called German church (Romanesque) belonged to the Minorite monastery (founded 1241, closed 1808). Antimony and zinc are mined near by, and enamelled iron utensils are made. Ten miles northwest are the baths and ruined castle of Neuhaus, after 1643 called Schlangenburg.

See E. Glautschnigg, *Cilli und Umgebung; Handbuch für Fremde* (Cilli, 1887).

CIMA, GIAMBATTISTA (CIMA DA CONEGLIANO, *c.* 1459–1517), Italian painter of the Venetian school, probably a pupil of Bartolomeo Montagna, and later influenced by Giovanni Bellini. He was born at Conegliano on the southern slopes of the Alps. His earliest dated picture is the altarpiece of 1489 in the Museo Civico of Vicenza. He was then 30 years old and his style was fully developed and altered very little during the course of his long life. In 1492 he settled in Venice. In 1493 he was commissioned to paint an altarpiece for the cathedral of Conegliano which is still in its original place. Most of his important works are in Venice in the churches of S. Giovanni in Bragora, S. Maria dell'Orto, the Carmine, and in the Academy; there are also pictures by him at Bologna, Modena and Parma and in many of the great galleries in Europe.

See V. Botteon, *Ricerche intorno alla vita e alle opere di G. Cima* (1893); R. Burckhardt, *Cima da Conegliano* (1905).

CIMABUE, name of a Florentine painter Cenni di Pepo active in the 13th and the beginning of the 14th century. Some Italian painters preceded Cimabue—particularly Guido of Siena and Giunta of Pisa; but though he worked on much the same principle as they, and to a like result, he was held up to admiration as the "Father of Italian Painting" by Florentine writers, inspired by local patriotism. There is no documentary evidence that a single picture attributed to Cimabue was painted by him.

His fame rested chiefly on a colossal "Madonna and Child with Angels," the largest altarpiece produced up to that date, which was painted in tempera for the chapel of the Rucellai in St. Maria Novella, Florence; but research proved this work to be by the Siennese Duccio.

Among paintings still extant attributed to Cimabue are the following:—In the Uffizi in Florence, a "Madonna and Child," with eight angels, and some prophets in niches—better than the Rucellai picture in composition and study of nature, but more archaic in type, and the colour now spoiled (this work was painted for the Badia of St. Trinita, Florence); in the National Gallery, London, a "Madonna and Child with Angels," which came from the Ugo Baldi collection, and had probably once been in the church of St. Croce, Florence; in the Louvre, a "Madonna and Child," with twenty-six medallions in the frame, originally in the church of St. Francesco, Pisa. In the lower church of the Basilica of St. Francesco at Assisi, Cimabue, succeeding Giunta da Pisa, is said to have adorned the south transept—painting a colossal "Virgin and Child between Four Angels," above the altar of the Conception, and a large figure of St. Francis. In the upper church, north transept, he has the "Saviour Enthroned and some Angels," and, on the central ceiling of the transept, the "Four Evangelists with Angels." It is, however, impossible to say whether Cimabue was at Assisi or not.

In the closing years of his life he was appointed capomaestro of the mosaics of the cathedral of Pisa, and was afterwards,

hardly a year before his death, joined with Arnolfo di Cambio as architect for the Cathedral of Florence. In Pisa he executed a Majesty in the apse—"Christ in glory between the Virgin and John the Evangelist," a mosaic, now much damaged. This was probably the last work that he produced.

He was the master of Giotto, whom (is the tradition) he found a shepherd boy of ten, in the pastures of Vespignano, drawing with a coal on a slate the figure of a lamb. Cimabue took him to Florence, and instructed him in the art; and after Cimabue's death Giotto occupied a house which had belonged to his master in the Via del Cocomero. Another painter with whom Cimabue is said to have been intimate was Gaddo Gaddi.

Giovanni Cimabue was buried in the cathedral of Florence, St. Maria del Fiore, with an epitaph written by one of the Nini:

> Credidit ut Cimabos picturae castra tenere,
> Sic tenuit vivens; nunc tenet astra poli.

Here we recognize distinctly a parallel to the first clause in the famous triplet of Dante:

> Credette Cimabue nella pintura
> Tener lo campo; ed ora ha Giotto il grido,
> Si che la fama di colui' oscura.

BIBLIOGRAPHY.—Vasari, ed. Frey (1911); Crowe and Cavalcaselle, ed. Langton Douglas (1903); J. Strzygowski, *Cimabue und Rom* (1888); J. P. Richter, *Lectures on the National Gallery* (1898); H. Thode, *Franz v. Assisi* (1904).

CIMAROSA, DOMENICO (1749–1801), Italian musical composer, was born at Aversa, in the kingdom of Naples, Dec. 17, 1749. His parents were poor, but anxious to give their son a good education, and after removing to Naples they sent him to a free school connected with one of the monasteries of that city. He obtained a free scholarship at the musical institute of Santa Maria di Loreto, where he remained for eleven years, studying chiefly the great masters of the old Italian school. Piccini, Sacchini and other musicians of repute are mentioned amongst his teachers. At the age of twenty-three Cimarosa began his career as a composer with a comic opera called *Le Stravaganze del Conte,* first performed at the Teatro dei Fiorentini at Naples in 1772. The work met with approval as did its successors *Le Pazzie di Stellidanza e di Zoroastro,* a farce full of humour and eccentricity, and another comic opera called *L'Italiana in Londra.* From 1784–87 Cimarosa lived at Florence, and wrote the following works for the theatre of that city:—*Caio Mario;* the three biblical operas, *Assalone, La Giuditta* and *Il Sacrificio d'Abramo;* also *Il Convito di Pietra;* and *La Ballerina amante,* a pretty comic opera first performed at Venice with enormous success.

About the year 1788 Cimarosa went to St. Petersburg (Leningrad) by invitation of the empress Catherine II. In 1792 he went to Vienna at the invitation of the emperor Leopold II. Here he produced his masterpiece, *Il Matrimonio segreto* which ranks amongst the highest achievements of light operatic music. In 1793 he returned to Naples, where *Il Matrimonio segreto* and other works were received with great applause. Amongst the works belonging to his last stay in Naples may be mentioned the charming opera *Le Astuzie feminili,* which during recent years has been adapted with great success as one of the productions of the Diaghilev Ballet.

This period of his life is said to have been embittered by the intrigues of envious and hostile persons, amongst whom figured his old rival Paisiello. During the occupation of Naples by the troops of the French Republic, Cimarosa joined the Liberal party, and on the return of the Bourbons, was, like many of his political friends, condemned to death. By the interces ion of influential admirers his sentence was commuted into banishment. But his health was broken, and after much suffering he died at Venice Jan. 11, 1801, of inflammation of the intestines. The nature of his disease led to the rumour of his having been poisoned by his enemies, which, however, a formal inquest proved to be unfounded.

CIMBALO: *see* CEMBALO.

CIMBRI, a Teutonic tribe which in 113 B.C. defeated the consul Gnaeus Papirius Carbo near Noreia. They had been wandering along the Danube for some years, warring with the Celtic tribes on either bank. After the victory of 113 B.C. they passed westwards over the Rhine, threatening the territory of the Allobroges. Their request for land was not granted, and in 109 B.C. they defeated the consul Marcus Junius Silanus in southern Gaul, but did not at once follow up the victory. In 105 B.C. they returned to the attack under their king, Boiorix, and annihilated the Roman armies at Arausio (Orange). Again the victorious Cimbri turned away from Italy, and, after attempting to reduce the Arverni (*q.v.*), moved into Spain, where they failed to overcome the desperate resistance of the Celt-iberian tribes. In 103 B.C. they marched back through Gaul, which they overran as far as the Seine, where the Belgae made a stout resistance. Near Rouen the Cimbri were reinforced by the Teutoni and two cantons of the Helvetii. They marched southwards by two routes, the Cimbri moving on the left towards the passes of the eastern Alps, while the newly arrived Teutoni and their allies made for the western gates of Italy. In 102 B.C. the Teutoni and Ambrones were totally defeated at Aquae Sextiae by Marius, while the Cimbri succeeded in passing the Alps and driving Q. Lutatius Catulus across the Adige and Po. In 101 B.C. Marius overthrew them on the Raudine Plain near Vercellae. Their king, Boiorix, was killed, and the whole army destroyed. The Cimbri were the first in the long line of the Teutonic invaders of Italy.

The original home of the Cimbri has been much disputed. From information gained from the *Monumentum Ancyranum* and the map of Ptolemy, it may reasonably be conjectured that they came from the peninsula of Jutland, where their name may be preserved in Himmerland (Aalborg). Strabo and other early writers related a number of curious facts concerning the customs of the Cimbri, which are of great interest as the earliest records of the manner of life of the Teutonic nations.

BIBLIOGRAPHY.—Livy or Florus, *Epitome of Roman History,* lxiii., lxvii., lxviii.; Pomponius Mela, *De situ orbis,* Bk. III. iii.; C. Plinius Secundus, *Nat. Hist.,* Bk. IV. xiii. and xiv., all in Bibliotheca Script. Graec. et Roman. Teubneriana, Leipzig; Plutarch, "Marius," in vol. ix. of Plutarch's *Lives,* with Eng. trans., B. Perrin (1920); Strabo, *Geography,* Bk. VII. i. and ii., with Eng. trans., H. L. Jones (1917–27), both in the Loeb Classical Library; Ptolemy, *Geography,* Bk. II. xi., ed. O. Cuntz (1923). For *Monumentum Ancyranum see* ANCYRA.

CIMICIFUGA, a genus of herbs of the family Ranunculaceae, comprising 12 species widely distributed in the north temperate zone; the bugbanes. The root of *C. foetida* was used as a preventive against vermin and that of the North American black snake-root (*C. racemosa*) as an emetic.

CIMINIA, VIA, an ancient road of Italy, which diverged from the Via Cassia at Sutrium, and led along the east side of the Lacus Ciminius (Macaulay's "Ciminian mere," mod. Lago di Vico, an extinct crater basin) out of which it climbed on the north to 2,785 feet. Thence it descended and rejoined the Via Cassia at Aquae Passeris, a few miles north of Viterbo. The Ciminian hills are still wooded, and of great beauty. Caprarola on the east slopes of the crater, contains a very fine palace built for Alessandro Farnese in 1547–59 by Vignola, with the interior decorated by the Zuccari brothers; other villages in the district (notably Soriano with the Palazzo Chigi, which also has a fine castle of 1278), also contain good specimens of his architecture; while S. Martino al Cimino has a fine French Gothic 13th century church.

See S. Bargellini, *I Monti del Cimino* (Bergamo, *Arti Grafiche,* 1914, well illustrated).

CIMMERII, an ancient people of the far north or west of Europe, first spoken of by Homer (*Odyssey,* xi. 12–19), who describes them as living in perpetual darkness. Herodotus (iv. 11–13), in his account of Scythia, regards them as the early inhabitants of South Russia (after whom the Bosporus Cimmerius [*q.v.*] and other places were named), driven by the Scyths along by the Caucasus into Asia Minor, where they maintained themselves for a century. But it is quite possible that some Cimmerii made their raids across the Hellespont, having been cut off by the Scyths as the Alani (*q.v.*) were by the Huns. Certain it is that in the middle of the 7th century B.C., Asia Minor was ravaged by northern nomads (Herod. iv. 12), one

body of whom is called in Assyrian sources *Gimirrai* and is represented as coming through the Caucasus. They were probably Iranian speakers, to judge by the few proper names preserved. The name has also been identified with the biblical Gomer, son of Japheth (Gen. x. 2, 3). Later writers identified them with the Cimbri of Jutland, who were probably Teutonized Celts, but this is a mere guess due to the similarity of name.

For the Cimmerian invasions described by Herodotus, *see* SCYTHIA; LYDIA; GYGES.

CIMON (*c.* 507–449 B.C.), Athenian statesman and general, was the son of Miltiades (*q.v.*) and Hegesipyle, daughter of the Thracian prince Olorus. Cimon's first task in life was to pay the fine (about £12,000) which had been imposed on Miltiades after the Parian expedition. After winning a high reputation in the second Persian invasion, he served under Aristeides with the Athenian fleet and later (477, see *Camb. Anc. Hist.,* vol. v. App. B) became sole commander. His first success was the expulsion of Pausanias from Byzantium. Having captured Eion (at the mouth of the Strymon), he expelled the Persian garrisons from the entire seaboard of Thrace with the exception of Doriscus, and, having captured Scyros (470), confirmed his popularity by transferring thence to Athens the supposed bones of Theseus. In 466 Cimon proceeded to liberate the Greek cities of Lycia and Pamphylia, and at the mouth of the Eurymedon he defeated the Persians decisively by land and sea.

The Persian danger was now over, and the immediate purpose of the Delian League was achieved. Already, however, Athens had introduced the policy of coercion which was to transform the league into an empire, a policy which, after the ostracism of Themistocles and the death of Aristides, must be attributed to Cimon, whose fundamental idea was the union of the Greeks against all outsiders (*see* DELIAN LEAGUE). Carystus was compelled to join the league; Naxos (*c.* 469) and Thasos (465–463), which had revolted, were compelled to accept the position of tributary allies. In 464 Sparta was in difficulties, owing to the revolt of her Helots. Cimon persuaded the Athenians to send aid, on the ground that Athens could not "stand without her yokefellow" and leave "Hellas lame." The expedition was a failure, and Cimon was attacked by the democrats led by Ephialtes. The history of this struggle is not clear. The ordinary account is that Ephialtes during Cimon's absence in Messenia overthrew the Areopagus (*q.v.*) and then obtained the ostracism of Cimon, who tried to reverse his policy. It may be pointed out that when the Messenian expedition started, Cimon had twice within the preceding year triumphed over the opposition of Ephialtes, and that presumably the Cimonian party was predominant until after the expedition proved a failure. It is therefore unlikely that, immediately after Cimon's triumph in obtaining permission to go to Messenia, Ephialtes was able to attack the Areopagus with success. The chronology would thus be: ostracism of Cimon, spring, 461; fall of the Areopagus, summer, 461.

A more difficult question is involved in the date of Cimon's return from ostracism. The ordinary account says that he was recalled after Tanagra (457) to negotiate the Five Years' Truce (451 or 450). Some writers, maintaining that Cimon did return soon after 457, say that the truce which he arranged was really the four months' truce recorded by Diodorus (only). To this there are two main objections: (1) if Cimon returned in 457, why does the evidence of antiquity connect his return specifically with the truce of 451? and (2) why does he after 457 disappear for six years and return again to negotiate the Five Years' Truce and to command the expedition to Cyprus? It seems much more likely that he returned in 451, at the very time when Athens returned to his old policy of friendship with Sparta and war against Persia (*i.e.,* the Cyprus expedition).

Cimon died in Cyprus (449), and was buried in Athens. Later Attic orators speak of a "Peace" between Athens and Persia, which is sometimes connected with the name of Cimon and sometimes with that of Callias. If any such peace was concluded, it cannot have been soon after the battle of the Eurymedon as Plutarch assumes. It can have been only after the evacuation of Cyprus (*i.e., c.* 448). There are weighty reasons which render it improbable that any formal peace can have been concluded at that period between Athens and Persia (see further Ed. Meyer's *Forschungen,* ii.).

Cimon's services in consolidating the empire rank with those of Themistocles and Aristeides. He is described as genial, brave and generous. The one great principle for which he is memorable is that of the balance of power between Athens and Sparta, as respectively the naval and military leaders of a united Hellas. It has been the custom to regard Cimon as a man of little culture. The truth is that, as in politics, so in education and attitude of mind, he represented the ideals of an age which, in the new atmosphere of democratic Athens, seemed to savour of rusticity and lack of education.

BIBLIOGRAPHY.—The lives of Cimon by Plutarch and Cornelius Nepos are uncritical; the conclusions above expressed are derived from a comparison of Plutarch, *Cimon,* 17, *Pericles,* 10; Theopompus, frag. 92; Andocides, *de Pace,* §§ 3, 4; Diodorus xi. 86 (the four months' truce). *See* histories of Greece (*e.g.,* Grote, ed. 1907), *Cambridge Ancient History,* vol. v., c. ii. and iii.; also PERICLES; DELIAN LEAGUE, with works quoted.

CIMON OF CLEONAE, an early Greek painter, who is said to have introduced great improvements in drawing. He represented "figures out of the straight, and ways of representing faces looking back, up or down; he also made the joints of the body clear, emphasized veins, worked out folds in garments" (Pliny).

CINCH, a Mexican saddle girth; figuratively, a secure hold.

CINCHONA, an important genus of shrubs and trees, family Rubiaceae, closely related to coffee and ipecac. The 38 species are found on the warm, moist Amazonian slopes of the Andes from Colombia to Bolivia at elevations of 5,000–8,500 feet, a few above and some below this. They have opposite leaves and pink or whitish, sometimes fragrant, usually cymose, flowers in lilac-like clusters. A few of the species are of world importance because their bark is the only source of quinine (*q.v.*) the specific for malaria, and widely used in the treatment of influenza, the common cold and some other diseases.

Some species also yield totaquina. The medicinal value of cinchona bark was unknown to the Incas, and it is not mentioned in Gracilasso de la Vega's *Royal Commentaries on the Incas* or in Pedro de Cieza de Leon's *Chronicles of Peru,* published in 1553.

The oft repeated tale of the first use and introduction of cinchona bark to Europe by the Countess of Chinchon in 1638 was completely disproved by A. W. Haggis in 1941, as the wife of the Viceroy of Peru never had malaria, died at Cartagena on her way to Spain and hence could not have carried cinchona bark to Europe. Who took it there, and when, will probably never be settled. It was known to the Jesuits at Lima about 1630, hence its common appellation of Jesuits' bark and Peruvian bark. The first mention in European medical literature was by Herman van der Heyden, in his *Discours et advis sur les flus de ventre douloureux,* Antwerp, 1643.

For the next two hundred years cinchona bark was ruthlessly exploited especially after the isolation of its chief constituent by Pelletier and Caventou in 1820 had demonstrated that the quinine content dictated its price. Bark depletion seemed so inevitable that Hasskarl for the Dutch and Sir Clements Markham for the English were sent to South America between 1859–63 in an attempt to introduce cinchona culture to Java and India. Both expeditions failed because they did not secure varieties of high quinine content. In December 1865 there arrived in Java a pound of seed from Charles Ledger of Puño, Peru, collected on the banks of the upper Marmoré River in Bolivia.

The progeny of these, and subsequent skilful cultivation by the Dutch, resulted in Java becoming the world source of cinchona bark and hence of quinine. Part of the Ledger seed was planted by the British at their government cinchona station in Madras, where it failed. That failure was disastrous, for India has the highest incidence of malaria in the world and the inferior Indian varieties have never yielded enough quinine. Private planters have abandoned its culture for more profitable crops; and government plantations are supplemented by importation from Java. Dutch bark production yielded 1017 tons of quinine in 1941, all derived from *Cinchona ledgeriana.* The only other spe-

cies grown commercially in Java is *C. succirubra* which yields quinidine, cinchonine and cinchonidine. (N. TR.)

CINCHONA BARK, ALKALOIDS OF. About 30 distinct alkaloids have been isolated from cinchona bark, of which quinine is by far the most important, followed by quinidine, cinchonidine and cinchonine. Owing to the therapeutical importance of cinchona bark and its four principal alkaloids most of the National Pharmacopeias prescribe methods of estimating these constituents in the bark and lay down standards both for the bark and for quinine. Thus the British Pharmacopeia requires that red cinchona bark should yield from 5% to 6% of alkaloids, of which not less than half must consist of quinine and cinchonidine, and for quinine sulphate a test is prescribed which excludes all but a minimum quantity of cinchona alkaloids, other than quinine. (For further information *see* ALKALOIDS.)

Quinine, $C_{20}H_{24}O_2N_2$.—This alkaloid is rarely seen or used, except in the form of its salts with acids. Though it contains two atoms of nitrogen it behaves as a monoacidic base yielding a sulphate of the formula $(C_{20}H_{24}O_2N_2)_2$, H_2SO_4, $7H_2O$, popularly known as "quinine." It crystallizes in bulky masses of colourless, glistening needles, which become dull on exposure to air owing to the loss of five of their molecules of water of crystallization, so that the thoroughly, stable, air-dry salt has the composition $(C_{20}H_{24}O_2N_2)_2$, H_2SO_4, $2H_2O$. It is sparingly soluble in water, more so in alcohol and still more in a mixture of alcohol and chloroform. The solutions are laevorotatory and those in water, especially when acidified, are strongly fluorescent. Two other sulphates, $C_{20}H_{24}O_2N_2$, $H_2SO_47H_2O$ (so-called disulphate) and $C_{20}H_{24}O_2N_2$, $2H_2SO_4$, $7H_2O$ (so-called tetra-sulphate) are known and are used when more soluble salts are required. Quinine hydrochloride $C_{20}H_{24}O_2N_2$ HCl, $2H_2O$, which closely resembles the ordinary sulphate in appearance but has the advantage of being a little more soluble in water, is also in use. In addition, a great variety of special salts have been made in attempts to combine the therapeutic advantages of quinine with those of medicinally valuable acids, *e.g.*, quinine salicylate, acetylsalicylate, valerianate, cacodylate, etc.

On reduction quinine furnishes hydroquinine, which also occurs in cinchona bark and is the raw material for the production of a series of drugs in which the side-chains of quinine are modified to enhance its therapeutic properties in certain directions. The best known of these modified cinchona alkaloids is "eucupin."

Quinidine, $C_{20}H_{24}O_2N_2$ (also called conquinine). This alkaloid, which is a dextrorotatory isomeride of quinine, crystallizes from alcohol in colourless prisms and melts when dry at 171·5°C. It forms two series of salts analogous with those of quinine.

Cinchonine $C_{19}H_{22}O$ N_2.—This alkaloid crystallizes from alcohol in rhombic prisms and melts at 264°C. It is dextrorotatory in solution and like the other cinchona alkaloids yields two series of salts with acids.

Cinchonidine, $C_{19}H_{22}O$ N_2.—This laevorotatory isomeride of cinchonine (*see* above), is one of the chief constituents of the mixture of alkaloids present in red cinchona bark, the variety now generally produced for making galenical preparations of cinchona. It crystallizes from alcohol in large colourless prisms, melting at 207°C, and corresponds with quinine in being laevorotatory in solution, but is unlike it in showing no fluorescence in dilute sulphuric acid. It forms two series of salts, analogous with those of quinine described above.

These four cinchona alkaloids have been the subject of investigations designed to determine their constitution and permit of their synthesis, almost continuously since they were discovered in 1820. The reactions of the four alkaloids indicate that they can all be represented by the following general formula due to Rabe (1909) and based on that of König (1906), which represents them as containing a quinoline (left) and a quinuclidine (right) nucleus, joined by a secondary alcohol group. The chemical differences between the two pairs (1) quinine and quinidine and (2) cinchonidine and cinchonine, depend on the fact that in the first pair R is the group $\cdot OCH_3$ and in the second pair R is a hydrogen atom. In all four alkaloids R′ is the group $CH{:}CH_2$ which can either be oxidized to a carboxyl group $\cdot COOH$, giving rise to a new alkaloid from each of the four, or can be reduced to $CH_2{\cdot}CH_3$ giving rise also to four new alkaloids (hydro-quinine, hydro-cinchonine, etc.). These eight new alkaloids can in turn each produce series of new derivatives, some of which are of special interest since in them the therapeutic properties of the parent alkaloids seem to be enhanced at least in certain directions.

Further it should be noted that there is now some reason to believe that the protozooicidal action of these alkaloids, to which is due their value in malaria, is associated mainly with the quinoline nucleus, whilst their action on the heart, which has led to the use of quinidine in cardiac therapeutics, is due to the quinuclidine nucleus, since sparteine, which also contains this nucleus, is stated to exert a similar action. (*See* also QUININE.) (T. A. H.)

CINCINNATI, a city and the county seat of Hamilton county, O., U.S.A. 39° 6′ N., 84° 30′ W., on the north bank of the Ohio river, opposite the mouth of the Licking, about 100 m. S.W. of Columbus, about 305 m. by rail S.E. of Chicago, and about 760 m. (by rail) W.S.W. of New York. Through the city flows Mill creek, to the east the Little Miami; and to the west the Great Miami empties into the Ohio. Population, 1920, 401,247; 1930, 451,160; 1940, 455,610, a gain of 4,450 or 0·9% against 49,913 or 12·4% in the preceding decade. Of the 1930 population 7·7% were foreign-born, 28·9% of foreign stock and 10·6% Negroes. German is the most important foreign element. In addition to the large number of inhabitants of German descent, there were, in 1900, 107,152 of German parentage; and of the foreign-born in 1930, 13,944 or 40% came from Germany. At present over 92% are American born. Previous census reports were: (1810) 2,540, (1820) 9,642; (1830) 24,831; (1840) 46,338; (1850) 115,435; (1860) 161,044; (1870) 216,239; (1880) 225,139; (1890) 296,-908; (1900) 325,902; (1910) 363,591.

Cincinnati is on two plateaus—one about 60 ft., the other 100–150 ft., above low water—and on hills (400 to 460 ft.) which enclose these terraces on three sides. The city datum is 546·9 ft. above sea level, zero river gauge 430·06 ft., low water mark 431·96 feet. The low water record is 1·9 ft. (Sept. 1899) and high water 79·9 ft. (Jan. 26, 1937). About half the plain (average above sea level 550 ft.) lies south of the Ohio in Kentucky and here are Covington suburbs. Cincinnati has a river frontage of about 27 mi., extends back about 6 mi. on the west side in the valley of Mill creek and occupies a total area of 72·2 sq.mi. In 1867 it was connected with Covington by a bridge (1,056 ft. long between towers, in all 3,284 ft.). Two bridges lead to Newport; one (Cincinnati Southern railway) to Ludlow; and one to West Covington.

On the terraces the streets generally intersect at right angles, but on the hills, irregularly. In the "bottoms" are the manufacturing and wholesale districts; these are spreading to the higher levels and suburbs. The principal retail houses are on the higher levels north of Third street. Most of the finer residences are on picturesque hills in the city; but there is a tendency towards more remote and larger estates. The model town, Mariemont, constructed as an entity with complete public service systems, has an extensive population. Two inclined plane railways, Mt. Adams (268 ft.) and Price hill (350 ft.) afford transportation and excellent panoramic views. Average summer temperature is 75·30°; autumn, 56·77°; winter, 32·87°; spring, 52·73°; the yearly average, 53·60°.

The birth rate in 1940 was 13·4 and death rate 13·6 per thousand. The wind velocity is 7 mi. per hour.

Buildings.—Brick, blue limestone, and a grayish buff freestone are the common building materials. The new U.S. government building, Union station, city hall, county court house and the Soldiers', Sailors' and Pioneers' building (1907) are monumental structures. St. Monica cathedral is the seat of the archbishopric; the church of St. Francis de Sales, the First (1835) and Second Presbyterian (1872), Central Christian, St. Paul's Methodist (1870), St. Paul's Protestant Episcopal pro-cathedral (1851), Christ's church, First Church of Christ and the Jewish temples are notable among the 400 churches. Cincinnati is the seat of a Roman Catholic archbishopric and a Protestant Episcopal and Methodist bishopric. The Union Central building, an adaptation

of Italian Renaissance (495 ft.) is visible for many miles. The Masonic temple, Chamber of Commerce building, Carew Tower, Queen City club, Druggists' and Doctors' buildings and Cincinnati club are important new structures. The buildings of the Fifth-Third-Central Trust company, First and Second National banks, Provident Savings Bank and Trust company and Western and Southern Life, the Dixie terminal, Enquirer, Southern Railway, Telephone, Traction, Mercantile library, Temple Bar and Young Women's Christian association buildings are other notable modern structures.

In many manufacturing plants industrial requirements are being combined with artistic expression.

Parks, etc.—A city planning commission established by charter prepared (1925) a plan for the development and construction of streets, subways, bridges, playgrounds and parks. It has become a law, the first American one of such comprehensive character. In 1940 there were 126 parks (3,724 ac.); suburbs are often park-like in character and are of unusual beauty. Eden park (184 ac.) on Mt. Adams, about 1 mi. E. of the business centre and overlooking the river, is well landscaped and has commanding views. It originally belonged to Nicholas Longworth (1782–1863), a wealthy horticulturist, who there grew the grapes from which Catawba wine, introduced by him in 1828, was made.

The park contains the art museum and academy. Its gateway, Elsinore, is a mediaeval reproduction; other features are the reservoirs, which resemble natural lakes, and a high water tower, from which there is a delightful view. Public concerts are given there in a natural amphitheatre.

In Burnet Woods park (116 ac.), N.W. of Eden, is the University of Cincinnati, including the library of the Historical and Philosophical society of Ohio with its great collection of Americana.

There is a lake for boating and skating and public concerts are given.

Recently new parks have been added and the boulevards and bluffs beautified.

The Mt. Airy forestry project includes 1,344 acres. Ault park (234 ac.), Alms (85 ac.), Mt. Storm (68 ac.) and Mt. Echo park (82 ac.) afford fine views. Other large parks are Victory, Salway, Caldwell, Avon field, Kroger, Inwood, Lincoln and Garfield and the Fleischman Rose garden. There are 1,000 acres used for directed play.

These grounds were attended (summer of the year 1939) by some 2,500,000.

The Zoological garden (60 ac.) contains unusual collections of animals in a picturesque environment. Here concerts, operas and other entertainments are given. Spring Grove cemetery (600 ac., 6 mi. N.W. of Fountain square) is laid out on the park plan, as are the Catholic and Jewish cemeteries. Parkway boulevard (a part of the park system) covers the old Miami canal bed through the centre of the city and extends 4·6 miles. Victory parkway and Noyes field include some 134 acres. The Lunken airport (1,100 ac.) is 5 mi. E. of the post office; the Watson (100 ac.) is at Blue Ash, Ohio.

Education.—There are 65 grammar, 10 junior high, 6 high, 9 vocational and 5 special schools (enrolment 64,183). Parochial schools are attended by 23,532. Students may pass at public expense from the kindergarten through the graduate departments of the municipal university of Cincinnati (1873). The university, since 1895 on a campus of nearly 50 acres, has an astronomical observatory on Mt. Lookout and was the first strictly municipal university in the United States. It embraces a graduate school and schools of liberal arts, engineering and commerce, education, medicine, nursing and health, law, applied arts, household administration and evening college. The co-operative system, originated in Cincinnati, of supplementing college instruction by practical training in shops and manufacturing establishments is expanding greatly. In 1941 there were 11,617 students registered and the officers of government and instruction in excess of 800. The law department developed from the Cincinnati Law school, the oldest west of the Alleghenies and the third in the United States, a survivor of the Lancaster seminary (1814) and Cincinnati college (1819).

The Medical school developed from the Medical college of Ohio (1820), the oldest west of the mountains. The Observatory dates from 1842. In 1868 the director, Cleveland Abbe, inaugurated a system of daily weather reports from which developed the U.S. weather bureau. Among the numerous university buildings are a men's dormitory, the Tanner's Council Research building and a stadium. The university is governed by trustees appointed by the mayor. Its large endowments are supplemented by taxation.

The Roman Catholic Xavier university moved its college department in 1919–1920 to a 48 ac. tract near the boulevards. Founded (1831) by Bishop Fenwick as the Athenaeum, it gives the usual university instruction and degrees, completing the educational system of an archdiocese of 12,043 sq.mi. and Roman Catholic population of 234,500. It has 1,573 students. Other Catholic educational institutions are Mt. Saint Mary's of the West (Norwood) and St. Gregory Preparatory seminary with a station at Mt. Washington, Cincinnati.

The Ohio Mechanics institute (1828) prepares skilled workmen and industrial executives. Instruction is given in every phase of mechanics and science, as well as language, history, economics and music. It maintains summer schools and day and night sessions.

The Hebrew Union college (1875) is the leading American institution for preparing rabbis.

It is a graduate school with a handsome building near the university. Other educational institutions of importance are the Eclectic Medical college (1845); the College of Pharmacy, dental and several business colleges.

The municipal library (1,258,033 vols.) serves 187,000 from its main building, 38 branches and about 369 other agencies. There are some 13 other libraries, including law, medicine, science, theology, botany and pharmacy. The Law library is very complete. The Lloyd library and museum of botany and pharmacy are also important. The library of the Historical and Philosophical society of Ohio (1831) contains a valuable collection of rare books, pamphlets, maps and manuscripts.

There is an American house for training aliens for citizenship and social service. The educational department of the Young Men's Christian association includes commercial and law schools. There is also a Young Men's Mercantile library (111,800 vols.).

Hospitals, etc.—The General hospital (1941, 965 beds, 26 buildings, 27 ac.) is perhaps the best American example of the pavilion type. It has administrative relationship with the University of Cincinnati whose Medical school adjoins it. Nearby are the Children's (1926) and the Jewish (1922) hospitals. Others are the Bethesda, Deaconess', Good Samaritan, Christ's, Christian Holmes and Seton and the Tuberculosis sanatorium. There are numerous charitable institutions.

A community chest was initiated in 1915 and has operated successfully since. Its budget for 1940 asked for over $1,800,000, of which $1,760,621 was raised from a record number of subscribers (121,786).

Water Supply.—The waterworks (municipally owned; original cost $25,000,000) was virtually completed in 1907. Water is taken from the Ohio river on the Kentucky side several miles above the discharge of the city sewers. It comes through a gravity tunnel under the river to the Ohio side, the water being thence elevated by four pumping engines, each with a daily capacity of 30,000,000 gal., to settling basins; it goes through filters of the American or mechanical type, and flows thence by a gravity tunnel about 4 mi. to the main pumping station, on the river bank within the city. Owing to diversified topography there are three pumping districts. In the business district Eden park reservoir stores 96 million gal. (3 average days' supply); in the Eastern hills, the Mt. Auburn and Eastern hills tanks and reservoirs contain 41 millions (2 days' supply), and in the Western hills two groups of tanks contain 9½ million gal. (2 days' supply). This system is constantly being improved with municipal funds,

setting a record in 1940 by providing a daily average of 65,900,000 gallons through meters. The system is entirely self-supporting.

Railways, Streets, Sewers.—Cincinnati has over 768 miles of paved streets and of sewers. There is a Rapid transit loop (initial cost, $6,100,000) encircling the city in connection with subway, surface and elevated railways giving access to suburban and inter-urban traffic. The electric street railways and autobus lines are owned by the Cincinnati Street Railway company which operates them on a service at cost system. There are several privately owned autobus lines. Street railways and autobus lines connect Cincinnati with the neighbouring Kentucky cities.

Seven railroads operating 19 trunk lines radiate from Cincinnati using a single Union station, considered by many as the finest passenger station in the world. There is one passenger and freight line and there are numerous barge lines on the river. The city owns the railway (336 mi.) from Cincinnati to Chattanooga, valued at approximately $48,000,000. It is leased to the Cincinnati, New Orleans and Texas Pacific railway company for a term ending in 2026 at a rental beginning at $1,250,000 per year plus certain percentages of net profits.

Administration.—The Home rule charter (1917) was amended (1924) to establish the city manager form of Government with a council of nine nominated by petition and elected at large for a term of two years by proportional representation voting. The charter operated from Jan., 1926. Council elects one of its members presiding officer; he becomes mayor. Council also elects from its number a vice mayor. The city manager is chosen by council for an indefinite term at $25,000 per year.

The bonded debt in 1940 was $78,072,081; the net amount not self supporting was $37,865,642. The tax rate for 1940 was $21.46 per thousand, of which $10.80 was for the city and the remainder for state, county and educational purposes.

Industries.—As listed by the U.S. census (1937) the major types of industry represented in Cincinnati were as follows: machine tools, 30 firms with a product value of $40,145,476; paper, 12 firms and $38,037,909; meat packing, wholesale, 36 firms and $37,989,379; motor vehicles, bodies and parts, 12 firms and $26,590,524; men's, youths' and boys' clothing, 32 firms and $21,466,583; machinery, 49 firms and $20,053,282; printing and publishing, 211 firms and $35,925,215; bread and bakery products, 179 firms and $17,949,418. Cincinnati is the centre of the U.S. radio industry. The total value of products within the city limits for 1937 was $413,763,938 and for the industrial area $794,340,890. Before the Civil War Cincinnati was the centre of the U.S. pork-packing industry and ranked high in the production of whiskies and malt liquors. There are 4 national banks and 11 state banks and trust companies (capital, $23,100,000; deposits, $316,320,000). There are 210 state chartered building and loan associations with assets of over $134,927,572. Post office receipts for 1940 were $6,876,470.

Art, Music.—Musical development began in 1810–20; by 1825 musical academies, choral societies performing the works of Handel and Haydn, and musical publications were quite numerous. The drama was popular. It was, however, the large influx of Germans in the '40s and later that promoted music most. A *Sängerfest* was held in 1849 and again in 1870, when a hall was built for it. Under Theodore Thomas (1835–1905) the Cincinnati Musical Festival association was incorporated, and its biennial May festivals began in 1873. In 1875–78 was built the Springer music-hall and the Cincinnati college of music was endowed in 1878. Theodore Thomas was director in 1878–81; a statue of him by Barnhorn stands in Music hall. Until his death Thomas was director of the May festivals. The *Sängerfest* met in Cincinnati for the third time in 1879 and its jubilee was held there in 1899. Choral societies have been important in musical life, as has the Cincinnati Conservatory of music (1867) and the Cincinnati Symphony Orchestra (1893).

A number of early American artists, such as Eckstein and Hiram Powers, lived in Cincinnati, where German influence greatly promoted art. In 1877 an organization of women (as in the case of the Symphony Orchestra) brought about the building of the Art museum (1886). A school of design (1869) remained a part of the university until 1884 when it was transferred to the museum. An Art academy was erected (1887) near the Art museum. Frank Duveneck was for some time director of the academy, and the Duveneck room in the museum contains the most complete collection of his works. The Rookwood pottery was the first (1880) in the United States to devote exclusive attention to art ware. The earlier wares were yellow, brown and red, then came deep greens and blues, followed by mat-glazes and by "vellum" ware (1904), a lustrous pottery resembling old parchment, with decoration painted or modelled or both. There are several art reproducing establishments.

In the centre of the city is the Tyler Davidson bronze fountain (1871) on Fountain Square. It was designed by August von Kreling and comprises 15 bronze figures cast at the royal bronze foundry in Munich; the chief is a female figure with outstretched arms (43 ft. high) from whose fingers the water falls in a fine spray. The base is of porphyry. Other notable monuments are those to Garfield by Charles H. Niehaus, to W. H. Harrison by L. T. Rebisso, George Grey Barnard's Lincoln, the Galbraith memorial, the Ft. Washington monument, McCook and Hecker busts and a monument to Ohio volunteers killed in the Civil War. The chief clubs are the Queen City (1874); Cincinnati; University; Cuvier Press; Woman's; Woman's City; Camargo; Cincinnati Country; Losantiville; Maketewah; Hyde Park; Western Hills and Riding. The Cincinnati Literary club, the oldest of the kind in the United States, dates from 1849. The Cincinnati Chamber of Commerce dates from 1839.

Several hundred religious and fraternal periodicals and technical and trade journals are published. The principal daily newspapers are the *Enquirer* (1842); *Times-Star* (*Times* 1836) and *Post* (1881). The *Freie Presse* is a German daily and the *Union*, a negro weekly.

History.—The site of Cincinnati was a centre of the mound builder civilization. LaSalle is said to have passed this point on LaBelle Rivière in 1669. White traders passed down the river frequently after 1750, and the valley of the Miami ("The Miami slaughter house") was the line of Indian approach upon the early Kentucky settlements via the Licking. George Rogers Clark built two small block houses here in 1780 and 1782, but they soon disappeared.

Cincinnati was one of the first settlements (1788) in the Northwest Territory. It lies on part of the land purchased for himself and others by John Cleves Symmes (1742–1814) from the U.S. Government in 1788 (the Miami purchase). The immigrants were chiefly from New Jersey and Kentucky. When the town was first laid out early in 1789 around Ft. Washington it was called Losantiville, a hybrid word signifying "the city opposite the mouth of the Licking," but early in the next year it was named as at present in honour of Gen. St. Clair, the governor of the Northwest Territory, then president of the Pennsylvania society of the Order of Cincinnati. St. Clair arrived about this time and erected Hamilton county, with Cincinnati as its seat. Indians threatened it and the Harmar (1790) and St. Clair (1791) expeditions into Indian fastnesses were unsuccessful. In 1794 Gen. Anthony Wayne won the decisive victory of Fallen Timbers at Maumee rapids from which followed the treaty of Greenville (1795) and the end of Indian warfare. The military post became a town (incorporated 1802). In 1801 the territorial legislature, which had held its sessions here from time to time, moved to Chillicothe. Cincinnati became a city in 1819. It has had many charters with more or less varying forms of government.

The opening of steam navigation on the Ohio (1816), followed by the completion of the Miami canal (1830), and of the first section of the Little Miami Railway (1843) brought rapid development of river, canal and rail traffic and the establishment of manufacturing plants. The development of agriculture and viticulture attracted many immigrants, particularly Germans, in 1845–60. In 1819 the area of the city was approximately 3 sq.mi.; this had been increased by the time of the Civil War to 7 sq.mi.; in 1904 it was 42·5 sq.mi., and in 1939 it was 72·38 sq. miles.

Close commercial and social relations made anti-slavery agitation a most unpleasant topic. The abolitionists were numerous

and active and the city was an important station on the "Underground railroad," with many homes open to escaping slaves as temporary resting places. Harriet Beecher Stowe lived in the city from 1832 to 1850 and gathered there much material for *Uncle Tom's Cabin.* In 1834 came the Lane seminary controversies over slavery. In 1836 James G. Birney established his anti-slavery journal, *The Philanthropist;* mobs destroyed its presses. Many episodes of this character grew out of the feeling of some that the trade with the South would be affected by such agitation. This feeling was by no means universal and Cincinnati became the rendezvous of fugitive slaves and the scene of the activities of Salmon P. Chase, Levi Coffin and others on their behalf. When war came the community sided with the North. In 1862 the city was threatened by a Confederate force under Gen. Kirby Smith and for a time was put under martial law; the Confederates did not come very near the city, however.

In 1884 occurred a flood unequalled till 1937, and in March of the former year the "Cincinnati Riots." A mob, infuriated by the lax administration of law, broke into the jail to lynch some murderers found guilty of manslaughter only. The prisoners had been removed but the mob burned the court-house with its records. The militia was called out and after a few days order was restored with 45 killed and 148 wounded.

Evils growing out of the large council retained in the new self-governing charter of 1917 led to the formation of the "citizens charter committee," which waged a campaign for a more responsible Government. As a result of their activities the charter was amended in 1924 to provide for a city-manager form of Government with a small council of nine elected by proportional representation ballot. In the election of 1925, the people approved the same bond issue which they had rejected when proposed by the former administration, thereby showing their willingness to furnish funds to further the city's growth under proper administrative responsibility. The efficiency of the government under City Manager Dykstra achieved national notice during the disastrous floods of March 1936 and January 1937.

BIBLIOGRAPHY.—C. T. Greve, *Centennial History of Cincinnati* (1904); C. F. Goss, *Cincinnati, The Queen City* (1912); L. A. Leonard, *Greater Cincinnati and Its People* (1927); *Chamber of Commerce Compendium; Municipal Reports;* M. Seasongood, *Local Government in the United States* (1935). (C. T. G.; X.)

CINCINNATUS, LUCIUS QUINTIUS (b. *c.* 519 B.C.), one of the heroes of early Rome. He worked his own small farm. A persistent opponent of the plebeians, he resisted the proposal of Terentilius Arsa to draw up a code of written laws applicable equally to patricians and plebeians. Twice he was called to the dictatorship of Rome (458 and 439). In 458 he defeated the Aequians in a single day, and after entering Rome in triumph with large spoils returned to his farm. The story of his success, related five times under five different years, possibly rests on an historical basis, but the account given in Livy is incredible.

See Livy iii. 26–29; Dion. Halic. x. 23–25; Florus i. 11. For a critical examination of the story *see* Schwegler, *Römische Geschichte,* bk. xxviii. 12; E. Pais, *Storia di Roma,* i. ch. 4 (1898).

CINCLIDAE: *see* DIPPER.

CINDERELLA, the heroine of an almost universal fairy-tale (*i.e.,* little cinder girl). Its essential features are (1) the persecuted maiden whose youth and beauty bring upon her the jealousy of her step-mother and sisters; (2) the intervention of a fairy or other supernatural instrument on her behalf; (3) the prince who falls in love with and marries her. In the English version, a translation of Perrault's *Cendrillon,* the *glass* slipper which she drops on the palace stairs is due to a mistranslation of *pantoufle en vair* (a *fur* slipper), mistaken for *en verre.* It has been suggested that the story originated in a nature-myth, Cinderella being the dawn, oppressed by the night-clouds (cruel relatives) and finally rescued by the sun (prince).

See A. Lang, *Perrault's Popular Tales* (1888); Marian Rolfe Cox, *Cinderella; Three Hundred and Forty-five Variants* (1893).

CINEAS, a Thessalian, the chief adviser of Pyrrhus, king of Epirus. He was regarded as the most eloquent man of his age. He tried to dissuade Pyrrhus from invading Italy, and after the defeat of the Romans at Heraclea (280 B.C.) was sent to Rome to discuss terms of peace. These terms, which are said by Appian (*De Rebus Samniticis,* 10, 11) to have included the freedom of the Greeks in Italy and the restoration to the Bruttians, Apulians and Samnites of all that had been taken from them, were rejected. Two years later Cineas was sent to renew negotiations on easier terms. The result was a cessation of hostilities, and Cineas crossed over to Sicily to prepare the ground for Pyrrhus's campaign. Nothing more is heard of him. He is said to have made an epitome of the *Tactica* of Aeneas, probably referred to by Cicero, who speaks of a Cineas as the author of a treatise *De Re Militari.*

See Plutarch, *Pyrrhus,* 11–21; Justin xviii. 2; Eutropius ii. 12; Cicero, *Ad Fam.* ix. 25.

CINEMATOGRAPHY: *see* MOTION PICTURES: *Technology.*

CINERARIA, cultivated ornamental plants originated from species of *Senecio.* There are two distinct types, the garden species, of which one of the most common is a Dusty Miller, *S. cineraria* and the greenhouse varieties of *S. cruentus,* commonly referred to as Cinerarias.

Greenhouse cinerarias are of two types: one a dwarf, compact growing plant with large flowers in dense clusters; the other a taller growing variety with larger, more spreading clusters of small star-shaped flowers. These are known horticulturally as stellate varieties of *Cineraria cruentus.* Both are easily grown from seed and are sold commercially as potted plants. The very free-flowering stellate varieties are more popular than are the large-flowered types and through a careful selection and crossing of varieties many beautiful colours are available.

For a succession of blooming plants during the late winter and spring months seeds are first sown in August in the cool greenhouse. As soon as the seedlings can be handled conveniently they are put in 2¼″ pots. Later they are shifted to 3″ pots as the root system develops. The final shift into 6″ flowering pots is made early in January. Soil for cinerarias should be of a light, porous character and a mixture of one-half fibrous loam, one-half leaf mould with a liberal sprinkling of sharp sand suits them admirably. They grow best in a night temperature of from 45° to 50° F. with an increase of about 10° during the day. The soft succulent character of foliage and stems makes cinerarias especially liable to be attacked by green fly. The plants should be frequently fumigated with nicotine preparations or sprayed with nicotine solutions.

CINGOLI (anc. CINGULUM), a town of the Marches, Italy, province of Macerata, about 14 mi. N.W. direct, and 17 mi. by road from the town of Macerata. Pop. (1936) 1,751 (town); 15,496 (commune). Cingulum, a town of Picenum, founded by Caesar's lieutenant, T. Labienus, at his own expense in 63 B.C., played an important part in the civil wars owing to its lofty site (2,300 ft.). Remains of the ancient city walls survive and there are interesting works of art in the Gothic church of S. Esuperanzio.

CINNA, a Roman patrician family of the gens Cornelia. The most prominent member was LUCIUS CORNELIUS CINNA, who, after serving in the war with the Marsi as praetorian legate, became consul in 87 B.C. After Sulla's departure for the East, riots broke out in Rome, and Cinna was expelled. He at once collected an army, Marius joined him, and the two captured Rome. Proscriptions followed, and the death of Marius (Jan. 86) left Cinna leader of the party. L. Valerius Flaccus became his colleague, and afterwards Cn. Papirius Carbo. In 84, however, Cinna, who was still consul, was forced to advance against Sulla; but while embarking his troops for Thessaly, he was killed in a mutiny. His daughter Cornelia was the wife of Julius Caesar, but his son, L. CORNELIUS CINNA, praetor in 44 B.C., sided with Caesar's murderers.

The hero of Corneille's tragedy *Cinna* (1640) was the Cn. Cornelius Cinna pardoned by Augustus for conspiracy.

CINNA, GAIUS HELVIUS, Roman poet of the later Ciceronian age, the friend of Catullus, whom he accompanied to Bithynia in the suite of the praetor Memmius. Suetonius, Valerius Maximus, Appian and Dio Cassius all state that, at Caesar's funeral, a certain Helvius Cinna was killed by mistake for Cornelius Cinna, the conspirator. The last three writers mentioned

above add that he was a tribune of the people, while Plutarch states that the Cinna who was killed by the mob was a poet. This points to the identity of Helvius Cinna the tribune with Helvius Cinna the poet. The chief objection to this view is based upon two lines in 9th eclogue of Virgil, supposed to have been written 41 or 40 B.C., which seem to imply that Helvius Cinna was then alive. But such an interpretation of the passage is not absolutely necessary. Cinna's chief work was a mythological epic poem called *Smyrna*. A *Propempticon Pollionis*, a send-off to [Asinius] Pollio, is also attributed to him. In both these poems, the language of which was so obscure that they required special commentaries, his model appears to have been Parthenius of Nicaea.

See A. Weichert, *Poëtarum Latinorum Vitae* (1830); L. Müller's edition of Catullus (1870), where the remains of Cinna's poems are printed; A. Kiessling, "De C. Helvio Cinna Poëta" in *Commentationes Philologicae in honorem T. Mommsen* (1878); O. Ribbeck, *Geschichte der römischen Dichtung*, i. (1887); Teuffel-Schwabe, *Hist. of Roman Lit.* (Eng. tr. 213, 2–5); Plessis, *Poésie latine* (1909).

CINNABAR, sometimes written cinnabarite, is red mercuric sulphide (HgS), or native vermilion, the common ore of mercury (Ger. *Zinnober*). The name comes from the Greek κιννάβαρι used by Theophrastus, and probably applied to several distinct substances. Cinnabar is generally found in a massive, granular or earthy form, of bright red colour, but it occasionally occurs in crystals, with a metallic adamantine lustre. The crystals belong to the hexagonal system, and are generally of rhombohedral habit, sometimes twinned. Cinnabar presents remarkable resemblance to quartz in its symmetry and optical characters. Like quartz it exhibits circular polarization, and A. des Cloizeaux showed that it possessed 15 times the rotatory power of quartz (*see* LIGHT). Cinnabar has higher refractive power than any other known mineral, its mean index for sodium light being 3.02, while the index for diamond is only 2.42 (*see* REFRACTION). The hardness of cinnabar is 3, and its specific gravity 9. Cinnabar is found in all localities which yield mercury. Hepatic cinnabar is an impure variety from Idria, in which the cinnabar is mixed with bituminous and earthy matter; and metacinnabarite is a cubic form of mercuric sulphide, this compound being dimorphous.

CINNAMIC ACID, or **PHENYLACRYLIC ACID,** is present in Peru and Tolu balsams, in storax and in some gum-benzoins, combined with benzyl alcohol as an ester. Its formula is $C_6H_5{\cdot}CH{:}CH{\cdot}COOH$. It can be prepared by the reduction of phenyl propiolic acid with zinc and acetic acid, by heating benzal malonic acid, by the condensation of ethyl acetate with benzaldehyde in the presence of sodium ethylate or by the so-called "Perkin reaction"; the latter being the method commonly employed. In this process benzaldehyde, acetic anhydride and anhydrous sodium acetate are heated to about 180° C.; the mixture is made alkaline with sodium carbonate, and excess of benzaldehyde removed by a current of steam. The residual liquor is acidified with hydrochloric acid, when cinnamic acid is precipitated, and recrystallized from hot water. Cinnamic acid crystallizes in needles or prisms, melting at 133° C. It exists in two stereoisomeric varieties one of which is trimorphous. On nitration it gives a mixture of ortho- and para-nitrocinnamic acids, the former of which is of historical importance, as by converting it into orthonitrophenylpropiolic acid A. Baeyer was enabled to carry out a complete synthesis of indigo (*q.v.*).

Cinnamic acid and its esters find employment in the production of perfumes. Its sodium salt is applied in tuberculosis; its cresol and guaiacol esters and ethyl ditrome cinnamate have also been used therapeutically.

CINNAMON, the inner bark of *Cinnamomum zeylanicum*, a small evergreen tree belonging to the family Lauraceae, native to Ceylon. The leaves are large, ovate-oblong in shape, and the flowers, which are arranged in panicles, have a greenish colour and a rather disagreeable odour. The tree is grown at Tellicherry, in Java, the West Indies, Brazil and Egypt, but the produce of none of these places approaches in quality that grown in Ceylon. In 1940 imports of cinnamon oil into the United States were 184,673 lbs., valued at $112,000. Ceylon cinnamon of fine quality is a very thin, smooth bark, with a light-yellowish brown colour, a highly fragrant odour, and a peculiarly sweet, warm and pleasing aromatic taste. Its flavour is due to an aromatic oil. This is prepared by pounding the bark, macerating it in sea water, and then quickly distilling the whole. It is golden-yellow, with the peculiar odour of cinnamon and a hot aromatic taste. Cinnamon is principally employed in cookery as a condiment and flavouring material, being largely used in the preparation of some kinds of chocolate and liqueurs. It is also used in soap perfumes. Being a much more costly spice than cassia, that comparatively harsh-flavoured substance is frequently substituted for or added to it.

CINNAMON STONE: *see* GARNET.

CINNAMUS (KINNAMOS), **JOHN,** Byzantine historian. He was imperial secretary to Manuel I. Comnenus (1143–1180), whom he accompanied on his campaigns in Europe and Asia Minor. He appears to have outlived Andronicus I., who died in 1185. Cinnamus was the author of a history of the period 1118–76, which thus continues the *Alexiad* of Anna Comnena, and embraces the reigns of John II. and Manuel I., down to the unsuccessful campaign of the latter against the Turks, which ended with the rout of the Byzantine army at Myriocephalum. Cinnamus was probably an eye-witness of the events of the last ten years which he describes. The work breaks off abruptly, and there are indications that it is an abridgement. The text is in a very corrupt state. The author's hero is Manuel; he is strongly impressed with the superiority of the East to the West, and is a determined opponent of the pretensions of the papacy; but he cannot be reproached with undue bias.

C. Tollius *Editio princeps* (1652); in Bonn, A. Meincke, *Corpus Scriptorum Hist. Byz.* (1836), with Du Cange's valuable notes; Migne, *Patrologia Graeca*, cxxxiii.; *see* also H. von Kap-Herr, *Die abendländische Politik Kaiser Manuels* (1881); C. Neumann, *Griechische Geschichtsschreiber im 12. Jahrhundert* (1888); C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897).

CINO DA PISTOIA (1270–1336), Italian poet and jurist, whose full name was GUITTONCINO DE' SINIBALDI, was born in Pistoia, of a noble family. He studied law at Bologna under Dinus Muggelanus (Dino de Rossonis: d. 1303) and Franciscus Accursius, and in 1307 is understood to have been assessor of civil causes in his native city. In that year, however, Pistoia was disturbed by the Guelph and Ghibelline feud. Cino was a Ghibelline, and had to leave Pistoia. Pitecchio, a stronghold on the frontiers of Lombardy, was yet in the hands of Filippo Vergiolesi, chief of the Pistoian Ghibellines; Selvaggia, his daughter, was beloved by Cino (who was probably already the husband of Margherita degli Unghi); and Cino betook himself to Pitecchio. He was not with the Vergiolesi at the time of Selvaggia's death (1310), at the Monte della Sambuca, in the Apennines, whither the Ghibellines had been compelled to shift their camp. In 1313 the emperor died, and the Ghibellines lost their last hope. Cino appears to have thrown up his party, and to have returned to Pistoia. Thereafter he devoted himself to law and letters. After filling several high judicial offices, a doctor of civil law of Bologna in his 44th year, he lectured and taught from the professor's chair at the Universities of Treviso, Siena, Florence and Perugia in succession.

Cino, the master of Bartolus, and of Joannes Andreae the celebrated canonist, was long famed as a jurist. His commentary on the statutes of Pistoia, written in two years, is said to have great merit; while that on the code (*Lectura Cino Pistoia super codice*, Pavia, 1483; Lyons, 1526) is considered by Savigny to exhibit more practical intelligence and more originality of thought than are found in any commentary on Roman law since the time of Accursius. He was the friend and correspondent of Dante's later years, and possibly of his earlier also, and was certainly, with Guido Cavalcanti and Durante da Maiano, one of those who replied to the famous sonnet *A ciascun' alma presa e gentil core* of the *Vita Nuova*. In the treatise *De Vulgari Eloquio* Dante refers to him as one of "those who have most sweetly and subtly written poems in modern Italian." Petrarch coupled Cino and Selvaggia with Dante and Beatrice in the fourth chapter of his *Trionfi d'Amore*. As a poet Cino has moments of true passion and fine natural eloquence. Of these qualities the sonnet in memory of Selvaggia, *Io fui in sull' alto e in sul beato monte*, and the canzone to Dante, *Avengnachè di omaggio più per tempo*, are interesting examples.

The text-book for English readers is D. G. Rossetti's *Early Italian Poets*, which contains a memoir of Cino da Pistoia and some admirably translated specimens of his verse. *See* also Ciampi, *Vita e poesie di messer Cino da Pistoia* (Pisa, 1813).

CINQ-MARS, HENRI COIFFIER RUZÉ D'EFFIAT, MARQUIS DE (1620–1642), French courtier, was the second son of Antoine Coiffier Ruzé, marquis d'Effiat, marshal of France (1581–1632), and was introduced to the court of Louis XIII. by Richelieu, who had been a friend of his father and who hoped he would counteract the influence of the queen's favourite, Mlle. de Hautefort. He became the king's accredited favourite, master of the wardrobe and master of the horse. After distinguishing himself at the siege of Arras in 1640, Cinq-Mars became restive. He had fallen in love with Louise Marie de Gonzaga, afterwards queen of Poland, who was not disposed to favour a suitor who could not satisfy her ambition. Cinq-Mars demanded a high military command, but Richelieu opposed his pretensions and the favourite talked rashly about overthrowing the minister. He was probably connected with the abortive rising of the count of Soissons in 1641; however that may be, in the following year he formed a conspiracy with the duke of Bouillon and others to overthrow Richelieu. This plot was under the nominal leadership of the king's brother, Gaston of Orleans. The plans of the conspirators were aided by the illness of Richelieu and his absence from the king, and at the siege of Narbonne Cinq-Mars almost induced Louis to agree to banish his minister. Richelieu, however, recovered; Gaston betrayed the conspirators, and Richelieu laid before the king the proofs of the treasonable negotiations of the conspirators for assistance from Spain. Cinq-Mars was brought to trial, admitted his guilt, and was executed at Lyons on Sept. 12, 1642. The conspiracy of Cinq-Mars forms the subject of a novel by Alfred de Vigny, *Cinq-Mars*.

See d'Hancour, *La Conspiration de Cinq-Mars* (1902).

CINQUECENTO, a term used to describe that period of the Italian Renaissance between 1500 and 1600. The word is applied especially to the artistic styles prevalent at that time, and particularly to the classicism of the high Renaissance.

CINQUEFOIL, a decorative form of five lobes or cusps.

CINQUE PORTS, the name of an association of maritime towns in the south of England, exercising a jurisdiction dating from about the time of the Norman Conquest, organized, it seems on French lines, in the 13th century, and still surviving. The ports originally constituting the body were only five in number—Hastings, Romney, Hythe, Dover and Sandwich; but to these were afterwards added the "ancient towns" of Winchelsea and Rye with the same privileges, and other places, both corporate and non-corporate, which, with the title of limb or member, held a subordinate position. To Hastings were attached the corporate members of Pevensey and Seaford, and the non-corporate members of Bulvarhythe, Petit Iham (Yham or Higham), Hydney, Bekesbourn, Northeye and Grenche or Grange; to Romney, Lydd, and Old Romney, Dengemarsh, Orwaldstone and Bromehill or Promehill; to Dover, Folkestone and Faversham, and Margate, St. John's, Goresend (now Birchington), Birchington Wood (now Woodchurch), St. Peter's, Kingsdown and Ringwould; to Sandwich, Fordwich and Deal, and Walmer, Ramsgate, Reculver, Stonor (Estanor), Sarre (or Serre) and Brightlingsea (in Essex). To Rye was attached the corporate member of Tenterden, and to Hythe the non-corporate member of West Hythe. The jurisdiction thus extends from Seaford in Sussex to Birchington near Margate in Kent, and includes part of the Essex coast.

The duty of the Cinque Ports until the reign of Henry VII. was to furnish nearly all the ships and men that were needful for the king's service; and for a long time after they were required to give large assistance to the permanent fleet. In return for their services the ports enjoyed extensive privileges (*see* Jeake's *Charters of the Cinque Ports*, still the chief authority in print).

The highest office in connection with the Cinque Ports is that of the lord warden, who is also constable of Dover Castle; the two offices have for centuries been held by the same persons, but are still distinct. He has a maritime jurisdiction as admiral of the ports. His power was formerly of great extent, but he has now practically no important duty to exercise except that of chairman of the Dover harbour board. Walmer Castle was for long the official residence of the lord warden, and its use as such, though intermittent, is not obsolete.

Admiralty Jurisdiction.—The court of admiralty for the Cinque Ports exercises a co-ordinate but not exclusive admiralty jurisdiction over persons and things found within the territory of the Cinque Ports. The limits of its jurisdiction were declared at an inquisition taken at the court of admiralty, held by the seaside at Dover in 1682, to extend from Shore Beacon in Essex to Redcliff, near Seaford, in Sussex; and with regard to salvage, they comprise all the sea between Seaford in Sussex to a point five miles off Cape Grisnez on the coast of France, and the coast of Essex. An older inquisition of 1526 is given by R. G. Marsden in his *Select Pleas of the Court of Admiralty*, II. xxx. The judge sits as the official and commissary of the lord warden, just as the judge of the high court of admiralty sat as the official and commissary of the lord high admiral. And, as the office of lord warden is more ancient than the office of lord high admiral (*The Lord Warden* v. *King in his office of Admiralty*, 1831, 2 Hagg. Admy. Rep. 438), it is probable that the Cinque Ports court is the more ancient of the two.

The jurisdiction of the court is in theory concurrent with that of the king's court of admiralty, subject to some statutory modifications. Cases of collision have been tried in it (the "Vivid," 1 *Asp. Maritime Law Cases*, 601), but of late mainly salvage cases (the "Clarisse," *Swabey*, 129; the "Marie," *Law. Rep.* 7 *P.D.* 203).

Dr. (afterwards the Right Hon. Robert Joseph) Phillimore succeeded his father as judge of the court from 1855 to 1875. He was succeeded by Arthur Cohen, K.C. In 1914 Cohen resigned, and Sir F. Pollock was appointed by Lord Beauchamp, who had lately become lord warden. As Sir R. Phillimore was also the last judge of the high court of admiralty, from 1867 (the date of his appointment to the high court) to 1875, the two offices were, probably for the only time in history, held by the same person. Dr. Phillimore's patent had a grant of the "place or office of judge official and commissary of the court of admiralty of the Cinque Ports, and their members and appurtenances, and to be assistant to my lieutenant of Dover castle in all such affairs and business concerning the said court of admiralty wherein yourself and assistance shall be requisite and necessary." Of old the court sat sometimes at Sandwich, sometimes at other ports. But the regular place for the sitting of the court has for a long time been, and still is, the aisle of St. James's church, Dover. For convenience the judge has in recent times sat at the royal courts of justice. There has been no full sitting since Cohen's time. The office of marshal in the high court is represented in this court by a serjeant, who also bears a silver oar. There is a registrar who, according to general civilian practice, can act as the judge's deputy; he deals at Dover with the small matters which keep the jurisdiction alive. An appeal is to the king in council, advised by the judicial committee. For details of the jurisdiction *see* the Cinque Ports Act, 1821. At present the judge's only active duty is to officiate at the installation of a new lord warden. Sir F. Pollock died Jan. 18, 1937.

The Cinque Ports from the earliest times claimed to be exempt from the jurisdiction of the admiral of England. Their early charters do not, like those of Bristol and other seaports, express this exemption in terms. It seems to have been derived from the general words of the charters which preserve their liberties and privileges.

The lord warden's claim to prize was raised in, but not finally decided by, the high court of admiralty in the "Ooster Ems," 1 *C. Rob.* 284, 1783. No trace has been found of any later attempt to assert it.

See S. Jeake, *Charters of the Cinque Ports* (1728); Knocker, *Grand Court of Shepway* (1862); M. Burrows, *Cinque Ports* (1895); *Indices of the Great White and Black Books of the Cinque Ports* (1905); Benoist-Lucy, *Les Cinq-Ports* (1911), a short but accurate study; J. H. Round, *Feudal England* (1895), p. 552 *seq.*; *Encyclopaedia of the Laws of England* (2nd edition, 1907) iii. 70; Halsbury, *Laws of England*, i. 139; ix. 127; Sir F. Pollock, "Cinque Ports Jurisdiction,"

Law Quart. Rev. xli. 453. The archives of the Cinque Ports are naturally not in one place; the chief repositories are at New Romney, Dover and Rye.

CINTRA, town of central Portugal (modern spelling, Sintra), 17m. W.N.W. of Lisbon by the Lisbon-Caçem-Cintra railway, and 6 mi. N. by E. of Cape da Roca, the westernmost promontory of the European mainland. Pop. (1940) 6,307. Cintra is magnificently situated on the northern slope of the Serra da Cintra, a rugged mountain mass, largely overgrown with pines, eucalyptus, cork and other forest trees, above which the principal summits rise in a succession of bare and jagged grey peaks; the highest being Cruz Alta (1,772ft.). Every educated Portuguese is familiar with the verses in which the beauty of Cintra is celebrated by Byron in *Childe Harold* (1812), and by Camoens in the national epic *Os Lusiadas* (1572). One of the highest points of the Serra is surmounted by the Palacio da Pena, a fantastic imitation of a mediaeval fortress, built on the site of a Hieronymite convent by the prince consort Ferdinand of Saxe-Coburg (d. 1885); while an adjacent part of the range is occupied by the Castello des Mouros, an extensive Moorish fortification containing a small ruined mosque and a very curious set of ancient cisterns.

In the town itself the most conspicuous building is a 14th–15th-century royal palace, partly Moorish, partly debased Gothic in style, and remarkable for the two immense conical chimneys. The 18th-century Palacio de Seteaes is said to derive its name ("Seven Ahs") from a sevenfold echo; here, on Aug. 22, 1808, was signed the convention of Cintra, by which the British and Portuguese allowed the French army to evacuate the kingdom. Beside the road which leads for 3½m. W. to the village of Collares, celebrated for its wine, is the Penha Verde, an interesting country house and chapel, founded by Dom João de Castro (1500–1548), fourth viceroy of India. Castro also founded the Capuchin convent of Santa Cruz, better known as the Cork convent. Beyond the Penha Verde, on the Collares road, are the palace and park of Montserrate. The palace was originally built by William Beckford, the novelist and traveller (1761–1844), and was purchased in 1856 by Sir Francis Cook, an Englishman, who afterwards obtained the Portuguese title viscount of Montserrate. The park, with its tropical luxuriance of vegetation and its variety of lake, forest and mountain scenery, is by far the finest example of landscape gardening in the Iberian Peninsula, and probably among the finest in the world.

CIPHER or **CYPHER,** the symbol o, nought, or zero (Arab. *ṣifr,* void), and so a name for symbolic or secret writing (*see* CRYPTOGRAPHY), or for shorthand (*q.v.*), and also in elementary education for doing simple sums ("ciphering").

CIPPUS (Lat. for a "post" or "stake"), in architecture, a low pedestal, either round or rectangular, set up by the Romans for various purposes such as military or mile stones, boundary posts, etc. The inscriptions on some in the British Museum show that they were occasionally funeral memorials.

CIPRIANI, GIOVANNI BATTISTA (1727–1785), Italian painter and engraver, Pistoiese by descent, was born in Florence in 1727. He studied first under Ignatius Heckford or Hugford, and afterwards under Antonio Domenico Gabbiani. He was in Rome from 1750 to 1753, where he became acquainted with Sir William Chambers, the architect, and Joseph Wilton, the sculptor, whom he accompanied to England in Aug., 1755. When Chambers designed the Albany in London for Lord Holland, Cipriani painted a ceiling for him. He also painted part of a ceiling in Buckingham Palace, and a room with poetical subjects at Standlynch in Wiltshire. Some of his best and most permanent work was, however, done at Somerset House, London, built by his friend Chambers. He not only prepared the decorations for the interior of the north block, but, says Joseph Baretti in his *Guide through the Royal Academy* (1780), "the whole of the carvings in the various fronts of Somerset place—excepting Bacon's bronze figures—were carved from finished drawings made by Cipriani." These designs include the five masks forming the keystones to the arches on the courtyard side of the vestibule, and the two above the doors leading into the wings of the north block, all of which are believed to have been carved by Nollekens. The grotesque groups flanking the main doorways on three sides of the quadrangle and the central doorway on the terrace appear also to have been designed by Cipriani. The central panel of the library ceiling was painted by Sir Joshua Reynolds, but the four compartments in the coves, representing Allegory, Fable, Nature and History, were Cipriani's. These paintings still remain at Somerset House, together with the emblematic painted ceiling, also his work, of what was once the library of the Royal Society. He was an original member of the Royal Academy (1768), for which he designed the diploma so well engraved by Bartolozzi. He was much employed by the publishers, for whom he made drawings in pen and ink, sometimes coloured. His friend Bartolozzi engraved most of them. Drawings by him are in both the British Museum and Victoria and Albert Museum, London. His best autograph engravings are "The Death of Cleopatra," after Benvenuto Cellini; "The Descent of the Holy Ghost," after Gabbiani; and portraits for Hollis's memoirs, 1780. He painted allegorical designs for George III.'s state coach—which is still in use—in 1782, and repaired Verrio's paintings at Windsor and Rubens's ceiling in the Banqueting House at Whitehall. He designed nymphs and *amorini* and medallion subjects to form the centre of Pergolesi's bands of ornament, and they were continually reproduced upon the elegant satin-wood furniture which was growing popular in his later days. Almost certainly some of the beautiful furniture designed by the Adams was actually painted by Cipriani himself. He also occasionally designed handles for drawers and doors. Cipriani died at Hammersmith in 1785 and was buried at Chelsea, where Bartolozzi erected a monument to his memory. He had married an English lady, by whom he had two sons.

CIRCAR, an Indian term applied to the component parts of a *subah,* or province, each of which is administered by a deputy-governor. In English it is principally employed in the name of the Northern Circars, used to designate a now obsolete division of the Madras presidency, which consisted of a narrow slip of territory lying along the western side of the bay of Bengal from 15° 40′ to 20° 17′ N. lat. These Northern Circars were five in number, Chicacole, Rajahmundry, Ellore, Kondapalli and Guntur, and their total area was about 30,000 sq. miles.

The district corresponds in the main to the modern districts of Kistna, Godavari, Vizagapatam, Ganjam and a part of Nellore. It was first invaded by the Mohammedans in 1471 and conquered by them in the following century, but they appear to have acquired only an imperfect possession of the country, as it was again wrested from the Hindu princes of Orissa about the year 1571. In 1687 the Circars were added, along with the empire of Hyderabad, to the empire of Aurangzeb. In 1759, by the conquest of Masulipatam, the dominion of the maritime provinces on both sides, from the river Gundlakamma to the Chilka lake, was transferred from the French to the British. But the latter left them under the administration of the nizam, with the exception of the town and fortress of Masulipatam, which were retained by the English East India company. In 1765 Lord Clive obtained from the Mogul emperor Shah Alam a grant of the five Circars. Hereupon the fort of Kondapalli was seized by the British, and in 1766 a treaty of alliance was signed with Nizam Ali, by which the company, in return for the grant of the Circars, undertook to maintain troops for the nizam's assistance. By a second treaty, signed in 1768, the nizam acknowledged the validity of Shah Alam's grant and resigned the Circars to the company, receiving as a mark of friendship an annuity of £50,000. Guntur, as the personal estate of the nizam's brother, was excepted during his lifetime under both treaties. He died in 1782, but it was not till 1788 that Guntur came under British administration. In 1823, the claims of the nizam over the Northern Circars were bought out by the company, and they became a British possession.

CIRCASSIA: *see* CAUCASIAN AREA, NORTH; KARACHAEV; KABARDA-BALKARIA; INGUSHETIA; ADIGEI.

CIRCASSIANS. The Cherkesses or Circassians differ from the other tribes of the Caucasus in origin and language. They designated themselves by the name of Adigheb, that of Cherkesses

being a term of Russian origin. The government under which they lived was a peculiar form of the feudal system. The free Circassians were divided into three distinct ranks, the princes or *pshi,* the nobles or *uork* (Tatar *usden*), and the peasants or *hokotl.* They were also divided into numerous families, tribes or clans, some of which were very powerful and carried on war against each other with great animosity. The slaves, of whom a large proportion were prisoners of war, were generally employed in the cultivation of the soil, or in the domestic service of some of the principal chiefs.

The will of the people was the supreme source of authority; and every free Circassian had a right to express his opinion in those assemblies of his tribe in which the questions of peace and war, almost the only subjects which engaged their attention, were brought under deliberation. The princes and nobles, the leaders of the people in war and their rulers in peace, were only the administrators of a power which was delegated to them. The administration of justice was regulated solely by custom and tradition, and in those tribes professing Mohammedanism by the precepts of the Koran. The most aged and respected inhabitants of the various auls or villages frequently sat in judgment, and their decisions were received without a murmur by the contending parties. The Circassian princes and nobles were professedly Mohammedans; but in their religious services many of the ceremonies of their former heathen and Christian worship were still preserved. A great part of the people had remained faithful to the worship of their ancient gods—Shible, the god of thunder, of war and of justice; Tleps, the god of fire; and Seosseres, the god of water and of winds. One of their marriage ceremonies was that the young man who had been approved by the parents, and had paid the stipulated price in money, horses, oxen, or sheep for his bride, was expected to come with his friends fully armed and to carry her off by force from her father's house. Every free Circassian had unlimited right over the lives of his wife and children. Although polygamy was allowed by the laws of the Koran, the custom of the country forbade it. The respect for superior age was carried to such an extent that the young brother used to rise from his seat when the elder entered an apartment, and was silent when he spoke. Circassians were distinguished for the most generous hospitality and implacable vindictiveness. The individual who had slain any member of a family was pursued with implacable vengeance by the relatives, until his crime was expiated by death. The murderer might, indeed, secure his safety by the payment of a certain sum of money, or by carrying off from the house of his enemy a newly-born child, bringing it up as his own and restoring it when its education was finished. In either case, the family of the slain individual might discontinue the pursuit of vengeance without any stain upon its honour. The man closely followed by his enemy, who, on reaching the dwelling of a woman, had merely touched her hand, was safe from all other pursuit so long as he remained under the protection of her roof. The commission of theft was not considered so disgraceful as its discovery. The Circassian father was always willing to part with his daughters to Turkish merchants for the harems of Eastern monarchs. But no degradation was implied in this transaction, and the young women themselves were generally willing partners in it. Herds of cattle and sheep constituted the chief riches of the inhabitants. The princes and nobles, from whom the members of the various tribes held the land which they cultivated, were the proprietors of the soil. The Circassians carried on little or no commerce.

CIRCE, in Greek legend, a famous sorceress, the daughter of Helios and the ocean nymph Perse. She was able by means of drugs and incantations to change human beings into the forms of wolves or lions, and with these beings her palace was surrounded. Odysseus visited her island, Aiaie, with his companions, whom she changed into swine, but the hero, protected by the herb *molu,* which he had received from Hermes, compelled her to restore them to their original shape. He lived with her for a year, and when he determined to leave, she instructed him how to sail to the House of Hades in order to learn his fate from the prophet Teiresias. Upon his return she also gave him directions for avoiding the dangers of the journey home (Homer, *Odyssey,* x.–xii.; Hyginus, *Fab.* 125). Graeco-Italian tradition placed her island near Italy, or located her on the promontory Circei. *Cf.* PICUS, SCYLLA AND CHARYBDIS.

See C. Seeliger in W. H. Roscher's *Lexikon der Mythologie.*

CIRCEIUS MONS (mod. MONTE CIRCEO), an isolated promontory on the south-west coast of Italy, about 80m. S.E. of Rome. It is a ridge of limestone about 3½m. long by 1m. wide at the base, running from east to west and surrounded by the sea on all sides except the north. The land to the north of it is 53ft. above sea-level, while the summit of the promontory is 1,775ft. The origin of the name is uncertain: it has naturally been connected with the legend of Circe. It is true that the promontory ceased to be an island at a very early date; but it looks exactly like one from a distance. Upon the east end of the ridge are the remains of an *enceinte,* forming a rectangle of about 200 by 100yds. of very fine polygonal work. It seems to have been an acropolis, and contains no traces of buildings, except for a subterranean cistern, circular, with a beehive roof of converging blocks. The modern village of S. Felice Circeo occupies the site of the ancient town, the citadel of which stood on the mountain top, for its mediaeval walls rest upon ancient walls of Cyclopean work of less careful construction than those of the citadel, and enclosing an area of 200 by 150yds.

Circeii was founded as a Roman colony at an early date. At the end of the republic, the city of Circeii was no longer at the east end of the promontory, but at the south end of the Lago di Paola (a lagoon—now a considerable fishery—separated from the sea by a line of sandhills and connected with it by a channel of Roman date; Strabo speaks of it as a small harbour). The transference of the city did not, however, mean the abandonment of the east end of the promontory, on which stand the remains of several very large villas. An inscription, indeed, cut in the rock near S. Felice, speaks of this part of the *promonturium Veneris* (the only case of the use of this name) as belonging to the city of Circeii. For its villas Cicero compares it with Antium, and both Tiberius and Domitian possessed residences there. The villa of the latter indeed, on the east shores of the Lago di Paola, has been mistaken for the Roman town of Circeii. It extends over an area of some 600 by 500yds., consisting of fine buildings along the lagoon, including a large open *piscina* or basin, surrounded by a double portico, while farther inland are several very large and well-preserved water-reservoirs, supplied by an aqueduct of which traces may still be seen. The beetroot and oysters of Circeii had a certain reputation.

The view from the highest summit of the promontory (which is occupied by ruins of a platform attributed with great probability to a temple of Venus or Circe) is of remarkable beauty; the whole mountain is covered with fragrant shrubs. From any point in the Pomptine Marshes or on the coast-line of Latium the Circeian promontory dominates the landscape in the most remarkable way.

See G. Lugli, *Forma Italiae* 1. i. 2. (1928), the Italian archaeological survey.

CIRCLE, a curve consisting of all those points of a plane which lie at a fixed distance from a particular point in the plane, called the *centre.*

The circle is the simplest and most useful *plane curve* and alone possesses the property of being exactly alike at all points. If the curve be turned in its plane about its centre, the new position taken up is the same as the original position. This property constitutes the "roundness" of the circle, and distinguishes it from other plane curves. A circle may be traced upon a plane by the continuous movement of a point rigidly connected with the centre, as in the use of compasses, and it is in part the simplicity of this construction which explains the fundamental importance of this curve. The tracing of a circle is a much simpler problem than the tracing of a straight line, since the common method of drawing the latter, with the aid of a ruler, only reproduces the straight line already constructed along the ruler's edge. A difference in the use of the word "circle" is observable between the older writers and those of the present century. With the former

the word is understood to mean the part of the plane enclosed by the curve, while the curve itself is called the *circumference*. The latter consider the circle and its circumference identical, except that the latter is often spoken of as the measure of the former; and the enclosed portion of the plane is spoken of as the *interior*, not as the circle itself.

The straight line joining the centre to a point on the circle, *e.g.*, *OP* or *OQ* (fig. 1) is called a *radius;* from the definition of a circle, the radii drawn to various points on the circle are equal. A straight line drawn through the centre and having its ends on the circle, *e.g.*, *EOH* (fig. 1) is called a *diameter;* evidently all diameters of the same circle are equal in length, and twice as long as a radius. A straight line, such as *ABC* (fig. 1), joining *any* two points on a circle is called a chord; and the greatest possible chord is a diameter. The portion of the circle intercepted between two points is called an *arc*. Any two points on the circle divide it into two arcs; thus, in fig. 1, *ADC* is the *minor arc*, and *APEC* the *major arc*, between *A* and *C*. The figure composed of an arc and the chord joining its extremities is a *segment* of the circle. In fig. 1, *ADCB* and *APECB* are respectively the minor and major segments made by the chord *AC*. A *sector* of a circle is the figure formed by two radii and one of the arcs joining their extremities. The angle between these radii and within the sector is called the angle of the sector. Thus *ODKC* (fig. 1) is a sector, and *DOC* its angle.

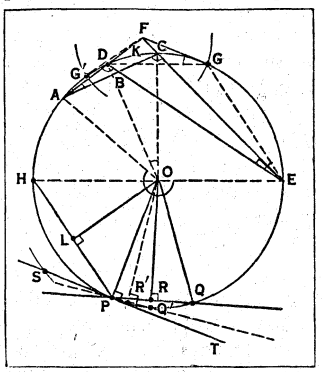


FIG. 1.—THE CIRCLE AND ITS PARTS Showing the radius OP or OQ, diameter EOH, chord ABC, minor arc ADC, major arc APEC, minor and major segments ADCB and APECB, sector ODKC and the angle of sector DOC

Geometrical Properties.—A number of properties of the circle are direct results of the symmetry and regularity of the curve. For instance, if two chords in the same circle are equal, the arcs corresponding to them are equal; if two sectors of the same circle have equal angles, they have equal arcs, and contain equal areas, etc. A useful property of this kind is that *every chord is bisected by the perpendicular drawn to it from the centre*. This allows the centre to be found when the circle is given, and to draw the circle when three points on it are given. Thus, to construct the circle through *H, P* and *Q*, draw the perpendicular bisectors *LO* and *RO* to *HP* and *PQ* as in fig. 1, and take as centre the point *O* where these meet.

A less evident property is that, *when any arc is taken, the angle between the lines joining its end-points to the centre is double the angle between the lines joining these end-points to any point on the remaining part of the circle, each angle being measured in the position facing the arc.* In fig. 1, by using the minor arc *CD*, the angle *COD* is double the angle *CED*, and also double the angle *CAD*. By using the major arc *APE*, the outer (reflex) angle *AOE* is double either *ACE* or *ADE*. An immediate consequence is that the angle *ACE* is equal to the angle *ADE*. Here *A, C, D* and *E* are any four points on a circle so placed that *C* and *D* lie on the same arc having *A* and *E* for end-points. The theorem is commonly stated in the form: *angles in the same segment are equal.* (To exhibit the segment it is necessary to join *AE*.) It is a property of wide application, and numerous instances of it may be seen in fig. 1 by joining various pairs of points. Thus the angles *CAD, CED, CGD, CQD* (when the lines *CQ, QD* and *CG* are drawn), are equal. In particular, *the angle in a semi-circle is a right angle.* Closely related to this is the theorem that *a four-sided figure whose four corners all lie on the same circle has the sum of either pair of opposite angles equal to two right angles.* The converse is true that if the sum of one of the pairs of opposite angles of a four-sided plane figure is two right angles, a circle may be drawn to pass through the four corners.

It is readily seen that a straight line whose shortest distance from the centre is less than the radius cuts a circle in two points, and that a line whose shortest distance is greater than the radius does not meet the circle at any point. The intermediate case occurs when the line is at a distance from the centre equal to the radius, as is the case with *SPT* (fig. 1). Such a line has only one point in common with the circle; it is said to *touch* the circle and is called a *tangent* to the circle. The tangent at any point of a circle is the line through that point drawn at right angles to the radius; thus *OPT* is a right angle. The tangent at *P* is the limiting position approached by a chord *PQ*, drawn through *P*, as the other extremity *Q* approaches *P*. The chord must be prolonged as shown in the figure, in order that it may not be lost as its length vanishes. It is known that the perpendicular *OR* from the centre falls on the middle point of the chord. As *Q* moves to *Q'*, *R* moves to *R'*, and, as *Q* approaches *P*, *R* approaches *P* also. Finally the right angle *ORQ* approaches the limiting position *OPT*, and the chord *PQ*, prolonged sufficiently, is finally represented by the tangent *PT* at right angles to the radius *OP*. This second view of a tangent, as the limiting form of a short chord, is more generally applicable than the former, being valid for curves other than circles. It also enables many tangent theorems to be recognized as the limiting forms of related theorems on chords, and leads to a better understanding of tangent relations.

From a point *F* outside a circle two tangents may be drawn. The *points of contact G* and *G'* of these may be found by first drawing the tangent at a point *P* on the circle, finding with the compasses a point *S* on this such that *OS=OF*, and then finding *G* and *G'* on the circle and at distance from *F* equal to *PS*. *The angle made by a tangent with a chord through its point of contact is equal to the angle in the segment on the other side of the chord.* Thus the angle *FGD* is equal to the angle *GED*. An important theorem on intersecting chords follows readily from the law of equal angles in a segment. *If two chords intersect, the product of the distances of the extremities from the point of intersection is the same for either chord.* Thus, in fig. 1, *AC* and *DE* intersect at *B*. The figure represents the case where *AB* contains 4·5 units, *BC* 3·2 units, *DB* 1 unit, and *BE* 14·4. It will be seen that $4{\cdot}5\times3{\cdot}2=1\times14{\cdot}4$. The relation remains true when the chords have to be prolonged to meet outside the circle, as *AD* and *CE*, meeting at *F*. In the figure *AF*=7·2, *DF*=3·2, *CF*=1·6 and *EF*=14·4, so that $AF\times DF=CF\times EF$, each being 23·04. In the case of external intersection each of the equal products is also equal to the *square of the tangent from the point of intersection.* In the figure, *FG*=4·8, the square of which is 23·04. This is one of the cases where the tangent represents a chord whose ends are coincident.

Circle Constructions.—The circle plays an important part in the problems of constructive geometry. This will be easily understood when it is remembered that, in the traditional view, a geometrical solution means a solution by ruler and compasses; that is, the only steps available are to rule a straight line through two given points and to draw a circle having a given centre and radius. It is therefore a matter of importance to the student of geometry to be able to construct circles to satisfy various standard sets of conditions; and several of these processes will be indicated briefly:

1. *Circle through three given points.* The method of finding the centre by the right bisectors of the joining lines has already been given. When the three points are thought of as the corners of a triangle, the circle is said to be *circumscribed* to the triangle.

2. *Circle touching three given straight lines.* Bisect the angles between two of the lines *l* and *m*, obtaining a pair of bisector lines *a* and *b*. Bisect in the same way the angles between *l* and the third line *n* by a pair of bisectors *c* and *d*. The centre of a circle touching *l* and *m* must be equidistant from *l* and *m*, and so must lie either on *a* or on *b*. The centre of a circle touching *l* and *n* must be either on *c* or on *d*. Four solutions are obtained, the positions of the centre being the intersections of *a* and *c*, of *a* and *d*, of *b* and *c*, and of *b* and *d*. The circle that lies between the given lines and touches them is said to be *inscribed* to the triangle.

3. *Circle through two given points and touching a given line* (which does not pass between the points). Let *A* and *B* be the

given points, and l the given line (fig. 2). Let AB cut l in O. Draw any circle c through A and B, by taking as centre any point on the right bisector of AB. Draw the tangent OT touching c at T. Find points H and K on l so that $KO=OH=OT$. The circle c_1 through A, B and H and the circle c_2 through A, B and K will each be a solution of the problem. The proof is briefly that $OH^2=OK^2=OT^2=OA.OB$, so that OH and OK are each of the right length for a tangent from O.

4. *Circle through a given point and touching two given lines.* Let l and m (fig. 2) be the given lines, and A the given point. Draw n, the bisector of that angle between l and m in which A lies. Draw AL perpendicular to n and prolong to B so that $LB=AL$. The circles c_1 and c_2 constructed as in 3 to pass through A and B and to touch l will then constitute the two solutions of the problem.

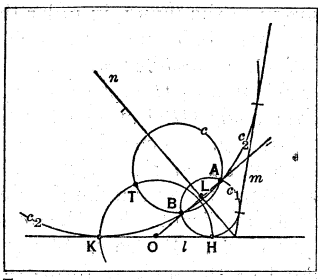


FIG. 2.—SHOWING THE CONSTRUCTION OF A CIRCLE THROUGH TWO GIVEN POINTS AND TOUCHING A GIVEN LINE, AND THROUGH A GIVEN POINT TOUCHING TWO GIVEN LINES

Circle constructions in which some of the conditions are that the circle should touch certain given circles require refined geometrical methods. A celebrated case of this type is Apollonious's problem: —*to construct a circle to touch three given circles.* If the three circles are entirely external to one another, this problem admits of eight solutions. A number of problems of this kind, due to Jakob Steiner and others, are discussed by Coolidge (*see* bibl.). It is often useful to remember that a circle through two given points may have its centre anywhere on the right bisector of their joining line, and that a circle touching two given intersecting straight lines has its centre anywhere on either of the lines bisecting the angles between them. A circle through a given point and touching a given line has its centre on a curve known as a parabola; but this fact is not of much direct assistance in finding constructions.

In many cases a point moving under specified conditions traces a circular path. The definition of the circle shows that this curve is the *locus* (or path) of a variable point whose distance from a fixed point remains constant. But there are numerous other ways in which the circular path may be recognized. If the base of a triangle is fixed, and the angle at the vertex is of constant magnitude, the moving vertex traces an arc of a circle as long as it remains on the same side of the fixed base; the property involved here is that of equal angles in a segment. If the base of a triangle is fixed, and the other two sides are in constant ratio, the moving vertex traces a circle which encloses one of the fixed vertices. If the sum of the squares of the distances of a variable point from two fixed points is constant, the point traces to a circle whose centre is half-way between the two fixed points.

Analytic Treatment. — We may take for axes of reference two lines OX and OY at right angles; and, drawing PN perpendicular to OX from any point P, denote by x and y the measurements ON and NP. The two quantities x and y are called the co-ordinates of P, and the position of P depends on their values. the point P is denoted by (x, y).

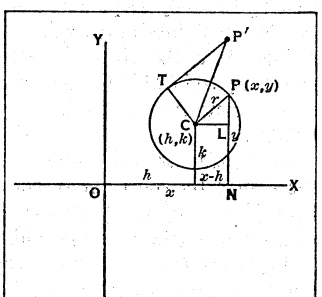


FIG. 3.—ANALYSIS OF THE CIRCLE TO DETERMINE ITS EQUATION

If C is a fixed point (h, k), P will be restricted to a circle of centre C and radius r provided $CP=r$; *i.e.*, $CP^2=r^2$, or $CL^2+LP^2=r^2$, if CL is perpendicular to NP; therefore

$$(x-h)^2+(y-k)^2=r^2 \qquad (1)$$

This is the *equation of the circle.* The variable point P will lie on the circle if, and only if, (1) is satisfied.

The equation $x^2+y^2+2ax+2by+c=0$ ..... (2)

may be written in the form $(x+a)^2+(y+b)^2=a^2+b^2-c$, which is equivalent to (1) if $h=-a$, $k=-b$ and $r^2=a^2+b^2-c$. The last of these conditions is not possible for any real value of r if a^2+b^2-c is negative; but, if a^2+b^2-c is positive, the equation (2) is seen to represent a circle whose centre is $(-a,-b)$ and *radius* $\sqrt{(a^2+b^2-c)}$. The constants a, b and c in (2) may be determined to satisfy specified conditions, and the circle becomes then definitely fixed. For instance, if the circle is to pass through three given points, the co-ordinates of these must satisfy the equation (2), and, on substituting them for x and y, three equations are obtained giving a, b and c. If the point (x, y) is not on the circle, but outside it, as at P' (fig. 3), the left-hand side of equation (2) is *not* equal to zero, but, when written as $(x+a)^2+(y+b)^2-(a^2+b^2-c)$, or $(x-h)^2+(y-k)^2-r^2$, is seen to represent CP'^2-CT^2 (if $P'T$ is a tangent), which is $P'T^2$.

A point (x, y) from which the tangent to the circle (2) is equal to the tangent to the circle $x^2+y^2+2a'x+2b'y+c'=0$ ..... (3) satisfies the equation

$$x^2+y^2+2ax+2by+c=x^2+y^2+2a'x+2b'y+c';$$
$$i.e.,\ 2(a-a')x+2(b-b')y+(c-c')=0.$$

This equation (if the circles (2) and (3) have not the same centre) is of the first degree, so that the point (x, y) lies on a fixed straight line, called the *radical axis* of the circles. If the circles (2) and (3) have two points in common, the radical axis is the line joining these points. The equation $x^2+y^2+2kx+c=0$ represents, for different values of c, different circles of which any two have OY for radical axis. These circles are said to form a *coaxial system.* If c is negative, all the circles pass through the same two points on OY. If c is positive, none of the circles intersect. In either case one circle of the system may be found to pass through any given point not on OY.

The equation of the tangent at a point (x_1, y_1) on the circle (2) may be shown to be

$$x_1x+y_1y+a(x+x_1)+b(y+y_1)+c=0. \qquad (4)$$

If, however, (x_1, y) is not on, but outside the circle, equation (4) represents the *polar* of (x_1, y_1) that is the straight line joining the points of contact of tangents from (x_1, y_1).

Mensuration of the Circle.—The ratio of the length of the circumference to the diameter is the same for all circles. This number can only be calculated approximately, and is 3·141592-65358979323846 as far as 20 places of decimals. The true value of this number is always denoted by π, and has been recognized from antiquity as a most important constant. $\frac{22}{7}$ may be used as a rough approximation to π. Mathematicians have devoted an incredible amount of time to the calculation of this number, even reaching hundreds of decimal places. It is difficult to believe, however, that more than about ten figures could ever be put to any practical use; in fact 3·1415926 is likely to serve well enough. If r is the radius, the length of the whole circumference is $2\pi r$.

Let s measure the arc AB, c the chord AB, and h the distance from the middle of the arc to the chord. By dividing up the area of the sector AOB as suggested (fig. 4), and reasoning from the sum of a number of small triangles, it is inferred that the *area of the sector* is $\frac{1}{2}rs$; and the area of the whole circle is $\frac{1}{2}r\times 2\pi r=\pi r^2$.

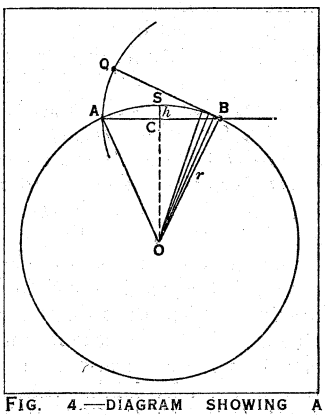


FIG. 4.—DIAGRAM SHOWING A METHOD OF DETERMINING THE AREA OF A CIRCLE

It has long been known that no construction by ruler and compasses can furnish a straight line of length equal to that of the circumference of a given circle, or a square equal in area to a given circle; though in ancient times "squaring the circle" was considered an important unsolved problem. Also a straight line cannot be constructed equal to any given arc of a circle, though approximate methods exist which work well for an arc which is not

too large compared with the radius. For instance, produce AB to P, making $BP=\frac{1}{2}AB$. With centre P and radius PA draw an arc cutting at Q the tangent at B. Then BQ = the arc AB approximately. For an arc forming a quarter circle the error is about one part in 300. For $\frac{1}{36}$ of the circumference the error is less than one in a million. An approximate relation between c, h and s is $s=c+8h^2/(3c)$. For a value of h less than $\frac{1}{12}$ of c, this gives s to within $\frac{1}{10,000}$ of its value. The radius of the circle does not appear in this relation. As an example of its use, if $c=144$, and $s=144{\cdot}2$, then $h=3{\cdot}3$.

BIBLIOGRAPHY.—Euclid, *Elements*, Bk. III; J. L. Coolidge, *A Treatise on the Circle and the Sphere* (1916); H. S. Hall and F. H. Stevens, *A School Geometry* (1924); D. M. Y. Sommerville, *Analytical Conics* (1924).

CIRCLEVILLE, a city of Ohio, U.S.A., on the Scioto river, 25m. S. of Columbus; the county seat of Pickaway county. It is on federal highways 22 and 23 and is served by the Norfolk and Western and the Pennsylvania railways. The population in 1940 was 7,982. Canned vegetables, pork products, straw paper for boxes, stock feeds and soybean meal and oil are among its distinctive manufactures. An annual pumpkin show is held.

The city was laid out (1806) within a circular embankment of prehistoric origin, with an octagonal court-house in the centre and circular streets around it. The court-house was burned in 1841, and no trace remains of the original plan or of the ancient earthworks. The city was chartered in 1853.

CIRCUIT is a path for transmitting electrical energy.

CIRCUIT RIDER, a preacher or minister who supplies several localities, preaching at each in succession and thereby forming a "circuit." Francis Asbury, a follower of John Wesley inaugurated the custom in the United States in Nov. 1771, and for 45 years travelled on horseback, at the rate of 5,000 m. a year, preaching twice a day on weekdays and three times on Sunday. Each circuit was under the supervision of a Wesleyan conference preacher and he might have any number of lay-assistants. Any young man who showed aptness for public speaking and willingness to endure the hardships of travelling in the saddle for weeks at a time over a wild and rough country, might become an assistant and finally a circuit rider. The salary was $64 a year until 1800, when it was raised to $80 a year, with the horse furnished by the circuit. There were almost no meeting houses and services were held in log cabins, bar-rooms or in the open. Circuit riders were a considerable religious and moral force, especially along the frontier.

CIRCUITS, in a legal sense, are the periodical progresses of the judges of the superior courts of common law through the several counties of a given region for the purpose of administering civil and criminal justice. These modern circuits in progresses have taken the place of the *eyres* or *itinera* of the ancient system. The word circuit is also applied to the rotative sittings of judges of county courts in the various towns of the districts over which they preside.

It is provided by s. 70 of the Supreme Court of Judicature (Consolidation) Act, 1925, that judges of the king's bench division of the high court and every judge of the probate division (if the state of business of that division permit) together with such commissioners of assize as may be appointed by letters patent shall be judges of assize. By virtue of their commission all judges and commissioners of assize are entitled within the districts fixed by their commission (including the counties palatine of Lancaster and Durham) to exercise all the powers of civil or criminal jurisdiction capable of being exercised by the high court, including (s. 71) the trial of revenue causes or proceedings. It is further provided by the act (s. 77) that: If at any time it appears to the lord chief justice that there is no business, or no substantial amount of business, to be transacted at the assizes about to be held at any particular place on a circuit, he may, with the concurrence of the lord chancellor, direct that assizes shall not on that occasion be held at such place.

The general regulation of circuits throughout England and Wales, in modern times, was originally provided for by s. 23 of the Judicature Act, 1875 (now replaced by s. 70 of the Supreme Court of Judicature [Consolidation] Act, 1925). By this section power was conferred on the Crown by order in council to make regulations respecting circuits, including the discontinuance of any circuit, and the appointment of the places at which assizes are to be held on any circuit. Under this power, an order in council, dated Feb. 5, 1876, was made reconstructing and remodelling the circuit system throughout England and Wales. By virtue of this order the then existing circuits were discontinued and were replaced by fresh circuits. These, after various mutations, are now settled as follows: the northern, the north-eastern (taken from the northern), the midland, the south-eastern, the Oxford, the western, and the north Wales (with Chester) and south Wales (divisional) circuits. The delimitation of these circuits together with the names of the towns throughout England and Wales at which assizes are held are set out in some 14 orders in council, all of which are printed in *Statutory Rules and Orders.* Birmingham was first constituted a circuit town in the year 1884 and, by arrangement, the work there became the joint property of the midland and Oxford circuits. There are alternative assize towns in the following circuits, viz., on the western circuit, Salisbury and Devizes for Wiltshire and Wells and Taunton for Somerset; on the south-eastern, Ipswich and Bury St. Edmunds for Suffolk; on the north Wales circuit, Welshpool and Newtown for Montgomery; and in the south Wales (division), Cardiff and Swansea for Glamorgan.

The approximate dates for the holding of circuit assizes are: winter (about the middle of January), summer (about the middle of May), and autumn (about the middle of October). Spring assizes for both civil and criminal business are held in April and May in two circuits only, viz., at Manchester and Liverpool on the northern, and at Leeds on the north-eastern. In the past considerable difficulty was experienced in coping with assize work in the provinces and at the same time maintaining the efficiency of the common law sittings in London. With the object of obviating this as far as possible it has been arranged that certain of the common law judges shall remain in London during the whole of the circuits, and the others until their respective commission days which are generally arranged to fall on varying dates.

Counsel are not expected to practise on a circuit other than that to which they have attached themselves, unless they receive a special retainer. They are then said to "go special," and the fee in such a case is 100 guineas for a king's counsel and 50 guineas for a junior. In such cases it is customary to employ in the action one member of the circuit on which the counsel has come special. Certain rules have been drawn up by the bar council for regulating the practice as to retainers on circuit: (1) A special retainer must be given for a particular assize (a circuit retainer will not, however, make it compulsory upon counsel retained to go the circuit, but will give the right to counsel's services should he attend the assize and the case be entered for trial); (2) if the venue is changed to another place on the same circuit, a fresh retainer is not required; (3) if the action is not tried at the assize for which the retainer is given, the retainer must be renewed for every subsequent assize until the action is disposed of, unless a brief has been delivered; (4) a retainer may be given for a future assize, without a retainer for an intervening assize, unless notice of trial is given for such intervening assize. There are also various regulations enforced by the discipline of the circuit bar mess.

In Scotland the judges of the supreme criminal court, or high court of justiciary, form also three separate circuit courts, consisting of two judges each; and the country, with the exception of the Lothians, is divided into corresponding districts, called respectively the northern, western and southern circuits. On the northern circuit, courts are held at Inverness, Perth, Dundee and Aberdeen; on the western, at Glasgow, Stirling and Inveraray; and on the southern, at Dumfries, Jedburgh and Ayr. (W. W.-P.)

United States.—In the Federal judiciary in the United States there are nine circuit courts of appeals. Each has appellate jurisdiction over a number of the Federal district courts, and each has from three to six judges, appointed by the President. Judges of the district courts are competent to sit on this bench. A justice of the Supreme Court formerly visited each circuit once a year but this practice has substantially been abandoned. These courts have

appellate jurisdiction over most of the matters determined by the district courts, but certain matters are taken directly to the supreme court. The courts of appeals, which sit at the places indicated, are composed of the following districts: first circuit at Boston, Maine, New Hampshire, Massachusetts, Rhode Island and Puerto Rico; second circuit at New York, Vermont, Connecticut, northern, southern, eastern and western New York; third circuit at Philadelphia, New Jersey, eastern, middle and western Pennsylvania and Delaware; fourth circuit at Richmond, Maryland, northern and southern West Virginia, eastern and western Virginia, eastern and western North Carolina and eastern and western South Carolina; fifth circuit at Atlanta, with alternate sittings at Montgomery, Ft. Worth and New Orleans, northern, southern and middle Georgia, northern and southern Florida, northern, middle and southern Alabama, northern and southern Mississippi, eastern and western Louisiana, northern, southern, eastern and western Texas and the Canal Zone; sixth circuit at Cincinnati, northern and southern Ohio, eastern and western Michigan, eastern and western Kentucky, and eastern, middle and western Tennessee; seventh circuit at Chicago, Indiana, northern, southern and eastern Illinois, and eastern and western Wisconsin; eighth circuit at St. Louis, with alternate sittings at Denver, Cheyenne and St. Paul; Minnesota, northern and southern Iowa, eastern and western Missouri, eastern and western Arkansas, Nebraska, Colorado, Kansas, North Dakota, South Dakota, eastern, western and northern Oklahoma, Wyoming, Utah and New Mexico; ninth circuit at San Francisco, with alternate sittings at Seattle and Portland; northern and southern California, Oregon, Nevada, Montana, eastern and western Washington, Idaho, Arizona, Alaska and Hawaii.

In several of the states, such as Illinois and Massachusetts, the system of circuits prevails, with the judges sitting in succession in the various counties of the circuit. In a few states the term district judge is applied to such officials.

BIBLIOGRAPHY.—Clarence N. Callender's *American Courts, Their Organization and Procedure* (1927).

CIRCULAR NOTE, a documentary request by a bank to its foreign correspondents to pay a specified sum of money to a named person. The person in whose favour a circular note is issued is furnished with a letter (containing the signature of an official of the bank and the person named) called a letter of indication, which is usually referred to in the circular note, and must be produced on presentation of the note. Circular notes are generally issued against a payment of cash to the amount of the notes, but the notes need not necessarily be cashed, but may be returned to the banker in exchange for the amount for which they were originally issued. A forged signature on a circular note conveys no right, and as it is the duty of the payer to see that payment is made to the proper person, he cannot recover the amount of a forged note from the banker who issued the note. (*See* also LETTER OR BILL OF CREDIT.)

CIRCULARS AND CIRCULARIZING, a means of advertising and selling which has reached large proportions as a result of rapid printing and postal extension in the past half century. This consists of descriptive circulars and other forms of advertising literature sent through the mails to bring about sales direct to possible customers. It has long been widely used in France and the United States, in connection with catalogues mailed on request by department stores, seedsmen and manufacturers of various articles that can be economically shipped.

With the development of the mail-order houses, particularly in the United States, the use of this method of advertising has greatly extended. Catalogues of 1,000 pages or more sometimes are sent broadcast to urban and farm dwellers alike, who give orders for clothing, pianos, agricultural implements, household utensils and a great variety of other articles. The number of mail-order houses in the United States is estimated at 125, with yearly sales approximating $500,000,000. With the extension of the parcel post and favourable postal rates, this form of advertising has been widely adopted by manufacturers. (W. S. HI.)

CIRCULATING MEDIUM: *see* MONEY.

CIRCULUS IN PROBANDO, in logic, a phrase used to describe a form of argument in which the very fact which one seeks to demonstrate is used as a premise, *i.e.,* as part of the evidence on which the conclusion is based. This argument is one form of the fallacy known as *petitio principii,* "begging the question." It is most common in lengthy arguments, the complicated character of which enables the speaker to make his hearers forget the data from which he began. The following duologue may serve as a simple illustration of circular argument. "He speaks with angels," said one of the Master's disciples. "How know you that?" I asked. "He himself admits it," he replied solemnly. "But suppose he lies?" I persisted. "What!" he exclaimed, "a man who speaks with angels capable of telling a lie?" (*See* FALLACY.)

CIRCUMCISION. From a medical as distinguished from a ritual aspect this simple operation consists in removal of a sufficient portion of the foreskin to allow of its free retraction beyond the glans penis. The operation is performed chiefly for purposes of cleanliness and to facilitate removal of the smegma which normally collects beneath the foreskin but sometimes is necessary to allow free passage of urine. For these purposes it is done as a preventive measure in the infant. In adults the chief reason for its performance is balanitis or inflammation beneath the foreskin due to lack of cleanliness or to the presence of a venereal sore; in this case circumcision is a necessary part of the treatment. It is noteworthy that in India the Hindus who do not circumcise ritually suffer far more frequently from cancer of the penis than the Mohammedans who circumcise. Circumcision is also an initiation or religious ceremony among Jews and Mohammedans, and is a widespread institution in many Semitic races. It remains, with Jews, a necessary preliminary to the admission of proselytes. Its origin among them is placed in the age of Abraham (Genesis xvii), and at all events it must have been very ancient, for flint stones were used in the operation. The significance of the rite has been much disputed, including views that it was a tribal badge, a substitute for sacrifice and an act of cleanliness. Most probably, it was connected with marriage. (*See* MUTILATIONS AND DEFORMATIONS.)

CIRCUMNAVIGATION OF THE WORLD. Although the efforts to find a route to the Indies had already led to the great voyages of Columbus, the Cabots, Bartholomew Díaz and Vasco da Gama, to Ferdinand Magellan was due the honour of having first sailed round the world (1519–22), although he himself died on the way. The first British circumnavigator was Sir Francis Drake (1577–80), who was followed by others, English, French and Dutch in the next two centuries, until the celebrated three voyages of Captain James Cook in 1768–70, 1772–75, 1776–79, practically completed the discovery of the main outlines of the known world. (*See* individual biographies and the articles GEOGRAPHY and MAP.)

CIRCUMSTANTIAL EVIDENCE is a kind of indirect evidence. Suppose something happens in the presence of witnesses who observe it, then their evidence is *direct* evidence of the occurrence. But now suppose there is no such direct evidence of the event, then we have to rely on indirect evidence, if any. Such indirect evidence usually consists of certain circumstances surrounding the event or in some way connected with it. By piecing these circumstances together we may get an intelligible, coherent account of the whole course of the event or events in question. This piecing together of the data is a kind of hypothesis, and there may be several rival hypotheses to account for the facts. But as in all cases of the use of hypotheses, the hypothesis which gives the most adequate and consistent explanation is usually accepted. Inference from circumstantial evidence resembles ordinary induction to the extent that it involves the use of hypotheses and their verification, but it is unlike ordinary induction inasmuch as it does not aim at a generalization, being concerned only with some particular event. The systematic character of inference is perhaps most obvious in the case of inference from circumstantial evidence, for it manifests most clearly the process of the imaginative construction of a coherent system out of fragmentary evidence. The most familiar occasions for the exercise of inference from circumstantial evidence are criminal cases. Criminals naturally take precautions against the possibility of direct evidence, and are usually betrayed by circumstantial evidence. *See* EVIDENCE. *See* A. Wolf, *Essentials of Logic* (1926).

CIRCUMVALLATION, LINES OF, in fortification, a continuous circle of entrenchments surrounding a besieged place, facing outwards, by which the besieger protected himself against the attack of a relieving army from any quarter (from Lat. *circum,* round, and *vallum,* a rampart). "Lines of contravallation" were similar works but naturally of less circumference, facing inwards, as a resistance against the sorties of the besieged.

CIRCUS, a space in the strict sense circular, but sometimes oval or even oblong, intended for the exhibition of races and athletic contests generally (Lat. *circus,* Gr. κίρκος or κρίκος, a ring or circle; probably "circus" and "ring" are of the same origin). The circus differs from the theatre inasmuch as the performance takes place in a central circular space, and not on a stage at one end of the building.

In Roman Antiquities the circus was a building for the exhibition of horse and chariot races and other amusements. It consisted of tiers of seats running parallel with the sides of the course, and forming a crescent round one of the ends. The other end was straight and at right angles to the course, so that the plan of the whole had nearly the form of an ellipse cut in half at its vertical axis. Along the transverse axis ran a fence (*spina*) separating the return course from the starting one. The straight end had no seats, but was occupied by the stalls (*carceres*) where the chariots and horses were held in readiness. This end constituted also the front of the building with the main entrance. At each end of the course were three conical pillars (*metae*) to mark its limits.

The oldest building of this kind in Rome was the *Circus Maximus,* in the valley between the Palatine and Aventine hills, where, before the erection of any permanent structure, races appear to have been held beside the altar of the god Consus. The first building is assigned to Tarquin the younger, but for a long time little seems to have been done to complete its accommodation, since it is not till 329 B.C. that we hear of stalls being erected for the chariots and horses. It was not in fact till under the empire that the circus became a conspicuous public resort. Caesar enlarged it to some extent, and also made a canal 10 ft. broad between the lowest tier of seats (*podium*) and the course, as a precaution for the spectators' safety when exhibitions of fighting with wild beasts, such as were afterward confined to the amphitheatre, took place. When these exhibitions were removed and the canal (*euripus*) was no longer necessary, Nero had it filled up. Augustus is said to have placed an obelisk on the *spina* between the *metae* and to have built a new *pulvinar,* or imperial box; but if this is taken in connection with the fact that the circus had been partially destroyed by fire in 31 B.C., it may be supposed that besides this he had restored it altogether. Only the lower tiers of seats were of stone, the others being of wood, and this, from the liability to fire, may account for the frequent restorations to which the circus was subject; it would also explain the falling of the seats by which a crowd of people were killed in the time of Antoninus Pius.

In the reign of Claudius, apparently after a fire, the *carceres* of stone (tufa) were replaced by marble, and the *metae* of wood by gilt bronze.

Under Domitian, again after a fire, the circus was rebuilt, and the *carceres* increased to twelve instead of eight as before. The work was finished by Trajan.

The circus was the only public spectacle at which men and women were not separated. The lower seats were reserved for persons of rank; there were also various state boxes, *e.g.,* for the giver of the games and his friends (called *cubicula* or *suggestus*). The principal object of attraction apart from the racing must have been the *spina* or low wall which ran down the middle of the course, with its obelisks, images and ornamental shrines. On it also were seven figures of dolphins and seven oval objects, one of which was taken down at every round made in a race, so that spectators might see readily how the contest proceeded. The chariot race consisted of seven rounds of the course. The chariots started abreast, but in an oblique line, so that the outer chariot might be compensated for the wider circle it had to make at the other end. Such a race was called a *missus,* and as many as 24 of these would take place in a day. The competitors wore different colours, originally white and red (*albata* and *russata*), to which green (*prasina*) and blue (*veneta*) were added. Domitian introduced two more colours, purple and gold (*purpureus et auratus pannus*), which probably fell into disuse after his death. To provide the horses and large staff of attendants it was necessary to apply to rich capitalists and owners of studs, and from this there grew up in time four companies (*factiones*) of circus purveyors, which were identified with the four colours, and with which those who organized the races contracted for the proper supply of horses and men. The drivers (*aurigae, agitatores*), who were mostly slaves, were sometimes held in high repute for their skill. The horses most valued were those of Sicily, Spain and Cappadocia, and great care was taken in training them. Chariots with two horses (*bigae*) or four (*quadrigae*) were most common, but sometimes also they had three (*trigae*) and exceptionally more than four horses. Occasionally there was combined with the chariots a race of riders (*desultores*), each rider having two horses and leaping from one to the other during the race. At certain of the races the proceedings were opened by a *pompa* or procession in which images of the gods and of the imperial family deified were conveyed in cars drawn by horses, mules or elephants, attended by the colleges of priests, and led by the presiding magistrate (in some cases by the emperor himself) seated in a chariot in the dress and with the insignia of a *triumphator.* The procession passed from the capitol along the forum, and on to the circus, where it was received by the people standing and clapping their hands. The presiding magistrate gave the signal for the races by throwing a white flag (*mappa*) on to the course.

Next in importance to the Circus Maximus in Rome was the *Circus Flaminius,* erected 221 B.C. in the censorship of C. Flaminius, from whom it may have taken its name; or the name may have been derived from Prata Flaminia, where it was situated. The only games that are known to have been celebrated in this circus were the *Ludi Tourii* and *Plebeii.* There is no mention of it after the 1st century. Its ruins were identified in the 16th century at S. Catarina dei Funari and the Palazzo Mattei.

A third circus in Rome was erected by Caligula in the gardens of Agrippina, and was known as the *Circus Neronis,* from the notoriety which it obtained through the Circensian pleasures of Nero. A fourth was constructed by Maxentius outside the Porta Appia near the tomb of Caecilia Metella, where its ruins are still, and now afford the only instance from which an idea of the ancient circi in Rome can be obtained. It was attributed to Caracalla, till the discovery of an inscription in 1825 showed it to be the work of Maxentius. Old topographers speak of the six circi, but two of these appear to be imaginary, the Circus Florae and the Circus Sallustii.

Circus races were held in connection with the following public festivals and generally on the last day of the festival, if it extended over more than one day:—(1) The *Consualia,* Aug. 21, Dec. 15; (2) *Equirria,* Feb. 27, March 14; (3) *Ludi Romani,* Sept. 4–19; (4) *Ludi Plebeii,* Nov. 4–17; (5) *Cerialia,* April 12–19; (6) *Ludi Apollinares,* July 6–13; (7) *Ludi Megalenses,* April 4–10; (8) *Floralia,* April 28–May 3.

In addition to Smith's *Dictionary of Antiquities* (3rd ed., 1890), *see* articles in Daremberg and Saglio's *Dictionnaire des antiquités,* Pauly-Wissowa's *Realencyklopädie der classischen Altertumswissenschaft,* iii. 2 (1899), and Marquardt, *Römische Staatsverwaltung,* iii. (2nd ed., 1885), p. 504.

The Modern Circus.—The "circus" in modern times is a form of popular entertainment which has little in common with the institution of classical Rome. It is frequently nomadic in character, the place of the permanent building known to the ancients as the circus being taken by a tent, which is carried from place to place and set up temporarily on any site procurable at country fairs or in provincial towns, and in which spectacular performances are given by a troupe employed by the proprietor. The centre of the tent forms an arena arranged as a horse-ring, strewn with tan or other soft substance, where the performances take place, the seats of the spectators being arranged in ascending tiers around the central space. The traditional type of exhibition in the modern

travelling circus consists of feats of horsemanship, such as leaping through hoops from the back of a galloping horse, standing with one foot on each of two horses galloping side by side, turning somersaults from a springboard over a number of horses standing close together, or accomplishing acrobatic tricks on horseback. These performances, by male and female riders, are varied by the introduction of horses trained to perform tricks, and by drolleries on the part of the clown, whose place in the circus is as firmly established by tradition as in the pantomime.

The popularity of the circus in England may be traced to that kept by Philip Astley (d. 1814) in London at the end of the 18th century. Astley was followed by Ducrow, whose feats of horsemanship had much to do with establishing the traditions of the circus, which were perpetuated by Hengler's and Sanger's celebrated shows in a later generation. The influence of P. T. Barnum (United States), whose claim to be the possessor of "the greatest show on earth" was no exaggeration, brought about a considerable change in the character of the modern circus. In arenas too large for speech to be easily audible, the traditional comic dialogue of the clown assumed a less prominent place than formerly, while the vastly increased wealth of stage properties relegated to the background the old-fashioned equestrian feats, which were replaced by more ambitious acrobatic performances and by exhibitions of skill, strength and daring requiring the employment of immense numbers of performers and often of complicated and expensive machinery. These tendencies are, as is natural, most marked in shows given in permanent buildings in large cities, such as the London Hippodrome, which was built as a combination of the circus, the menagerie and the variety theatre, where wild animals such as lions and elephants from time to time appeared in the ring and where convulsions of nature such as floods, earthquakes and volcanic eruptions have been produced with an extraordinary wealth of realistic display. At the Hippodrome in Paris, a circus of the true classical type in which the arena is entirely surrounded by the seats of the spectators, chariot races after the Roman model were held in the latter part of the 19th century, at which prizes of considerable value were given by the management. In accordance with the developments just described, the circus may at the present time be divided into three distinct types. The British is a caravan, the continental a music-hall fitted with arena and stables, and the American a mobile arsenal of amusements.

In none of these are the traditions of Philip Astley, father of the modern circus, strictly upheld. His amphitheatre, a combination of riding school and music house, retained much of the ancient dignity of horsemanship.

Since about 1920, interest in the circus has been re-awakened in several countries, including Russia, where the Soviet has permitted companies to be reorganized.

In France where the vogue took long to die, as the building of the handsome Cirque de Paris a few years before World War I proves, the revival came quickly, partly because of the enthusiasm for the ring shown by the modern school of painters. This return to popularity was first marked by the redecoration of the Cirque Medrano in 1921; in the same year the Nouveau Cirque, which from 1914 had been an ordinary music-hall, was occupied by a menagerie, and, as the next step, the American bar was abolished so that the stables could be restored; the Cirque d'Hiver, the scene of Gémier's production of *Oedipe Roi,* in the season 1919–20 and afterwards a motion picture theatre, once more became a circus in 1923–24; and this upward progression was crowned in 1923 when the French Minister of Public Instruction made the three Fratellini, the most popular clowns of France, officers of the Academy. In Australia the Wirth Brothers have conducted a railroad circus on the American model (*see* below) for many years, but the mammoth show has yet to establish itself in Europe despite the success of Barnum and Bailey's visits between the years 1889 and 1900.

Although it long has drawn its performing talent from the ends of the earth, the circus in its vast size and peculiar mobility is American to the core. Nowhere else has it achieved the proportions existing in the U.S.A.

International Circus.—Successful attempts to create an international circus have been made at Olympia, London. For the Christmas holidays of 1906–07 C. B. Cochran installed there a company from the Cirque de Paris with other acts; for the season of 1913–14 he brought instalments of the Hagenbeck Zoo from Berlin, thus introducing the idea of Mappin terraces into England, and engaged a German stud of 250 horses, besides an American trick rider, French clowns and many other performers, mostly from the European continent. Each Christmas since 1920 there has been at Olympia an international circus managed by Bertram W. Mills. Otherwise the British circus is still a kind of large family party travelling from town to town in little cottages on wheels and congregating each Christmas at the Agricultural Hall, Islington, just as they congregated 100 years ago in St. George's Fields.

To-day they still perform the tricks that amused the country before the circus was invented. Thus, in 1925, dogs and monkeys were acting in Bostock's Royal Italian Circus a scene called *The Deserter,* ending with the execution of a Pomeranian by a monkey seated on a pony, which recalls the drama of *The Deserter* acted by dogs and a monkey at Sadler's Wells in 1785. After most of the buildings installed by Hengler, Sanger and others, in the chief towns and cities of the United Kingdom had been put to other uses, the "tenting" companies became more like the old fair folks than Astley's performers. They exhibited personal skill instead of combining to present "equestrian dramas," of which the last relic was the Wembley stag hunt and Roman chariot races, two favourite circus items since Astley's was first built. Likewise the jester is disappearing, the fun now being provided mainly by silent clowns wearing the one-piece garment of the French "grotesque," the ill fitting evening clothes of the "Auguste" or the costume of Charlie Chaplin of the films.

Entertainments of a character similar to the circus include the International Rodeo, held under C. B. Cochran's management at the British Empire Exhibition in 1924, which was a contest in steer wrestling and buck-jumping between cowboys who were showmen in the sense that prize money was their livelihood. In July 1925 a band of Cossacks gave an exhibition of horsemanship in London and Paris, including a dramatic spectacle enlivened by comic tumbles from horseback.

BIBLIOGRAPHY.—Files of *Variety, Clipper and Billboard* (New York, 1920–25); George Concklin, *The Ways of the Circus* (1921); Gustave Fréjaville, *Au Music Hall* (1923); M. R. Werner, *Barnum* (1923); C. B. Cochran, *Secrets of a Showman* (1925); M. Willson Disher, *Clowns and Pantomimes* (1925). (X.)

UNITED STATES

The American circus is a spectacular form of entertainment, nomadic in character, presenting its exhibitions in tents (rarely in buildings), and moving its performers, staff, working crew, animals and all paraphernalia on its own railway cars; or, in the case of a few small shows, by horse-drawn wagons, motor trucks or river boats. It comprises, physically, in the order met with from the approach ("front"); refreshment booths ("candy stands"); ticket and office wagons; one or more side shows ("kid shows") containing human and animal oddities; the big show main entrance ("front door"); the canopied way ("marquee") leading to the menagerie; the menagerie tent exhibiting animals caged and in corrals; the elephant "line up" and refreshment stands; the canvas-walled passage ("connection") leading from the menagerie to the main-tent ("big top"); the rear entrance ("back door") to the main-tent, opening on a compound ("back yard") in which are located performers' dressing tents, properties, property and wardrobe wagons, vehicles used in pageant ("the spec."), and other equipment essential to the production.

Early American Circus.—During colonial days several English showmen brought small troupes to the United States. Among the first was Ricketts' Circus which exhibited in the Greenwich theatre near the Battery, New York, in 1795. Probably the first American born showman of note was Rufus Welch, who in 1818 managed a wagon show and later directed larger outfits. In Nov. 1826, the Mt. Pitt Circus opened on Broome street, New York, in a building seating 3,500 persons, said at that time to be the largest

place of amusement in America. Early circuses, but subsequent to the foregoing, were those of "Old" John Robinson, Dick Sands and Van Amburgh, the two last named making European tours in the '40s.

Notable among American tent showmen may be named L. B. Lent, Adam Forepaugh, Dan Rice, the Sells brothers, W. C. Coup, P. T. Barnum, James A. Bailey and the Ringling brothers. Lent's historic New York circus played winter engagements in 14th street opposite the old Academy of Music, and toured under canvas during the summer months of the '60s and early '70s, his being the first show of size to travel by rail. Forepaugh was one of the tent world's most picturesque characters and the reputed precursor of the modern beauty contests. In 1880 he offered a prize for America's most beautiful woman, resulting in the selection of Louise Montague who thereafter rode in his street parade as "the $10,000 beauty." Rice was the most famous of American clowns and operator of boat shows on the Mississippi. The Sells brothers, Ephraim, Allen, Lewis and Peter, in 1872 founded the show bearing their name, giving distinct impetus to the "brother idea" in the circus world. Coup, a remarkable organizer who, in 1869, projected the largest circus known up to that time, originated performances in two rings, and assisted by Dan Costello persuaded P. T. Barnum to enter the circus field. Barnum, in his 60th year, brought his internationally advertised name and ability as a proprietor of museums, impresario, lecturer and author to the tent show world, thereby giving it incalculable publicity and advancement. Bailey, generally acknowledged to have been the master showman both past and present, introduced a third ring and devised intervening stages. Brilliant alike as an organizer, originator and financial genius, he directed superb productions throughout America and toured European countries at the head of the largest circus ever sent across the Atlantic. The Ringling brothers, August G., Otto, Albert, Alfred T., Charles, Henry and John were remarkable for their individual ability to direct separate departments of their show. Beginning in 1882 the Ringlings brought the show bearing their name to a size equalling that of the largest. Upon the death of Bailey they in 1907 purchased the Barnum and Bailey "Greatest Show on Earth," but conducted it as a separate institution until 1919 when they combined it with that bearing their name.

The consolidation was directed by John Ringling, until his death in 1936.

The Modern Circus.—Unlike European circuses, the modern American circus sells a ticket which includes admission to both the menagerie and circus performance. Following the "big show" programme an after show is given in the main-tent for which there is an additional charge.

This is called the "concert," though it has frequently taken on the character of a "wild west" entertainment. The "big show" programme appeals largely to the eye, since the greater size of the modern main-tent has rendered impossible a continuance of the "talking clown" and like audible features of the former one-ring circus.

Today the feats of human equestrians, aerialists, gymnasts, acrobats and clowns, interspersed with a number of trained jungle beasts and domestic animals are presented in ground rings, on ground platforms ("stages"), from aerial apparatus and from steel arenas so distributed as to be enclosed within or above the confines of an oval course-way ("hippodrome track") with the spectators seated in chairs ("grand stand") and on bleachers ("the blues") in such a manner as practically to surround the entire area of action.

An average of 30 different tent shows (the largest requiring approximately 100 railway cars to transport it and the smallest using but a single car) tour more or less extensively through the United States each year.

The touring season usually begins in April or May and continues into November. The intervening time is spent in "winter quarters."

The biggest of the circuses, Ringling Bros. and Barnum & Bailey, makes its springtime debut in Madison Square Garden (a large building) in New York city, and then plays a short engagement in a similar building in Boston. Thereafter it tours under canvas.

There are not many circuses travelling by rail; most of the smaller ones are motorized, travelling the highways of the country much the same as their ancestors, the wagon or "mud" shows, did a hundred years ago. (E. P. N.; X.)

CIRENCESTER (sīs'ĕs-tur or sīs'ĕt-ur), market town and urban district, Gloucestershire, England, on the river Churn, 95 mi. west-northwest of London.

Pop. (1938) 8,138. Area 9 sq.mi. It is served by the Great Western railway.

It is the site of the Romano-British *Corinium*, at first perhaps a military post, but afterwards, a civilian city. There are ruins of an amphitheatre and indications of the walls. At Chedworth, 7 mi. northeast, is a Roman villa. Cirencester (*Cirneceaster, Cyrenceaster, Cyringceaster*) is described in Domesday as ancient demesne of the crown. The manor was granted by William I to William Fitzosbern; on reverting to the crown it was given in 1189, with the township, to the Augustinian abbey founded here in 1117 by Henry I, of which there remain a Norman gateway and a few capitals. The parish church is mainly Perpendicular, with a high embattled tower. Among its many chapels that of St. Catherine has a beautiful roof of fan-tracery in stone, dated 1508. The townsmen struggled in vain throughout the middle ages to show that Cirencester was a borough. For their success against the earls of Kent and Salisbury Henry IV in 1403 gave the townsmen a guild merchant. In 1418 the charter was annulled, and in 1477 parliament declared that Cirencester was not corporate. There were several unsuccessful attempts to re-establish the guild merchant. Besides the "new market" of Domesday book the abbots obtained charters in 1215 and 1253 for fairs during the octaves of All Saints and St. Thomas the Martyr. The wool trade gave these great importance; in 1341 there were ten wool merchants in Cirencester, and Camden calls it the greatest market for wool in England. The grammar school dates from 1460.

Oakley Park was laid out during the 18th century by Lord Bathurst. A mile west of the town is the Royal Agricultural college, incorporated in 1845, but later reorganized. Closed 1915–22, it was considerably enlarged in 1938. There are two museums containing mosaics, inscriptions, carved and sculptured stones. The industries of Cirencester comprise various branches of agriculture. It has connection by a branch canal with the Thames and Severn canal. Cirencester became a parliamentary borough in 1572, returning two members until 1867. From that year until 1885 it returned one member. It is now included in the Cirencester and Tewkesbury division of Gloucestershire.

CIRE PERDUE: *see* SCULPTURE TECHNIQUE: *Casting and Finishing.*

CIRILLO, DOMENICO (1739–1799), Italian physician, botanist, and revolutionist, was appointed as a young man to a botanical professorship, and later travelled to France and England, where he was elected a fellow of the Royal Society. On his return to Naples he was appointed successively to the chairs of practical and theoretical medicine. He wrote voluminously on scientific subjects, particularly botany, on which his most important work was *Fundamenta botanica sive Philosophiae botanicae explicatio*. On the establishment of the Parthenopean republic in Naples, Cirillo became president of the legislative commission. When the town surrendered to Cardinal Ruffo, the vengeance of the royalists was wreaked upon Cirillo, and despite Lady Hamilton's intercession, Nelson had him hanged Oct. 29, 1799.

See L. Conforti, *Napoli nel 1799* (Naples, 1889); C. Giglioli, *Naples in 1799* (1903); C. Tivaroni, *L'Italia durante il dominio francese*, vol. ii.

CIRQUE, a French word used to denote a semi-circular amphitheatre, with precipitous walls, at the head of a valley in a glaciated mountain region (Lat., *circus*, ring), generally due to the basal sapping and erosion beneath the *bergschrund* of a glacier. The bergschrund is a large crevasse, in the form of a great symmetrical arc, parallel to the head of the *névé* (*see* GLACIER); it lies at a short distance from the exposed rock surface and separates the stationary from the moving ice, and in early summer,

when the glacier commences to move, it opens and exposes the rock at its base to diurnal changes of temperature. Frost action then causes rapid disintegration downward at its base and backward upon such part of the rock surface as is exposed in the bergschrund beneath the stationary ice, thus producing the characteristic form of the cirque. The formation of cirques has played an important part in the development of the scenery of glaciated mountain tracts. Arêtes (sharp ridges) are formed by the intersection of two cirques, and pyramidlike peaks such as the Matterhorn and Snowdon are remnants left by the recession of three or more cirques. Cirques frequently contain lakes, for, owing to the action of the bergschrund, the floor slopes toward the mountain mass. W. D. Johnston (*Journ. of Geol.* vol xii p. 569) first recognized the processes giving rise to cirque formation by actually descending a bergschrund on the Mount Lyell glacier. Hollows of similar shape to cirques occur in limestone regions which may not have been glaciated. These are formed by aqueous solution and are not true cirques.

CIRRIPEDIA, a subclass of the Crustacea (*q.v.*), comprising the barnacles and acorn shells and certain parasitic forms related to them. All Cirripedes are completely sedentary in the adult state and with the loss of the power of locomotion they have become so modified as to show, at first sight, little trace of resemblance to the more ordinary Crustacea.

The common goose barnacle, *Lepas anatifera,* is found adhering to the bottom of ships and to floating timber. It has a fleshy stalk, fixed at one end to the supporting object and having at the other end a shell of five separate plates enclosing the body of the animal. The stalk is formed from the front part of the head, and the body, when exposed by opening the shell, is seen to be bent nearly at right angles to it. Embedded in the cement which fastens the end of the stalk to the support may be found the remains of the antennules which served for the attachment of the larva. The antennae are wanting, but within the shell the mouth is surrounded by mandibles, maxillulae and maxillae, and these are followed by six pairs of long, curled, two-branched appendages fringed with hairs. These appendages can be protruded from the slitlike opening of the shell, forming a kind of casting net for the capture of minute floating particles of food. The acorn shells which are abundant in most seas attached to rocks in shallow water, differ from the goose barnacle and its allies in having no peduncle. The shell is conical, cemented directly to the rock, and has an opening at the top closed by four movable valves. The shell has a more or less perfect radial symmetry. Barnacles are important ship fouling organisms, which may impede the speed of a ship by 50%, delaying voyages, increasing fuel consumption, the wear and tear on machinery and frequent loss of time in docking to remove offending growths. It has been estimated (1927) that the annual cost of fouling was $100,000,000. The fleshy parts of the largest barnacle are relished in Chile, where *Balanus psittacus* grows to imposing size, 9 in. in height by 3 in. in diameter; other large balanoids are eaten by the aborigines on the northwest coast of America. In Japan smaller species are cultivated on clumps of bamboo set along shore. At intervals of three months the attached barnacles are beaten off for use as manure.

Allied to the more normal Cirripedia just described are a number of more degenerate and, for the most part, parasitic forms. The most degenerate are the members of the order Rhizocephala, of which the genus *Sacculina,* a common parasite of crabs, is a familiar example. It has a simple saclike body attached under the abdomen of the crab by a short stalk from which rootlike processes ramify throughout the internal organs of the host. The body is enveloped by a fleshy mantle with a small opening and is without appendages, mouth or alimentary canal, the only organs which are well developed being those of the reproductive system. There is no trace of Arthropodous structure and only the larval development allows *Sacculina* to be referred to the Cirripedia. For the effect of *Sacculina* on its host, *see* SEX. Largest of the Rhizocephala is *Briarosaccus callosus* found living on a lithodid crab taken from more than 250 fathoms off the southeastern United States. This huge, tumourlike parasite is nearly 4 in. long, more than 2 in. high, and 1¼ in. thick.

Unlike the majority of Crustacea and, indeed, of Arthropoda in general, the Cirripedia are nearly all hermaphrodite, but in a few species dwarf and degenerate male individuals are found attached at, or within, the opening of the shell of the normal individuals. The latter may be, as usual, hermaphrodites, in which case the males were termed by Darwin "complemental males" but in a few instances the large individuals are purely female and the separation of the sexes is complete. It was demonstrated (1942) in the Rhizocephalan *Peltogaster paguri* that the cypris larvae attaching within the mantle cavity of young Peltogasters become masculinized to serve as functional males.

Most Cirripedes are hatched from the egg in the nauplius stage, but the earliest larvae are characterized by the development of spines and processes from the body and in some oceanic species these spines are of relatively enormous length. At a later stage the larva is enclosed in a bivalve shell superficially resembling that of an Ostracod and on this account it is known as the "cypris" stage. Like the nauplius stages the cypris swims freely but ultimately it attaches itself by the antennules, which are provided with glands producing an adhesive secretion. The shell is cast off, leaving a membranous mantle within which calcareous plates appear, at first, apparently, always five in number.

The Cirripedia are almost exclusively marine animals, only one or two species penetrating a little way into estuaries and the like. Certain species attach themselves to whales, marine turtles, or the larger Crustacea, and truly parasitic forms are found on Echinoderms and Crustacea. The earliest fossils definitely referable to the Cirripedia occur in the Rhaetic formation and belong to the Lepadomorpha.

Though complicated by the obscure relationship of parasitic forms to more normal Cirripedes, the classification generally adopted is as follows:

Order *Thoracica,* with six pairs of thoracic appendages, divided into four suborders: *Lepadomorpha,* the stalked barnacles (*Lepas, Scalpellum, Mitella*); *Verrucomorpha,* asymmetrical sessile forms (*Verruca*), *Brachylepadomorpha* (sessile, fossil only, *Pycnolepas, Brachylepas*); *Balanomorpha,* the sessile acorn shells and rock barnacles (*Balanus, Chthamalus, Coronula, Chelonibia*).

Order *Acrothoracica,* somewhat degenerate forms with fewer thoracic appendages, boring in shells and corals (*Alcippe*).

Order *Ascothoracica,* six pairs of thoracic appendages, only Cirripede with definite, at times segmented, abdomen, parasitic on Coelenterates and Echinoderms; affinities obscure (*Laura, Dendrogaster*).

Order *Apoda,* no thoracic limbs, only known specimen described by Darwin; from mantle cavity of another Cirripede (*Proteolepas*).

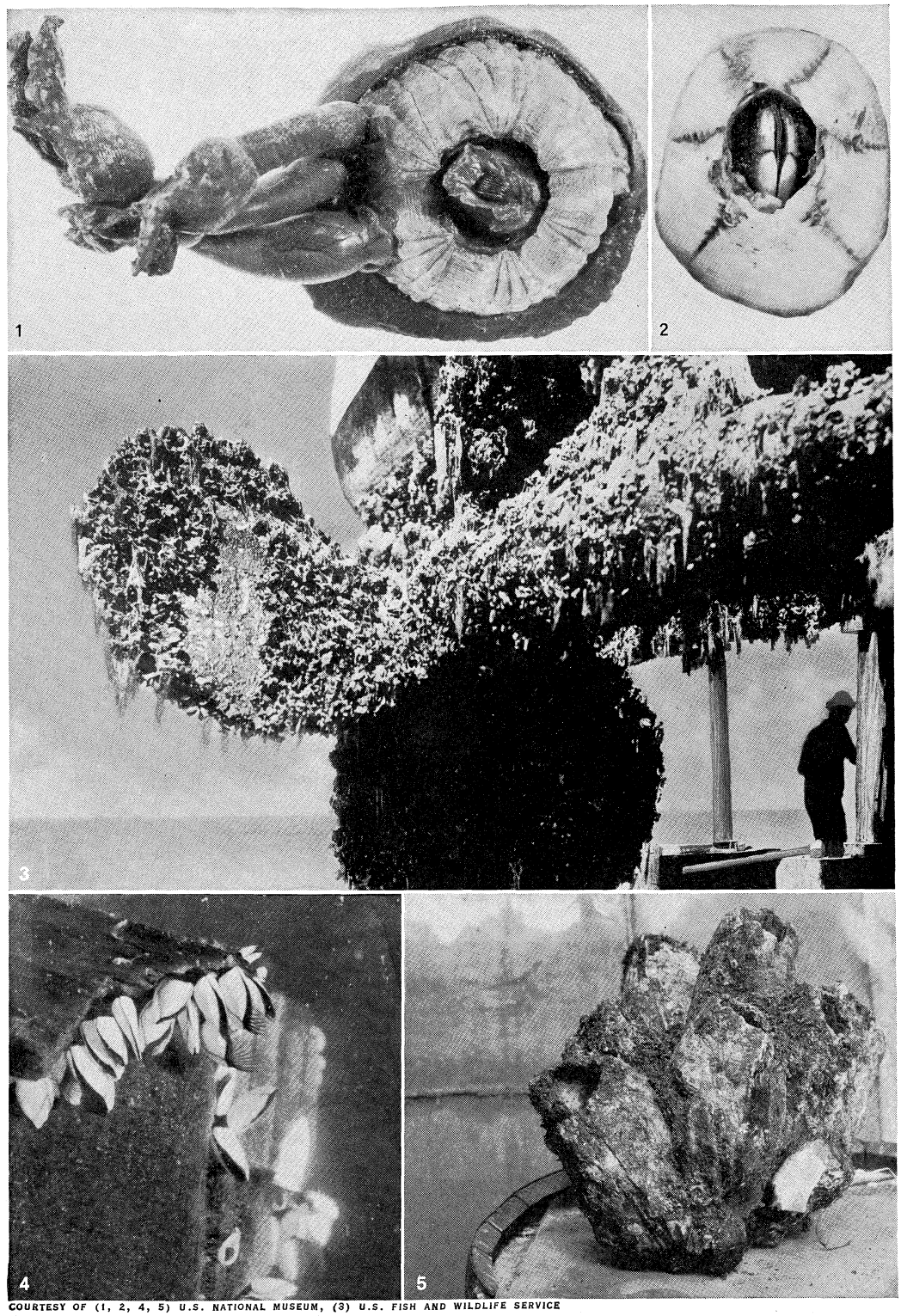
Order *Rhizocephala,* degenerate parasites of Decapod Crustacea, only Cirripedes without any alimentary canal; no trace of segmentation in adult, wholly without appendages (*Sacculina, Peltogaster*). (*See* ACORN SHELL; BARNACLE; CRUSTACEA.)

(W. T. C.; W. L. ST.)

CIRTA: *see* CONSTANTINE, ALGERIA.

CISCO, a city of Eastland county, Texas, U.S.A., 108 mi. W. by S. of Ft. Worth on federal highway 80, and served by the Missouri-Kansas-Texas and the Texas and Pacific railways. Pop. (1940) 4,868. It is in a gas and oil region; has several manufacturing industries; and is an important market for horses, mules, cattle, corn, wheat, cotton, peanuts, poultry and other agricultural products. Just north of the city is Lake Cisco and Williamson dam, and just below it is an immense concrete swimming pool. Cisco was founded in May 1881, and was incorporated later in that year. It was named after John J. Cisco, banker and director of the Texas Central railway.

CISSEY, ERNEST LOUIS OCTAVE COURTOT DE (1810–1882), French general, was born at Paris on Sept. 23, 1810, and after passing through St. Cyr, entered the army in 1832. He served in Algeria and in the Crimean War, and became general of division in 1862. When the Franco-German War broke out in 1870, de Cissey was given a divisional command in the army of the Rhine, and he was included in the surrender of Bazaine's



COURTESY OF (1, 2, 4, 5) U.S. NATIONAL MUSEUM, (3) U.S. FISH AND WILDLIFE SERVICE

VARIOUS BARNACLES (Cirripedia, Order Thoracica)

1. Whale barnacle, *Coronula diadema* (suborder Balanomorpha) with portion of whale skin to which it was attached. To the *Coronula* in turn are attached two fleshy stalked barnacles, *Conchoderma auritum* (suborder Lepadomorpha); their specific name is derived from the two processes arising either side of the orifice in which the cirri can be seen. In *Conchoderma* the typical calcareous plates are quite vestigial. *Coronula diadema* at times is also called "whale louse" (*q.v.*). This species, so far as known, occurs only on humpback whales (*Megaptera*) and so is widely distributed in the north Atlantic and Pacific, with records also from Chile, Tonga and New Zealand. Specimen photographed is natural size, but the species attains a diameter of 3½ in. *Conchoderma auritum* seems to have much the same distribution, though not necessarily always attached to *Coronula*, as some specimens, unlike the whale barnacle, are known from ships' bottoms and iron buoys
2. Turtle barnacle, *Chelonibia testudinaria* (suborder Balanomorpha), from loggerhead turtle, Dry Tortugas, Florida. This barnacle is widely distributed on turtles in all temperate and tropic seas, Atlantic as well as Pacific. The specimen figured is natural size, but the species grows half again as large in the eastern tropical Pacific
3. Heavy marine growth, in considerable part barnacles (chiefly *Balanus* species), on propeller and struts of vessel
4. Goose barnacle, *Lepas anatifera* (suborder Lepadomorpha) on piece of driftwood from Gulf of Mexico. Specimens shown are about ⅔ natural size. Size of this species varies greatly, ranging up to 2 and 3 times that of those shown, with stalks here very short but in some cases three or more times as long as the shelly portion or capitulum. *Lepas anatifera* is common in all seas
5. Group of barnacles, showing large and massive form of *Balanus psittacus* (suborder Balanomorpha) from Chile, where it attains its largest growth, up to 9 in. in length and 3 in. in diameter. The fleshy portion of the body of these barnacles is much relished as a sea food in Chile

army at Metz. He held a command in the army engaged in the suppression of the Commune. From July 1871 de Cissey sat as a deputy, and he had already become minister of war. He occupied this post several times during the critical period of the reorganization of the French army. In 1880 he was accused of treasonable relations with a German agent, but was exonerated by a court of inquiry. He died on June 15, 1882 in Paris.

CISSOID: *see* CURVES, SPECIAL.

CIS-SUTLEJ STATES. Southern part of the Punjab, India. Sikh chiefs south of the Sutlej passed under British protection in 1809 and the name was applied to the country south of the Sutlej and north of the Delhi territory. Before 1846 the greater part was independent, the chiefs being subject merely to control from the agent of the governor-general for the Cis-Sutlej States at Umballa. After the first Sikh War the full administration of the territory became vested in this officer. In 1849 the Punjab was annexed and the Cis-Sutlej States commissionership, comprising Umballa, Ferozepore, Ludhiana, Thanesar and Simla districts, was incorporated with the new province. The name continued to be used until 1862, when, Ferozepore having been transferred to the Lahore, and a part of Thanesar to the Delhi division, it became obsolete.

CIST, in Greek archaeology, a wicker-work receptacle used in the Eleusinian and other mysteries to carry the sacred vessels; and also, in prehistoric archaeology, a coffin formed of flat stones placed edgeways with another flat stone for a cover. Cist-burial was probably introduced into the British Isles by the Beaker-folk about 1800 B.C., but lasted in some parts down to the present era. The cist was generally, but not always covered by a round barrow or cairn.

CISTERCIANS, otherwise GREY or WHITE MONKS (from the colour of the habit, over which is worn a black scapular or apron). In 1098 St. Robert, born of a noble family in Champagne, at first a Benedictine monk, and then abbot of certain hermits settled at Molesme near Châtillon, being dissatisfied with the manner of life and observance there, migrated with twenty of the monks to a swampy place called Cîteaux in the diocese of Châlons, not far from Dijon. Count Odo of Burgundy here built them a monastery, and they began to live a life of strict observance according to the letter of St. Benedict's rule. In the following year Robert was compelled by papal authority to return to Molesme, and Alberic succeeded him as abbot of Cîteaux and held the office till his death in 1109, when the Englishman St. Stephen Harding became abbot, until 1134. In 1112, however, St. Bernard and thirty others offered themselves to the monastery, and a rapid and wonderful development at once set in. The next three years witnessed the foundation of the four great "daughter-houses of Cîteaux"— La Ferté, Pontigny, Clairvaux and Morimond. With Clairvaux Bernard's work is specially associated. At Stephen's death there were over 30 Cistercian houses; at Bernard's (1154) over 280; and by the end of the century over 500; and the Cistercian influence in the Church more than kept pace with this material expansion, so that St. Bernard saw one of his monks ascend the papal chair as Eugenius III.

The Cistercians rejected alike all mitigations and all developments of St. Benedict's rule, and tried to reproduce the life exactly as it had been in his time; indeed in various points they went beyond it in austerity. The most striking feature in the reform was the return to manual labour, and especially to field-work, which became a special characteristic of Cistercian life. In order to make time for this work they cut away the accretions to the divine office which had been steadily growing during three centuries, and in Cluny and the other Black Monk monasteries had come to exceed greatly in length the regular canonical office.

It was as agriculturists and horse and cattle breeders that, after the first blush of their success and before a century had passed, the Cistercians exercised their chief influence on the progress of civilization in the later middle ages: they were the great farmers of those days, and many of the improvements in the various farming operations were introduced and propagated by them; it is from this point of view that the importance of their extension in northern Europe is to be estimated. They depended for their income wholly on the land. This developed an organized system for selling their farm produce, cattle and horses, and notably contributed to the commercial progress of the countries of western Europe. Thus by the middle of the 13th century the export of wool by the English Cistercians had become a feature in the commerce of the country. Farming operations on so extensive a scale could not be carried out by the monks alone, whose choir and religious duties took up a considerable portion of their time; and so from the beginning the system of lay brothers was introduced on a large scale. The lay brothers were recruited from the peasantry and were simple uneducated men, whose function consisted in carrying out the various field-works and plying all sorts of useful trades; they formed a body of men who lived alongside of the choir monks, but separate from them, not taking part in the canonical office, but having their own fixed round of prayer and religious exercises. A lay brother was never ordained, and never held any office of superiority. It was by this system of lay brothers that the Cistercians were able to play their distinctive part in the progress of European civilization. But it often happened that the number of lay brothers became excessive and out of proportion to the resources of the monasteries, there being sometimes as many as 200, or even 300, in a single abbey. On the other hand, at any rate in some countries, the system of lay brothers in course of time worked itself out; thus in England by the close of the 14th century it had shrunk to relatively small proportions, and in the 15th century the régime of the English Cistercian houses tended to approximate more and more to that of the Black Monks.

For a hundred years, till the first quarter of the 13th century, the Cistercians supplanted Cluny as the most powerful order and the chief religious influence in western Europe. But then in turn their influence began to wane, chiefly, no doubt, because of the rise of the mendicant orders, who ministered more directly to the needs and ideas of the new age. But some of the reasons of Cistercian decline were internal. In the first place, there was the permanent difficulty of maintaining in its first fervour a body embracing hundreds of monasteries and thousands of monks, spread all over Europe; and as the Cistercian very *raison d'être* consisted in its being a "reform," a return to primitive monachism, with its field-work and severe simplicity, any failures to live up to the ideal proposed worked more disastrously among Cistercians than among mere Benedictines, who were intended to live a life of self-denial, but not of great austerity. Relaxations were gradually introduced in regard to diet and to simplicity of life, and also in regard to the sources of income, rents and tolls being admitted and benefices incorporated, as was done among the Benedictines; the farming operations tended to produce a commercial spirit; wealth and splendour invaded many of the monasteries, and the choir monks abandoned field-work.

The later history of the Cistercians is largely one of attempted revivals and reforms. The general chapter for long battled bravely against the invasion of relaxations and abuses. In 1335 Benedict XII., himself a Cistercian, promulgated a series of regulations to restore the primitive spirit of the order, and in the 15th century various popes endeavoured to promote reforms. All these efforts at a reform of the great body of the order proved unavailing; but local reforms, producing various semi-independent offshoots and congregations, were successfully carried out in many parts in the course of the 15th and 16th centuries. In the 17th another great effort at a general reform was made, promoted by the pope and the king of France; the general chapter elected Richelieu (commendatory) abbot of Cîteaux, thinking he would protect them from the threatened reform.

In this they were disappointed, for he threw himself wholly on the side of reform. So great, however, was the resistance, and so serious the disturbances that ensued, that the attempt to reform Cîteaux itself and the general body of the houses had again to be abandoned, and only local projects of reform could be carried out.

The Reformation, the ecclesiastical policy of Joseph II., the French Revolution, and the revolutions of the 19th century, almost wholly destroyed the Cistercians; but some survived, and

after the beginning of the last half of the 19th century there was a considerable recovery.

In 1933 there were 9 congregations of Cistercians with 37 monasteries, a provostship and many residences. The order numbered about 1,000 members, of whom about 700 were priests. The general of the order resides in Rome.

In 1930 the Cistercians made a foundation at Spring Bank, Wis. Prior to this the order had been represented in the United States by the Strict Observance or Trappists (*q.v.*).

Accounts of the beginnings of the Cistercians and of the primitive life and spirit will be found in the lives of St. Bernard, the best whereof is that of Abbé E. Vacandard (1895); also in the Life of St. Stephen Harding, in the *English Saints*. *See* also Henry Collins (one of the Oxford Movement, who became a Cistercian), *Spirit and Mission of the Cistercian Order* (1866). Useful sketches, with references to the literature, will be found in the *Catholic Encyclopaedia*, art. "Cistercians"; Herzog-Hauck, *Realencyklopädie*, "Cisterciensèr"; and Heimbucher, *Orden und Kongregationen* (1933), i. §46. On the English houses, *see* F. A. Gasquet's *English Monastic Life;* and on the Cistercian polity, *see* the same writer's "Sketch of Monastic Constitutional History," prefixed to Eng. tr. of Montalembert's *Monks of the West* (1895).

CISTUS, a genus of the family Cistaceae. The members of the family live in dry, sunny places, especially on a sandy or chalky soil.

There are 20 species in the Mediterranean region; many are cultivated ornamental shrubs, in English-speaking countries commonly called rock-rose.

C. villosus and *C. ladaniferus* yield the resin ladanum, which is not to be confused with the hypnotic laudanum.

CITADEL, a municipal fortress. The beginnings of the citadel are remote. At Tanis in Egypt there is a very ancient example; roughly quadrangular, it was built to command a stream and the adjacent ground.

During the 12th dynasty of the first Theban empire a most formidable citadel was evolved, typified at Semneh, where a low wall of first defense rises upon a platform; the citadel proper is a series of crenelated buttress-redoubts projecting at short intervals from a high, rectangular wall, with an additional highly fortified projection at one corner; scaling would have been impossible without fatal casualties.

Ancient Greek citadels were usually of Cyclopean construction (*see* Cyclopaean Masonry) but that of Tiryns (*q.v.*) has upper walls of brick. It contains the king's palace, a fact which does not change its *rôle* as the true municipal fortress but which points to the origin of the municipality itself. The amalgamation of several hamlets into a *polis* or city, very frequently depended upon the existence of an *acron,* or height, which might be fortified and which became a storehouse of provisions and ammunition as well as the shrine of the god, the home of the king and the refuge of the people.

Just as the acropolis of Athens or the walled hill of the temple of Solomon in Jerusalem were vital municipal influences, so the capitol was the consolidating and protecting factor in Rome. But the citadel of Roman cities in general was less important than those of Greece. In strong countries not contiguous upon others of the same status citadels are rare because they are unnecessary. The Roman *castella* covered Europe and a part of Asia and Africa at one time; they were military centres around which a town might group itself, but they were never, in their beginnings, an integral element of normal municipal life. They existed for the empire and for themselves, and the fact that they protected municipalities was incidental.

After Rome, here and there, the citadel recovered its importance. The growth of feudalism meant the decline of the free, or nominally free, city. It should not be said, however, that in feudal times citadels ceased to be built; sometimes the right of fortification was granted by a lord and sometimes it was acquired by arms; the lord's castle might be a true citadel, or a new one might be erected by the city-State. As a type of architecture distinguished from the castle, the modern citadel is generally said to date from 1568, when the duke of Alva built one to dominate Antwerp. But the rapid multiplication of small States in the late middle ages made the citadel common in Europe.

See Castle: Bibliography; Fortification and Siegecraft; Daremberg and Saglio, *Dict. ant. class.*, "Acropole"; Planat, *Enc. archit.*, "Citadelle"; C. Enlart, *Man. archéol. fr.*

CITATION, in law, a summons to appear, answering to a writ of summons at common law, and it is now in English probate practice an instrument issuing from the principal probate registry, chiefly used when a person, having the superior right to take a grant, delays or declines to do so, and another, having an inferior right, desires to obtain a grant; the party having the prior right is cited to appear and either to renounce the grant or show cause why it should not be decreed to the citator. In divorce practice, when a petitioner has filed his petition and affidavit, he extracts a citation; *i.e.*, a command drawn in the name of the sovereign and signed by one of the registrars of the court, calling upon the alleged offender to appear and make answer to the petition. In Scots law, citation is the judicial notice served upon a person convening him to court as a party litigant, a witness, a haver of documents, or a juror. Citation, as a legal term, is used in the United States to show a reference to a particular law, decision or treatise which tends to support the proposition advanced in a brief or argument. In such cases the volume, section or page, or all, is indicated.

Citation is also a military term denoting special mention for gallantry in action of a military unit, or of an individual under arms. In most nations the Citation is issued by some general officers in charge of a division or brigade, or is published by the War Department. It frequently appears in the General Orders of a military command, outlining the heroic action of those concerned. In the United States military forces the individual cited is given a silver star in recognition of his service. The *fougère* or Citation Cord is given by France to members of a unit receiving such an award. In the British and American Military forces, this *fougère* is not given but units having received it from the French or other governments are allowed to wear it. A typical General Order issued by the military command of the United States was published in General Order on July 9, 1918 (General Order 112) by the commander of the American forces, General John J. Pershing, citing the heroic action of the First and Second Divisions.

CÎTEAUX, a village of eastern France, in the department of Côte d'Or, 16 m. S.S.E. of Dijon. It is celebrated for the great abbey founded by Robert, abbot of Molesme, in 1098, which became the headquarters of the Cistercian order. The buildings which remain date chiefly from the 18th century.

CITHAERON, now called from its pine forests Elatea, a mountain range (4,626 ft.), separating Boeotia from Megaris and Attica. Its west end reaches the Corinthian Gulf; eastward it is separated from Mount Parnes by the pass through Panactum and Phyle. It was famous in Greek mythology. Here Actaeon was changed into a stag, Pentheus was torn to pieces by the Bacchantes and the infant Oedipus was exposed. It was the scene of the mystic rites of Dionysus, and the festival of the Daedala in honour of Hera. The carriage-road from Athens to Thebes traverses the picturesque pass of Dryoscephalae ("Oak-heads"), guarded on the Attic side by the ruined fortress of Ghyphtokastro ("Gipsy Castle"). Plataea is situated on the north slope, and the strategy of the battle of 479 B.C. was considerably affected by the necessity for the Greeks to keep open the passes (*see* Plataea), of Dryoscephalae, and the roads farther west from Plataea to Athens and to Megara.

CITHARA, one of the most ancient stringed instruments, may be traced back to 1700 B.C. among the Semitic races, in Egypt, Assyria, Asia Minor, Greece and the Roman empire, whence the use of it spread over Europe. Having as its leading feature a sound-box or sound-chest which consisted of two resonating tables, either flat or delicately arched, connected by ribs or sides of equal width, the cithara may be regarded as an attempt to improve upon the lyre (*q.v.*), while retaining some of its features.

The strings, varying in number from four to 20 and made of gut, hemp or silk, were vibrated by means of the fingers or of a plectrum, according to the requirements of the music and the

different quality of tone desired. Like the lyre the cithara was made in many sizes, according to the pitch required and the use to which the instrument was to be put. It was in Greece the instrument alike of the professional singer or citharoedus (*κιθαρῳδός*) and, of the instrumentalist or citharista (*κιθαριστής*), and thus served the double purpose of (1) accompanying the voice (a use placed by the Greeks far above mere instrumental music) in epic recitations and rhapsodies, in odes and lyric songs; and (2) of accompanying the dance. It was also used for playing solos at the national games, at receptions and at trials of skill.

From the cithara by successive stages was evolved the guitar. The first of these steps produced the rotta, by the construction of body, arms and transverse bar in one piece. The addition of a finger-board, stretching like a short neck from body to transverse bar, leaving on each side of the finger-board space for the hand to pass through in order to stop the strings, produced the crwth or crowd (*q.v.*), and brought about the reduction in the number of the strings to three or four. The conversion of the rotta into the guitar (*q.v.*) was an easy transition effected by the addition of a long neck to a body derived from the oval rotta. When the bow was applied the result was the guitar or troubadour fiddle. The *cittern* (*q.v.*), a later descendant of the cithara, although preserving the characteristic features of the cithara, the shallow sound-chest with ribs, adopted the pear-shaped outline of the eastern instruments of the lute tribe.

CITIES SERVICE COMPANY, incorporated in the State of Delaware on Sept. 2, 1910, controls through stock ownership 32 corporate enterprises in the United States and foreign countries engaged principally in the production, transportation and sale of petroleum, petroleum products and natural gas. The petroleum subsidiaries, which constitute the primary interest of the company, form a complete unit embracing the four essential phases of the industry, namely, production, transportation, refining and marketing. In 1939, the subsidiary companies produced 22,255,000bbl. of crude oil, principally from the mid-continent area, and processed 35,745,000bbl. of crude oil. These companies operate seven refineries and distribute petroleum products through more than 16,000 outlets in 40 States, the Dominion of Canada and Argentina. In 1939, these companies sold more than 135,000,000,000 cu.ft. of natural gas.

Cities Service Company also owns a substantial interest in the 900mi. Texas-Chicago natural gas pipe-line.

Heretofore, Cities Service Company controlled directly or indirectly, through stock ownership, a number of other companies engaged in the electric light and power and gas distribution businesses, serving numerous communities, including the cities of Denver, Colo., Toledo, O., Kansas City, St. Joseph and Joplin, Mo., Kansas City and Wichita, Kansas. Cities Service Company, further to assure the freedom of its large petroleum interests from the provisions of the Public Utility Holding Company Act of 1935, divested itself of control of most of its public utility subsidiaries by a pledge of shares of such companies (including the voting power thereof for all purposes) with trustees, as security for the outstanding debentures of Cities Service Company.

The consolidated gross revenue plus other income of Cities Service Company, subsidiary companies and utilities not controlled for the year 1939 was $227,456,274. The consolidated total assets amounted to more than $1,000,000,000.

As of Dec. 31, 1939, Cities Service Company had outstanding 3,703,978 shares of $10 par value common stock, $67,994,275 stated value of preferred and preference stocks, and $174,977,800 principal amount of debentures of various maturities from 1950 to 1969. (W. A. Jo.)

CITIUM (Gr. *Kition*), the principal Phoenician city in Cyprus, situated on the south-east coast at the north end of modern Larnaca (*q.v.*). Converging currents from east and west greatly facilitated ancient trade. To south and west the site is protected by salt lagoons. The earliest remains go back to an Aegean colony of Mycenaean age (*c.* 1400–1100 B.C.), but in historic times Citium is the centre of Phoenician influence in Cyprus. The biblical name Kittim, representing Citium, is, in fact, used quite generally for Cyprus as a whole; later also for Greeks and Romans in general. In a list of the allies of Assur-bani-pal of Assyria in 668 B.C. a king, Damasu, of Kartihadasti (Phoenician for "New-town") occurs where Citium would be expected. A Phoenician dedication to "Baal of Lebanon," found here, suggests that Citium may have belonged to Tyre: and an official monument of Sargon II. indicates that Citium was the administrative centre of Cyprus during the Assyrian protectorate (709–668 B.C.). During the Greek revolts of 500, 386 *et seq.*, and 352 B.C., Citium led the side loyal to Persia and was besieged by an Athenian force in 449 B.C. It remained a considerable city even after the Greek cause triumphed with Alexander. But it suffered repeatedly from earthquakes and in mediaeval times its harbour became silted and the population moved to Larnaca, on the open bay. Harbour and citadel have now quite disappeared, the latter having been used to fill up the former shortly after the British occupation; some gain to health resulted, but an irreparable loss to science. There are traces of the circuit wall and many tombs.

BIBLIOGRAPHY.—W. H. Engel, *Kypros* (Berlin, 1841) (classical allusions); J. L. Myres, *Journ. Hellenic Studies*, xvii. 147 *et seq.* (excavations); *Cyprus Museum Catalogue* (Oxford, 1899); G. F. Hill, *Brit. Mus. Cat. Coins of Cyprus* (London, 1904) (coins). E. Oberhummer in *Pauly-Wissowa* (*s.v.*).

CITIZEN: *see* NATIONALITY AND NATURALIZATION.

CITOLE, an obsolete musical instrument of which the exact form is uncertain. It has been supposed to be another name for the psaltery (*q.v.*).

CITRANGE, the hybrid tree and its fruit produced by crossing any variety of sweet orange (*Citrus sinensis*) with the trifoliate orange (*Poncirus trifoliata*). Since 1892 American scientists have endeavoured to produce some form of *Citrus*, or a relative, which would thrive in a winter temperature subnormal for oranges. Plants raised from cross-fertilized fruits, using these two species as reciprocal parents have been tested. By 1943 there were less than a dozen varieties of citranges of restricted cultural importance. Some citranges closely resemble oranges; all are inferior to the orange in flavour, but are serviceable in flavouring cakes or jams and for citrangeade. The trees and fruit endure considerable frost. Some varieties of citrange are used for rootstocks for oranges and grapefruit. Citrangequats, trigeneric hybrids made by crossing a kumquat (*Fortunella margarita*) with a citrange, are cultivated as novelties in the United States. (L. D. B.)

CITRIC ACID, *Acidum citricum* or HYDROXYTRICARBALLYLIC ACID, first obtained in the solid state by Karl Wilhelm Scheele, in 1784, from the juice of lemons. It is present also in oranges, citrons, currants, gooseberries and other fruits, bulbs and tubers. Citric acid, $CO_2H{\cdot}CH_2{\cdot}C(OH)(CO_2H){\cdot}CH_2{\cdot}CO_2H$, is made commercially on a large scale from lime or lemon juice, and also by the fermentation of glucose under the influence of *Citromycetes pfefferianus*, *C. glaber* and other ferments. Lemon juice is fermented for some time to free it from mucilage, then boiled, filtered and neutralized with powdered chalk and a little milk of lime; the precipitate of calcium citrate so obtained is decomposed with dilute sulphuric acid, the solution filtered, evaporated to remove calcium sulphate and concentrated, preferably in vacuum pans. The acid is thus obtained in colourless rhombic prisms of the composition $C_6H_8O_7+H_2O$. About 2ogal. of lemon juice should yield about 10 lb. of crystallized citric acid. The acid may also be prepared from the juice of unripe gooseberries.

The synthesis of citric acid was accomplished by L. E. Grimaux and P. Adam in 1881. (*See* any standard textbook of organic chemistry.)

Citric acid has an agreeable sour taste. It is soluble in $\frac{3}{4}$ of its weight of cold and in half its weight of boiling water, and dissolves in alcohol, but not in ether. At 150° C it melts, and on the continued application of heat boils, giving off its water of crystallization. At 175° C it is resolved into water and aconitic acid, $C_6H_6O_6$, a substance found in *Equisetum fluviatile*, monkshood and other plants. A higher temperature decomposes this body into carbon dioxide and itaconic acid, $C_5H_6O_4$, which, again, by the expulsion of a molecule of water, yields citraconic anhydride, $C_5H_4O_3$. Citric acid digested at a temperature below 40° C with concentrated sulphuric acid gives off carbon monoxide and forms acetonedicarboxylic acid.

The citrates are a numerous class of salts, the most soluble of which are those of the alkaline metals; the citrates of the alkaline earth metals are insoluble. Citric acid, being tribasic, forms several series of salts. On warming citric acid with an excess of lime-water a precipitate of calcium citrate is obtained which is redissolved as the liquid cools.

Citric acid is used in calico printing, also in the preparation of effervescing draughts, as a refrigerant and sialogogue, and occasionally as an antiscorbutic, instead of fresh lemon juice. In the form of lime juice it has long been known as an antidote for scurvy. Several of the citrates are much employed as medicines, the most important being the scale preparations of iron. Of these iron and ammonium citrate is much used as a haematinic, and as it has hardly any tendency to cause gastric irritation or constipation it can be taken when the ordinary forms of iron are inadmissible. Iron and quinine citrate is used as a bitter stomachic and tonic. In the blood citrates are oxidized into carbonates; they therefore act as *remote alkalis*, increasing the alkalinity of the blood and thereby the general rate of chemical change within the body. (*See* ACETIC ACID.)

CITRON, a species of *Citrus* (*C. medica*) belonging to the subfamily Aurantioideae; the same genus furnishes also the orange, lemon, lime, shaddock (pummelo) and grapefruit. The citron is a small, evergreen tree or shrub growing to a height of about 10 ft.; it has irregular, spreading spiny branches; large pale green, broadly oblong, slightly serrate leaves, with wingless petioles, and generally perfect flowers. The acid varieties such as the Diamante have flowers purplish without and white within, while the sweet varieties such as the Corsican have creamy white flowers throughout. The fruit is ovate or oblong, protuberant at the tip, from 5 in. to 6 in. long, furrowed; rind adhesive, the inner portion thick, white and fleshy, the outer, thin, greenish-yellow and very fragrant. The pulp is firm, either acid or sweet, and is used only for byproducts. The thick peel has an agreeable flavour when candied.

There are many varieties of citron but the two commonly grown for production of candied peel are Corsican and Diamante. The fruit of the Etrog citron is used only for ceremonial purposes in religious rites of the Hebrew people. It has a pronounced protuberant tip with persistent pistil even on the ripe fruit.

Candied citron is highly esteemed as a confection, of which moderate quantities, averaging 3,600,000 lb., were annually consumed in the United States, from 1922 to 1937. There was no trend of increase in the per capita consumption during the two decades after 1923. Supplies come from the Mediterranean countries and Puerto Rico. Citron peel must be cured in brine or sea water prior to being candied.

The citron tree may be grown in the various countries of the world where lemon and limes are grown, as it is only slightly less resistant to frost injury than they are.

See Lucia McCulloch, "Curing and Preserving Citron," *Cir. No. 13,* U.S. Dept. of Agric. (1927); Walter T. Swingle, "Botany of Citrus" chap. IV, *The Citrus Industry,* edited by H. J. Webber and L. D. Batchelor, Univ. of Calif. Press (1943). (L. D. B.)

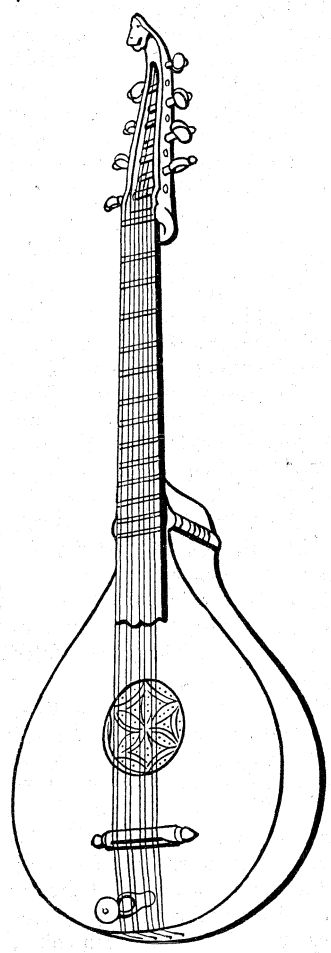
CITRUS BELT, a term applied to that region of the United States where citrus fruits (oranges, lemons, grape-fruit, limes, tangerines and kumquats) can be grown successfully. The subtropical nature of these fruits limits their culture to the warmer States of the Union, including southern Georgia, Florida, the southern portions of Alabama, Mississippi, Louisiana, Texas and Arizona, and the southern three-fourths of California. In 1926 California produced 69.9% of the oranges and tangerines, 7.5% of the grape-fruit and over 99% of the lemons. In the same year, Florida produced 28.8% of the oranges and tangerines, 87.1% of the grape-fruit, 75% of the kumquats and over 99% of the limes.

CITTADELLA, a town of Venetia, Italy, province of Padua, 20 mi. N.W. by rail from the town of Padua; 160 ft. above sea-level. Pop. (1936) 4,588 (town); 12,966 (commune). The Paduans founded Cittadella to counterbalance the Trevisan Castelfranco Veneto (founded in 1199) 8 mi. E.; the walls and ditch are well preserved. It is an agricultural centre with intersection of railways: Padua-Bassano and Vicenza-Treviso.

CITTÀ DELLA PIEVE, a town and episcopal see of Umbria, Italy, in the province of Perugia, finely situated 1,666 ft. above the sea, 3 mi. N.E. of its station on the railway between Chiusi and Orvieto. Pop. (1936) 2,457 (town); 9,347 (commune). It was the birthplace of the painter Pietro Vannucci (Perugino), and possesses several of his works, but none of the first rank. It has a Romanesque cathedral and a 13th century castle.

CITTÀ DI CASTELLO, a town and episcopal see of Umbria, Italy, in the province of Perugia, 38 mi. E. of Arezzo by rail (18 mi. direct), on the left bank of the Tiber, 945 ft. above sea-level. Pop. (1936) 8,816 (town); 32,658 (commune). It occupies the site of the ancient *Tifernum Tiberinum,* near which the younger Pliny had a villa. Devastated by Totila, it soon recovered and was called Castrum Felicitatis in the 8th century; it oscillated between pope and emperor in the middle ages. Its plan is rectangular with walls (1518) and fine palaces of the Vitelli, its Renaissance lords. The cathedral was originally Romanesque and the Palazzo Comunale was built 1334–52. Some of Raphael's earlier works were painted for the churches of this town, but none of them remains there.

CITTÀ VECCHIA or **CITTÀ NOTABILE,** a fortified city of Malta, 7 mi. W. of Valletta, known in Maltese as Mdina. The town, built in 700 B.C., was known to the Arabs as Medina. Named Notabile in 1478, it was the capital of the island till 1570, when Valletta (*q.v.*) was completed; then it became known as Città Vecchia ("old city"). It contains the Cathedral Church of Malta, said to occupy the site of the house of the governor Publius, who welcomed the apostle Paul; it was rebuilt after destruction by earthquake in 1693, and contains some rich stalls of the 15th century. In the rock beneath the city there are catacombs, partly pre-Christian, but containing evidence of early Christian burial. Below the church of San Paolo is a grotto, reputed to have sheltered the apostle. Roman buildings have been excavated in the town. Città Vecchia was severely damaged during World War II by attacking Italian and German aircraft.



FROM "OLD MUSICAL INSTRUMENTS" (METHUEN & CO.)

THE CITTERN, A MEDIAEVAL INSTRUMENT BELIEVED TO BE OF ENGLISH ORIGIN

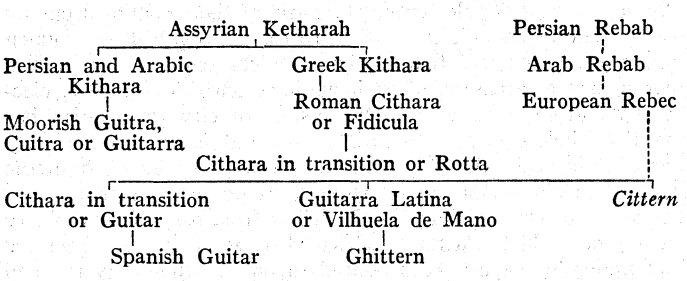
CITTERN (also CITHERN, CITHRON, CYTHREN, etc.), Fr. *citre, cistre, cithre, guitare allemande* or *anglaise;* Ger. *Cither, Zither (mit Hals,* with neck); Ital. *cetera, cetra,* a medieval stringed instrument with a neck terminating in a grotesque and twanged by fingers or plectrum. The popularity of the cittern was at its height in England and Germany during the 16th and 17th centuries. The cittern consisted of a pear-shaped body similar to that of the lute but with a flat back and soundboard joined by ribs. The neck was provided with a fretted finger board; the head was curved and surmounted by a grotesque head of a woman or of an animal (*see* Shakespeare, *Love's Labour's Lost,* act v, sc. 2, where Boyet compares the countenance of Holefernes to a cittern head; John Ford, *Lovers' Melancholy* (1629), act ii, sc. 1, "Barbers shall wear thee on their citterns."). The strings were of wire in pairs of unisons, known as courses, usually four in number in England. A peculiarity of the cittern lay in the tuning of

the courses, the third course known as bass being lower than the fourth styled tenor.

According to Vincentio Galilei (the father of the great astronomer) England was the birthplace of the cittern (*Dialogo della musica,* Florence, 1581, p. 147).

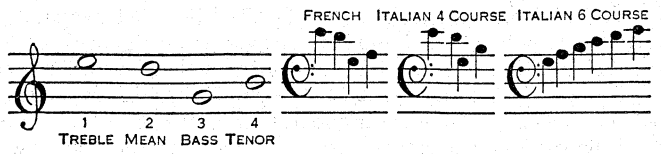
Several lesson books for this popular instrument were published during the 17th century in England. A very rare book (of which the British museum does not possess a copy), *The Cittharn Schoole,* written by Anthony Holborne in 1597, is mentioned in Sir P. Leycester's manuscript commonplace book dated 1656, "For the little Instrument called a *Psittyrne* Anthony Holborne and Tho. Robinson were most famous of any before them and have both of them set out a booke of Lessons for this Instrument. Holborne has composed a Basse-parte for the Viole to play unto the Psittyrne with those Lessons set out in his booke. These lived about Anno Domini 1600." The musical extracts from the commonplace book were prepared by Dr. Rimbault for the Early English Text Society. Holborne's work is mentioned in his *Bibliotheca Madrigaliana.* The descriptive list of the musical instruments in use in England during Leycester's lifetime (about 1656) has been extracted and published by Dr. F. J. Furnivall in *Captain Cox, his Ballads and Books, or Robert Laneham's Letter* (1575), (London, 1871), pp. 65–68. Thomas Robinson's *New Citharen Lessons with perfect tunings for the same from Foure course of strings to Fourteene course,* etc. (printed London, 1609, by William Barley), contains illustrations of both kinds of instruments. The fourteen-course cittern was also known in England as *Bijuga;* the seven courses in pairs were stretched over the finger board, and the seven single strings, fastened to the grotesque head, were stretched as in the lyre *à vide* alongside the neck; all the strings rested on the one flat bridge near the tail-piece. Robinson gives instructions for learning to play the cittern and for reading the tablature. John Playford's *Musick's Delight on the Cithren* (London, 1666) also contains illustrations of the instrument as well as of the viol da Gamba and Pochette; he claims to have revived the instrument and restored it to what it was in the reign of Queen Mary. The cittern of the 16th century was the result of certain transitions which took place during the evolution of the violin from the Greek kithara (*see* CITHARA).

Genealogical Table of the Cittern



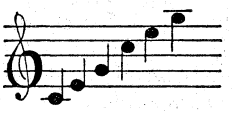
The cittern probably owed its popularity at this time to the ease with which it might be mastered and used to accompany the voice; it was one of four instruments generally found in barbers' shops, the others being the gittern, the lute and the virginal. The customers while waiting took down the instrument from its peg and played a merry tune to pass the time (*see* Knight's *London,* i, 142). We read that when Konstantijn Huygens came over to England and was received by James I at Bagshot, he played to the king on the cittern (cithara), and that his performance was duly appreciated and applauded. He tells us that, although he learned to play the barbiton in a few weeks with skill, he had lessons from a master for two years on the cittern (see *De Vita propria sermonum inter liberos libri duo,* Haarlem, 1817, and E. van der Straeten, *La Musique aux Pays-Bas,* ii, 348–350). On the occasion of a third visit he witnessed the performance of some fine musicians and was astonished to hear a lady, mother of twelve, singing in divine fashion, accompanying herself on the cittern; one of these artists he calls Lanivius, the British Orpheus, whose performance was really enchanting.

Michael Praetorius (Syntagma Musicum, 1618) gives various



tunings for the cittern as well as an illustration (sounded an octave higher than the notation).

During the 18th century the cittern, citra or English guitar, had 12 wire strings in six pairs of unisons tuned thus:



Different accordances are also given in M. Mersenne's *Harmonie universelle* (Paris, 1636), livre ii, prop. xv.

The introduction of the Spanish guitar, which at once leaped into favour, gradually displaced the English variety. The Spanish guitar had gut strings twanged by the finger. The last development of the cittern before its disappearance was the addition of keys. The keyed cithara was first made by Claus & Co. of London in 1783 (*see* Carl Engel, *Catalogue* of the exhibition of ancient musical instruments, London, 1872, Nos. 289 and 290). The keys, six in number, were placed on the left of the soundboard, and on being depressed they acted on hammers inside the sound-chest, which rising through the rose sound hole struck the strings. Sometimes the keys were placed in a little box right over the strings, the hammers striking from above. M. J. B. Vuillaume of Paris possessed an Italian cetera (not keyed) by Antoine Stradivarius, 1700 (now in the Museum of the Conservatoire, Paris), with 12 strings tuned in pairs of unisons to E, D, G, B, C and A, which was exhibited in London in 1871. (Illustration in A. J. Hipkins, *Musical Instrument; Historic, Rare and Unique* [Edinburgh, 1888].)

The cittern has retained the following characteristics of the archetype. (1) The derivation of the name, which after the introduction of the bow was used to characterize various instruments whose strings were twanged by fingers or plectrum, such as the harp and the rotta (both known as cithara), the citola and the zither (*q.v.*). In an interlinear Latin and Anglo-Saxon version of the Psalms, dated A.D. 700 (Brit. Mus., Vesp. A. 1), *cithara* is translated *citran,* from which it is not difficult to trace the English *cithron, citteran, cittarn,* of the 16th century. (2) The construction of the sound chest with flat back and soundboard connected by ribs. The pear-shaped outline was possibly borrowed from the eastern instruments, both bowed as the rebab and twanged as the lute, so common all over Europe during the middle ages, or more probably derived from the kithara of the Greeks of Asia minor, which had the corners rounded. These early steps in the transition from the *cithara* may be seen in the miniatures of the Utrecht psalter, a unique and much-copied Carolingian manuscript executed at Reims (9th century), the illustrations of which were undoubtedly adapted from an earlier psalter from the Christian east. The instruments which remained true to the prototype in outline as well as in construction and in the derivation of the name were the ghittern and the guitar, so often confused with the cittern. It is evident that the kinship of cittern and guitar was formerly recognized, for during the 18th century, as stated above, the cittern was known as the English guitar to distinguish it from the Spanish guitar. The grotesque head, popularly considered the characteristic feature of the cittern, was probably added in the 12th century at a time when this style of decoration was very noticeable in other musical instruments, such as the cornet or *Zinck,* the *Platerspiel,* the chaunter of the bagpipe, etc. The cittern of the middle ages was also to be found in oval shape. From the 13th century representations of the pear-shaped instrument abound in miniatures and carvings. References to the cittern are plentiful in the literature of the 16th and 17th centuries. *See* the *New English Dictionary,* "Cittern," and Godefroy's *Dict. de l'anç, langue franc. du IXe siècle.* (K. S.)

CITY. In Great Britain strictly speaking "city" is an honorary title officially applied to those towns which, in virtue of some pre-eminence (*e.g.,* as being episcopal sees or great industrial centres), have by traditional usage or royal charter acquired the right to

the designation. The official style of "city" does not necessarily involve the possession of municipal power greater than those of the ordinary boroughs, nor indeed the possession of a corporation at all (*e.g.*, Ely). In the United States and the British dominions, on the other hand, the official application of the term "city" depends on the kind and extent of the municipal privileges possessed by the corporations, and charters are given raising towns and villages to the rank of cities. Both in France and England the word is also used to distinguish the older and central nucleus of some of the large towns, *e.g.*, the *cité* in Paris, and the "square mile" under the jurisdiction of the lord mayor which is the "City of London." In common usage, however, the word is loosely applied to any large centre of population, and in the United States any town, whether technically a city or not, is usually so designated, with little regard to its actual size or importance.

As the translation of the Greek πόλις or Latin *civitas*, the word involves the ancient conception of the state or "city-state," *i.e.*, of the state as not too large to prevent its government through the assembled body of citizens, and is applied not to the place but to the whole body politic. From this conception both the word and its dignified connotation are without doubt historically derived. On the occupation of Gaul the Gallis states and tribes were called *civitates* by the Romans, and subsequently the name was confined to the chief towns of the various administrative districts. These were also the seats of the bishops. It is thus affirmed that in France from the 5th to the 15th century the name *civitas* or *cité* was confined to such towns as were episcopal sees, and Du Cange (*Gloss.* s.v. *civitas*) defines that word as *urbs episcopalis*, and states that other towns were termed *castra* or *oppida*. How far any such distinction can be sharply drawn may be doubted. No definite line can be drawn between those English towns to which the name *civitas* or *cité* is given in mediaeval documents and those called *burgi* or boroughs (*see* J. H. Round, *Feudal England;* F. W. Maitland, *Domesday Book and After*). It was, however, maintained by Coke and Blackstone that a city is a town incorporate which is or has been the see of a bishop. It is true that the actual sees in England all have a formal right to the title and the boroughs erected into episcopal sees by Henry VIII thereby became "cities"; but towns such as Thetford, Sherborne and Dorchester are not so designated, though they are regularly incorporated and were once episcopal sees. In 1075 the bishop's see was transferred from Sherborne to Salisbury. After eight and a half centuries, by an order published in the *London Gazette* of Feb. 10, 1924, Sherborne was re-created a suffragan bishopric. On the other hand it has only been since the latter part of the 19th century that the official style of "city" has, in Great Britain, been conferred by royal authority on certain important towns which were not episcopal sees, Birmingham in 1889 being the first to be so distinguished. London contains two cities, one (the City of London) outside, the other (the City of Westminster) included in the administrative county.

For the history of the origin and development of modern city government *see* BOROUGH and COMMUNE: *Mediaeval.*

BIBLIOGRAPHY.—For American cities, *see:* William B. Munro, *The Government of American Cities,* 4th ed. (1924); Chester C. Maxey, *An Outline of Municipal Government* (1924).

CITY CLERK, the chief clerical official of the cities of the United States performing most of the duties of an English town clerk. In cities under the council form of government he is usually elected either as a partisan candidate or candidate without regard to party lines. In cities under the commission or commission-manager form of government, he usually is appointed by the mayor subject to the approval of the commission, or is chosen by the commission. He may serve for an indefinite number of terms. The city clerk keeps the minutes of the meetings of the city council or commission. He also keeps all other city records, and in many states has authority to issue licences. He usually has a force of deputies appointed by him or by the authority which appoints him, or selected by civil service regulations.

See H. G. James, *Local Government in the United States* (1921); C. C. Maxey, *An Outline of Municipal Government* (1924).

CITY GOVERNMENT. The cities of the ancient and to a large extent the mediaeval world were either states in themselves or their governments were closely assimilated to those of the states in which they were located. To describe their forms of government would be merely to rehearse the many forms of government man had then devised for his general needs. Modern cities, at least those which are the products of western civilization, exhibit certain common traits. They are, generally, subordinate units of national states. They possess the character and privileges of corporations. With certain exceptions, they have as a governing body an elective council and some form of locally selected chief magistrate. They differ chiefly in the size and method of election of the council, the form of the executive authority and the process of its selection and in the extent and methods of control exercised over municipal affairs by the central government. There is, however, a sufficient similarity in their structure, their procedures and the scope of their authority to make the subject of municipal government a recognized division of the field of political science. A few capital cities like Washington, Paris and London have less complete organs of self-government than normal cities. The only significant exceptions, however, to the general trend of municipal development are to be found in communist Russia and the defunct totalitarian regimes of Italy and Germany.

England.—English municipalities, generally known as boroughs, are governed by a town council consisting of mayor, aldermen and councillors. The councillors are elected by the local government electors, *i.e.*, occupiers as owners or tenants of any land or premises in the borough and the husband or wife of a person so entitled, for three-year terms, one-third being renewed each year. Aldermen, to one-third the number of the councillors, are elected by the councillors for six-year terms. The mayor, called lord mayor in some places, is elected by the council in which the aldermen sit and vote in the same manner as councillors. The mayor presides. The mayor has no distinctively executive functions. There is a council committee for each important department of the borough government which exercises supervision and control over its professional head, as the watch committee over the chief constable, and the health committee over the medical officer of health. In spite of the absence of formal provision for recruitment and tenure of borough employees, they are in fact usually selected on the basis of their qualifications by the respective committees subject to the approval of the council and enjoy permanent tenure. The services rendered by English boroughs are extensive, often including such things as gas, electricity and street railways. This system of city government has on the whole given great satisfaction and is on a completely democratic basis, the only important groups excluded from the local franchise being adult children living with their parents, lodgers and servants living in. It differs from other forms of city government chiefly in the fact that there is no unified executive but numerous departments related to one another only through the council. The mayor may have great influence but he has little authority. The borough clerk, the most important member of the permanent staff, however, serves in some degree as a connecting link between departments.

The powers of English cities are derived from acts of parliament and orders issued under the authority of acts of parliament by the ministry of health and other departments of the central government. A characteristic feature of the English system of local government is the quasi-judicial procedure employed by parliament in the consideration of private bills, *i.e.*, special acts for particular municipalities.

France.—French cities are organized in accordance with a very brief general law applicable to all communes irrespective of size except Paris (*see* PARIS). Councils, which vary with the size of the commune from 10 to 36 members, are elected by the same suffrage as prevails in national elections, in the larger cities by districts and in the smaller cities at large. The councils are renewed as a whole every six years. The council chooses from its own number a *maire* for a term of six years. He is the chief executive officer of the commune, appointing all strictly municipal

employees subject to the terms of the national personnel code. He also exercises independently of the council extensive police powers including the power to make regulations which in England or the United States would require action by the city council. The council, according to its size, also chooses from 2 to 12 assistants to the *maire* known as *adjoints*. The *maire,* however, is solely responsible for the conduct of the city administration. He receives no salary and the office carries with it a great deal of prestige.

A French city council is given by the municipal law a very broad grant of power to "regulate by its deliberations the affairs of the commune." Its activities are, on the other hand, subject to very close supervision by the national government, chiefly through the prefect of the department or, in the case of small municipalities, the subprefect of the *arrondissement*. Any action of a communal council may be annulled if it violates a law or decree of the national government, and the municipal law lists 12 categories of acts, including the annual budget, which may go into effect only with the approval of the prefect who may also write into the budget any of the obligatory items which the council may have omitted. A city council may be suspended by the prefect for one month or dissolved by the national government. The police powers of the *maire* are subject to close supervision and control by the prefect. The results of French municipal government have in general not been conspicuously outstanding. Outside of Paris there are few visible evidences of the effects of first-class municipal housekeeping.

Other European Systems.—Municipal government in pre-Hitlerite Germany was much admired by British and U.S. observers for both the scope and quality of services rendered. Prior to World War I it was based in Prussia on the so-called "three-class system" of voting which gave one-third of the members of the city council to the limited group of the largest taxpayers who paid one-third of the city's taxes, another third to the next highest group paying one-third of the taxes and only one-third to the great mass of citizens. This taxpayers council chose an executive board or *Magistrat* consisting partly of salaried professional officers and partly of unpaid civilians. The chairman of this board was a professional official, qualified for the higher administrative service, known as the *Bürgermeister,* who acted likewise as the ceremonial head of the city. With the chief magistrate appointed for a long term, with liberal pension provisions, much official prestige and a salary comparing favourably with that of other officials in Germany, and a council responsible to the wealthiest taxpayers, economy and efficiency were to be expected. Furthermore, the municipal authorities were subject to supervision by a series of superior administrative authorities beginning with the district committee (*Bezirksausschuss*) and ending with the minister of the interior. Subject to this supervision Prussian cities were permitted to exercise almost all powers pertinent to local government.

The Weimar republic introduced briefly universal suffrage without much changing the other features of the municipal regime. The nazis swung sharply away from all municipal precedents. The *Bürgermeister* and other principal salaried officers were named by the party delegate (himself named by the "substitute" of the fuehrer) subject to the approval of the central government. To the *Bürgermeister* was entrusted all the powers of city government subject only to the obligation of consulting on important matters with the city council, also selected by the party delegate.

Municipal government in the rest of Europe follows more or less the French or prewar Prussian systems, except as modified by the advent of one-party totalitarianism, as in Italy, for example, where Mussolini replaced elected *syndicos* and councils rather on the French model by a *podesta* in whom was vested all local authority, and an advisory council, both appointed by the central government. In southern Germany the executive authority was a *Bürgermeister* chosen by the city council rather than the collegial executive of Prussia. The local institutions of the Netherlands and Belgium followed a similar line of development, the burgomaster's appointment by the crown being in fact practically always on the nomination of the city council itself. In fact no better examples of sturdy local self-government can be found than in the Low Countries, in spite of the existence of organs of central supervision similar to those of France which, however, operate chiefly in the guidance of the very numerous small communes where the personnel of the local government often lacks education and experience.

Russian cities are governed by a city soviet elected by the workers in the various industries and other units of the soviet system. The city soviet is a very large body, exceeding in some cases 1,000 members. It elects on the nomination of the party a president and a praesidium or executive committee of from 11 to 17 members. Within this body a bureau or "working trio" consisting usually of the president, his deputy and his secretary, constitutes the day-by-day executive. The activities of the city soviet are rigidly supervised by the higher soviets or their executive committees.

The British dominions follow in a general way the models of the mother country both as to the source of municipal power and the organization of municipal government. The remainder of the world's cities, to the extent that they have come under European influence, are governed, generally speaking, after the French fashion.

The United States.—The few cities incorporated before and immediately after the American Revolution followed closely the contemporary English pattern. The limited powers granted them by the colonial and early state legislatures were mainly lodged in a council elected on a limited suffrage as in New York or self-perpetuating as in Philadelphia, and a mayor not possessing much distinctly executive authority. The mayor, aldermen and recorder, as in English cities, constituted the local judiciary. In the course of the first half of the 19th century, however, the governments of most cities, including all the larger ones, were remodelled in imitation of the state governments of the period, with a council of two chambers, one or both elected by wards; a mayor independently elected and possessing a veto over the acts of the council, but whose appointments were subject to confirmation by the council; council committees taking an active part in administration; and numerous elective administrative officers and department heads. It cannot be said that this system ever worked well. It responded all too easily to the virulent spoils politics of the era. It was further complicated toward the middle of the 19th century by the widespread introduction of boards and commissions as directory agencies of the departments, who were appointed usually for long and overlapping terms. The motive for the use of these bodies was often ostensibly to remove a particular branch of the government from politics. They served rather as hotbeds of political activity, and by eliminating clear-cut responsibility on the part of the mayor for the conduct of the administration of the city made it most difficult for public opinion to be brought to bear effectively on the many abuses which followed. Coupled with the rapid growth of city population and the unexampled opportunities for corruption in connection with swiftly developing public works, this loose form of government produced a situation which led James Bryce in the *American Commonwealth,* published in 1888, to declare, "There is no denying that the government of cities is the one conspicuous failure of the United States."

After that time great progress was made toward good city government. It began with a movement for the concentration of greater power and responsibility in the hands of the mayor, accompanied by demands for a merit system of appointments, nonpartisanship in city affairs, and better nominating and election procedures. These were all items in the program of the National Municipal league founded in 1894. As a result two-chamber city councils began to disappear, the mayor's powers to increase and the list of independently elected or commission-operated department heads to decline.

Commission Government.—In 1901 Galveston, Tex., stricken by wind and flood, originated a new type of organization known as commission government. In this form of government there is a very small council, usually five members, elected at large, who are individually the heads of the principal departments of the

city government and collectively its legislative body. One of the number is designated as mayor either by the people at the council election or afterward by his colleagues. He ordinarily, however, has no more power than his fellow members although he may have greater prestige. This in a sense was a return to the English councilmanic form of government, only with a much smaller council and five committees of one for each of the five major divisions of the administration.

The commission plan spread rather slowly until 1907 when Iowa adopted an optional form of commission government usually known as the Des Moines plan which contained such added features as a nonpartisan ballot, a double or majority election system, and the initiative, referendum and recall. Irrespective of the merits of these devices, they contributed to the rapid progress of commission government in the following decade by removing popular fear of concentrated government.

On the whole the commission plan has worked satisfactorily in small cities but has been severely criticized in places of 100,000 population or more. It completely confuses the functions of representation, to which popular election is essential, and that of administration which requires special training and skills. In consequence the commission form of government is to be found in a slowly diminishing number of cities, 327 of the 2,033 places of more than 5,000 population in 1945. No important city adopted the plan in the two decades ending in 1945.

Manager Plan.—The defects of the commission form were such as to suggest that they might be cured if its board-of-director-size city council were to appoint, as corporation directors do, a manager to execute their decisions. The first commission-manager charter was granted to Sumter, S.C., in 1912. The movement for the manager plan received a strong impetus from its successful application in Dayton, O., in the following year. The cities adhering to it have steadily increased in number until in 1945 it was in effect in 350 cities of more than 5,000 population in the United States, the largest being Cincinnati with a 1940 population of 455,610.

Under the manager plan the council is small, seldom exceeding nine, and is usually elected at large on a nonpartisan ballot. In a few instances it is elected by proportional representation. The mayor who is generally merely the presiding officer of the council and the city's ceremonial head is, as a rule, chosen by the council from among its own number. The number of other elective officers varies considerably but is much smaller than under pre-20th century charters. The school board continues to be separately elected as in most other cities in the United States. Except for these other elective officers the council is solely responsible to the people for the conduct of the city government. Its most important act, however, is the appointment of the city manager whose business it is to keep the council informed as to the city's affairs and problems, to prepare the annual budget, to recommend policies, and when decisions have been made by the council loyally to carry them out. He has, subject to civil service regulations, complete control over the appointment, removal and direction of the city's personnel. He holds office at the pleasure of the council and is in effect their agent, occupying the same relation to the council as the manager of a private corporation occupies in relation to his board of directors. The position is regarded in most cities as a professional one and appointment usually is not limited to residents of the city or even the state in which it is located. City managership has become a career for which men prepare as for any other profession. These ideals are not realized in all cities with the city manager form of government, but they represent the situation in a large and growing majority of them.

In spite of some disappointments, usually growing out of the failure on the part of the council and manager to remain in their respective spheres, the success of the plan has been remarkable. Its soundness as a method of city organization is amply attested by its steady growth in popularity for more than a quarter of a century. It has not appealed strongly, however, to the major cities of the United States. Cleveland, the only city of more than 500,000 population to adopt it, abandoned it after eight years of trial as the result of the combined opposition of both the Republican and Democratic machines.

Mayor and Council Form.—The majority of the cities of the United States, 1,277 of those of more than 5,000 population, still retain an independently elected mayor and council, of only one chamber, except for New York city and a few cities in New England and the southeastern states, but usually much larger than under the commission or city manager plan. A nonpartisan ballot is used in 43.3% of these cities. Even where city elections are fought on national party lines, improved registration and election laws have removed much of the scandal which prevailed in Lord Bryce's day.

The tendency has been to increase the power of the mayor, a movement corresponding in other cities to the concentration of executive authority in the city manager. Certain cities, of which New York, Boston, Detroit, St. Louis and Indianapolis are examples, have carried this tendency so far that they may properly be said to have a "strong-mayor" form of government. The mayor of Boston, for example, having full power of appointment to all the principal offices without the necessity of council confirmation, sole power to initiate the budget and all supplementary appropriations which cannot be increased by council action beyond his recommendation, is to all intents and purposes a municipal dictator for the term for which he is elected.

The great majority of cities with mayor and council government, however, must be classified as adhering to the "weak-mayor" plan. There is, of course, no hard and fast line between the strong and weak mayor types of government. There are innumerable degrees of relationship between mayors and councils, and in some cities in which the mayor's legal authority is weakest the personality of the mayor added to the prestige of his office makes him the undisputed director of the city's affairs.

Sources of City Powers.—In the United States cities derive their existence from their respective state governments. The national government has only occasional and incidental relations with cities, dealing in most matters affecting cities only through the states. The basic conception of city-state relationships is English. The first cities were created and their powers defined by acts of the colonial and early state legislatures. Unlike the English parliament, however, the state legislatures never developed a sound procedure for dealing with the special needs of cities. Special acts relating to them were passed in the same manner as other laws, and in the middle of the 19th century special legislation came to be so abused that most of the states were led to forbid it in their constitutions. Several states, like Connecticut, Georgia and Texas, continue the practice unhampered, and many others have avoided constitutional prohibitions by the device of classifying cities on a population basis. For example, while the constitution of Pennsylvania prohibits special legislation there is only one first-class city, Philadelphia. Seventeen states—Arizona, California, Colorado, Maryland, Michigan, Minnesota, Missouri, Nebraska, New York, Ohio, Oklahoma, Oregon, Texas, Utah, Washington, West Virginia and Wisconsin—provide in their constitutions for "municipal home rule." In other words, they permit cities to adopt charters prescribing the form of their own government and authorizing them to exercise such powers of a municipal nature as do not contravene general laws. Some states whose constitutions do not provide for home rule and even permit special legislation, notably Massachusetts, have provided several optional forms of city government which any city may adopt by vote of its people.

Elections.—The right to vote in city elections belongs, throughout the United States, to residents of the city possessing the qualifications required by the state for voting in state elections. The procedures for the nomination of candidates and the method of election not only vary from state to state, but within the same state municipal practice not infrequently departs from the state standard. In some states candidates for city office are nominated by ward caucuses or city conventions of their respective parties. In others the direct party primary is in vogue. Many cities by charter, special act or general optional act, however, have the privilege of electing their candidates on a nonpartisan

basis. In the great majority of these cities, candidates are nominated by petition of a specified number, usually not very large, of the qualified voters and run against one another in a preliminary election or run-off primary. The two candidates for each office receiving the largest number of votes become the sole candidates at a final election held a few weeks later. In some instances a candidate receiving a majority of the votes cast at the preliminary election is declared elected without further formality. A very few cities use some system of preferential voting in which the voter indicates the order of his preference among the candidates, certain specified values being attached to each first, second or third choice. In these cities there is no preliminary election or primary. Several important cities, including New York, Cincinnati and Toledo, elect their councils by means of proportional representation (*q.v.*).

Further information concerning city government may be found under the names of the various countries and of some of the larger cities.

BIBLIOGRAPHY:—W. Anderson and others, *Local Government in Europe,* (1939); W. B. Munro, *The Government of European Cities* (1927); H. Finer, *English Local Government* (1934); J. J. Clarke, *Outline of Local Government of the United Kingdom,* 13th ed. (1938); H. Berthélemy, *Traité Élémentaire de Droit Administratif,* 13th ed. (1933); R. H. Wells, *German Cities* (1932); C. M. Kneier, *City Government in the United States* (1934); T. H. Reed, *Municipal Government in the United States* (1934); *Municipal Management* (1941); National Municipal League, *A Model Charter with Home Rule Provisions* (1941); H. A. Stone and others, *City Manager Government in the United States* (1940); H. L. McBain, *The Law and Practice of Municipal Home Rule* (1916); J. D. McGoldrick, *The Law and Practice of Municipal Home Rule, 1916–1930* (1933); The International City Managers' association, *The Municipal Year Book,* 1945. (T. H. RD.)

CITY MANAGER. The city manager is the principal executive and administrative officer of a municipality under the council-manager form of local government, which spread widely in the United States and Canada after Dayton, O., became the first large city to adopt it in 1913.

Under the council-manager plan, the voters elect only the city council, which appoints a city manager to administer municipal affairs under its supervision.

The members of the council, usually five to nine in number, may be elected either at large or by wards. The mayor is a member of the council and serves as its presiding officer. He may either be designated to this position by the council, or elected as such by the voters. The council acts only collectively, and its individual members, including the mayor, have no executive functions.

The city manager serves at the pleasure of the city council. Subject to its general supervision, he is in full charge of the administration of municipal affairs. He prepares the budget, appoints and dismisses personnel and directs the work of the municipal departments. He attends all council meetings, presents recommendations on municipal business and usually takes an active part in the discussions.

Origin and Spread of Plan.—The council-manager plan was devised and first advocated in the U.S. by the National Short Ballot organization, an association which proposed to improve state and local government by reducing the number of elective offices in order to fix responsibility on a few officials. This organization, of which Woodrow Wilson was president and Richard S. Childs, a young New York advertising man, was the secretary and active promoter, undertook first to support the commission plan of municipal government. Under that plan, all municipal powers were vested in a commission, the members of which collectively served as a legislative body and individually administered the departments.

Since the dispersion of administrative functions proved to be a serious weakness of the commission plan, Childs' attention was attracted by the news that the city council of Staunton, Va., had appointed a general manager and delegated to him the function of directing the municipal departments. He seized on this idea as a means of overcoming the weakness of the commission plan, and the National Short Ballot organization formulated and began to promote the commission-manager plan, which in all essentials was the plan later known as the council-manager or city-manager plan.

Sumter, S.C., adopted the plan in 1912, and was followed by several other small cities. The greatest impetus to its spread came with its adoption in 1913 by Dayton, which had suffered a severe flood that required emergency action by its local authorities.

The National Municipal league, the principal organization in the United States for the promotion of municipal reform, had previously concentrated its efforts on strengthening the authority of the mayor and eliminating partisan patronage. After the early success of the council-manager plan, it adopted the plan in 1915 as the basis of its Model charter for municipal governments. This charter added to the essential features of the council-manager plan provisions to establish a civil service system, to forbid members of the council to interfere with the city manager's administrative work or appointments, to forbid municipal employees to engage in political activity and to provide for election at large or by proportional representation. (About three-fourths of the cities that adopted the plan before 1945 elected their councils at large; only ten of these cities elected by proportional representation.)

While it generally proved impractical to write into law a precise definition of the respective functions of the council and the city manager, in view of the fact that the city manager serves at the council's pleasure, the principal objectives of the plan were achieved in most of the cities that adopted it. The plan spread most rapidly from 1918 to 1923, as many cities undertook programs of public works and municipal improvements and realized their need for more efficient administration.

By Aug. 1945 the council-manager plan was in effect in 593 cities and 9 counties in the United States and 23 cities in Canada. With local modifications, it had been adopted by 5 cities in Eire and one in Puerto Rico. Of the 396 cities in the United States with 25,000 to 500,000 population in 1945, 103 operated under the council-manager plan; of the 92 cities with more than 100,000 population, 22 operated under the plan.

Legal and Political Basis.—The legal basis of the plan in the United States varies with state law. In states which permitted municipal "home rule" cities established the plan by adopting by popular vote charters drafted by local reform groups, often following the Model charter or the advice of expert consultants. Others adopted by popular vote an optional council-manager plan provided by state law. Others had their state legislatures enact special council-manager charters for them. And in others the city council adopted the plan by municipal ordinance without submitting it to popular vote.

The political circumstances under which the plan was adopted often affected the role of the city manager. Some cities, especially those in which the leaders in business affairs and civic organizations had never before taken part in municipal politics, adopted the plan as part of a vigorous campaign of municipal reform. Their purpose was to break the hold of partisan or factional organization on city government, and to eliminate patronage in jobs or contracts. In these cities the plan required the support of an active reform organization, and the plan itself and the city manager were likely to remain the subjects of political controversy.

At the other extreme, some cities in which the municipal leadership was generally respected adopted the plan on the initiative of their city councils, and the city manager was never identified with either side of a political contest.

Most cities were between these two extremes. In states where the national party organization did not take a direct part in municipal affairs (usually states in which one or another party was predominant) cities generally found it easier to get general acceptance for the council-manager plan, and to establish the city manager as a noncontroversial career officer whose position was not at stake in elections.

Characteristics of Managers.—More city managers had training or experience as engineers than in any other occupation. A

considerable proportion of the remainder were trained in other types of public administration. During the years 1938–44, only one-sixth of the men appointed as city managers came to their new jobs from other than governmental positions.

From the first, city managers were highly conscious that they were creating a new profession, even though, unlike the more generally recognized professions, city managership had no definite training or entrance requirements. The traditions of the engineering profession contributed to this group consciousness, and encouraged city managers, by comparison with other municipal chief executives, to look on municipal administration more as a business in which objective standards should be developed, and less as one in which local political considerations should be paramount. By the end of 1944, 30% of the city managers in the United States had been in the city manager profession for ten years or more.

City managers, with rare exceptions, refrained from taking part in local political campaigns, even when they were personally attacked by opposition factions. On the other hand, many took the lead in public discussions of municipal policy. Some of the most successful managers were extremely active as public speakers and as public advocates of improving or extending municipal services.

More than half the cities that adopted the plan appointed other than local residents as their first city managers, and the promotion of a city manager from one city to another was a common occurrence.

City managers looked on their work as a professional career, but at the same time they never expected to hold their positions except at the pleasure of their city councils. Their professional society, the International City Managers' association, always took the position that the city manager was subject to dismissal by the council, and refused to support proposals that he be removed only by more than a simple majority vote of council members. Similarly, it admitted to membership any city manager duly appointed by a city council, and never sought to establish any criteria of its own for recognition or membership in the profession.

The association did a great deal not only to stimulate a professional attitude among its members, but also to advance the general level of municipal administration. It sponsored research in municipal administration; published the *Municipal Year Book*, an annual encyclopaedia of factual and statistical data on all cities in the United States; and conducted courses of training in various branches of municipal management.

The city manager movement had effects beyond the sphere of municipal affairs. In the United States, city managers often went from municipal government into state and national administration, and did much to help develop administrative systems in which federal, state and local agencies co-operate in the management of national programs.

See International City Managers' Association, *The Municipal Year Book* (published annually); Harold A. Stone, Don K. Price and Kathryn H. Stone, *City Manager Government in the United States* (1940). (D. K. Pe.)

CITY PLANNING: *see* Town and City Planning.

CIUDAD BOLÍVAR, an inland city and river port of Venezuela, capital of the state of Bolívar, on the right bank of the Orinoco river, 240 mi. above its mouth. Population (census of 1941) 19,789. The mean temperature is about 83° F.

The city stands upon a small hill some 125 ft. above sea level, and faces the river where it narrows to a width of less than half a mile. It is the commercial centre of the great Orinoco basin, being the chief port both for imports to the inland of Venezuela and for exports from the country. The Venezuelan Airmail line serves the city; and there is regular steamship communication with the lower Orinoco, Port of Spain and the Caribbean coast of Venezuela.

During the rainy season small steamers run far up the river. There is a road 600 mi. long which connects Ciudad Bolívar with the Venezuelan capital, Carácas.

The principal exports from this region include gold, cattle, horses, mules, tobacco, cacao, rubber, tonka beans, bitters, hides, timber and many valuable forest products. There are large gold mines southeast of the city.

The town was founded by Mendoza in 1764 as San Tomás de la Nueva Guayana, but its location at this particular point on the river gave to it the popular name of *Angostura*, the Spanish term for "narrows." Angostura bitters were invented there in 1824, although the manufacture was thereafter transferred to another city.

The name Angostura was used until 1849 when that of the Venezuelan liberator was bestowed on it. Ciudad Bolívar played an important part in the struggle for independence and was for a time the headquarters of the revolution.

The town suffered severely in the fight for its possession, and the political disorders which followed greatly retarded its growth.

CIUDAD JUÁREZ, formerly El Paso del Norte, a northern frontier town of Mexico, in the state of Chihuahua, 1,223 mi. by rail N.N.W. of Mexico City. Pop. (1910) 10,621; (1940) 48,881. Ciudad Juárez stands 3,800 ft. above sea level on the right bank of the Rio Grande del Norte, opposite the city of El Paso, Texas, with which it is connected by bridges. It is the northern terminus of the Mexican National railway, and has a large transit trade with the United States, having a custom house and a United States consulate. It is also a military post with a small garrison. The town has a straggling picturesque appearance, a considerable part of the habitations being small adobe or brick cabins. The town was founded in 1681–82; its present importance is due entirely to its position on the border and the railway into the interior. It was the headquarters of President Benito Juárez in 1865, and was renamed in 1885 because of its devotion to his cause.

CIUDAD REAL, a province of central Spain, formed in 1833 of districts taken from New Castile, and bounded on the north by Toledo, northeast by Cuenca, east by Albacete, south by Jaén and Cordova and west by Badajoz. Population (1940) 530,368; area, 7,622 sq.mi.; density per sq.mi. 69.6. In the east and centre are extensive high plains forming part of the region known as La Mancha and rising on the southeast to low hills. The west consists of broken hilly country bordered on the south by the parallel ridges of the Sierra de Alcudia and by the Sierra Madrona, foreranges of the Sierra Morena. The province is drained, except on the southeast, by the Guadiana river which traverses it from east to west and receives several tributaries, notably the Gigüela, Záncara and Bullaque on the right and the Azuel and Jabalón on the left.

The climate on the plains is oppressively hot in summer, and in winter bitterly cold winds prevail. The rainfall is scanty and prolonged droughts are common. Forests occur only on the higher ground in the west. The vegetation on the La Mancha plains is limited to poor pasture. Cereals, saffron, the olive and vine are cultivated, but agricultural development is hindered by the scantiness of the population, the aridity and poverty of the soil, the want of proper irrigation and the occasional ravages of locusts. Large numbers of sheep and goats, however, are reared on the plains and Ciudad Real is famous for its mules. Pigs are kept in the oak forests of the west, and cork is an important product of this region. Coal is mined round Puertollano, lead in various districts, and important mercury deposits at Almadén. There is no other industrial development. The roads are insufficient and ill-kept, especially in the northwest, where they form the sole means of communication. The Madrid-Lisbon railway passes through the capital, Ciudad Real, and through Puertollano, where there is a branch line to San Quintin. Farther east, the Madrid-Linares railway passes through Alcázar de San Juan, junction for the Albacete line, and Manzanares and Valdepeñas, where branch lines link it with Ciudad Real and Puertollano respectively. There is also a branch in the northeast to Tomelloso. The capital is Ciudad Real (pop. 1940, 30,015) (*q.v.*). The principal towns (pop. 1940) are Valdepeñas (29,891), Tomelloso (28,462), Puertollano (22,099), Alcázar de San Juan (23,083), Manzanares (18,182), Almodóvar del Campo (8,488) and Almadén (12,468). Almagro (8,551), famous for its lace, and Daimiel (19,277), a market centre of La Mancha and site of a military

aerodrome, belonged in the middle ages to the knightly order of Calatrava, formed in 1158 to keep the Moors in check. Campo de Criptana (14,361) and La Solana (13,407) are other market towns. Education is very backward. (*See* also CASTILE.)

CIUDAD REAL, a town of central Spain, capital formerly of La Mancha and after 1833 of the province described above. It lies 107 mi. S. of Madrid, on the Madrid-Badajoz-Lisbon and Ciudad Real-Manzanares railways. Pop. (1940) 30,015 (mun., 32,931). Ciudad Real, situated on a wide plain, between the river Guadiana in the north and its tributary the Jabalón on the south, offers little of interest beyond its lofty Gothic cathedral, built without aisles. It is the market for the cereals, oil, wine, potatoes and figs produced with irrigation on the surrounding plain. Ciudad Real was founded by Alphonso X. of Castile (1252–84), and fortified by him as a check upon the Moorish power. Its original name of Villarreal was changed to Ciudad Real by John VI in 1420. It is said to have suffered greatly, especially in the loss of its flourishing leather industry, by the expulsion of the Moriscos in the 17th century. During the Peninsular War a Spanish force was defeated here by the French, on March 27, 1809.

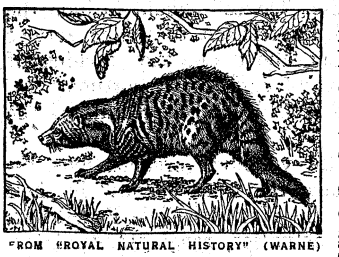
CIUDAD RODRIGO, a town of western Spain, in the province of Salamanca. It is situated on an eminence on the right bank of the river Agueda, 13½ mi. E. of the Portuguese frontier, and on the railway from Salamanca to Coimbra in Portugal. Pop. (1940) 3,872 (mun., 12,082). Ciudad Rodrigo is an episcopal see, and was for many centuries an important frontier fortress. It was founded in the 12th century by Count Rodrigo González and named after him, but remnants of a Roman aqueduct and bridge indicate that it occupies the site of a Roman settlement. The 12th century cathedral, with fine cloisters and carved portico, was disfigured by additions in 1538 and has suffered during sieges from its position almost astride the walls. During the Peninsular War, it was captured by the French under Marshal Ney, in 1810; but on Jan. 19, 1812, it was retaken by the British under Viscount Wellington, who, for this exploit, was created earl of Wellington, duke of Ciudad Rodrigo, and marquess of Torres Vedras, in Portugal. (X.)

Siege of Ciudad Rodrigo, 1812.—For the operations preceding and following the siege of Ciudad Rodrigo in 1812 *see* PENINSULAR WAR. Having insufficient troops to provide a covering force Wellington decided to use the element of surprise. He waited till both armies were scattered in winter quarters, made all his preparations in secret, and then suddenly, on Jan. 8, appeared before the town. Ciudad Rodrigo lies on the right bank of the Agueda and in 1812 its fortifications were modern and formidable, but it was commanded on the north by a hill, the Great Teson, which, crowned by a strong redoubt, rose to a height of 150ft., only 600yd. from the walls. Between this hill and the town lay a slightly lower ridge, the Little Teson, which was flanked at its eastern end by the Convent of San Francisco, at its western by that of Santa Cruz. The very night of his arrival Wellington stormed the redoubt on the Great Teson and at once began his preparations for an intensive siege. The weather was terribly severe, so that the troops in the trenches had to be relieved every 24 hours, but the men worked with great speed and enthusiasm. Within six days the British had dug a parallel and constructed batteries for 32 guns on the Great Teson, had sapped across the low ground and dug a parallel within assaulting distance on the Little Teson, and had stormed the convents which flanked it. For five days a furious bombardment was maintained, the enemy replying with equal vigour. By Jan. 19 two breaches had been made in the walls and, though the counterscarp had not been destroyed nor the enemy's guns silenced, Wellington gave orders for an assault. The main breach, at the northern corner of the fortifications was to be stormed by the 3rd Division; the lesser breach, 200yd. to the east, by the Light Division. Pack's Portuguese were to make a feint attack upon the San Pelayo gate at the other side of the town. At 7 P.M. on the 19th Campbell's Brigade of the 3rd Division entered the ditch at the south-west corner of the fortress, with orders to scale the outer wall and clear the left flank of the main breach. Their actual entry was premature and the garrison opened fire while the other attacking troops were still in their assembly trenches. The storming columns at once dashed forward. The 3rd Division was checked at the main breach by a land mine, but quickly drove the defenders back to a retrenchment behind the breach, which for a time held them back. The Light Division met with less opposition and, pouring through the lesser breach, cleared the way for their comrades on the right. The garrison quickly surrendered, but the storming troops got out of hand and for the rest of the night plundered, drank, burnt, and murdered; only at daylight was order restored. The siege cost Wellington 1,000 casualties, half in the assault, but 1,500 prisoners and 150 guns fell into his hands. Marmont only received definite news of the siege on the 15th; by the time he had collected his army the town had fallen. (H. L. A.-F.)

CIUDAD VIEJA, a highland village of Guatemala about 22 miles S.W. of Guatemala city and 3 mi. S.E. of Antigua, situated in the valley of the Almolonga at the foot of the volcano *Agua* (water). Urban population of the *municipio* of Ciudad Vieja (1940 census), 6,011. Originally named Santiago de los Caballeros de Guatemala, the city was founded in 1527 under the direction of Jorge de Alvarado, brother of Pedro de Alvarado, conqueror of Guatemala, and became the third capital of the Spanish Captain Generalcy of Guatemala. (The first and second capitals were, respectively, Iximché and Xepau.) News of Pedro de Alvarado's death in Mexico reached Ciudad Vieja on Aug. 29, 1541; on Sept. 8 his widow, Beatriz de la Cueva, had herself decreed governor of the province. Either as the result of a storm or an earthquake which cracked open the crater of the volcano *Agua,* an avalanche of mud and water descended upon the city on Sept. 10, burying, among several hundred other people, Doña Beatriz. Following this disaster, the capital was moved to Antigua, whence it was in turn removed, because of an earthquake in 1773, to the present site of Guatemala (*q.v.*).

CIVERCHIO, VINCENZO, an early 16th century Italian painter, born at Crema. There are altar-pieces by him at Brescia, and at Crema the altar-piece at the duomo (1509) is his work. His "Birth of Christ" is in the Brera, Milan; and at Lovere are other of his works dating from 1539 and 1540.

CIVET, or, properly, CIVET CAT, the name given to the more typical members of the Viverridae (*see* CARNIVORA), which are characterized by the presence of a deep pouch near the genital organs into which a fatty, yellowish substance, known as civet and having a strong musky odour, is secreted. Several species are known. The African civet (*Civettictis civetta*) measures 3–4½ ft. in length, of which a third is tail, and stands 10–12 in. high. The hair is long, forming an erectile ridge down the middle of the back; in colour it is dark grey with black bands and spots. The animal is nocturnal and largely carnivorous; it climbs trees with agility. It is kept in captivity (where, however, it never becomes tame) for its perfume, the larger quantity of which comes from the male and is scraped from the pouch with a spoon twice a week. The zibeth (*Viverra zibetha*) extends from Arabia to India and several East Indian islands. Other species occur in India, China and Malaya. The odorous principle (a ketone) has been isolated and named civetone. Civet is used for blending scents.



"FROM "ROYAL NATURAL HISTORY" (WARNE)

CIVET, A CAT-LIKE ANIMAL, VALUED FOR A GLANDULAR SECRETION USED FOR PERFUME

CIVICS, in its broadest signification, may be taken to include the activities of the citizen in his relationship to the state and society in general. Formerly it meant the study of civil government. "Civics" is defined as follows: "The science and consideration of the structure and administration of local, state and national government; of the development in the public mind of the will for constructive, intelligent and healthful participation in the work which governments—local, state and national—are empowered by the people to perform; and of the development of the procedures and processes which make for the greatest good of

the greatest number in the governmental and group relations of all social units." "Civics" embraces much more than a study of or dissertation on structures and functions, or a general interpretation of laws applying to these. It includes public-mindedness; the creation of right attitudes toward public duties; the formation of habits of helpful, constructive, participating citizenship; the development of activities which result in effective participation in good government; the consideration and application of procedures and processes which will result in the greatest good for the greatest number in all social units, big or little. The more modern textbooks on civics make the formal study of civil government only a part, and far from the largest part of their treatment. They teach the essential facts concerning sanitation; personal and community hygiene; fire prevention; care of the water supply; and a long list of other public activities. Whatever affects the well-being of social co-operative units is considered a part of civics even more than the purely governmental phases of the handling of such units.

In an address before a Congressional committee which had under consideration the operations of the U.S. Housing Corporation, the secretary of the American Civic Association, Harlean James, made this distinction between a social worker and a civic worker:—"A social worker deals with those persons who fall below the level of self-support either financially, physically or morally, and this holds true even when an effort is exerted to prevent any of these catastrophies. The civic worker deals with those persons who are sufficiently above the level of self-support financially, physically, mentally and morally to be in a position to contribute to the improvement of the community. Community improvement may be accelerated by good governmental machinery, but it is not the inevitable result of reform in municipal, county or state forms of government." A well-known writer of books under this heading, Mabel Hill, described "civics" as it is presented in high schools and junior colleges, as a study of the "social life in municipalities," and that life includes in its social relationships the Government of the town and city, the State and Federal Government, the institutions, social and ethical, as well as political, and sometimes, though not by any means always, would include religious institutions. Such a survey of municipal life, whether in the small manufacturing village or crowded metropolis gives opportunity to touch upon the theory of present government and the possibilities of changes that may occur because of trade unions. Likewise, "civics" should include the problem of the rural town and its relation to public service through agricultural interests; but above all, the teaching of "civics" should be a presentation of insistent opportunity for practice of the laws of sound citizenship and the ideals of the better citizenship for the future.

Sundry national, State and local volunteer organizations, especially in the United States, have the word "civics" in their titles. One of the oldest of these, the National Civic Federation, has an elaborate programme of activities, ranging from international relations to the individual voter, including economic and industrial questions and the relation of capital and labour. It grew out of the old Chicago Civic Federation, which was originally just what its name implied, a federation of local bodies interested in city or civic affairs. The American Civic Association which was formed of the merger of the American Park and Outdoor Art Association and the American League for Civic Improvement is concerned with the improvement of physical conditions in city, State and nation.

Generally speaking at the present time civic organizations are motivated by the broader idea of civics. Their objectives are no longer of a strictly political nature; their objectives now include the well being, physical and economic as well as political, of the individuals in the social unit. This broader meaning in practice of the word "civics" is largely due to the modern textbooks on the subject. (C. R. W.)

CIVIDALE DEL FRIULI, a town of Venetia, Italy, province of Udine, 10 mi. E. by N. by rail from the town of Udine; 453 ft. above sea-level; it was the ancient Forum Iulii. Pop. (1936) 4,715 (town); 10,424 (commune). The river Natisone forms a picturesque ravine here. The cathedral of the 15th century contains an octagonal marble canopy with sculptures in relief, with a font below it belonging to the 8th century. The museum contains Roman and Lombard antiquities, mss. and gold, silver and ivory objects formerly belonging to the chapter. The small church of S. Maria in Valle belongs to the 8th century, and contains fine decorations in stucco probably of the 12th century. The fine 15th-century Ponte del Diavolo leads to the church of S. Martino, which contains an altar of the 8th century with reliefs executed by order of the Lombard king, Ratchis. At Cividale was born Paulus Diaconus, the historian of the Lombards in the time of Charlemagne. A railway runs to Caporetto (16m.).

The Roman town of Forum Iulii was founded either by Julius Caesar or by Augustus, when the Via Iulia Augusta was built through Utina (Udine) on its way north. After the decay of Aquileia and Iulium Carnicum (Zuglio) it became the chief town of the district of Friuli and gave its name to it. The patriarchs of Aquileia resided here from 773 to 1031, then returned to Aquileia, and finally in 1238 removed to Udine. This last change of residence was the origin of antagonism between Cividale and Udine, terminated by their surrender to Venice in 1419 and 1420 respectively.

See G. Fogolari, *Cividale del Friuli* (Bergamo, 1906), well illustrated; *Memorie Storiche Forogiuliesi, passim* (Udine, 1905, *sqq.*—in progress).

CIVIL ENGINEER. When, in the 18th century, attention began to be given in England to such works of public value as roads, canals, harbours, docks, and lighthouses, the regulation of rivers, the production of iron by improved methods, and the construction of steam engines and of the machinery called forth by that new source of motive power, there arose men of great natural gifts, either with little technical training but great practical intelligence and skill, such as Brindley, or of equal practical capacity coupled with scientific attainments, such as Smeaton and Watt. These men applied to beneficent purposes the mechanical and constructional arts which previously had formed almost entirely the vocation of the military engineer, and they called themselves "engineers"; but Smeaton, seeing the inappropriateness of assuming a title hitherto belonging to military men, adopted the title "civil engineer," to make it clear that he was a civilian practitioner of those arts.

It was with this conception of the civil engineering profession that the Institution of Civil Engineers was founded. A royal charter of incorporation was granted to the institution on June 3, 1828. Before applying for the charter, the Society drew up a definition of the profession, "the art of directing the great sources of power in Nature for the use and convenience of man."

Many societies have since arisen having for their object the advancement of particular branches of engineering work, but the institution adheres to the conception of civil engineering held by its founders, and admits to its ranks any engineer who is adequately trained and experienced in the design and execution of any works or machinery instrumental in the application of sources of power for the benefit and convenience of mankind. The roll of the institution in 1928 numbered upwards of 10,000. Its house in Great George street, Westminster (the third building which it has occupied in that street), was built in 1912–13.

Specialization has brought about separate grouping of those interested in mechanical, electrical mining, etc., engineering. Underlying all groups is the work of the civil engineer, whose field particularly is that of structures. Foundations, simple or extremely complicated, are within his realm. He designs and supervises the construction of bridges and great buildings, tunnels, dams, reservoirs and aqueducts; he brings water to the centres of population and disposes of their wastes. He irrigates the desert and reclaims the swamps. He lays out, constructs and maintains highways and railroads, digs canals, regulates rivers, deepens harbours, builds lighthouses and constructs wharves and piers. He measures the earth's surface and the objects on it, and charts the resulting data. The work is frequently of a very definitely pioneering character, involving protracted physical effort. The civil engineer must have a scientific attitude of mind, and should

have imagination, initiative, accuracy and good judgment, trained by special study. He should be able to work with men as well as with materials, and he should have administrative ability. In the United States with over 100 million inhabitants, probably 75,000 persons would call themselves civil engineers.

The American Society of Civil Engineers, founded in 1852, admits engineers from various fields. It has a membership of about 14,000 and is an important engineering institution.

CIVILIS, CLAUDIUS, or more correctly IULIUS, a Batavian leader of the German revolt against Rome (A.D. 69–70). He had served as a Roman auxiliary. During the disturbances that followed the death of Nero, he induced the Batavi to rebel, under the pretence of assisting Vespasian. The neighbouring Germans joined the revolt. The Roman garrisons near the Rhine were driven out, and 24 ships captured. Two legions were blockaded in Castra Vetera (near the modern Xanten), and the survivors were finally massacred. Eight cohorts of Batavian veterans joined their countrymen, and the troops sent by Vespasian to the relief of Vetera threw in their lot with them. The result of these accessions to the forces of Civilis was a rising in Gaul. The Roman generals were murdered (A.D. 70), and the whole of the Roman forces were induced by two commanders of the Gallic auxiliaries (Julius Classicus and Julius Tutor) to revolt from Rome and join Civilis. Most of Gaul declared itself independent, and the foundation of an empire of the Gauls was contemplated. Vespasian resolved to take strong measures for the suppression of the revolt. The arrival of Petillius Cerialis with a strong force awed the Gauls and mutinous troops into submission; Civilis was defeated at Augusta Treverorum (Trier, Trèves) and Vetera, and forced to withdraw to the island of the Batavians. He finally came to an agreement with Cerialis whereby his countrymen obtained certain advantages, and resumed amicable relations with Rome. From this time Civilis disappears from history.

BIBLIOGRAPHY.—The chief authority for the history of the insurrection is Tacitus, *Histories,* IV., V., whose account breaks off at the beginning of Civilis's speech to Cerialis; also Josephus, *Bellum Judaicum,* vii. 4. *See* also Merivale, *Hist, of the Romans under the Empire,* ch. 58; H. Schiller, *Geschichte der römischen Kaiserzeit,* bk. ii. ch. 2. § 54 (1883); B. Henderson, *Civil War and Rebellion in the Roman Empire* (1908); Mommsen, *Provinces of the Roman Empire* (ch. iv.), trans. Dickson (1909).

CIVILIZATION. This Encyclopædia is in itself a description of civilization, for it contains the story of human achievement in all its bewildering developments. It shows what men during hundreds of thousands of years have been learning about themselves, their world and the creatures which share it with them. They have reached out into remote space and studied nebulae whose light reaches them after a million years; they have, on the other hand, dissected atoms and manipulated electrons as they might handle pebbles. In the present magnificent series of volumes man's inventions are reviewed from the rudest chipped flint to the most delicately adjusted microscope; his creation of multiform beauties of design, colour and word, his ways of dealing with his fellows, his co-operations and dissensions; his ideals and lofty aspirations, his inevitable blunders and disappointments; in short, all his gropings, disheartening failures and unbelievable triumphs are recalled.

Several thousand contributors have been brought together to do each his special part in writing some thirty-five million words on what mankind has hitherto done and said. It might therefore seem at first sight superfluous, and indeed impossible, to treat civilization itself as a separate topic in a few pages. But there is danger that owing to the overwhelming mass of information given in these volumes certain important underlying considerations may be lost sight of. There are highly significant questions concerning the nature and course of human development, the obstacles which have lain in the way of advance; the sources of success and frustration, which could hardly be brought together in dealing with any of the special aspects of human culture. Accordingly an attempt will be made under this caption to scan civilization as a single, unique and astonishing achievement of the human species.

To begin with, it is a startling fact that civilization, which sets off man in so astounding a manner from all other animals, should only lately have begun to be understood. We are immersed in it from infancy; we take it for granted, and are too near it to see it, except in this detail and that. Even to-day, with all our recently acquired knowledge, those who strive most valiantly in imagination to get outside civilization so that they may look upon it dispassionately and appraise it as a whole, are bewildered by its mysteries. As for the great mass of intelligent people, they still harbour many ancient illusions and misapprehensions from which they can only be weaned with great reluctance.

The object of the present article is to describe the newer ways of viewing civilization, its general nature, origin, progress, transmission and chief developments, in the light of information which has been accumulating during the past fifty or sixty years. The study of man himself has been revealing quite as many revolutionary facts and hypotheses during the past half century as the scientific investigation of the world in which he lives. The history of human achievement has been traced back, at least in vague outline, hundreds of thousands of years; man's original uncivilized nature and equipment have been studied and compared with the behaviour of his nearer relatives; new conjectures have emerged in regard to the functioning of speech and the nature and origin of human reasoning; careful investigations of primitive civilizations have cast great light on more complicated ones; the tremendous importance of childhood and its various implications in the development of civilization have been elaborated.

These and many other discoveries conspire to recast our conception of civilization, its past progress and its future possibilities.

It is instructive to note that the word civilization is by no means an old one. Boswell reports that he urged Dr. Johnson to insert the term in his dictionary in 1772, but Johnson refused. He preferred the older word "civility." This, like "urbanity," reflects the contempt of the townsman for the rustic or barbarian; it is an invidious term, although in a way justified by the fact that only where cities have grown up have men developed intricate civilizations. The arduous and dispersed tasks of the hunter, shepherd and peasant folk do not afford the leisure, or at least the varied human contacts, essential to the generation of new ideas and discoveries. But modern anthropologists have pointed out that peoples without cities, such as the tribes of Polynesia and the North American Indians, are really highly "civilized," in the sense that upon sympathetic examination, they are found to have subtle languages, ingenious arts, admirably suited to their conditions, developed institutions, social and political; religious practices and confident myths, no better and no worse substantiated than many that prevail to-day among the nations of Europe. All these betoken and presuppose a vastly long development. Among English speaking people the first to point this out clearly was E. B. Tylor, who published his famous *Primitive Culture* in 1871, the same year in which Darwin's *Descent of Man* appeared. These two books would alone have served, by different approaches, to give the word civilization a far more profound meaning than it had ever had before.

NEW CONCEPTION OF CIVILIZATION

There could be no real understanding of the fundamental characteristics of civilization until the fact was well established and digested that could we trace back man's lineage far enough we should find it merging into that of wild animals, without artificial shelters, clothes or speech; dependent for sustenance on the precarious daily search for food. It requires a considerable effort of the imagination to picture the human race without these seeming necessities of even primitive civilization. Without fire and tools men must have existed as did a wild girl discovered near Châlons, France, in 1731. She possessed a monkey-like agility which enabled her to catch birds and rabbits; these she skinned with her nails and gobbled raw, as would a dog. She delighted to suck the blood from living pigeons, and had no speech except hideous screams and howls.

This conception of man's former animal existence is gradually supplanting the older one, based upon ancient Hebrew tradition, that the first man and first woman were special creations with fully developed minds, speech and reason, which enabled them forthwith to dress the garden in which they found themselves, to

name its animal denizens, and to talk with one another, and with God himself in the cool of the evening. This view is still passively accepted by an overwhelming majority of Americans and Europeans and is at present hotly defended by a powerful group in the United States.

The former assumption was that man was *by nature* endowed with a *mind* and with *reason*. These distinguished him sharply from the animals, which did wondrous things it is true, but not as a result of reason. Their behaviour was guided, it was argued, by instinct. Darwin says that "the very essence of an instinct is that it is followed independently of reason." But if we agree, as manifold evidence seems to force us to do, that long, long ago men behaved and lived like wild animals, are we not forced to ask if they did not live wholly according to what Darwin calls "instincts"? And if once upon a time our ancestors lived solely by their animal equipment, did they as yet have a mind and reason? May not the human mind be something that has very gradually developed as a result of man's peculiar animal make-up and capacities? May not his reason be but another name for his slowly accumulated knowledge and beliefs and his ways of dealing with them and building upon them? In any case the discovery that our ancestors once lived like wild animals raises entirely new and difficult questions as to the nature, origin and interpretation of those powers of his known as mind and reason, which have enabled him to seek out those inventions and come upon beliefs and practices which have produced in the aggregate civilization.

In short, it seems to be more and more apparent that mind and reason were not part of man's original equipment, as are his arms and legs, his brain and tongue, but have been slowly acquired and painfully built up. They are themselves *inventions*—things he has come upon. Like other inventions *they are part and parcel of civilization*—not innate in man but dependent for their perpetuation on education in the widest sense of that term. This is so novel an idea that many readers may find it difficult to grasp, but when grasped it alters one's whole estimate of human progress. We ordinarily think of civilization as made up of mechanical devices, books and pictures, enlightened religious ideas, handsome buildings, polite conduct, scientific and philosophical knowledge, social and political institutions, ingenious methods of transportation and the rest. We think that all these things are due to man's possession of a mind, which no animal has, and as a result of the exercise of reason. In a way this is true enough, only we must reconceive mind and reason and regard them just as truly a part of the gradual elaboration of civilization as a House of Commons or a motor car, and quite as subject to improvement. At the risk of making a seemingly irrelevant philosophical digression, which is really most essential to a modern understanding of civilization, something may be said of the newer conception of mind and its variant, reason.

The word mind was originally a verb, not a noun; it meant action, not a thing or agent. It was remembering and purposing, and taking note of—as for instance "I minded"—that is, remembered, or paid attention to, or was concerned by. But as time went on philosophers made a noun of the good old verb. It was conceived as that incorporeal substance which was the seat of a person's consciousness, thoughts, feelings, and especially of his reasoning. The body was set over against the mind whose orders it was supposed to execute. The Scottish philosopher of common sense, Reid, says explicitly that "we do not give the name of mind to thought, reason or desire; but to that power which both perceives and wills." Even John Stuart Mill says in his *Logic* that "mind is the mysterious something which feels and thinks."

Recently there has been a tendency to reduce the noun mind once more to a series of verbs—desiring, remembering, feeling, thinking, distinguishing, inferring, planning—and to regard the assumption of "a mysterious something" as unfounded, unnecessary and a serious embarrassment. Relieved of this embarrassment it is possible to begin to bridge the gulf between the original behaviour of the human race and that of mankind to-day. Descartes and all the older philosophers believed that man had always had a mind as good as theirs. They sought to tell him how to employ it in the pursuit of truth. Mind was to them a sort of divine instrument, conferred solely upon man, that could be sharpened and efficiently used by following the laws of logic; but they could not think of it as something accumulated, so to speak, through the many thousands of years since man made his first contributions to the upbuilding of civilization.

The way is now cleared for a new view of civilization which would not have been possible 50 or 60 years ago. Civilization is no longer contrasted with "rusticity," "barbarity" or "savagery," but with man's purely animal heritage. Modern men are still animals, they have to eat and sleep, protect themselves from the inclemencies of the weather, and defend themselves from attacks of their fellow creatures and other animals, and to rear a new generation, if the species is to be perpetuated. They closely resemble kindred animals in much of their physical structure, in their important organs, breathing, digestion and the circulation of their blood. All these peculiarities are hereditarily transmitted no matter how much or how little men may be civilized. On the other hand, civilization—language, religion, beliefs, morals, arts and manifestations of the human mind and reason—none of these can be shown to be handed down as biological traits. They can only be transmitted to a new generation by imitation or instruction.

All mankind to-day has a double heritage. The one comes to us without any effort on our part, as do the spider's peculiar characteristics or those of birds, or of any of our fellow mammals, come to them. It is secure and tends to remain the same for thousands of years. Civilization, on the other hand, is precarious; it must be assimilated anew by each one of us for himself in such a degree as circumstances permit. It can increase indefinitely but it may also fall off tremendously, as the history of man amply testifies. It is a legacy that can be lost as well as kept and increased.

To illustrate: it may be that before human beings had acquired any of this loseable thing, civilization, they would pick up a stick to strike an assailant or hurl a stone at him. They might have found themselves riding astride floating tree trunks to cross a stream. Certain persons would occur, let us say, in each generation who would do all these things without ever having seen them done. These acts would be classed in man's animal heritage. But should we find traces of men who chipped a flint nodule into a hatchet head, and hollowed out their log with such a hatchet, or with fire, we should have to class these acts among the arts of civilization since they presuppose so much accumulated experience and ingenuity that they could not be inborn. The art of making a rude boat might consequently be wholly lost, as surely many inventions must have lapsed, if a single generation passed without constructing one.

It seems now an imperative fact that all civilization—the total social and traditional heritage, would fall away immediately and completely should a thoroughgoing forgetfulness, an overwhelming amnesia and profound oblivion overtake humanity. Only their natural equipment would be left. As Graham Wallas suggests, those least civilized would have a possible chance of surviving. It is only uncivilized man that might go on indefinitely. We are all by nature wild animals *plus;* and our taming weakens us for the ancient struggle in the forest, naked and bare-handed.

PECULIAR ITEMS OF MAN'S BODILY FORM

At this juncture the question arises, what was there peculiar in man's physical make-up that enabled him to initiate civilization and build up a mind which he could use to increase his resources so far beyond that of any other animal? Before proceeding we should recollect that the ways of all living creatures are manifold and astonishing. Even a single-celled organism can marvellously adjust itself to altered conditions. It seems to learn by experience, it appears to have a sort of memory, it is modified by happenings which interrupt its comfortable routine. It is ingenious in defending itself, in seeking food and reproducing. It is, in short, purposive in its conduct. The tiger and the frog are able to adjust themselves to very different modes of life, and so are the orioles and cacti. Before man began to accumulate civilization we are forced to assume that he too made terms with the

daily need of adjustment which faced him, otherwise we should not be here to write the tale. These are the salient essentials of *Life,* and man is a part of what Julian Huxley calls "the stream of life." All these possibilities lay behind the development of man's intelligence. They are the hinterland from which civilization emerged and to which it ever tends to retreat.

In order to begin and carry on the accumulation of civilization, man had of necessity to be so constructed physically that he could *perceive* more clearly than his predecessors, make more accurate distinctions and so remember and imagine better; for all these are essential to talking and thinking. The awareness of animals is of a low, vague type, and so must pristine man's have been. The one-celled animals behave in a purposive way, but they have no eyes or ears or noses. They must live in silence and darkness like a human blind, deaf mute. They will nevertheless take in certain food and reject other things. They perceive and act without, so far as we can see, being conscious of their actions. They make the necessary decisions without deciding in a human sense. They have no nervous system, but, as has lately been discovered, the promise of one. The creatures most like ourselves have eyes, ears and noses, and evidently see, hear and smell; and they have an elaborate nervous system. Of these resources they make constant use. But compared with man they are ill-qualified to make careful distinctions and discriminations and remember clearly. They take note of far fewer factors in their situation. They must act somewhat as our digestive system does. It is a sort of animal within us which performs wondrous feats when given food. It works purposively, as does our heart and blood circulation. We can become *conscious* of these unconscious achievements when we choke, because the switch is not thrown promptly enough to prevent a morsel from going down our windpipe instead of taking the route to the stomach. Palpitation of the heart is a conscious suggestion of the faithful pump, which rarely reminds us of its constant attention to business. Let it neglect two or three beats and we are dead.

The essentials of man's physical equipment for initiating and piling up civilization have been dwelt upon by many writers. He has sensitive hands, and (after he got securely on his hind legs) he could use them far more freely than if he had to employ them as auxiliary feet. His thumb can be readily placed against any one of his fingers. There is no such expert feeler and handler as he to be found among his kindred. He could learn much of shape and form, of softness and hardness, of weight, texture, heat and cold, toughness, rigidity and flexibility, which could be but vaguely sensed with hoof or paw. Had he had ears that he could turn about like a jack-rabbit, and a prehensile tail, he might have been able to learn faster. And all these things were the beginning of knowledge. He could not only strike but hurl. His eyes were so placed that he was always looking through a stereoscope, so to speak, and seeing things in the round. His vocal organs promised a great range of delicate discrimination in the sounds he made. Then he was a helpless dependent for many years on his elders so that their acquired ways could become his.

Lastly there is man's brain with its complex cerebral cortex and its association paths, which develop astonishingly as a child grows up. The cortex is the prime correlator of impressions, and is modified through individual experience in a higher degree than any other part of the nervous system. Its functioning is still very mysterious, but no one doubts its essential rôle in the process of human learning and the increase of intelligence. Its operations are not, however, autonomous but closely associated with the experiences of the whole human organism and dependent on those singular capacities of mankind already mentioned.

So it becomes apparent that after hundreds of millions of years during which nature's experiments have been going on in physical structure and function, which have enabled creatures of the most diverse types to meet the absolute requisites of life—growing up and reproducing their species—a kind of animal finally appeared on the earth so constructed that he could become civilized. Man's biological make-up represents a unique combination of physical characteristics. Most of these, as we have seen, occur in other mammals. Even those which seem peculiar to him would not serve, however, as a foundation for the development of civilization except in a highly complex union. Cows might have a human cerebral cortex, foxes apposable thumbs, birds stereoscopic eyes, dogs vocal organs similar to ours, and yet civilization would be far beyond their reach. Man can teach all of them tricks. They themselves can learn something as their life goes on. Chimpanzees may under favourable circumstances, as Köhler has shown, make very simple, human-like inferences; but none of them could initiate and perpetuate the arts and sciences as a heritage of their species.

PROGRESS AND CONSERVATISM

Such then was man's original equipment for getting civilized. He had, obviously, no means of foreseeing the enterprise in which he was engaged. His evolution as a civilized being was no more premeditated than his rise from earlier simian ancestors. There seems to be sufficient evidence that for hundreds of thousands of years changes in his mode of life were so gradual and rare as to pass unperceived. Each generation accepted the conditions in which it was reared without thought of betterment. Our modern hope of "progress"—an indefinite increase of human knowledge and its application to the improvement of man's estate—was practically unknown even to the Greeks and Romans. From the 13th century onward a few writers dwelt upon the promise of the future, but they were outclamoured by those convinced that human woes were attributable to a departure from ancient standards. The Humanists strove to re-establish the wisdom of the classical writers, and the Protestants sought to revive the beliefs and practices of the early Christians. Only three centuries ago did Bacon unroll a programme of aggressive search for the hitherto unknown, which had any very wide influence. In the 18th century the conception of reform and progress found illustrious spokesmen, and their anticipations of coming changes in the economy of human life were destined, as it proved, to be far outrun by the events of the 19th and early 20th centuries.

We can, however, still note on all hands illustrations of man's confidence in routine sanctified by ancient authorities; his suspicion of innovation in wide realms of belief and practice. This dogged obstinacy in clinging to his habits, and his general suspicion of the unfamiliar, are exactly what might have been anticipated when we consider his animal origin. This trait has served to slow down the process of change, but at the same time has greatly increased the security and permanence of each achievement. Here we find a possible explanation of the great rôle that the veil of sacredness has played in man's development. He has cast it over beliefs and practices and so hid them from pert scrutiny and criticism. The number of those who can tolerate somewhat critical thinking here and there, has, nevertheless, greatly increased of late, but they are still few indeed. What we call to-day a conservative or reactionary mood must have been characteristic of mankind from the beginning. It corresponds to animal inclinations.

Among animal proclivities there is, however, from the one-celled organisms upward, a life-saving tendency to make random movements, extensions and contractions, to hasten hither and thither, in the pursuit of food and mates. This restlessness and groping are among man's legacies also. They offset his routine and static habits, and lie behind and back of the inventions and discoveries he has made. There is, too, especially obvious among the higher animals, something auguring what in man becomes curiosity. The danger of attack made preliminary scouting a valuable asset in survival. So men were by nature wont to pry and try and fumble, long before they scientifically analysed and experimented.

There can be no doubt that hundreds of thousands of years were required for man to reach even the lowest degree of culture to be found among the simplest tribes to-day. The discovery of fossil skulls, teeth and bones at different geological levels shows that more or less ape-like men have been on earth for from half a million to a million years. Several species, such as the Java man, the Heidelberg man and the much later Neanderthal race are now extinct. The only vestiges of their handiwork consist in chipped flint tools, becoming better made and more varied

as time went on. There is no way of telling what other arts, beliefs and practices were associated with a particular assortment of flint utensils. Sollas, in his *Ancient Hunters,* has sought to draw ingenious analogies between these prehistoric weapons and the civilizations of the Tasmanians, Australians, Eskimos, etc.

The so-called Cro-Magnon race had finely developed skulls quite as good as those of to-day. To them are ascribed the remarkable paintings and drawings found in caves of southern France and northern Spain. They are believed to be from 25 to 30 thousand years old. Halving this period we come upon traces of ground and polished stone tools, coincident with the relinquishment of hunting as man's exclusive pursuit and a settling down to sow and reap, spin and weave. Halving it again, we get news of the use of copper, the precursor of the metals on which our civilization largely rests. This can but be a rough chronology subject to much revision as time goes on and the earth is more thoroughly searched for evidences of man's past.

To get the matter clearly before one, let us imagine, as the writer has suggested elsewhere, that 500,000 years of developing culture were compressed into 50 years. On this scale mankind would have required 49 years to learn enough to desert here and there his inveterate hunting habits and settle down in villages. Half through the fiftieth year writing was discovered and practised within a very limited area, thus supplying one of the chief means for perpetuating and spreading culture. The achievements of the Greeks would be but three months back, the prevailing of Christianity, two; the printing press would be a fortnight old and man would have been using steam for hardly a week. The peculiar conditions under which we live did not come about until Dec. 31 of the fiftieth year.

There is a school of anthropologists, the diffusionists, who would derive all the higher types of civilization—writing, metallurgy, the construction of imposing stone buildings—from a single region, Egypt. They have collected much evidence to show that through the commerce of the Phoenicians, Egyptian inventions spread eastward into India, China and Japan, then across the Pacific to form the basis of Maya culture in Central America. The merits of the "diffusionist" arguments cannot be considered here. G. Elliot Smith, one of the best known advocates of this theory, dwells on the common lack of inventiveness and the reluctance of mankind to adopt new ideas, his tenacious hold on old ones and "his thick armour of obstinacy." "To obtain recognition of even the most trivial of innovations it is the common experience of almost every pioneer in art, science or invention to have to fight against a solid wall of cultivated prejudice and inherent stupidity."

All anthropologists are well aware of this hostility to change, which we may regard, as shown above, as a natural trait of mankind. They also admit the wide dissemination of inventions through commerce and conquest. Nevertheless many maintain that the same or similar discovery has been made independently in different parts of the earth, as the result of similar needs and conditions. When we have examined the exigencies of successful inventions in the following section we shall see that however commonplace they are now, with the accumulation of the past to build upon and modern facilities to work with, they were beyond measure difficult at the start when mankind still led the life of an animal. When once made and adopted by some tribe it is far easier to think of them as being introduced to other peoples than to assume that their presence represents an independent discovery.

Civilization depends upon the discoveries and inventions man has been able to make, together with the incalculable effects these have had upon his daily conduct, thoughts and feelings. As knowledge and ingenuity increased he departed further and further from his original wild animal life. The manner in which he began to learn is a matter of conjecture, since the manufacture of tools and weapons, the invention of language and artificial ways of producing fire, far antedate any written accounts of advances in man's education. The same may be said of the much more recent spinning, weaving and farming. As we have seen, it required hundreds of thousands of years to reach the degree of civilization represented by these achievements. Their importance, however, cannot be overestimated, since they formed the absolutely essential basis of all later developments. We may feel a certain pride in contemporary inventions, but let us remember that we owe to savage hunters and illiterate neolithic farmers the accumulation of knowledge and skill without which none of our modern experimentation would be possible. Where would we be without fire, speech, clothes and bread!

Since invention, discovery and the increase of knowledge are the stuff of which civilization is made, it is pertinent to our theme to consider how they occur. There is plenty of evidence available in the reports which discoverers now make of the manner in which they reach their conclusions. There is also evidence of how their results are received and acted upon by others. All explorers must be exceptionally curious and at the same time patient gropers. The curiosity observable in most children tends to die away, but survives in one form or another in rare instances through life. These exceptional persons possess a drive alien to their fellows. They may be the handyman of a village or a member of a highly endowed research staff. They avail themselves of what has already been found out; the village mechanical genius does not have to invent a monkey-wrench or bit of insulating tape, nor does the biologist need to know much about the optical principles of his lenses, much less invent or manufacture them. The geologist before he makes any discoveries is familiar with hundreds of treatises on his subject. It would be generally conceded by investigators that their discoveries are seemingly accidental. They do not know what they are going to find, and quite commonly find what they were not looking for, even as Saul, chasing lost asses, came upon a kingdom. All this applies to every kind of increase of knowledge, whether it have to do with the operations of so-called Nature or with novel suggestions in the realms of philosophy or art. All are the result of curiosity, patient examination and thought. At best they are no more than foot-notes and glosses added to existing human knowledge. This is now so varied and voluminous that no single person can compass it except in this detail and that. Should he attempt to do so, all chance of adding to it would be excluded.

But an invention or discovery or the rectification of an ancient error, does not become a part of civilization until it has been accepted by the tribe and been added to its habits of action and thought. Plenty of shocking tales could be recalled of professional and popular opposition to innovations on grounds which now seem grotesque. We owe discoveries to individual men and women, but new information and skill can only be propagated and disseminated in a favourable culture medium. Many instances could be cited of promising knowledge which has so far failed to get a footing in civilization.

The influence of particular discoveries and mechanical devices is by no means confined to their more immediate and obvious applications. It is impossible to foresee what wide-ranging effects they may ultimately exert on human life. Fire will cook a meal, harden an earthen bowl, keep a group of naked savages warm, frighten off prowling animals, soften or melt metals; it may also consume sacrifices to the gods, or form the central interest of a stately temple and be replenished by an order of vestal virgins. It may play its part in the symbolism of the theologian and the poet. The Indians of the North American plains were deeply affected by the introduction of the horse, and African tribes by fire-arms and whisky. The motor car and telephone altered social relations. The perfecting of the steam engine revolutionized the transport of men and their wares; it promoted city life; further, it caused Marx to write a big book which became the gospel of a momentous social upheaval, which threatened the peace of mind of all nations.

The invention of clothes—quite material things, whether of linen, wool, silk or cotton—not only created great industries but enabled men by changing their hide artificially to establish social distinctions akin to biological genera and species. Through clothes entered in prudery and the pious horror of bare bodies which has wrought consternation and disaster among the dark-skinned folk. After the World War women's skirts were gradually shortened. The warmth of houses and vehicles permitted this. One of the conventional distinctions between girls and women

was thus obliterated. The unveiling of women's faces in Mohammedan countries, the breaking down of *purdah* in India—all these material changes imply modifications of woman's life and of the attitude of the sexes to one another. They forecast further important changes in traditional civilization.

In view of these facts, and indefinitely more that each one can easily add for himself, it would seem that what are esteemed the "nobler" aspirations and creations of mankind, whether in art and literature or the pursuit of truth, are all not only dependent upon "material" inventions but so strangely interwoven with them and their effects that it is no easy thing to separate the higher and the lower, except in imagination. What is sometimes called "the higher life of man" arises from his more humble and practical knowledge and skill; accordingly the old distinction between the material and spiritual seems to be greatly attenuated as they are both seen to merge into the newer conception of civilization as a whole. This will become even more apparent when we come to deal with words.

RÔLE OF CHILDHOOD

One of the essential conditions for the perpetuation of civilization is the long period of dependence through which the human child must pass before it gains sufficient bodily strength and intelligence to achieve merely animal self-sufficiency and make its own way. Without the constant and prolonged succour of adults it would speedily perish. This means that the extended period of helpless susceptibility to his surroundings makes it possible vastly to modify a child's original disposition. A mouse is sexually mature in six weeks and fully grown in three months. Calves and colts walk about shortly after birth. The gorilla, on the other hand, has a prolonged childhood, requires ten or twelve years before it is able to breed, and goes on growing, like man, for a few years after. He lacks, however, in spite of his prolonged childhood, the other essential traits which have enabled mankind to initiate, increase and transmit civilization.

We are all born uncivilized and would remain so through life were we not immersed in civilization. There is a long time in which we may, according to the place where we are born, be moulded into a well authenticated Papuan, Chinaman, or Parisian. We cannot choose whether we shall find ourselves talking like a Hottentot, a Russian or a German. And we learn to do in all things as those do among whom we are brought up. We cannot but accept their respective customs, scruples, and ideas, for all these are imposed upon us before we have any choice or discretion. We must perforce follow the ways of our elders, who themselves were once children and gained their civilization before any discrimination or comparison with other than the prevailing habits was possible. This is the inexorable rule, and it accounts for many of the striking characteristics of civilization.

If the assimilation of culture is closely associated with the dependence and adaptability of childhood there need be no great surprise that accumulating evidence seems to indicate that when bodily maturity is once reached, the increase of knowledge and intelligence slackens or even almost ceases in many cases. By 13 or 14 the child has acquired an overwhelming part of the knowledge, impressions, cautions and general estimates of his fellow creatures and the world in which he lives, which he continues to harbour with slight modifications during his lifetime. When as a result of the participation of the United States in the World War it became necessary to test the competence of a great number of young men an unforeseen contribution was made to our insight into civilization. Of the 1,700,000 examined, 45% did not show themselves (to quote an eminent authority, Dr. Henry H. Goddard) "much above the 12-year-old limit." Those tested, it must be remembered, did not include idiots or "morons," but the average run of youths accepted by their fellows as normal. While tests may be as yet inadequate they but confirm the observable fact that the inculcation of culture is associated with bodily growth and especially with the strange changes in the cells of the forebrain and their intercommunications. These developments are tremendous from infancy to maturity in so-called normal cases.

Only in exceptional instances does mind-building continue steadily after childhood and adolescence. We have had time before 13 to take over the standardized sentiments of our elders, to learn all that they know, to accept their views of religion, politics, manners, general proprieties and respectabilities. The common run of mankind can, however, be taught tricks as time goes on and acquire special expertness. But a great part of our childish conceptions retain a permanent hold on us. There is usually little encouragement to alter them. We leave most of them unrevised, though we have to make adjustments as the years elapse. Human beings seem on the whole easily subdued to routine and the routine is established, as it would seem, by the time we are grown up. That the *ability* to learn, however, falls off very slowly after adulthood has been recently shown by E. L. Thorndike.

The experts in advertising, the publishers of "tabloid" newspapers and the contrivers of moving picture films seem to conform to the supposition that what appeals to a 12- or 13-year-old child is admirably adapted to the intelligence and tastes of the multitude. This means that the overwhelming majority of men and women assimilate in childhood the common and familiar forms of civilization or culture in the midst of which they find themselves, but hardly outrun them as life goes on. Perhaps one in a hundred may allow his opinions to be altered by assiduous reading, or take pains to cultivate his insight into art and literature and scientific discoveries. But all these and other contributions to one's personal civilization are outside the range of the human animal in general. Indeed the mere upkeep of our present complicated culture must depend upon a very trifling percentage of the population. Were a few thousand carefully selected infants in the various progressive countries of the world to be strangled at birth not only would advances in industry, arts and letters cease but a decline would set in owing to the lack of those to make the essential readjustments in our industries and their financing; to keep up laboratories and books at their present standards. Accordingly the great majority of human beings can barely maintain at best the civilization in which they were reared. Even the innovators considered above, are unable to escape from the toils in which they were so easily enmeshed and which they regard not as entanglements and restraints but as comforts and assurances. It would be faithless and disloyal to regard them otherwise. Only peculiar temperaments under highly favourable conditions question what they have been taught. They can do this only on a most modest scale as a result of continued curiosity and study. A physicist may reach a new theory of the constitution of atoms and yet cling stolidly to the notions of religion he had acquired at ten years of age; he may even engage in subtle philosophical speculation and remain a hot defender of the *mores* of the most commonplace persons 50 years ago.

If these points be well taken the whole contrast between Society and the individual which has been played up in various rather futile ways takes on a new aspect. From the standpoint of civilization each individual owes his entire equipment as a civilized being to others. Biologically even, he is vastly modified by his domestication, in habits, impulses and moods. The so-called "instinct of the herd," which Trotter has made famous, tends to become an unnecessary hypothesis. For every child is made by others in their own image. How gregarious mankind was before the onset of civilization it is impossible to say; but the prolonged infantile weakness implied multiform dependence upon others. Of course there is really no such thing as Society in the sense of some powerful and precious personality for whose welfare the so-called individual is invited to make appropriate sacrifices of personal preferences. What we have to do is to make terms with the notions of "the good" and "the bad" which those profess with whom we are thrown. These rules of conduct and sentiment constitute Society. They have their heavy sanctions if violated or impeached—disgrace, persecution, imprisonment and even death. The methods of eluding Society constitute a highly interesting chapter in the history of civilization. It is not difficult for the shrewd, and seems greatly to enrich life for certain temperaments, whether one be a burglar, a story-teller, or a philosopher. Wholesale deceit has established the reputation and fame of many a hero from Jacob and Ulysses to those in high places to-day. Boldness of thought is less likely as yet to arouse primitive enthusiasm.

WORDS VIEWED AS DEEDS

One of the most stupendous elements in civilization has hitherto been only casually mentioned—words. Without language civilization could hardly even have begun and certainly could never have attained its higher forms. Speech underlies thinking and conscious planning and research. It does more. It creates a world of ideas which interpenetrates and seems to transcend that of the facts of human experience. What pass for facts are indeed so moulded by our notions of them that recent philosophers are less and less confident in their efforts to separate the functioning of ideas from that of facts. Much has been discovered of late which serves to revolutionize the older theories of language and thinking, and to eliminate some of the age-long quandaries in which philosophers have found themselves involved. These new views can be only briefly suggested here.

The Fourth Gospel opens, "In the beginning was the Word; . . . All things were made by it; . . . In it was life; and the life was the light of men." Goethe declared that in the beginning was the deed. The most recent writers who deal with speech would seek to shed new light on civilization by recognizing that words have always been deeds. They have always been regarded as wonder-working acts; they create things which without them could never exist; they are the chief light of man—and his darkness as well.

Making noises is a conspicuous animal trait. Katydids, frogs, whippoorwills, dogs, and many other creatures exhibit a tireless patience in this matter. Man, too, is a great chatterer. His fellow men may be bored by his talk, but they are likely to be scared by his silence. It is portentous and bodes no good. To keep still is an unfriendly act. So, as Malinowski has pointed out, one of the many functions of utterances has been reassurance and the expression of companionability. The cries of animals as related to their needs and behaviour are only just beginning to be carefully studied. Whitman and Craig have discovered a marvellous correlation between the ejaculations of pigeons and their ways of life. Köhler, Yerkes and others are attending to our nearer relatives. But all that needs be noted here is that human language must have emerged from the spontaneous sounds made by pre-man.

Only when men began to make pictures of events and gestures, and painfully developed writing from the pictures, have we the least actual evidence of language. The Egyptian inscriptions illustrate picture writing and its later and most ingenious metamorphosis into sound symbols—an alphabet. This happened five or six thousand years ago. But it is clear from the Egyptian language that its surprising complexity and sophistication imply an antecedent development of incalculable length, to judge from the slowness of man's material inventions.

While the beginnings of language are hidden from us by the lapse of hundreds of thousands of unrecorded years, there are several new ways of coming to a far better understanding of them than hitherto. There are historical and contemporaneous sources of information which have been exploited of late and serve to revolutionize the older views. For example, the so-called primitive languages (until recently, never reduced to writing), afford a sufficient proof that words are fundamentally acts, closely related to man's other conduct. Then, watching the way that babies—the Latins aptly called them *infantes,* or speechless creatures—learn to talk, greatly re-enforces and corroborates the evidence derived from the study of "illiterate" tribes. Lastly, anyone who has learned the trick, can substantiate the same thing if he tests the babble always going on around him.

We have already noted one way in which speech is a mode of action, a friendly gesture, not an expression of thought or conveyance of ideas as philosophers have taught us. "How do you do?" is not a question to be answered under usual circumstances. One concurs in the obvious statement, which conveys no fresh information, "Fine day, sir." These are just tail-waggings, like taking off one's hat, bowing, smiling and hand-shaking. We can, however, do far more with language; we at times can strike with a word more safely and more effectively than with our fist; by words we can cower, and dodge, and elude danger. Those in highest standing in all communities make a living by words, unwritten and written. Whole professions confine their activities to words, —clergymen, teachers (of the older type), lawyers, politicians; brokers deal in alternately saying "buy" or "sell." Doubtless other things lie behind this trafficking, but words are effective acts, or so intimately intertwined with them, that it is impossible to say where one sets in and the other ends. Pure talk and written words seem often to do the business without the intervention of so-called things. The magic operations and achievements of words can be observed everywhere and in all ages. Jacob and Esau struggled bitterly to win a blessing from their blind old father. His words were momentous. They might cause unborn generations to bow down before his son's offspring or doom him and his children to perpetual slavery.

As a clergyman of the 18th century remarked, "Words have a certain bewitchery or fascination which makes them operate with a force beyond what we can naturally give account of." Joy and infinite woe follow in their train; from which our wordless ancestors must have been spared. The main emotional structure of civilization—so poignant and so unique an element in human life—is largely reared on words. They serve to establish new orders of sensitiveness and excitability. Words increase the clarity of our memory to a tremendous degree and at the same time they vivify imagination, which could exist on no considerable scale without them. With these word-created adjuncts we can elaborate our hopes, fears, scruples, self-congratulations, jealousies, remorses and aspirations far beyond anything that seems justified to the onlooker; we can project them backward into the past and forward into the future. Words can rear more glorious palaces and dig deeper, darker dungeons than any made with hands.

TALKING AND THINKING

What has so far been said of the recent views of language helps to explain the newer interpretation of the old terms mind and reason. These seem to be processes, as we have seen, rather than agents. They are ways of doing things rather than things themselves. John Dewey calls his admirable little book on mind, *How We Think.* When older philosophers began to think about thinking, and how by thinking we reached truth, they commonly found themselves writing very long books, very hard to read; and they called their great theme epistemology or the theory of cognition. The effective thinking which has built up civilization has not, however, relied upon their treatises; nor has it been influenced by them. Two or three considerations only can be touched upon here which impress recent students in investigating thinking.

Thinking and words go together. For thinking, to be clear, has to rely upon names and their various associations with one another. For instance, grocer's bill, cheque-book, fountain-pen, envelope, stamp, letter-box are names put together in a particular sequence. Of late there has been a good deal of discussion as to whether thinking was not always talking quite noiselessly to ourselves. A child will first utter sounds at random, then begin to find that the sounds he makes bring things; then he gets to naming with vast enthusiasm; then he prattles too freely and inopportunely to please his elders; then he may merely move his lips—as many childish people continue to do—and finally hold his tongue. It can be shown, however, by appropriate tests that this suppressed talking is accompanied by muscular adjustments of the vocal organs which indicate a silent execution of the words and sentences. We can say openly "That's too bad," or mutter it, or adjust our organs so as to say it if we wished. This suppressed talking seems to be thinking. That all thinking is merely talking to ourselves many will doubt or deny. While some minor reservations are justifiable there is an overwhelming mass of evidence, derived for instance from the study of deaf mutes, that fortifies the contention stated above—no words, no thinking.

But thinking can easily be seen to be of several varieties. There is the meandering succession of recollections, vague apprehensions, hopes, preferences, disappointments and animosities which has come to be called *reverie.* It underlies other and more exacting forms of thinking. It is found on inspection to consist of recollections, anticipations, excuses for past or contemplated con-

duct, reflections on the unfairness of our fellow creatures and of the world in general; or assurances that all is well and must in the nature of things remain so. Ordinary daily planning is an essential form of thought—making homely decisions and adjustments. Underneath, we can perceive the reverie flowing as a sort of undercurrent—for thinking is very complicated.

We occasionally turn our thinking to trying to find out something that we do not yet know. This may be the result of mere personal suspicions and vulgar curiosity, or of an honest desire to improve a defective social situation, or learn more of light waves, Chinese paintings, psychoneuroses or investments. In dealing with the workings of the physical universe a special kind of thinking, the mathematical, has produced results that tend to safeguard the investigator from the usual prejudices which beset us in all thinking. It is a peculiar, highly refined language, or way of talking about things, by employing the vocabulary of sines and cosines, logarithms, constants, variables, roots, powers, etc. It has proved to be a wonderfully fruitful way of talking about light, for instance, and the nature of "matter" and "force" and in dealing with engineering problems. Few are addicted to this type or any other variety of scientific thinking. Most practical inventions seem to proceed from our power to experiment by thinking; to fumble and stumble mentally, and sometimes succeed. This mental trying-out is a kind of trial and error. It cannot proceed long without various external acts to check up the guesses and inferences produced by meditation.

One of the most novel and promising methods of learning more about all kinds of thinking is abnormal psychology. Illusional and obsessive thinking which fill the mad-houses appear to be only the exaggerations of the thinking of those at large. The psychiatrists hold out hopes of discovering through their special knowledge, and a study of infants and children, ways of eliminating or reducing some of the vices of civilization as it has hitherto developed. To them civilization is in many of its manifestations a species of mild madness; these can only be eliminated by a great change in the way children are brought up, so as to obviate the maladjustments and distress incident to a rapidly altering cultural environment.

Men and women think not only when they are awake but when they are asleep. Their sleeping thoughts and visions and experiences we have learned to set off sharply—far too sharply as it would appear—from waking thought. Primitive man did not do this. He did not deem his dreams mere illusions, comical or distressing, to be banished when he opened his eyes. They were not negligible to him but quite as real and instructive for conduct as what he saw in the day-time. Indeed they had a weight and authority superior to the pronouncements of daily experience; and they served vastly to widen it. What civilization would have been without the manifold influences of dreams it is quite impossible to guess. Had man been dreamless would he have had his religions, his symbolism and his allegories, his poetry and much of his art? This much at least is assured that the beliefs and practices of primitive peoples are in many cases directly attributable to their dreams. Later beliefs and practices of more elaborately civilized peoples can usually be traced back to primitive ideas, which seem to be the soil from which they sprang. So we have to conclude that dreams are one of the most remarkable factors that have entered into the fabrication of civilization as we know it to-day.

When asleep we find ourselves visiting distant places; for instance when walking the streets of Paris we suddenly wake in New York. How could early men escape the conviction that they had a second self which could wander forth from the body, leaving it behind in the hut, while the "spirit" led for a time an emancipated and adventurous existence freed from the slow and lumpish flesh? Then in dreams the dead appear to us in full life and activity. They may admonish or fortify us; rebuke our departure from the old ways, or fill us with assurance of success. The North American Indians shared the confidence of the ancient Hebrews and Romans in dreams. In India and China the veneration of ancestors forms a highly practical obstacle to the introduction of Western institutions. So have we here, without the possibility of much question as to the main issues, a fair explanation of the original belief in the spirit or soul and its survival of death. We have much more. We have the dawn of the gods and the demi-gods, and the whole foundation of beliefs about supernatural beings and their converse with men; their anger and the possibility of their propitiation by sacrifice.

LOOKING FORWARD

In the preceding sections of this article certain important considerations are enumerated which escaped until recently the attention of students of mankind. They are clear enough when once pointed out. But it has always been a tragic trait of civilization that the obvious has been difficult to perceive, for it is too familiar to catch our attention. It requires a peculiar penetration to discover what in all discussions we are unconsciously taking for granted. And what we are most prone to take for granted are unrevised childish impressions.

There is much complaint of the childishness of mankind, which has become more conspicuous with the democratic assumption that everyone should have his say. Langdon-Davies' *New Age of Faith,* and E. C. Ayres' *Science the False Messiah,* to cite two examples, dwell with some petulance and bitterness on the easy gullibility and obstinate ignorance of humanity. They assume standards of intelligence which obviously do not prevail, as one reads popular newspapers, sermons and political speeches. They are disappointed, but have no reason to be surprised. Why should an ex-animal not have made grotesque mistakes as he floundered about with words and besetting mysteries and hardened orthodoxies? Then, as we have seen, civilization is mainly acquired in childhood and perforce ever haunted with infantile longings and misapprehensions. When there is an issue between his dreams and visions and his waking experiences why should man not prefer the former? As a matter of fact those reputed as great and deep thinkers have dealt mainly, until very recently, with imaginary beings, with events that never happened; with empty concepts, allegories and symbols and false analogies. John Dewey has in his *Reconstruction in Philosophy* deduced philosophy and ethics from savage antecedents and shown how these have interpenetrated later speculations. The hardly to be overcome prejudice which attributes to mind and body separate existence and regards them of diverse substance is the easily explained and inevitable mistake of a savage. The will, the unconscious, the moral sense, regarded as agents, belong to the category of primitive animistic conceptions. Even causation as it used to be conceived is but an expression of the naïve urge to blame or praise some particular person or thing for this or that event. We are now learning to think in terms of situations. For example when Edward Carpenter wrote many years ago on *Civilization, its Cause and Cure,* he yielded to a venerable usage. It has become apparent enough that civilization has had no one cause but is the result of a situation of cosmic complexity. There can be no one cure for its recognized defects. A recent Italian writer, Pareto, has filled two large volumes with instances of the misapprehensions upon which current sociological treatises are based.

As humanity, or at least their leaders, become more fully aware of the nature and origin of civilization and the manner in which it has hitherto developed they will discover firmer foundations on which to build, more efficient ways of eradicating the inevitable and congenial errors of the race, and of stimulating patient and fruitful reconstruction and reform. So far mankind has stumbled along, enslaved by its past rather than liberated by it for further advances. The reasons for this are beginning to become more apparent than ever before and might as time goes on be made the basis of a type of education, especially in man's early years, which would greatly forward and direct the progress of civilization rather than retard its development. (J. H. Rob.)

CIVIL LAW, a phrase which, with its Latin equivalent, *ius civile,* has been used in a great variety of meanings. *Ius civile* was sometimes used to distinguish that portion of the Roman law which was the proper or ancient law of the city or state of Rome from the *ius gentium,* or the law common to all the nations comprising the Roman world, which was incorporated with the former

through the agency of the praetorian edicts. This historical distinction remained as a principle of division in the body of the Roman law. The municipal or private law of a state is sometimes described as civil law in distinction from public or international law. Again, the municipal law of a state may be divided into civil law and criminal law. The phrase, however, is applied *par excellence* to the system of law created by the genius of the Roman people, and handed down by them to the nations of the modern world (*see* ROMAN LAW). The civil law in this sense would be distinguished from the local or national law of modern states. It is further to be distinguished from that adaptation of its principles to ecclesiastical purposes which is known as the canon law (*q.v.*). In countries which have codified their law the civil code contains the legislation which governs the civil relation of the citizens *inter se,* but excluding subjects dealt with in special codes, such as commerce, procedure and crime. It therefore includes citizenship, marriage, divorce, contract, sale, partition, exchange, mortgage, usufruct, servitudes, succession, wrongs and so on. (*See* CODE.)

CIVIL LIBERTIES. The word "liberty" describes social situations characterized by an absence of restraint. Civil liberties are personal and social liberties guaranteed by law. Granted freely by an outside sovereign and revocable at will, a liberty is a "privilege"; but if claimed and enforced by and for the people concerned, liberties become specific "rights." Every right has its negative and its positive aspects: liberties are the negative aspects of rights, freedoms the positive. Freedom is self-direction: it is not an automatic result of liberty.

On the negative side are found personal security of life and limb from bodily restraint and violence (*i.e.,* from slavery, lynching, raiding and other irresponsible uses of force); safeguards of private property; the sanctity of the home; the defense of reputation; protection from unfair taxation, from class legislation and from ex post facto laws, bills of attainder, and double jeopardy.

To these negative aspects correspond certain positive aspects of rights, more properly called freedoms. Such are the right of self-defense; freedom of movement and residence; the right to privacy, and freedom of choice in marriage and childbearing; the positive rights of ownership; freedom of contract; freedom of competition; equal access to legal procedures; freedom of conscience and worship; freedom of communication (speech, publication, arts). Freedom of assembly involves freedom of movement and of speech.

(It should be noted that "freedom" in the foregoing sense applies to citizens, not to the state as such. In the latter sense, "freedom" is synonymous with sovereignty or independence. This meaning comes forward in defensive, insurrectionist or secessionist struggles, but is then often confused with personal freedom.)

If a right is a claim upon the conduct of other persons, that corresponding conduct is a *duty;* if a right is a claim upon the state, there are those who insist that it is the duty of the state to implement the right with such facilities as permit its exercise. When social standards are asserted as "rights," such as the "right to be well born," "rights to safety, play, education," they can properly be called such only as the state validates them by providing the wherewithal to convert liberty into opportunity. Freedom of press is useless without paper, type or news space; freedom of speech is useless without halls, space or airtime.

Civil rights protect certain universal human needs and interests from other equally human needs and interests and (when rights conflict) each right is defended from the other's claims. The adjustment of conflicting claims is the function of legal justice in the courts, or (ultimately) of social justice through the legislature or direct action. Rights are claims which the courts will enforce: legislation becomes law in the fullest sense when courts uphold it. It is, therefore, in the processes of the courts that civil liberties become rights. The rights to a fair trial, and the several special safeguards thereof, become indispensable means for the preservation of liberties, freedoms, democratic responsibilities and orderly social change. Due process of law is guaranteed through the rights of proper arrest, counsel, *habeas corpus,* equality before the law, indictment, prompt public trial by jury, challenging the prejudices of judge or jurymen, confrontation of witnesses, reasonable bail, reasonable penalties.

The right to due process of law (which is thus supposed to protect one's various liberties and freedoms) may actually begin, paradoxically, with a *right to be arrested; i.e.,* to be legally *held* for due process instead of being coerced, kidnapped, sequestered or deported irresponsibly. The right of *habeas corpus* (*q.v.*) is another basic and essential aspect of this safeguarding of due process against lawless police or other "star chamber" or "gestapo" tactics by officers of so-called "law and order," secret or private police, or irresponsible "vigilantes." The period of sedition trials, during which (1794–1801) the writ of *habeas corpus* was suspended, was also a period of low ebb in other English liberties, in reaction against excesses in the French Revolution.

"Civil liberty" includes those liberties which involve civic relationships, and is thus distinguished from moral liberty or "freedom of will," from political liberties, from economic liberties and from academic freedom. Each of these fields overlaps civil liberties to the extent that law supports liberty of conscience, self-government, industrial or academic liberty.

Political liberty comprises the right of franchise; the rights to petition and to hold office; safeguards of the people's representatives and judges from intimidation and undue influence; the right of equality before the law, regardless of such circumstances as race or colour, with safeguards of "due process" before, during and after trial, without discrimination; and the right to bear arms.

Economic rights were developed first for enterprisers as freedoms of ownership, trade, competition, contract. Free competition and contract extended to labour but proved as much a danger as an opportunity, until supported by the civil rights of collective bargaining. The rights to organize, to bargain through representatives of their own choosing and to strike provide the chief guarantees and opportunity for other economic freedoms, actual or to come. Collective bargaining was established by the decisions of the supreme court confirming the National Labor Relations act. Major issues, as to whose freedom shall limit whose, lie frequently in the field of distribution of wealth and of economic power over wealth and persons. Where this is the situation, those who are currently in control of industrial property and financial credit (hiring power) naturally resist or attack movements from the "left," the "have-nots," all those who are claiming new "rights" in the name of "labour," share-croppers, tenants, dependent minority races, etc. Extremists in support of "property rights" and the *status quo* may, by contrast, advocate or permit anti-democratic (*i.e.,* irresponsible) measures with relative impunity. Much labour legislation now accepted as constitutional exercise of the police power of the state in the general welfare can be considered, from this angle, as establishing economic rights of labour—positive civil rights to a living wage and living leisure, health and security, and the corresponding negative rights of liberty from want, exploitation, domination and fear, whether through forced labour, peonage or mere bargaining power. Other industrial claims as yet not fully supported as civil rights in America are: the so-called "rights" to a job, to picket, and to petition, confer and criticize management on the job. Unemployment insurance may slacken the pressure for the "right to the job" on the one hand and the "right to relief" on the other—both still putative. Employers claim offsetting rights to protect them from occasional irresponsible coercion or exploitation by organized labour.

Academic freedom is not a civil liberty but a professional claim to certain complementary responsibilities and immunities in the interests of the integrity of scientific and scholarly research and of the teaching and learning process, such integrity being considered indispensable to the valid services of educators, scholars and scientists to the community at large. The area of academic freedom overlaps that of civil liberties in that

teachers are often penalized as teachers for words or acts outside the classroom which constitute legitimate exercises of their rights *as citizens*.

Whipple notes that at any given time and place the traditional civil liberties, when applied to actual historical situations, acquire their own concrete meanings, legal, popular and philosophic, as well as specific degrees of actual enforcement.

The traditions of stubborn individualism and specific civil rights imported to America during the colonial period were strengthened by frontier conditions and by struggles against British Tory governors, and were later kindled into idealism by the more abstract and emotional libertarianism of French thinkers. The doctrine of rights reserved to the people implied that "natural" liberty was like an endowment fund, from which (by social compact) capital could only be alienated in exchange for a demonstrated *quid pro quo* of common welfare or legal rights. Reserved "natural rights" become bills of rights when they reappear in political compacts, charters or constitutions. Actual legal liberty becomes the defense of "reserved rights" from invasion. "Natural rights" being (according to this metaphysical theory) part of a person, the right of self-defense may be claimed for them, if legal protection is inadequate. Social conflicts still arise in which the logical confusion between the specific, concrete civil rights of Anglo-Saxon history and the rationalistic and metaphysical bases of "civil liberty" becomes apparent.

History of Civil Liberties.—Every culture has permitted its own liberties. The civil liberties as we know them are a cultural-legal complex deriving from the Anglo-Saxon cultures, especially from the common law, from certain historic enactments and from certain philosophic doctrines. These, in turn, derived from centuries of interaction of conquerors and conquered; of king, barons and commons; of church and state; and from earlier ideas of rights, justice, law, nature, reason, reserved powers, sovereignty, allegiance, contract and freedom, traceable in the intellectual history of Europe and even of Asia.

Even preceding the Christian doctrines of free and equal souls, the stark moral autonomy claimed for the individual by the Stoic philosophers, and their faith in nature and reason are historical sources for the later doctrines of "natural rights" superior to law, and of duties taking precedence of the demands of family and state. Christianity developed a discipline of freedom of conscience capable of martyrdom. Mediaeval feudalism seems to the layman anything but free, yet even in feudalism the individual nature of the compacts of allegiance is considered a forerunner of the right of free contract, as well as of the political theory of the "social compact" limiting liberty. In mediaeval cities persons split off from the feudal hierarchy acquired a new independence as burghers and as craftsmen. The charters of the guilds often safeguarded their members' liberties, though guild regulations represent anything but economic liberty in any modern sense. Freedom of parliamentary debate was won in England under James I—an early victory for free speech.

For certain aspects of civil liberty of religion the period of the Reformation is responsible; *e.g.*, the treaty of Augsburg (1555) and the edict of Nantes (1598). In the Protestant Reformation the independence of conscience, duty and will before God were reaffirmed. This root of liberty is to be seen flourishing in the English Puritan revolution (*e.g.*, Agreement of the People of England, 1647). Both in French and in German thought, however, as in Hobbes, there were also elements of absolute collectivism and doctrines of the folk-will or state-will which conflicted with libertarianism. Full religious liberty came in America before it was approximated in England, which still taxes for the support of a state church.

The "charters of Anglo-Saxon liberties" are: Magna Carta (1215); the Statutes of Westminster (1275); the Petition of Right (1628); Bushell's Case (trial by jury, 1670); the Habeas Corpus act (1679); the Bill of Rights (1688); the Toleration act (1689); the Acts of Settlement (1700–1701); the Libel act (1792). Parliament refused in 1695 to renew the Licensing act, thus abolishing censorship. One might well add such non-legal classics as Milton's *Areopagitica* (1644), Paine's *Common Sense* (1776) and *Rights of Man* (1791), and John Stuart Mill's *On Liberty* (1859). The content of these documents has penetrated and been incorporated into American constitutions and legal decisions.

American liberties are still basically English: even American colonial "ancestors" considered themselves Englishmen. The origins of England's liberties, however, include important contributions from the experience and fearlessness of her American colonial "radicals." The well-known intolerance of many early colonial governments may seem less culpable if it be recalled that they could hardly be said to "violate" liberties not yet legally established in England itself. Indeed, American libertarianism had its share in effecting English constitutional liberties and stimulating French libertarian thought. In New England, and later in old England, congregational democracy was extended into political democracy. The earliest American colonists brought with them the same ferment of ideas which was working during the English revolutions of 1648 and 1688, such as those of the "state of nature" and the "social compact." The Mayflower covenant and the doctrine of the sovereign autonomy of the soul may be considered, therefore, as religious prototypes of Rousseau's "natural rights" and "social contract." Once established in early New England the social-compact idea took precedence of the libertarian: heretics were treated as violators of the collective covenant. Later, "natural rights" were invoked to justify religious liberty as a corollary, and revolutionary French political theories were influential during and after the American Revolution.

In America, early milestones of liberty include Maryland's Toleration act (1649), the charter of Rhode Island (1662) and the Zenger case (New York, 1734). Classics of the later colonial period are James Otis' *The Rights of the British Colonies Asserted and Proved* (1764) and Samuel Adams' *The Declaration of the Rights of Men* (1772). The First Continental Congress issued a Declaration of Rights and Liberties (1774) and the less-known Address to the Inhabitants of Quebec.

Once split off from England, the American states promptly included bills of rights in the new constitutions, protecting the people's liberties against their own governments and (less effectively) against the tyranny of majorities. Virginia's Declaration of Rights preceded the Declaration of Independence by three weeks, and served as model for 11 states before the federal Bill of Rights amendments were incorporated in the constitution. Among early state bills of rights those of Maryland (1776), New York (1777) and Massachusetts (1780) are notable, as is Virginia's statute of religious freedom (1785).

Major documentary milestones of American civil liberty since the Revolution have included the Ordinance for the Government of the Northwest Territory (1787); the first ten amendments to the federal constitution (the Bill of Rights, 1791); Amendments XII, XIV, XV (the Civil War amendments, 1865–70); the National Labor Relations act (1935); and certain judicial opinions of Justices Holmes, Brandeis, Learned Hand and Cardozo.

Fertile soil for the roots of "rugged individualism" was found in the craving of pioneers, enterprisers and exploiters, long frustrated by guilds and monarchies, for irresponsible economic liberty. Later, labourites and less popular political, religious and racial minorities welcomed in their own defense the doctrines and legal guarantees of tolerance.

The Bill of Rights has regrettably been noticeable more when violated than when respected. American history is full of instances of its violation, as object lessons of the need for it. At various times and places minorities, many of which later became respectable, have been persecuted by Americans in ways which match the more wholesale horrors of the totalitarian terrors: Jews, Masons, Catholics, Quakers, Mormons, Abolitionists, Copperheads, southerners, Carpetbaggers, Irish, Germans, Negroes, Indians, Chinese, Japanese, strikers, employers, union organizers, "scabs," syndicalists, anarchists, communists, fascists, Neo-Malthusians, pacifists, feminists, artists, teachers. Some of these have in turn violated each other's liberties In general, achievement of civil rights by women has lagged far behind their achievement by men.

Developments in the United States.—During World War I both England (Defense of the Realm act) and the United States (Espionage acts) sharply limited freedom of discussion and of political criticism, and court interpretations and sentences under the Espionage acts were even harsher. Advocacy of change was called obstruction. Persons expressing opinions alleged to be adverse to the current policy of the then government, even under conditions not dangerous to public safety, were punished by heavy prison sentences, often for statements later corroborated by high authorities or by actual events. Often the prosecution itself gave nation-wide publicity to the very words supposed to be suppressed. Public opinion was hysterically suspicious and intolerant. State and local authorities were often more drastic than federal and military authorities. Speech and press were muzzled if the prosecutor could impute "evil tendency" or "constructive intent," even by indirection. Even silent non-co-operators and non-subscribers were persecuted. Many offenders convicted for honest devotion to political and economic principles were treated worse than violent criminals. Conscientious objectors and other pacifists were brutally treated until a more equitable procedure was set up by the war department.

During the postwar period, with general disillusionment in regard to the motivation and outcome of the war, attitudes toward war offenses relaxed and most of the extreme sentences were commuted or the prisoners pardoned. On the other hand, the anti-German hatred was shifted into anti-bolshevik and anti-labour-union channels, and epidemics of repressive laws, "red-raids," prosecutions and deportations ensued. Mere membership in organizations alleged to hold certain opinions was heavily penalized, thus creating "guilt by association." Many liberals felt that existing laws against overt acts had been adequate; that the "sabotage," "sedition," "criminal syndicalism" and "anarchy" statutes were enacted chiefly to facilitate the crusades against so-called "radical" organizations. The later vicious tactics of some such groups have been attributed to the hatreds inspired by their experiences in this period.

Between the World Wars, citizens' committees devoted to the defense of civil liberties were naturally called upon by those whose unpopularity of person, group or cause left them without other legal aid. Certain communists, moreover, like certain earlier capitalists, took advantage of civil rights to defend some whose social objectives have seemed alien to both liberty and welfare.

Since the first World War there have been a number of organizations specializing in defense of one or another area of freedoms. The American Civil Liberties Union, however, is the only non-partisan, general and nation-wide agency to maintain a consistent record of defending groups and persons threatened or injured in respect to civil rights, without sponsoring their ideas or programs. It went to the legal aid of unpopular but mutually opposed minorities, such as Jews and Ku Klux Klan, when either group was attacked by "un-American" methods. It defended the legal rights of communists, but excluded communists from its own executive board on the ground that they endeavoured to use the organization as a means to partisan goals inconsistent with the impartial liberalism of the organization's avowed policy. One principle underlying its policy, traceable to Locke, Montesquieu, Madison, Jefferson, Holmes and Brandeis, is that words alone do not constitute an overt act, and that speech is immune unless it creates imminent danger of a serious overt act.

The major areas of defense in civil liberties are, as ever, the frontiers of group conflict: viz., between racial, nationalistic, religious, political, economic, ideological and professional groups. Variant or minority elements of all these group interests may be found as victims or victimizers in any of the major public institutions: industries, schools, the press, churches, theatres, radio, moving pictures, hospitals, military forces, police stations and courts, even in philanthropies. One must add the fields of housing, public employment, relief, and public communication systems.

During the interbellum period the term "subversive" was popularized in lieu of the old term "seditious," and crept even into some statutes, though not adequately defined by law. Very mild legal and economic "welfare" measures were considered "subversive" by persons with vested interests in the *status quo*. The phrase "criminal syndicalism" (the latter word referring to the ideology of a formerly feared union, the Industrial Workers of the World) was also introduced in a flock of statutes under which "radical" union organizers were prosecuted and imprisoned. Men attempting to organize share-croppers and southern Negroes were charged with "inciting to insurrection," under a Civil War statute.

In World War II liberal leadership was strengthened by executive pronouncements, by certain supreme court decisions permitting federal protection in local situations, and by a public opinion which itself retained a strong element of horror of war. The Selective Service act made provisions for conscientious objectors which were considered fair even by most objectors themselves. From the World War I period, however, there were strong traditions in certain popular groups still maintaining intolerant and persecutive attitudes toward foreigners, Negro minorities, Jews, pacifists, liberals and political opponents in general. From such intolerant groups, whether in congress or on "Main street," the first World War produced a spawn of snoopers, raiders, vigilantes, private police and other prototypes of the storm troopers, who crusaded against civil liberties in the name of "defense" or "Americanism" without regard to the legitimacy of the means used.

Americans have strewn their history with violations of their own civil liberties. Yet those violations would not be known were it not for the protests of the American libertarians and of the minorities under persecution. And such protests would never have been heard without a modicum of civil liberties in speech and press. One may assume a vast amount of violation of rights never heard of because the victims were too ignorant and helpless, the local community too callous and lawless. But one may also assume a vast amount of freedom exercised unquestioned and accepted all too casually because never threatened. Defense of civil liberties does not, indeed, arise unless they are violated. The civil liberties "guaranteed" by constitutional rights require court action for their enforcement, and court action calls for courage and money. Courage and money are seldom found in the same hands for the protection of minority groups.

Although bills of rights are often violated or ignored, their symbolic value remains high: none would dare repeal them, and occasionally there is sufficient courage to claim and enforce their safeguards in the interest of unpopular or disadvantaged persons or groups, and of the community. Demonstrations of the plight of those bereft of civil liberties give to the latter an appreciated value in the so-called democracies.

Legal Limitations of Civil Liberties.—Since even anarchism advocates self-control, and total liberty would mean not only inequality, but anarchy, liberal-legal cultures recognize that liberty must be limited by custom, morals, taste and self-restraint, or by laws protecting others' welfare and freedom. Since liberty is never absolute, disputes about it concern its limits, actual or theoretical or desirable. The social principles of limitation have to do with workable degrees of difference and divergence of interest in the membership of a group or community. The legal principles have grown out of common law, in the protection of others' rights or interests and of the common welfare. They are as old as the liberties they limit. Many limitations have also been statutory, but statutes are validated, invalidated or interpreted by courts upon general legal principles.

Civil liberties, in protecting personal freedoms, necessarily constitute limitations upon others' freedoms. "Your right to swing your arms ends precisely where the other man's nose begins." The watchdog limits the freedom of the wolf to exploit the sheep: "eternal vigilance is the price of liberty."

Where common sense, common welfare or the rights of others are offended by some eccentric act or word, liberty is often said to have become "licence." This defines the situation as a matter of nuisance rather than of right. Public sentiment suddenly throws the burden upon the disturber, who is lucky if he can then still claim and win sanctuary in his civil rights.

Every legal issue involves a sacrifice of one interest and "right" to another. Guarantees of due process merely attempt to oblige

authorities and courts to give due weight to the personal and social values of the civil liberties.

Democracy, as a system of control and of holding responsible those in power, is based upon (1) majority responsibility for government and (2) minority dissent, criticism and opposition. It depends, therefore, upon freedom to speak, hear, print, read, organize and agitate, both for and against established rights or new rights. New rights usually destroy privileges which had helped produce the demand for new rights—privileges which had been claimed as rights by their beneficiaries and therefore have been defended at all costs. Systems of liberties and freedoms are, therefore, functions of the balance of power among economic and political groups. If power is monopolized it has no responsibility to minorities and, shortly, there are no minorities to share responsibility. Democracy then and there ceases.

In English law certain of the basic liberties are left as "natural rights," unspecified in any charter but enforced to the extent and in the sense that courts will not permit encroachments. Legal limits on civil liberties are, however, as old as the liberties themselves, both deriving in part from the common law in the courts of England and America. Freedom of speech or press may be limited in respect to language used ("blasphemous," "obscene" or merely alien); in respect to the meaning or content of the utterance (libellous, seditious, treasonable, obscene or reflecting upon some religion); or in respect to the use or effect of the words (inciting to violence, crime or furthering a conspiracy). *Potential* effects such as "probable" traffic obstruction, riot, lynching or panic have been put forward especially by police departments against the right of assembly, which in large cities is regulated by permit or licence, ostensibly to assure police protection in respect to fire, traffic and personal safety at the meeting place. Libertarians consider such irresponsible discretionary powers more dangerous in the long run than the risks of occasional violence.

Except for certain officials such as members of congress and judges in the performance of public functions, Anglo-American liberties have never provided immunity against the *consequences of the abuse of civil liberty*. Libertarians have protested chiefly against prior censorships which deny the right to be *heard*. If a speech, play, book, picture once publicized is then prohibited as "dangerous," "obscene" or "violent" or "treasonable" it must be found so by due process of law, under recognized constitutional principles, rather than by an executive fiat or legislative condemnation alone which might be whimsical, vague, prejudiced or vindictive. Courts have differed widely as to whether intent, or tendency, or actual effect, or a combination of these, shall make a statement "criminal." All three are hard to "prove" except at the very crises when the protection of civil rights is most needed.

In the United States, the supreme court, though recognizing the principle of "bad tendency," requires that a speech, article or meeting must create "clear and present danger" in the actual situation before it may be legally stopped or punished. The 14th amendment forbids any state to make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; also to deprive any person of life, liberty or property, without due process of law. These clauses have been declared by the supreme court to invalidate local statutes, ordinances, administrative acts, and even court rulings, which limit freedoms of speech, press, distribution, assembly, movement, residence and even of education (DeJonge *v.* Oregon, 299 U.S. 353, 1937; Lovell *v.* Griffin, 303 U.S. 444, 1938; Schneider *v.* Irvington, 308 U.S. 147, 1939; Herndon *v.* Lowry, 301 U.S. 242, 1939; Hague *v.* C.I.O., 307 U.S. 496, 1939; Edwards *v.* People of the State of California, 62 S.C.Rep. 164, 1941; Bridges *v.* State of California, 62 S.C.Rep. 190, 1941).

The inviolability of personal privacy has been extended to first-class mail matter and to telephone and telegraph messages; but the right of free communication has also been curtailed by post office censorship—the use of the second- and third-class mails for fraud, annoyance, obscenity, sedition, libel, etc., being forbidden by law, and its administration being subject largely to petty executive discretion. During wartimes, wire tapping and violation of private mail have been winked at by the authorities as "war censorship" or "military necessity," but under protest by exponents of civil rights. Control of radio transmission and reception is accepted like traffic control on the basis of "public interest, convenience and necessity," but only "clear and present danger" in a war emergency or similar crisis may constitute a "necessity" justifying censorship of transmission or seizure of receiving sets.

The film and microphone were unknown to the framers of the Bill of Rights, but the classic doctrines of freedom of speech and press have been extended by judicial construction to protect in some degree "freedom of the air" and "freedom of the screen," which have come to be of equal or greater importance.

Radio, having become more effective than platform, screen or press, has become a critical area of control. The Federal Communications commission requires all stations to give equal facilities to all sides of controversial issues; the law requires equal "freedom of the air" for all candidates for public office. Commercial programs, however, studiously censor anything supposedly offensive to the customer-public, and war censorship deletes all information of significance to the enemy.

In the law of libel it was gradually established, in both Great Britain and the United States, that a jury, not the judge, decides what is libellous; and, in certain cases, demonstration of good (*i.e.*, nonmalicious) motives in announcing a truth or fact is considered a valid defense against libel suit (*see* LIBEL AND SLANDER). It is clear that in "libel" situations two civil liberties (communications and reputation) come into conflict and limit one another.

Freedom of movement, limited by relief settlement laws and by border restrictions passed by many states, may be again liberated from state statutes by the supreme court decision in the Edwards case (*loc. cit.*) declaring freedom of movement, and therefore free entry, to be one of the privileges and immunities or liberties of United States citizens protected by the 14th amendment.

The right to organize and to combine may be used to monopolize, to exclude, to exploit, to intimidate, to ruin or to oppress; it has been so used upon occasion both by employers and by employees. Clearly it may be limited by others' personal rights and liberties. But where, as in totalitarian cultures, the state takes a monopoly of association, the interplay of institutional and cultural interests between groups, and within human minds, is greatly impoverished. The single person, moreover, is practically helpless unless he is upheld in the opportunity to share his views and organize a like-minded group.

Freedom to co-operate, to organize, is closely related to the freedom of assembly. It is limited by the law of conspiracy, just as freedoms of speech and press are limited by the law of libel and of incitement, and the limiting laws may in times of "crises" be unlimitedly interpreted. Organizing becomes conspiracy if the activities organized collectively are themselves illegal. All labour unions, not to mention strikes, were at one time declared conspiracies. Acts protected if performed alone may also be declared lawless if done together, by agreement, especially in a "dangerous" situation.

Freedom of contract implies a paradox: one's right to deny himself freedom. This freedom has therefore been limited on occasion in the interest of freedom of competition or the protection of welfare. Contracts have even been abrogated where a court has decided that the right may not be so abused as to abdicate another "inalienable" or "reserved" right: one can no longer sell himself into slavery or peonage. Labour legislation may limit freedom of the wage contract to minimum wages or maximum hours.

Freedom of assembly is limited by freedom of movement in the use of the streets and by the police power in respect to public safety. The nuisance character of traffic obstruction and street littering *limits* freedom of assembly and distribution of printed matter, but can no longer be legally used to *prohibit* these rights. The right of assembly is, of course, further limited by the law of riot: in constitutional law it appears usually as the "right *peaceably* to assemble." Some courts have declared, however, that a meeting is not "peaceable" if it is illegal, and not legal if it has been forbidden; a vicious circle in that the legality of the forbidding of a peaceable assembly is what is in question.

In England it was established (Beatty *v.* Gilbanks, 9 Queen's Bench Decisions 308) that, while a meeting which in itself threatens the peace may be stopped, a lawful meeting cannot legally be stopped to prevent others from attacking it.

"Picketing" is defended as an exercise of free movement, assembly and speech; except as a publicity device it is seldom effective without interference with others' civil liberties. It is the most frequently challenged form of assembly, since it tends toward coercion or riot, but cannot legally be stopped until it shows at least "clear and present danger" thereof.

Religious preaching and practices are not legally interfered with in the United States unless they are aggressive as "nuisances," offend "public morality," violate secular laws or are dangerous to the government. Quakers, Mormons and Jehovah's Witnesses have each provided their test cases. A few old blasphemy statutes have been revived, as excuses to "get" persons otherwise unpopular. Religious belief does not exempt from national service, flag salutes, or quarantine and vaccination.

Obscenity statutes are occasionally invoked, especially against contraceptive instruction or equipment, which still stand in the "Comstock" act (1873) as "obscene" despite marked changes of public opinion in this field. A questionable court decision (U.S. *v.* One Package, 86 F. 2nd 737: C.C.A. 2nd, 1936) has largely destroyed the effectiveness of this federal act in this respect. A few states retain restrictive legislation against birth control. The battle of obscenity after the turn of the century raged chiefly around the censorship of motion pictures—local *v.* national; lay *v.* "expert"; voluntary *v.* governmental; pre-release *v.* post-release. Reformers protesting against commercialized vice, attempting sex education or discussing the ethics of marriage have occasionally been prosecuted or persecuted for "obscene" publication in communities where the exploiters of prostitution were relatively immune. Films on maternity care have occasionally been censored where pornographic burlesque and elegantly salacious periodicals simultaneously went unchecked by public taste, morals, religion or law enforcement.

Liberty as Means or as End?—Whether liberty be an end in itself or a means (indispensable or not) to other ends has often been debated. Liberties in the sense here used have always been used as means toward freedom or power. Civil, political, economic and academic freedoms have been considered by some as ultimate values. Close examination of actual situations, however, shows many in which legal liberty has been invoked to permit a freedom, but the freedom is used to seek some ulterior satisfaction better described in terms of other values such as self-expression, personality, power, prestige, wealth, beauty, truth, good conscience, goodwill, peace, security, progress, pleasure or the common welfare.

The feeling of freedom is a satisfaction so precious to many people that (paradoxically) they will give up much welfare, many liberties, even such rights as guarantee their freedom, if they feel that in doing so they are free, or imagine they are thus ultimately protecting their freedom. Propaganda may glorify "liberty" as a goal in order to motivate national morale, while another people is equally willing to lay down both lives and liberty in defense of "welfare." Thus the setting up of goals is itself a device of propaganda: the end is used as a means!

Honest analysis is thus required to determine, in any given situation, which value is supreme and which of the others are means to it or must be sacrificed for it.

It is frequently said that, in modern war, liberties must be suspended in order to protect "liberty." Such a formula assumes (1) that criticism hinders war effort—an assumption which others believe proved contrary to fact in the Allied countries. It also assumes (2) that after victory both the people and their then rulers will retain enough attachment to the values of civil liberties to offset more immediate and selfish interests, and (3) that the political mechanisms for restoration of liberties are preserved.

That civil liberties are considered a safeguard by every insecure group is indicated by the fact that in the early American *state* constitutions the privileged sought such constitutional guarantees for protection against the disadvantaged groups; while in the formulation of the *federal* constitution it was the depressed groups who thus sought protection from government! Again, rights of protest against *governing* minorities can also be utilized as a right of protest (propaganda) against *protesting* minorities. And later, liberties set up for the protection of the weak were used as shelters for privilege or as weapons against the weak.

Sometimes a principle of liberty, long since invoked in the abstract to justify a successful claim for a particular freedom, is invoked in vain by others in support of other concrete claims which are less congenial to those who once used the same slogan for their own liberation. Liberty, though set up as an end, may thus be sought or denied as a means to other far different ends.

Legal "liberties" may be claimed for the underprivileged by those whose interests lie in exploiting those liberties; *e.g.*, labour legislation has been opposed by employers in the name of "free contract" and "equality before the law." Groups obviously devoted to programs destructive to civil liberty may use the present protection of the Bill of Rights to forward their "subversive" doctrines. These are risks which apparently must be assumed if the rights are to be preserved in the interests of other persons and groups and of the community as a whole.

Modern rationalization of civil liberties is not altogether in terms of individualism. They are defended not merely as ends but as means to the organic welfare of a nation, in which persons and community are mutually constituted facts in a total situation and equally indispensable. There is a diversity of gifts and roles, and all have a "right to each other's differences." Where liberties are denied, society as a whole is deprived, not only of the extreme expressions that have been penalized, but of the wiser oppositions and variants that have thereby been deterred.

Sociological Aspects.—How much or how little variation shall be tolerated in a given group? This is an essential and perennial issue in the field of social control. The encouragement of variation from the average or "mode" of the group's behaviour may be called a policy of variety, diversification or liberty. The discouragement of variation may be called a policy of uniformity, conformity or standardization. Neither of such policies is apt to be found consistently pursued, and many are the compromises between them.

Conformity may be sought and (in externals, at least) even achieved, by expelling or excluding the undesired variants from the group; or, by more or less pressure of prohibitions, punishments, threats, rewards, promises, persuasions, etc., to bring them back into the fold, closer to the "mode" of respectability.

Liberties remove barriers to variation: there are opportunities to differ, to experiment, to err or discover. But they do not *ipso facto* produce genius, invention, art, statesmanship, nor even the wish to vary. The results of civil liberties may be banal, whimsical, even sordid, if there be no talent or will to achieve; but without such opportunity neither individual genius nor fertile group-discussion can function at its best.

It should be noted that "liberty" and "equality" are usually incompatible: to enforce equality will cramp liberty. It has been customary, therefore, to interpret equality in terms of "opportunity" and "the pursuit of happiness," rather than of property or success. "Equality" becomes equal chance to develop unequal capacities. "Fraternity," or perhaps *noblesse oblige*, is supposed to mitigate the conflicts or problems of maldistribution, domination and illfare resulting from *laissez faire* and "free" competition.

Policies of conformity and curtailment of liberties (whether by majority pressure or by a dominant minority) tend to arise (1) when the group in power feels insecure in its property, position, prestige or prospects; (2) where innovation is supposed to be offensive to a supernatural being; (3) where a crisis (disaster, war, rebellion, etc.) confronts the group with imminent destruction, and unanimity of attitude and conduct seem imperative; (4) when a group under fanatic leadership feels its solidarity threatened by any "heresy" or relaxation of discipline; (5) when tradition is highly habituated and homogeneous, so that there is lack of spontaneous variation; (6) in situations of isolation and

general ignorance of possible alternate (variant) behaviours; (7) under large-scale production of standardized products by standardized processes under mechanical discipline and union rules; (8) where lack of either personal resources or social facilities prevent men from utilizing their rights or liberties to achieve either "equality" or "success," so that civil liberties are apt to mean little and fall into disuse in favour of measures called "social welfare," "social security" and "social justice."

Policies of liberty tend to appear (1) where people feel continually thwarted in the exercise of their organic cravings; (2) at frontiers, where there is physical and social room for variants; (3) where geographic isolation, strategic position or complacent power give a sense of security which can tolerate internal criticism and opposition; (4) where knowledge and discussion are already widespread and traditional; (5) where no interest of prestige, power or property is affected by the variant behaviour which is thus a matter of indifference; (6) where, as in large cities, anonymity and irresponsibility produce reciprocal tolerance.

Many of the legal regulations and restraints resented by powerful and successful minorities have been imposed in order to protect the liberties of those who are weak unless protected by organization, numbers, vigilant leadership and libertarian tradition. Legal liberties atrophy without vigorous popular *mores* of liberty. Freedom is not theoretical abstraction nor a quality one has; it is an actual situation in operation: in order to have it one must *do* it.

Wealthy and powerful persons either are not attacked for eccentric ideas or have ample personal means to defend their own liberties. This is probably why civil liberties are usually advocated by or for the underdog.

Civil liberties were justified by 17th and 18th century philosophers as "inherent" and "inalienable" rights. The "natural rights" doctrine derives in turn from mediaeval and Greek conceptions of the nature of souls as divinely created free, equal and rational. In current social philosophy, by contrast, rights do not issue as "natural law" from a divine sovereign, nor even as inherent attributes of man's biological nature, but as natural operations, inhering in social (moral, legal, political, economic) *situations* of certain classes. A "right" which ceases to be claimed and enforced ceases to exist, and with it the specific liberties which the right was supposed to safeguard.

The weakness of the "natural rights" doctrine was that it usually rested upon "natural law" either as divinely ordained or at least as beyond need of human enforcement. Recognition that rights are not providentially or automatically enforced, but only survive through the operation of reciprocal responsibilities between actual persons and groups in the state, may lead to more active maintenance of the necessary civil guarantees.

The collective right of majority rule has always conflicted with individualistic civil liberties in actual situations. History is largely the working out of this contradiction, sometimes by compromise, sometimes by ingenious formulae, sometimes by open violence on either or both sides. It is unfortunate that "democracy" has been defined in both ways—in terms of majority rule and of personal liberty. Neither is in itself democratic. Either is democratic if (and only if) the majority and the minorities remain *responsible to each other:* can hold each other responsible, and *do so.*

For and Against Policies of Liberty.—In favour of increased civil liberties there are the following arguments (some of them overlapping, others incompatible):

1. *"Natural rights":* that individual liberties are inborn—a 17th and 18th century political doctrine, considered a metaphysical rationalization from theological sources.

2. *Means of progress:* that liberty to differ encourages innovations and novel combinations of which the fittest (= best?) will survive. Repression of the "lunatic fringe" might be harmless if it did not also intimidate the less vociferous and silence many whose wiser criticisms would have been of definite value.

3. *Self-correction through discussion:* that ideas or proposals which might be worthless or harmful if segregated by repression may be revealed, modified and balanced by free access and discussion.

4. *Recruiting of the élite:* that without liberty of expression for talent among the masses the dominant group cannot select and induct the ablest potential leadership to maintain its continuity.

5. *Safeguarding majority rights:* that denial of civil liberties to unpopular minorities might lead to similar repressions of those now in the majority, if conditions were to change.

6. *Democratic responsibility:* that if governments are to be held responsible to the governed, they must have access to the feelings and grievances of all citizens. Minorities, in turn, tend to become irresponsible to the state if they are permitted no orderly and responsible channels for seeking redress, persuading others, and recruiting their numbers to a possible majority of their own.

7. *Peace and loyalty:* that a feeling of freedom actually reduces protest, since people then feel that "things will work themselves out." History seems to show that only civil liberties provide a regime sufficiently satisfying to insure stable and peaceful democracy, and that only democracy survives in large populations.

8. *"Safety-valve":* that without some escape in talk, discontent may accumulate in secrecy and become dangerously explosive.

9. *"Sublimation":* that, through toleration and discussion, resentment may be converted into competitive effort for the common good.

10. *Public confidence:* that abrogation of liberties is or seems to be evidence of insecurity and fear, or of guilty conscience, on the part of the repressing group; or, an admission by the "oppressors" of the strength or effectiveness of the repressed group, or of the cogency and infectiousness of its ideas.

11. *Injustice of repression:* that repressive measures are apt to injure others than the "guilty," and to insult and intimidate or antagonize the "innocent."

12. *Avoidance of incitation:* that persecution may actually produce dangerous attitudes that previously were only imputed to those persecuted; or may give recruits to previously negligible minorities, and rouse sympathy for the "underdog."

13. *Futility of repression:* that repression of liberties is seldom successful in stifling the ideas under attack.

14. *Fallibility of repression:* that the ideas of the repressing group may be in error, or those attacked, true.

The case *against* liberty may seem specious to those who value it and appreciate the values it protects, but it must be remembered that there are those for whom welfare, group prestige or the lust for power outweigh personal freedoms. The arguments are:

1. *Precondition of organization:* that group operation breaks down under the strains of heterogeneity of interests, or without some consensus based upon conformity to certain standards of thought and behaviour.

2. *Indispensable means:* that a group bent upon results at all costs tends by its nature to resent and attack those whose variance hinders its goal.

3. *Minority safeguard:* that the majority must be restrained from persecuting the unpopular variants, and the latter, if they look for trouble, must be protected against themselves by restraints on their freedoms.

4. *Choice of evils:* that between anarchy and oppression the latter is preferable.

5. *Last resort:* that policies of liberty are already outmoded by history, their results being such maldistribution and exploitation and injustice that only drastic discipline can weld peoples again into spiritual, cultural, economic and political unities.

6. *Safety first:* that only rigid control can draw the line; that liberty admits the bad with the good.

7. *Discipline and group pride:* that likeness and consciousness of kind improve solidarity, mutual confidence and morale, and that homogeneity even when originally compulsory, eventually maintains the continuity of group tradition through imitation.

8. *Dangers of innovation:* that the new may not only threaten continuity and solidarity but may menace privilege, prestige and power; that while an occasional new idea is viable, most are false.

9. *Exemplary value:* that compulsory uniformity gradually gives way to spontaneous imitation and eliminates the need for coercion. Drastic repression will also warn and intimidate other potential variates.

10. *"A stitch in time":* that, in group crises, even minor deviations may prove dangerous and should be "nipped in the bud."

11. *Satisfactions of submission:* that, especially after being confused and bogged down by multitude of counsel and conflicting (free) ideas and interests, people will welcome the unanimity of controlled opinion, the irresponsibility of habitual obedience.

12. *Welfare:* that liberty must be curbed to prevent the social problems resulting from an unplanned economy, free competition, and resultant inequalities and exploitations.

13. *Expert control:* that party politics and incompetence due to free franchise render difficult the merit system in public administration which rigorous homogeneity could provide.

14. *Group economy and efficiency:* that the group's energies are better polarized and its goals more effectively sought if it acts without distracting elements and wasteful frictions.

15. *Personal integration:* that through sharing uniformly in the

common interest and group ideals, and by identifying himself with the larger unity, every person develops his capacity for self-control, self-sacrifice, self-forgetfulness, or acquires a larger selfhood.

16. *Group freedom:* that collective independence (*e.g.*, national freedom) is a higher satisfaction than the privilege of personal eccentricity.

17. *Liberty not enough:* liberty being negative and truth positive, even a situation of civil tolerance needs persistent propaganda (sincere or insincere) for the accepted ideology, if a workable homogeneity is to be maintained in the culture.

18. Untrammelled initiative and choice may not automatically assure the appearance among the peoples of true, useful or even new ideas. It may prove to be the liberty of each "to go to hell in his own way": "the devil take the hindmost." Or, actual choice may be so limited by the economic situation or by collective pressures that a merely legal liberty becomes meaningless mockery, to which paternalism is preferable.

19. *Defense of dogma:* theocratic or fanatic oligarchies feel a thrill in destroying heresy and in being instruments of a sacred cause or an infallible hero; the doctrine need not even be immutable if there be the dogma that the God, hero, king, country, party or church can do no wrong.

It should be apparent that the several arguments cited are not all compatible: some are used by different groups under differing circumstances.

Arguments for conformity are more apt to be frankly stated in terms of special interests in actual situations than in terms glorifying homogeneity or conformity in the abstract.

BIBLIOGRAPHY.—John Milton, *Areopagitica* (1644); Thomas Paine, *The Rights of Man* (1791); Edith M. Phelps, ed., *Civil Liberties* (1927); Leon Whipple, *Our Ancient Liberties* (1927) and *The Story of Civil Liberty in the United States* (1927); Arthur Garfield Hays, *Let Freedom Ring* (1928); Horace M. Kallen, ed., *Freedom in the Modern World* (1928); George B. Logan, *Liberty in the Modern World* (1928); Roger Nash Baldwin, *Liberty under the Soviets* (1929); Ernest Sutherland Bates, *This Land of Liberty* (1930); Lamar T. Beman, ed., *Selected Articles on Freedom of Speech and the Press* (1930); Harold J. Laski, *Liberty and the Modern State* (London, 1930); Everett Dean Martin, *Liberty* (1930); Ernest Hopkins, *Our Lawless Police* (1931); Albert Venn Dicey, *Introduction to the Study of the Law of the Constitution* (London, 1902; 8th ed., 1931); C. E. M. Joad, *Liberty To-day* (London, 1934); Julia E. Johnsen, ed., *Freedom of Speech* (Bibliog., 1936); Sidney Webb and Beatrice Webb, *Soviet Communism: a New Civilization?* (1936); Roger Nash Baldwin and Clarence B. Randall, *Civil Liberties and Industrial Conflict* (1938); George Seldes, *Freedom of the Press* (1935) and *You Can't Do That* (Bibliog., 1938); Dorothy Fosdick, *What is Liberty?* (1939); Ruth Nanda Anshen, ed., *Freedom: Its Meaning* (1940); Zechariah Chafee, *Free Speech in the United States* (1940); literature of the American Civil Liberties Union, New York city.

(T. D. E.)

CIVIL LIST, the English term for the account in which are contained all the expenses immediately applicable to the support of the British sovereign's household and the honour and dignity of the crown. An annual sum is settled by the British parliament at the beginning of the reign on the sovereign, and is charged on the consolidated fund. But it is only from the reign of William IV. that the sum thus voted has been restricted solely to the personal expenses of the crown. Before his accession many charges properly belonging to the ordinary expenses of government had been placed on the Civil List.

William and Mary.—The history of the Civil List dates from the reign of William and Mary. Before the Revolution no distinction had been made between the expenses of government in time of peace and the expenses relating to the personal dignity and support of the sovereign. The ordinary revenues derived from the hereditary revenues of the crown, and from certain taxes voted for life to the king at the beginning of each reign, were supposed to provide for the support of the sovereign's dignity and the civil government, as well as for the public defence in time of peace. Any saving made by the king in the expenditure touching the government of the country or its defence would go to swell his privy purse. But with the Revolution a step forward was made towards the establishment of the principle that the expenses relating to the support of the crown should be separated from the ordinary expenses of the State. The evils of the old system under which no appropriation was made of the ordinary revenue granted to the crown for life had been made manifest in the reigns of Charles II. and James II.; it was their control of these large revenues that made them so independent of parliament. Moreover, while the civil government and the defences suffered, the king could use these revenues as he liked.

The parliament of William and Mary voted in 1689 an annual sum of £600,000 for the charge of the civil government. This was a mere resolution without statutory effect. In 1697 the first Civil List act was passed. Certain revenues (the hereditary revenues of the crown and a part of the excise duties), estimated to yield £700,000, were assigned to the king to defray the expenses of the civil service and the payment of pensions, as well as the cost of the royal household and the king's own personal expenses or "Privy Purse." The Civil List meant practically all the expenses of government except the debt charge and defence. If the yield of the assigned revenues exceeded £700,000 the surplus was to be disposed of by parliament. This restriction was removed by an Act of 1700. In the reign of Anne the Civil List consisted of the same assigned revenues (subject to certain deductions). The yield fell short of the estimate of £700,000, and at the end of the reign a debt of £500,000 was met from the Exchequer.

The Hanoverians.—For George I. additional revenues were assigned, and it was enacted in effect that the Civil List should become independent of the yield of the assigned revenues, and should be a fixed sum of £700,000 a year. Any surplus was to be surrendered, and any deficiency would be made good. But this was found insufficient and parliament from time to time made additional grants from the Exchequer to pay off debts amounting in the aggregate to £1,300,000. In the reign of George II. there was again a change of system. The Civil List was composed of the assigned revenues, together with certain fixed grants, and a *minimum* yield of £800,000 was guaranteed by parliament. Any surplus yield over £800,000 was retained by the king. On the accession of George III. the system of a fixed Civil List was reverted to. The assigned revenues were no longer paid to the crown but to the aggregate fund as part of the revenues of the Exchequer, and the fixed allowance of £800,000 was paid out of the aggregate fund to the king (subject to certain annuities payable to members of the royal family).

During the reign of George III., the Civil List played an important part in the king's effort to establish the royal ascendancy. The "king's friends," his supporters in parliament, were lavishly rewarded with places, pensions and even bribes. Upon the expenditure of the Civil List there was no independent check. So long as the total was not exceeded, the king, with the co-operation of complaisant ministers, was free to spend it as he pleased. As it turned out, despite stringent economies in the cost of the household, excesses were incurred. But parliament, already corrupted, was persuaded to provide extra funds to pay off the debts (£513,511 in 1769 and again £618,340 in 1777). Proposals for enquiry, supported by Chatham, were resisted and negatived.

Burke had already attacked the extravagance and corruption of the Civil List and in 1780 he introduced bills embodying his scheme of economic reform. The scheme could not be passed against Lord North's government, but in 1782 the Rockingham ministry passed a Civil List act which abolished many useless offices, imposed restraints on the issue of secret service money, stopped secret pensions payable during the king's pleasure, and provided for a more effectual supervision of the royal expenditure.

The Civil List was divided into classes, and the requirements of each were estimated as follows by a committee of 1786:—

1.	Pensions and allowances of the royal family	£203,500
2.	Salaries of Lord Chancellor, judges and Speaker	32,955
3.	Salaries of ministers to foreign courts	70,852
4.	Tradesmen's bills, etc., for His Majesty's service	147,200
5.	Menial servants of the household	90,966
6.	Pensions	118,189
7.	Other salaries	81,440
8.	Salaries and pensions of Commissioners of the Treasury	13,822
	Occasional payments	138,476
		£897,400

Substantially classes 1, 4 and 5, amounting to £431,666, represented what is now covered by the Civil List and the annuities

to the royal family, though a few items in class 4 belonged to the cost of government, and a few in class 6 and among the occasional items would now come under the Civil List. These estimates for the several classes were not binding, and they were in fact soon exceeded. Indebtedness accumulated and had from time to time to be paid off (£2,266,000 in all between 1782 and 1820). The amount of the Civil List itself was augmented, and in 1816 it was fixed at £1,083,727. Meanwhile the principal provision for the civil government had come to be made outside the Civil List. Annual votes of parliament for what were called miscellaneous services had been between £200,000 and £300,000 in the earlier years of George III.'s reign, and had been mainly casual and non-recurrent. By 1820 they amounted regularly to about £2,000,000 a year. On the accession of William IV. in 1830, the Civil List was finally freed from all charges for the government service as distinguished from the court and royal family. The charges for judicial and diplomatic salaries and for the Board of Treasury were transferred to the Exchequer. The expenses left were covered by a Civil List of £510,000. This included a sum of £75,000 for pensions.

Civil List Pensions.—The pensions were excluded from Queen Victoria's Civil List, which was reduced to £385,000 (separate provision of £100,000 being made for Queen Adelaide, who had had a privy purse of £50,000 during her husband's reign).

A new system of "Civil List Pensions" was set on foot. The queen might, on the advice of her ministers, grant pensions up to a limit of £1,200 granted in any one year, in accordance with a resolution of the House of Commons of Feb. 18, 1834, "to such persons as have just claims on the royal beneficence or who, by their personal services to the crown, by the performance of duties to the public, or by their useful discoveries in science and attainments in literature and art, have merited the gracious consideration of the sovereign and the gratitude of their country." The pensions in course of payment at any one time usually amount to about £24,000. The list of pensions must be laid before parliament every year.

Queen Victoria to Edward VIII.—Queen Victoria's Civil List amounted to £385,000. The sums granted since 1901 are as follows:—

	Edward VII. 1901	George V. 1910	Edward VIII. 1936
Privy purse	£110,000	£110,000	£110,000
Salaries and retired allowances of household	125,800	125,800	134,000
Expenses of household	193,000	193,000	152,800
Works	20,000	20,000	.....
Royal bounty and special service	13,200	13,200	13,200
Unappropriated	8,000	8,000	.....
	£470,000	£470,000	*£410,000

*Of this amount £40,000 in respect of the King's possible marriage, and £79,000 representing the revenues of the duchy of Cornwall, were undrawn.

The addition of £50,000 to the privy purse for King Edward VII. and for King George V. was to provide in each case for the Queen Consort. The new class for works introduced in 1901 was partly composed of an item previously included under expenses, and partly of expenditure previously voted by parliament. The reduction in salaries was due to the abolition of the post of Master of the Buckhounds, and some other reductions of establishments and emoluments. The allocation among classes is not absolutely binding, in that savings on one class can be applied to meet excesses on another (or added to the privy purse) with the consent of the Treasury. Class v. (works) is an exception, savings upon it being accumulated for future years.

No change was made either in the total or the details on the accession of King George V. in 1910, but there was a slight change of practice introduced. In 1842 Queen Victoria, though under no legal or constitutional obligation to pay taxes of any kind, undertook voluntarily to pay income tax. King Edward continued the voluntary payment. King George V. agreed with the government of the day that it should be discontinued, but in exchange placed on the Civil List the cost of State visits of foreign royalties previously defrayed from public funds. In 1916 the King made a voluntary gift of £100,000 towards the cost of the World War. In addition to the Civil List the King receives the revenues of the duchy of Lancaster. The revenues of the duchy of Cornwall belong to the prince of Wales as duke of Cornwall, but in the absence of a prince of Wales, as in the reign of Edward VIII., they revert to the crown.

At the beginning of a new reign it is the practice for the House of Commons to appoint a select committee to make recommendations for the Civil List and the annuities to the royal family. Constitutionally the settlement is still regarded as in the nature of a bargain for the surrender of the hereditary revenues to parliament (*see* preamble of the Civil List act 1910). The accounts of the Civil List are passed by an auditor appointed by the Treasury under the Civil List Audit act, 1816. He is always a high officer of the permanent staff of the Treasury, sometimes the Permanent Secretary himself. (R. G. H.)

CIVIL SERVICE, the generic name given to the public servants of a state employed in a civil capacity, excluding judges and teachers. Provincial, municipal and local employees are included in this term in some countries, excluded in others, such as Great Britain. In the United States the term is often used to describe that part of the government service entered by examination and offering permanent tenure. As a social formation the civil service stretches back beyond the memory of man, the Chinese being undoubtedly the oldest and one of the most distinguished. The able and powerful Roman civil service disappeared under the impact of the feudal system. The modern civil service appeared with the formation of the national state, notably in 17th century France and Prussia.

Contemporary civil services are large, permanent, inevitable, powerful agencies essential to the provision of mass services, to the support of armed power and to the regulation of economic life. They are feared by some who advocate economic freedom and by others who fear state domination of individual life. The terms "bureaucracy" and "bureaucrats," reflect this attitude. The personnel system of great industrial organizations steadily take on many of the characteristics of the civil service. On the other hand, the great industrial enterprises of the state such as the London Passenger Transport board, the Tennessee Valley authority and Russian productive agencies borrow from the managerial experience of big business. In-between stand the "mixed enterprises."

Apart from Russia and excluding colonial civil services there are three principal modern type forms of the civil service—those of Great Britain, of the European continent and of the United States.

GREAT BRITAIN

Passing through a long period of corruption and incompetence in the 18th and early part of the 19th centuries, the British civil service was reformed in the last half of the 19th and widely hailed in the first years of the 20th century as a model for the world. Harassed by unparalleled problems of war and depression, it has been criticized in recent years but its standards are still among the highest.

The era of reform was ushered in by the Order in Council of 1855 establishing the civil service commission and a modest system of pass examinations. In 1870 open competition was introduced; by 1900 the service had been transformed, and the standards of municipal services were being steadily raised by national influence exerted through grants-in-aid, notably for police.

The legal foundation of the British civil service is chiefly in orders in council, but there is legislation dealing with pensions, providing equal status for women and restricting political and union affiliation. The management of the civil service is, however, accepted as an executive function. An extensive organization has developed, including the civil service commission, the treasury and other agencies.

The civil service commission is principally an examining and certifying body for new entrants. Other personnel functions are the responsibility of the treasury and the departments, the former holding easily the dominant position. Since 1920 it has had

authority to determine policy through treasury regulations; it supervises the execution of policy by the departments; it dominates the official side of the National Whitley council; it handles all important civil service wage and salary arbitrations; and recently it has introduced modern management and organization methods. Each ministry has its own personnel office and within treasury directives and is responsible for dealing with its own personnel problems. The National Joint Council for the Administrative and Legal Services is paralleled by about 80 departmental joint councils (noted below). Finally the industrial court has a special panel to deal with arbitration in certain types of cases between the government and its workers.

The civil service (apart from the professional, technical and specialized branches and the minor and manipulative classes) falls into four divisions: the administrative class; executive class; clerical class; and writing assistants. The administrative class is concerned with advice on broad questions of policy, with over-all co-ordination and with direction at the highest and most general levels. It forms the link between the political and executive agencies of government, is based solidly on a university education and until 1920 was the prerogative of the governing group. The executive class has responsibility for the conduct of business within the framework of established policy and for the extensive auditing, accounting and fiscal operations. The clerical class performs simpler clerical functions, deals with particular cases in accordance with instructions, checks claims and collects material for statistical and other returns. Writing assistants perform routine operations.

Entrance to these classes is by open competitive examination closely articulated with the educational system and with low age limits—for the administrative class, 22 to 24 years; the executive class, 18 to 19 years; the clerical class and writing assistants, 16 to 17 years. The examinations are strongly literary and academic in content and are still designed, in the Macaulay tradition, to secure the best product of the schools—men and women the effect of whose studies "is merely to open, to invigorate, and to enrich the mind." Between these classes there were almost insurmountable barriers before 1914; they were condemned in principle in 1920 and were later gradually reduced. The consequence (before 1920) was to establish an administrative elite of genuine distinction and also to frustrate capacity in the lower levels.

The professional and scientific classes were subordinated to the administrative, not having direct access to ministers. Entrance was at somewhat higher age levels, generally about 28, and on the basis of a modified competitive system. Separately organized were the staffs of such agencies as the British Broadcasting corporation.

Responsibility for the municipal and county services rests with the borough and county councils respectively, but a long tradition of conditional grants-in-aid has tended toward a national minimum standard. In local governments there is usually no central personnel office; each department recruits as it sees fit, although municipal ordinances establish standard pay and working conditions. There is also a single retirement system for the municipal services, organized by parliament. Standards in local government services, which are generally high, are considerably influenced by a wide variety of professional and other associations including especially the National Association of Local Government Officers. The police are dealt with specially under an act of 1919, which among other matters organized the British Police federation. In the highest posts such as town clerk, health officer, education officer, chief constable and others, a nation-wide opportunity has developed by which qualified personnel move from smaller to larger jurisdictions. There is, however, little movement from local to national services or vice versa.

In the central government, unions of civil service employees were established on a permanent basis by 1890 in the post office, by 1910 in the lower clerical classes and by 1920 in all groups except the highest. They were officially recognized in 1906 and were introduced into the civil service machinery in 1919 as constituent elements of the Whitley councils. By 1920 two great federations had emerged, the Union of Post Office Workers (1920 membership of 100,000) and the civil service confederation (1920 membership of 65,000), as well as scores of smaller groups. In 1926 some sections of the civil service unions gave sympathetic support to the general strike called by the Trade Union congress, although none went out. In 1927, clause V of the Trade Disputes and Trade Unions act imposed limitations upon outside affiliation. Henceforth civil service unions were forbidden political objects and affiliation with any political parties or organization; they were also excluded from membership in outside labour unions; and local governments were forbidden to make membership in a union a condition of employment. These prohibitions remain controversial; the Labour party is committed to their repeal.

In 1919 the Whitley councils were organized. For general service questions there is a national council; for departmental questions, about 80 separate departmental councils; and for large field offices and establishments, local committees. Each body is jointly composed of official side and staff side representatives, the former appointed by the government or the minister, the latter elected by designated civil service unions and associations. The object in view was to secure a greater measure of co-operation, to provide machinery for dealing with grievances and to bring together different points of view; in particular to utilize more fully the ideas of the staff, to give them a greater share in and responsibility for determination of working conditions, to determine general personnel principles, encourage further education, improve office machinery and secure consideration of proposed civil service legislation.

These joint councils are bodies for negotiation. They have no power of their own, proceed only by agreement, and there is no way by which the staff side can force agreement upon a reluctant official side. Nevertheless, they have fully demonstrated their usefulness. Through their agency a reorganization of the civil service was worked out after World War I, and at the close of World War II they elaborated the plan for veterans' preference in public employment. They are a permanent part of the mechanism of the British civil service.

The principle of arbitration on certain civil service subjects was accepted in 1917 and was resumed in 1925 through the industrial court. Arbitration is obligatory at the request of either party on emoluments, weekly hours and leave. The government and the civil service, the latter through the staff side of the Whitley council, nominate panels of arbitrators; each case is presided over by a member of the industrial court. Many cases have been heard, but civil service gains have been relatively slight. The court has, however, ironed out many anomalies and its work is highly appreciated by the staff side.

In Great Britain civil servants are not eligible to sit in parliament and are barred from active participation in politics. With official consent they may sit on borough and county councils. A high standard of personal and official conduct prevails. In an official statement in 1928 it was said, "The public expects from them a high standard of integrity and conduct not only inflexible but fastidious. . . ." This view was fully endorsed by the civil service press.

(*See* Emmeline Cohen, *Growth of the British Civil Service, 1780–1939* [1941]; Harold E. Dale, *Personnel and Problems of the Higher Civil Service* [1945]; Herman Finer, *British Civil Service* [2d ed. 1939]; J. Donald Kingsley, *Representative Bureaucracy* [1945]; N. E. Mustoe, *Law and Organization of the British Civil Service* [1932]; Hiram Stout, *Public Service in Great Britain* [1939]; Harvey Walker, *Training Public Employees in Gt. Britain* [1935]; Leonard D. White, *Whitley Councils in the British Civil Service* [1933]; *Whitley Bulletin* [London, 1921–].)

Northern Ireland.—The civil service of Northern Ireland is organized on the same general principles as that of Great Britain and is subject to the same rules. A less elaborate organization is required in view of the relatively small size of the service.

British Dominions and Colonies.—In the self-governing dominions and colonies the civil service is controlled by the government of the dominion or colony in question. In colonies not possessing responsible government the civil service is recruited in increasing proportions from the locality, but the higher

officials are appointed directly through the colonial office.

Canada.—After long experience with patronage, Canada introduced an effective merit system in 1918, strengthening the position of the civil service commission. The dominion system is an amalgamation of British and American patterns, the former responsible for treasury control and a recently introduced university examination, the latter for the classification plan. The act of 1918 contains the basic provisions for recruitment, promotion, dismissal and political rights. A contributory pension plan was established in 1924. Each province has its separate civil service.

(*See* R. M. Dawson, *The Civil Service of Canada* [1929].)

Commonwealth of Australia.—Based upon long and varying experience in the states, the Commonwealth Public Service Act of 1902, amended in 1922, provides for a complete civil service system in conjunction with the Arbitration Act of 1911. The struggle to eliminate patronage has been protracted and is still not fully successful. A single public service commissioner in lieu of a board has generally prevailed, both in the commonwealth and the states. Examinations are related to the public school system and provide the foundation for a career system. There has been, however, much reluctance to establish a university-trained body for the most responsible civil service positions. Wages and salaries are determined by a public service arbitrator, whose relations with the Public Service board have given rise to difficulty. Substantial preference is given to veterans. Associations of civil servants are permitted and have been active in seeking better wages and conditions of work.

(*See* F. A. Bland, *Shadows and Realities of Government* [1923]; Robert S. Parker, *Public Service Recruitment in Australia* [1942].)

New Zealand.—Prior to 1912 the New Zealand civil service was "uneven in its standards and chaotic in its organization." Order and system developed after 1912 under the direction of the public service commissioner, an independent officer appointed for seven years.

The New Zealand system resembles the British in recruiting at early ages (17–21) but its democratic spirit permits no class barriers and has been cool to a cultural university education, preferring employees with technical and professional, or service backgrounds. There are five classes: the administrative, comprising the heads of departments who are outside the jurisdiction of the public service commissioner; the general, including technical and specialized personnel; the professional; the clerical; and the educational.

After 1941 there were important in-service training developments.

(*See* Public Service Commissioner, *Annual Reports;* Leslie Lipson, "Education and Training of Personnel in New Zealand," in *Public Administration Review,* vol. i, pp. 257–270 [1941].)

Union of South Africa.—The Public Service commission is established by the constitution of 1909 and vested with powers over appointment, discipline, retirement and superannuation. The Public Service Act of 1923 sets up five divisions: administrative; clerical; professional; general; and the services—defense, police and prisons. A Public Service Advisory council (1925) comprises eight members nominated by public service associations and four official side representatives; its powers correspond to those of the British Whitley council. Some general civil service examinations are conducted by the department of education.

(See *Annual Report,* Public Service Commission; *Official Year Book of the Union.*)

Irish Free State.—Full authority for civil service regulations is vested in the Free State government. Acts of 1924 and 1926 establish three commissioners and define their duties and powers; as in Great Britain the consent of the minister of finance is frequently required. Municipal civil service has been subject to considerable political influence, lessened by the temporary supersession of local self-government in Dublin and elsewhere and by the appointment by the Free State government of city managers.

British India.—The Indian civil service owes its early organization to Warren Hastings (1772); the appointive power was transferred from the East India company to the British government in 1853; demands for the appointment of Indians, only partially met before 1920, have been recognized in increasing measure as the number of British candidates diminished. The Indian civil service, based on a difficult university examination established by Thomas Babington Macaulay and Benjamin Jowett, has always been a small governing elite; in 1930 it numbered slightly more than 1,000. It held such offices as governor of province, member of executive council, head of department, judge, district officer and magistrate and technical and professional appointments. The district officer, responsible for an average area of more than 4,000 sq.mi., was in charge of police, jails, public order, revenue, and general supervision of all public activities; he also heard cases on appeal. The service, before the Government of India Act of 1919, was not responsible to Indians, but to the British government; from then a measure of local responsibility existed. The standards of integrity and competence of the service were high after 1853, but its contribution to self-government was secondary to its duty as a trustee of Indian welfare.

(*See* M. C. C. Seton, *India Office* [1927]; L. S. S. O'Malley, *The Indian Civil Service 1601–1930* [1931].)

EUROPE

France.—The French civil service was founded by absolute monarchs before 1789. Reorganized by Napoleon it survived many changes of régime, and although gradually modernized under the third republic it still keeps many of its older characteristics. Its legal basis rests preponderantly on executive decrees and the jurisprudence of the Conseil d'Etat, although there is legislation prescribing a general system for local authorities, and giving certain guarantees to civil servants. A general civil service act, often proposed, has never been achieved.

Due largely to the constructive work of the Conseil d'Etat a common national pattern underlies the maze of executive and departmental decrees. This includes the normal requirement of examination for entrance, graded positions and salaries, tenure and protection against arbitrary action by superiors. Supervision by national authorities (especially by the departments of interior, war and education) over departmental and municipal agencies is close, and contributes to consistency in fundamentals.

The examination system is organized departmentally, since there is no civil service commission at any level of government. The examinations are academic in character, are difficult, and although probably not highly selective, have contributed greatly to the prevention of influence and to a high intellectual standard. For most professional positions, France maintains excellent technical and professional schools, such as L'École Polytechnique, L'École Normale, L'École des Ponts et Chausses and L'École des Chartres.

Protection of employee rights has taken two forms, the right of appeal to the Conseil d'Etat and the organization of *syndicats* or unions. The former has been widely used and has been of great value. The right to form *syndicats* was long denied by the government but events overruled official objections. The postal service, the clerical service, the schools and the lower grades are highly organized and extremely active in the defense of their interests.

In the upper reaches of the French civil service standards have been high. In the middle and lower brackets there has been lack of energy and inventiveness, unwillingness to apply modern methods of personnel management and overemployment.

(*See* Walter R. Sharp, *The French Civil Service* [1931]; Alexandre Lefas, *L'Etat et les Fonctionnaires* [1911]; H. Berthelemy, *Traite Elementaire de Droit Administratif* [13th ed., 1933].)

Germany.—The German civil service emerged out of feudalism under a succession of powerful Prussian monarchs culminating with Frederick the Great (1740–1786). Here were formed deep traditions of obedience, frugality, industry, integrity and a sense of trusteeship. The legal foundations of the Prussian civil service are partly customary, partly executive acts and partly statutes, all developed by judicial construction. The German civil service has statutory foundation in the Civil Service Act of 1873, most recently revised in 1937. The Weimar constitution contained important civil service provisions, including equal status for women, freedom of association, eligibility of civil servants to the reichstag, state liability for wrongful acts of civil

servants and a declaration against party influence. Far-reaching enactments by the nazi party after 1933 excluded several categories from the public service, extended national standards over the states and demanded unquestioning party loyalty.

Although each German state, until 1933, had a separate civil service system, all were greatly influenced by the Prussian model, also the basis for the national system. Three levels of organization were recognized in the German-Prussian system: the higher service, requiring a university education; the middle service, based on the gymnasium; and the lower service, requiring only a primary education and largely reserved for soldiers at the end of their military service. Men preparing for the higher service usually took a university law course, with considerable economics, history and political science, were then admitted to a four-year training period of which two years were spent in the courts and two in administration (largely provincial and local), and finally took the state examination under the direction of the *Oberstaatsexaminationkommission,* a body established for this purpose in 1773. This rigorous selection process guaranteed a high level of ability, fostered a professional spirit, and through the process of admission favoured a strongly conservative point of view.

Examination was also relied on to select the technical and middle grades, but the lower grades were largely at the disposition of ex-soldiers. The tradition of executive domination, the late development of political parties and the dominance of conservative groups under the first reich combined to exclude partisanship. The Socialists made some partisan inroads after 1920, and the nazis required active party membership of the whole civil service after 1933. A high degree of protection of civil service rights was secured through the administrative courts. The union movement developed principally after 1920 and was absorbed by the nazi state after 1933.

The German civil service to 1933 was characterized by very high standards of integrity, competence and impartiality. It carried high prestige and was closely supported by active citizen advisory groups in municipalities and rural areas. Its standards suffered heavily under the nazi régime, but its competence remained high.

(*See* Arthur Brand, *Das Beamtenrecht* [1926]; Walter Jellinek, *Verwaltungsrecht* [1928]; Carl J. Friedrich, "The German Civil Service," in Leonard D. White, ed., *Civil Service in the Modern State* [1930]; Walter Dorn, "Prussian Bureaucracy in the Eighteenth Century," in *Political Science Quarterly,* vol. xlvi, p. 403 [Sept. 1931]; vol. xlvii, p. 75 [March, 1932], and p. 259 [June, 1932]; Fritz M. Marx, "Civil Service in Germany," in Leonard D. White and others, *Civil Service Abroad* [1935].)

An International Civil Service.—The elements of an international civil service were found in the Universal Postal union (1870) and in various international administrative agencies created before 1918. The League of Nations and the International Labour office required a staff of experts and subordinate personnel numbering about 600 which took the form of a true international civil service. It drew most heavily from British, French and Swiss sources, but more than 40 states had membership, in response to the requirement that the staff should be recruited "on as wide a geographical basis as possible." There were no formal methods of selection for the higher personnel; the director-general depended on personal acquaintance and trustworthy recommendations. The staff fell into three divisions: the administrative; the supervisory and clerical; and the custodial and manipulative.

The vital problem of an international civil service is whether it can free itself from its national loyalties. The pressure to observe national loyalties is greater in some forms of governmental organization than others, but is absent from none. The league existed during a period of rampant nationalism and irreconcilable conflict, but its experience showed that a broad measure of international loyalty can be achieved, even under unfavourable circumstances. The staff of the league was dispersed after 1939, but that of the I.L.O. was maintained, principally in Canada.

A much larger international civil service is required for the United Nations organization and such affiliated agencies as the United Nations Relief and Rehabilitation administration, the Food and Agriculture administration, the International Bank and Stabilization fund, the proposed educational organization and others. The same problem of conflict between national and international loyalties may well reappear, but in the United Nations charter, each member state stipulates that it undertakes to respect the international character of the duties of the staff and will refrain from influencing them in their work. In the new international bodies, the U.S. and Russia will play an important part and will doubtless supply a substantial quota of the personnel.

Officials and employees of the League of Nations, the I.L.O. and the international agencies established in 1944 and thereafter are paid exclusively from the funds of the organization, are assigned duties by its head, are subject to its discipline and owe it full responsibility. Valuable experience in international co-operation was earned during World War II through the various combined boards and through the Lend-Lease organization.

(*See* Pitman B. Potter, *International Organization* [4th ed., 1935]; Egon Ranshofen-Wertheimer, *The League Secretariat* [1945].)

THE UNITED STATES

The history of the civil service falls into three periods. The high standards of integrity, nonpartisanship and permanence of tenure established by Washington, D.C., on the whole prevailed in the national government until 1829, although the states were less fortunate. The Tenure of Office Act of 1820 put terms to some positions and under Andrew Jackson (1829–37) rotation in office, partisanship and personal favouritism introduced the spoils system on a national scale. The second period of party patronage and spoils endured, under mounting criticism from such men as Thomas A. Jenckes, George William Curtis, Dorman B. Eaton and Carl Schurz, until 1883, the date of enactment of the present national civil service act. Since 1883 there has been a steady extension and refinement of the merit system, but patronage still plays an important role in many states, most counties and some cities.

The character of the U.S. civil service system has been deeply affected by the democratic manners and aspirations of the people. The patronage system was defended because it was believed democratic; on the other hand, a permanent public service smacked of bureaucracy. Jackson spoke against the idea of property in office and the advantages of wide participation in office holding, the duties of which he said were relatively "plain and simple." Everyone, it is still held, should have an opportunity to compete in examinations, hence age limits are high (53 is common in the federal service) or nonexistent; hence objections to educational prerequisites except for scientific and professional posts. The U.S. has no historic tradition such as that which underlies the civil service institutions of Great Britain and the European continent.

In the national government the principal advances since 1883 have been the increasing coverage of the merit system both by legislation and executive order, culminating in the Ramspeck act of 1940; the classification of positions by duties and a systematic pay plan in 1923; a pension act, 1920; the development of progressive personnel practices in the Tennessee Valley authority after 1933; the extension of the merit system by act of congress in 1939 to state services receiving federal grants; further protection against political interference, by the Hatch acts of 1939 and 1940; statutory provision for veterans' preference in 1919 and 1944; and in 1945 a progressive wage and salary act. The centre of interest has shifted from protection against patronage to improved management methods, although the former still remains a principal duty of civil service commissions.

In 1945 the merit system included (1) more than 95% of all permanent federal employees, excluding war workers; (2) all state and county personnel receiving federal funds; (3) the state services generally in about 20 states; (4) county services generally in New York and Massachusetts, frequently in New Jersey and occasionally elsewhere, notably Los Angeles (Calif.) county and Milwaukee (Wis.) county; (5) city services in more than 800 municipalities and in addition the employees of more than 550 council-manager cities most of which have no civil service com-

missions; (6) police and fire departments generally.

The county services are still predominantly partisan. In some states and some larger cities, operating standards are low, the merit system being a form rather than reality. But such cities as New York, Cincinnati, Milwaukee and St. Paul have admirable records. The full adjustment of the U.S. party system to a nonpartisan public service has not yet been made and offers difficult problems.

The merit system also has to be adjusted to preference for veterans, which antedates civil service legislation. From 1920 to 1940, veterans of World War I received from 20% to 25% of federal positions filled by examination. The Veterans' Act of 1944 gave disabled veterans ten points in addition to their earned ratings and a place at the head of each register, five points to all other veterans and various further privileges. With perhaps 15,000,000 veterans of World War II the proportion of veterans' appointments will probably increase. In some states and cities even more impressive benefits are granted; each jurisdiction makes its own rules.

Attorney positions in most jurisdictions are exempt from civil service requirements. In 1939, President Roosevelt appointed a committee to examine the status of these positions and in 1941 he established a board of legal examiners to hold a nation-wide pass examination for most federal attorneys. Opposition in congress suspended the work of this board but not until valuable experience had been gained.

The legal foundation for the national civil service is a considerable body of legislation, a mass of executive orders and commission and departmental rules; in a few states there are constitutional requirements for civil service. State-wide laws govern county and municipal civil services in some cases; in others, cities are left a free hand. In many states there is a considerable body of judicial interpretation, a branch of the law of public officers.

The typical form of organization for the administration of civil service laws is a commission, usually comprising three persons of whom not more than two may belong to the same political party. There is a trend, however, toward either a single personnel director, or a commissioner with two associate commissioners concerned only with rules and hearings. The U.S. civil service commission is by far the largest of its kind, with a peacetime staff of about 3,000. Its principal divisions are concerned with examination, position classification, investigations, retirement records and appeals and review. A large field force is organized in 13 regional offices and many subordinate stations. Every federal department and establishment has, since 1938, a personnel office to deal with its own problems and with the civil service commission. The heads of these offices form the Council of Personnel administration, a body reestablished in 1938 to facilitate exchange of experience and the formulation of policy. Regional personnel councils exist in the principal centres. In the Tennessee Valley authority personnel work is in charge of a director of personnel; in the council-manager cities the same pattern is common. There are no special civil service tribunals in the U.S., but in the federal departments, since 1940, there are appeal boards (including a representative of the civil service commission) to hear appeals on efficiency ratings.

The examination system has developed markedly since 1920. Traditionally examinations were of the essay or problem type, or consisted of a demonstration of skill or strength. From the psychological laboratories came tests of "general intelligence" and aptitude which were progressively adapted to large-scale use. Most written examinations now given by the U.S. civil service commission are of the short-answer type. For nearly ten years they have been scored by an electric scoring machine which has greatly expedited operations and reduced costs. The short-answer form permits the progressive improvement of the reliability and validity of tests and much experimental work has been done inside and outside of government.

Tests for higher positions usually comprise a rating of education and experience and an oral interview, rather than a written paper. Tests for positions requiring skill or strength are usually demonstrations by actual performance. Grades are recorded numerically and although they are not infallible, they represent the most scientific standard yet achieved. Certification is normally made by sending the appointing officer three names from which he must select one; the others are returned to the register for future use. Federal examinations are announced in post offices, newspapers and in case of shortage, by radio and other means. State and municipal examinations are widely publicized.

The classification of positions by duties was initiated in Chicago, Ill., 1910–12, to facilitate equal pay for equal work. The procedure is to develop an accurate, detailed specification of the duties appropriate to each type or class of position, to determine a scale of pay for such positions, and then to allocate each particular job to its proper class. Hundreds of classes of positions will be found necessary in a given jurisdiction. This systematic description and arrangement of positions by duties has been found fundamental to many personnel operations, especially the preparation of examinations, certification, efficiency ratings, promotions, transfers and layoffs. The responsibility for classification is usually vested in the civil service commission, sometimes in a finance office; it is valuable even where there is no examination plan. Classification plans are frequently published and are usually open to inspection if not published. No co-ordination of the classification plans of different jurisdictions has yet been established, one (but only one) of the causes for the inadequate personnel statistics of the U.S.

Promotion is by merit, ascertained frequently by examination in the lower grades, and reaching into such positions as division and bureau chiefs. There is considerable movement from cities and states into the federal system, little in the contrary direction. Important career possibilities exist in all the professional and scientific branches, and in many of the administrative, specialized and clerical services. The foreign service was put on a career basis in 1924. It is independently administered by the state department.

Renewed attention was given during the decade 1930–40 to training young persons for the public service and to further training of those already employed. Following a national conference at the University of Minnesota in 1930 many universities and colleges developed courses in public administration, public finance, psychology and personnel management. The U.S. civil service commission and the New York city civil service commission were especially successful in organizing examinations to take advantage of graduates of these courses. State and municipal governments meanwhile had organized training facilities for their employees on a part-time after-hours basis, especially for police, fire, utility and inspectional personnel. In 1935 the graduate school of the U.S. department of agriculture expanded its work from the scientific field into the social sciences, including management. Many programs were opened up for municipal employees, especially in Los Angeles at the University of Southern California. This movement represented a marked advance in developing a professional interest within the public service.

Less attention has been given in the U.S. civil service to the formal protection of rights of employees, due partly to a patronage background, partly to the characteristically frequent change of occupation by Americans and partly to the influence of the business tradition of freedom to hire and fire, as well as to public concern over the growth of bureaucracy. The federal law prescribes a written notice and opportunity for a reply in case of discharge, but no hearing. In many federal establishments there are administrative provisions for a hearing within the agency; and if an employee can come forward with proof that he was discharged for political or religious reasons, he can appeal to the civil service commission. In some jurisdictions, such as Chicago, Ill., the civil service commission acts as a hearing board. In a few, such as Massachusetts, a discharged employee may secure a full judicial review of the law and the facts; this practice is exceptional.

Unions of public employees were first organized in the post office in the 1890s and were recognized by congress in 1912. Clerical employees formed the National Federation of Federal Employees in 1917, and other groups subsequently. Municipal organizations appeared in the larger cities about 1900; a few

organizations of state employees preceded World War I, but they and county employees remained relatively unorganized despite efforts after 1940 by the American Federation of Labor and the Congress of Industrial Organizations. Fire fighters are nationally organized; police are often forbidden to form unions but may organize local social and benevolent associations. Teachers have formed the National Federation of Teachers.

The purposes of these organizations are to secure legislation extending the merit system, better scales of pay and working conditions, protection against arbitrary action, and such benefits as group insurance, credit facilities and the like. They are free, as a rule, to affiliate with outside labour organizations, but are restrained from taking an active part in politics. In recent years they have sought recognition of a right to collective bargaining, written agreements and the majority union as the sole bargaining agent. Except in the Tennessee Valley authority these claims have not been widely granted.

Strikes of public employees have occurred rarely, the most dramatic exception being the Boston police strike of 1919. Police are now usually forbidden outside affiliation and the right to strike, a right which is rejected by the overwhelming majority of public employee unions.

The Tennessee Valley authority has an exceptional record of progressive personnel policies. It instituted a flexible but effective merit system in 1933 and withstood severe political pressure. It seeks out promising young men and women throughout the country. It has developed its personnel through training courses. It has complete machinery for hearing and adjusting disputes. It recognizes craft and clerical unions, and enters into written agreements with them. It maintains high standards of competence and integrity.

The public services of the states vary extremely in their legal organization and standards of competence. Less than half have formal merit systems, and some of these are indifferently administered. The number of states with merit systems steadily increases, nevertheless, and standards are steadily improving. The older type of bipartisan civil service commission predominates but Minnesota and other states have abandoned the commission in favour of a director of personnel. Functions are chiefly examination, classification and record keeping. Most states now have pension plans for teachers, and an increasing number have state-wide pension plans for all employees, on a contributory basis. In New Jersey and Massachusetts the state commissions carry on work for counties. In California there has been notable co-operation between state, county and municipal civil service commissions. There is no co-ordination between state and local agencies and the U.S. civil service commission.

State civil service agencies have been handicapped in some instances by political opposition, by lack of funds and by inadequate leadership. During the 1930s substantial progress was made, however, both in extending the merit system and in introducing better methods.

Primary and secondary school teachers are subject to minimum standards of training fixed by law. They are required to hold a certificate, usually issued by a state examining agency. Appointments are made by local school boards without competitive or other formal examinations. After a probationary period, teachers acquire a protected tenure. They are a part of the merit system, but not under the jurisdiction of civil service commissions.

In a country which has 96 cities with a population of 100,000 or more, the municipal civil services are of great importance. Until 1900, municipal employees were usually political appointees with low standards of competence and at times of integrity. The muckraking era (1900–05) and the ensuing period of municipal reform wrought a great transformation, supported by the increasingly technical nature of municipal functions. Municipal civil service commissions were widely established before 1910; in 1945 there were more than 800 cities under the merit system. The introduction of the council-manager plan after 1908 gave a great impetus to the further improvement of municipal standards, although city managers have not favoured the independent, bipartisan civil service commission. Political influence in appointments and promotions has not been eliminated in many of the larger cities, but in the middle-sized and small cities it has lost any major significance. One handicap to the professionalization of the municipal services lies in the preference for local residents for appointment—a universal requirement for police, fire, inspectional and clerical services and a usual requirement even in technical and professional posts. The practice of outside appointments has, however, become well-established among city managers, school superintendents, health officers, and city engineers.

Municipal civil service commissions perform the same type of duties as others, and require the same kinds of specialists. Policy is almost entirely in the hands of city authorities; administration is subject, with very few exceptions, to no interference by the state. The gradual extension of municipal ownership and operation of utilities (notably Detroit and New York) brings large numbers of industrial employees into the civil service system, with attendant problems. Sharp differences of opinion developed in 1943 between the city of New York and the Transport Workers union over the effect of civil service status on subway employees.

For the purpose of exchanging experience, improving procedures and publishing reports, civil service commissions and agencies in 1906 formed the Civil Service Assembly of the United States and Canada, with headquarters in Chicago. This body holds an annual convention, furnishes technical advice, carries on research and publishes professional bulletins and the quarterly journal, *Public Personnel Review*.

World War II introduced many changes, especially in the federal service. Employment increased, in round numbers, from 1,000,000 to 3,000,000, plus 500,000 civilian employees stationed abroad. After March 16, 1941, all appointments were "war service," for the duration of the war and six months thereafter. Normal methods of examination and certification were abandoned in favour of speed, but the commission remained the central personnel agency and as far as conditions would permit maintained minimum standards. Transfers were facilitated, in-service training was greatly expanded, and intelligent programs for the best utilization of personnel were introduced. Steps looking toward the return of normal conditions were taken by congress in the veterans' legislation of 1944. States and cities lost personnel and in general were forced to mark time.

Outlying Possessions.—In 1900 the act providing for civil government in Puerto Rico extended the civil service act and rules to it. The concept and procedures were unknown to the population, and the enforcement of high standards remained difficult. The P.R. civil service commission secures some technical aid from time to time from the U.S. commission.

In 1900 the merit system was also introduced in Hawaii. The civil service commission has maintained close contacts with trends on the mainland.

On Sept. 19, 1900, the U.S. Philippine commission introduced the merit system in the Philippine Islands, along the lines of the federal act. There is preference for local residents. With the passage of time the administration of the act has been taken over by native officials.

(*See* Ismar Baruch, *Position Classification in the Public Service* [1941]; "Commission of Inquiry on Public Service Personnel," *Better Government Personnel* [1935]; Oliver Field, *Civil Service Law* [1939]; Carl J. Friedrich and others, *Problems of the American Public Service* [1935]; Sarah Greer, *A Bibliography of Civil Service and Personnel Administration* [1935]; Arthur Macmahon and J. D. Millett, *Federal Administrators* [1939]; Lewis Meriam, *Public Service and Special Training* [1936]; and *Public Personnel Problems from the Standpoint of the Operating Officer* [1938]; William E. Mosher and J. D. Kingsley, *Public Personnel Administration* [2nd ed., 1939]; Leonard D. White and others, *Civil Service in Wartime* [1945]; U.S. Civil Service Commission, *Annual Reports, Good Government* [1881–], *Public Personnel Review* [1939–], *Public Administration Review* [1940–], *Public Management* [1926–].)

(L. D. W.)

CIVITA CASTELLANA (anc. *Falerii*), a town and episcopal see of the province of Viterbo, Italy, 45 mi. by rail N. of Rome. Pop. (1936) 7,289 (town); 8,622 (commune). Mt. Soracte lies about 6 mi. to the southeast.

Falerii was one of the twelve chief cities of Etruria. Wars between Rome and the Falisci (*q.v.*) appear to have been frequent. At the end of the First Punic War, they rebelled, but were soon conquered (241 B.C.) and lost half their territory. The ancient city, built upon a precipitous hill, was destroyed and another built on a more accessible site in the plain. Thus the original city occupied the site of modern Civita Castellana and the Roman town was transferred 3 mi. to the northwest. After this time, Falerii hardly appears in history. There were bishops of Falerii up till 1033, when the desertion of the place in favour of the modern site began, and the last mention of it dates from A.D. 1064. The site of the original Falerii is a plateau, about 1,100 yd. by 400, not higher than the surrounding country (475 ft.) but separated from it by gorges over 200 ft. in depth, and connected with it only on the western side, which was strongly fortified with a mound and ditch. The rest of the city, of which the circuit was about 2,250 yd., was defended by walls constructed of rectangular blocks of tufa. They reached in places a height of 56 ft. and were 7 to 9 ft. thick. There were about 80 towers and 8 gates. Two of the gates and some 50 of the towers have been preserved, as well as the remains of four temples within the city. Almost the only edifice now standing within the walls is the 12th century abbey church of S. Maria.

CIVITAVECCHIA, a seaport town and episcopal see of Italy, province of Rome, 50 mi. N.W. by rail and 35 mi. direct from the city of Rome. Pop. (1936) 24,822 (town), 31,858 (com-

mune). It is the ancient *Centum Cellae,* founded by Trajan. Interesting descriptions of it are given by Pliny the Younger and Rutilius. The modern harbour works rest on the ancient foundations, and near it was the cemetery of detachments of the fleets of Misenum and Ravenna. It was a strong populous place in the 6th century, but the Saracens destroyed it in 812. Leo IV built a new city for the refugees 8 mi. N.N.E. of Civitavecchia, where may be seen ruins of walls and streets and an inscription, that must have stood over a gate, recording its foundation. The people returned to the old town (whence the name Civitavecchia) in 889, but the new one continued as the castle of Cencelle until the 15th century. In 1508 Pope Julius II began the construction of the castle from the designs of Bramante, Michelangelo being responsible for the addition of the central tower. Under it lies a Roman house, possibly the port admiral's quarters. Pius IV added a convict prison. The arsenal was built by Alexander VII and designed by Bernini. Civitavecchia was the chief port of the papal state and has still a considerable trade. There are cement factories in the town, which will be considerably increased by the new electric railway to Orte, by which Terni (*q.v.*) is readily accessible. In 1926 ships to the number of 2,285, a total tonnage of 2,041,637, entered and cleared the port, and 789,921 tons of merchandise were imported (chiefly coal and cereals) and exported (chiefly salt) from the saltworks of Porto Clementino, southwest of Tarquinia. There is a thermal establishment in the town, and 3 mi. N.E. were the *Aquae Tauri,* warm springs; considerable remains of the Roman baths of the time of Trajan are still preserved there. About one mile west of these are hot springs (the *Ficoncella*), also known in Roman times. Five miles down the coast is the summer resort of S. Marinella, which has grown up and forms a part of the commune of Civitavecchia.

CLACKMANNAN, a civil parish, but the county town of Clackmannanshire, Scotland. Pop. (1931) 2,585. It lies near the north bank of the Forth, 2 mi. east of Alloa, with two stations on the L.N.E.R. Clackmannan tower is now a picturesque ruin, but at one time was the seat of a descendant of the Bruce family. The old market cross still exists, and close to it stands the stone that gives the town its name (Gaelic, *clach,* stone; Manann, the name of the district). About 1 mi. to the southeast is Kennet house, the seat of Lord Balfour of Burleigh, another member of the Bruce family. Coal is mined near Clackmannan, which, however, lost its industrial importance to Alloa (*q.v.*).

CLACKMANNANSHIRE, the smallest county in Scotland, bounded southwest by the Forth, west by Stirlingshire, northnortheast and northwest by Perthshire, and east by Fifeshire. Its land area is 34,927 ac., or 54.6 sq.mi. An elevated ridge, starting on the west, runs through the middle of the county, widening gradually till it reaches the eastern boundary, and skirting the alluvial or carse lands in the valleys of the Forth and Devon. Still farther north are the Ochil hills, which reach a height of 2,363 ft., a volcanic range of the Old Red Sandstone period, consisting mainly of basalts and andesites. A fault along their southern base brings down the Carboniferous strata, which occupy the southern part of the county. The rivers of importance are the Devon and the Black or South Devon. The first, noted in the upper parts for its scenery and trout fishing, runs through the county near the base of the Ochils, and falls into the Forth at the village of Cambus, after a winding course of 33 mi., although as the crow flies its source is only $5\frac{1}{4}$ mi. distant. The Black Devon, rising in the Cleish hills, flows westward in a direction nearly parallel to that of the Devon, and falls into the Forth near Clackmannan. It supplies power to mills and collieries; and its whole course is over the Carboniferous strata. The Forth is navigable as far as it forms the boundary of the county. The only lake is Gartmorn, which was dammed in order to furnish water to Alloa and power to mills.

Agriculture and Industries.—The soil is generally productive and well cultivated, though the greater part of the high ground between the carse lands on the Forth and the vale of Devon at the base of the Ochils on the north consists of inferior soils, often lying upon an impervious clay. Oats is the chief crop (2,410 ac. in 1938). The Ochils afford excellent sheep pasture. The average size of the 144 holdings in 1938 was about 102 ac. There is a small tract of moorland in the east, called the Forest, bounded on its northern margin by the Black Devon. Copper, silver, lead and other minerals have been discovered in small quantity in the Ochils, between Alva and Dollar. The Carboniferous strata belong mainly to the coal measures, forming a northern continuation of the Lanarkshire basin and including a number of valuable coal seams. Fire clay, sandstone and igneous rock are also worked. Coal is mined at Sauchie, Coalsnaughton, Devonside, Clackmannan and other pits. The spinning mills at Alloa and Clackmannan are active, Alloa yarns and fingering being famous; and woollen goods are largely manufactured at Alva, Clackmannan and Tillicoultry. Distilleries and breweries have a large export business. Minor trades include glass blowing, coopering, iron founding, shipbuilding and papermaking. Mentsrie near Alloa has a large furniture factory. The L.N.E.R. serves the whole county, while the L.M.S.R. has access to Alloa.

Population and Government.—The population was estimated in 1938 at 33,117. In 1931 Gaelic and English were spoken by 146 persons. The county, with part of Stirling, returns one member to parliament. Clackmannan (1931 pop. 2,585) is the county town, but is not classed as a small burgh, of which there are four—Alloa (est. 1938 pop. 13,436), Alva (3,986), Tillicoultry (3,136) and Dollar (1,428). There are two county districts. Clackmannan forms a sheriffdom with Stirling and Dumbarton shires, and a sheriff-substitute sits at Alloa. There is an exceptionally well-equipped secondary school in Alloa and a well-known academy at Dollar.

CLACTON-ON-SEA, a watering place and urban district in East Essex, England; 71 mi. E.N.E. from London by the L.N.E.R. Pop. (1938) 23,410. Area, 10.6 sq.mi. Clay cliffs of slight altitude rise from the sandy beach and face southeastward. In the neighbourhood, however, marshes fringe the shore. The church of Great Clacton, at the village $1\frac{1}{2}$ mi. inland, is of Norman and later date. It is an important watering place for London.

CLADEL, LÉON (1835–1892), French novelist, was born at Montauban (Tarn-et-Garonne) on March 13, 1835. He made a reputation by his first book, *Les Martyrs ridicules* (1862), a novel for which Charles Baudelaire, whose literary disciple Cladel was, wrote a preface. His best novels are realistic pictures of peasant life in his native district of Quercy. They include: *Le Nommé Qouael* (1868), *Le Bouscassié* (1869), *Les Va-nu-pieds* (1873), a volume of short stories, and *N'a qu'un oeil* (1882). He died at Sèvres on July 20, 1892.

See *La Vie de Léon Cladel* (1905), by his daughter Judith Cladel, containing also an article on Cladel by Edmond Picard.

CLAIRAULT (or CLAIRAUT), **ALEXIS CLAUDE** (1713–1765), French mathematician, was born on May 7 or 13, 1713, at Paris. Under the tuition of his father, a teacher of mathematics, he made such progress that at twelve years of age he read before the French academy an account of the properties of four curves which he had discovered. His *Recherches sur les courbes à double courbure,* finished in 1729 and published 1731, procured his admission into the Academy of Sciences, although he was still below the legal age. In 1736, with P. L. Maupertuis, he went on the expedition to Lapland, for the purpose of estimating a degree of the meridian; and in 1743 he published his treatise *Théorie de la figure de la terre,* in which he promulgated the theorem known as "Clairault's theorem," which connects the gravity at points on the surface of a rotating ellipsoid with the compression and the centrifugal force at the equator. In 1750 he gained the prize of the St. Petersburg academy for his essay *Théorie de la lune;* and in 1759 he calculated the perihelion of Halley's comet. He also detected singular solutions in differential equations of the first order, and of the second and higher degrees. Clairault died at Paris on May 17, 1765.

CLAIRON, LA (1723–1803), French actress, whose real name was CLAIRE LERIS, was born at Condé sur l'Escaut, Hainaut, on Jan. 25, 1723, the natural daughter of an army sergeant. In 1736 she made her first stage appearance at the Comédie Italienne, in a small part in Marivaux's *Ile des esclaves.* After several years in the provinces she returned to Paris. Her life, meanwhile,

had been decidedly irregular, even if not to the degree indicated by the libellous pamphlet *Histoire de la demoiselle Cronel, dite Frétillon, actrice de la Comédie de Rouen, écrite par elle-même* (The Hague, 1746), or to be inferred from the disingenuousness of her own *Mémoires d'Hippolyte Clairon* (1798); and she had great difficulty in obtaining an order to make her début at the Comédie Française for which she had the courage to select the title-rôle of *Phèdre* (1743). During her 22 years at this theatre, dividing the honours with her rival Mlle. Dumesnil, she filled many of the classical rôles of tragedy, and created a great number of parts in the plays of Voltaire, Marmontel, Saurin, de Belloy and others. She retired in 1766 and trained pupils for the stage, among them Mlle. Raucourt. Goldsmith called Mlle. Clairon, "the most perfect female figure I have ever seen on any stage" (*The Bee,* 2nd No.); and Garrick, while recognizing her unwillingness or inability to make use of the inspiration of the instant, admitted that "she has everything that art and a good understanding with great natural spirit can give her."

CLAIRTON, a city of Allegheny county, Pennsylvania, U.S.A., on the Monongahela river, 20 mi. S.E. of Pittsburgh; served by the Pennsylvania, the Pittsburgh and West Virginia, the Baltimore and Ohio, the Bessemer and Lake Erie and the Union railways. It was formed in 1922 by the consolidation of the boroughs of Clairton, North Clairton and Wilson, which in 1920 had a combined population of 10,777. The city's population in 1930 was 15,291 and in 1940 was 16,381 by the federal census. Clairton has important manufactures of structural iron, steel, boiler tubes, river boats and barges and an immense by-product coke plant.

CLAIRVAUX, a village of N.E. France, in the department of Aube, 40 mi. E.S.E. of Troyes. Clairvaux (*Clara Vallis*) is situated in the valley of the Aube on the eastern border of the forest of Clairvaux. Its abbey, founded in 1115 by St. Bernard, became the centre of the Cistercian order. The buildings (*see* ABBEY) belong for the most part to the 18th century, but there is a large storehouse which dates from the 12th century.

CLAIRVOYANCE, a word used with several different meanings in spiritualism and psychical research. Sometimes it is used to denote transcendental vision of beings on another plane of existence, while F. W. H. Myers, in the glossary to his *Human Personality,* defines it as "the faculty or act of perceiving as though visually, with some coincidental truth, some distant scene." It is now, however, often used as a term complementary to and exclusive of telepathy (*q.v.*), to denote all forms of supernormal cognition where the percipient's knowledge is not derived from another mind, whether or not the knowledge is communicated as a visual impression. It is in this last sense that the word is used in the article on PSYCHICAL RESEARCH (*q. v.*).

CLAM, the name applied to many bivalve molluscs (*see* LAMELLIBRANCHIA) from the vice-like firmness with which the shell closes. In Scotland the name is usually applied to the scallop (*q.v.*), in England to species of *Mya* and *Mactra* especially the gaper, *Mya truncata.* In the United States the name has a wider use, but most commonly denotes *Venus mercenaria,* the quahog or hard clam, and *Mya arenaria,* the soft clam, both of which are of great importance as food, besides being extensively used by fishermen as bait. The hard clam is allied to the cockle (*q.v.*) and has a heavy shell which was used as shell-money (*see* WAMPUM) by the Indians. It is found in one to six fathoms of water off the Atlantic coast of North America from Florida to Cape Cod and also off New Brunswick. It is obtained by raking the bottom. Young specimens, known as "little necks," are sold in large numbers in New York. The soft clam is found mainly between the tide-marks and has a thin shell and long siphons. "Clam bakes," where clams are placed on heated stones with potatoes and other food, the whole being covered with sea-weed and left to cook, make a popular picnic in America. Atlantic clams have been transplanted to the Pacific coast of North America with great success, though there are several indigenous species there which are also known by this name. It is an interesting point that while both *Mya* and *Mytilus* (the sea mussel, *q.v.*) occur on both sides of the Atlantic, the former is not eaten in Europe, the latter not in America; furthermore, in the prehistoric "kitchen-middens," remains of *Mytilus* are found in Europe and of *Mya* in America, but not vice versa. The American "fresh-water clams" are fresh-water mussels (*Unionidae*). The giant among the North American clams is the gweduc or geoduck (pronounced guey-duck), *Panomya generosa,* whose shell attains a length of almost seven in. and whose siphons may be extended to almost five times that measure; it is confined to the coast from northern California to British Columbia. Its flesh is greatly esteemed.

Of other species to which the name clam is applied, the most noteworthy are the bear's paw clam (*Hippopus maculatus*) of the Indian ocean, with a beautiful ridged white shell, marked with spots of purplish-red; and the giant clam (*Tridacna gigas*) of the East Indies, the largest of all lamellibranchs; the actual animal may weigh 20 lb. and the shell nearly $\frac{1}{4}$ of a ton.

CLAMECY, a town of central France, capital of an arrondissement in the department of Nièvre, at the confluence of the Yonne and Beuvron and on the Canal du Nivernais, 36 mi. N.N.E. of Nevers. Pop. (1936) 5,537. In the early middle ages Clamecy belonged to the abbey of St. Julian at Auxerre; in the 11th century it passed to the counts of Nevers. After the capture of Jerusalem by Saladin in 1188, Clamecy became the seat of the bishops of Bethlehem, who till the Revolution resided in the hospital of Panthenor, bequeathed by William IV., count of Nevers. The town figured in the *coup d'état* of 1851.

The church of St. Martin, dates chiefly from the 13th, 14th and 15th centuries. The town has fulling and flour mills, with a small leather and chemical trade. Wine and cattle, and timber are important.

CLAN, a social group of fundamental importance in the social structure of many primitive societies. The most important character of the clan is its exogamy—*i.e.,* marriage within the clan is forbidden, and regarded as incest (*see* EXOGAMY). This tabu applies even to persons between whom no genealogical relationship can be traced. Although for scientific purposes the clan is defined as an exogamous group, the term is frequently used in popular literature for groups that are not exogamous, such as the tribe; and that rather vague entity, the Scottish clan, though sharing some of the characters of the clan, is not an exogamous group, whatever it may once have been. Partly for these reasons, American writers use the term "sib" instead of "clan." The clan is a unilateral group; that is to say, membership of the clan is determined, either by descent through the mother ("matrilineal clan," "mother-sib," or "clan," as it has been variously named) or by descent through the father ("patrilineal clan," "father-sib," or "gens"). This does not mean, however, that descent from some original ancestor can be traced, though belief in such descent is usually present. The clan, therefore, has only a slight resemblance to the family (*q.v.*) which necessarily contains members of more than one clan, though it is possible that the clan has evolved from the family by emphasis of one line of descent.

Although the clan is not a kinship-group—for kinship implies not only relationship by direct descent, but the ability to trace it genealogically—nevertheless, it is common for members of a clan to address one another by means of relationship-terms used between close kin, and this carries with it the same sort of social relations as we find between close kin, though in less degree. This is a natural result of the classificatory system of relationships which is frequently associated with it, but even in the absence of this system it is common for distant members of a clan to claim brotherhood with one another, and to feel that kind of solidarity found in the case of the family. This solidarity is a most striking character of the clan. The individual identifies himself with his clan in a peculiarly intimate way, so that clan-responsibility for the action of individual members is common. This unity of the clan frequently extends into the political and economic sphere.

The unity of the clan is frequently emphasized by the possession of a totem (*see* TOTEMISM). Where clans are much interspersed and widely diffused, clan-identity may thus be established and maintained, which even the classificatory system of relationships need not reveal. It is doubtful whether habitation

of a common territory is ever the common tie uniting members of a clan, but localized clans do sometimes occur, though it is probable that in such cases the localization is secondary, and the common tie is belief in common descent.

Not uncommon is a grouping of clans into wider units, the simplest form of this being a dual organization (*q.v.*) in which the clans are grouped into two exogamous divisions. It is also not uncommon for there to be a division of function between the clans of a tribe, occasionally economic, *e.g.*, in India, but more usually political or religious, *e.g.*, in some African kingdoms.

BIBLIOGRAPHY.—The clan is defined and discussed in general books on Sociology, such as W. H. R. Rivers, *Social Organization* (1924), R. H. Lowie, *Primitive Society* (1921), and E. Westermarck, *History of Human Marriage*, vol. ii. (1921). (W. E. A.)

CLANRICARDE, EARL OF, Irish title, held since 1916 by the marquess of Sligo. In 1543, Ulick (d. 1544) (*q.v.*), chief of the "MacWilliam Eighter" branch of the De Burgh family (*q.v.*), surrendered his territory lying in the neighbourhood of Galway to Henry VIII, receiving it back to hold, by English custom, as earl of Clanricarde and Lord Dunkellin. Richard, the 4th earl (1601–35), who fought on the English side in O'Neill's rebellion, obtained the English earldom of St. Albans in 1628, his son, Ulick (*q.v.*), receiving the Irish marquessate of Clanricarde in 1646; but at the death of the latter, without heirs, the English honours and the marquessate expired, and the Irish earldom went to his cousin, Richard, 6th earl (1657–66). The 9th earl, John, forfeited his estates for his support of James II but they were restored to him in 1702, and his great-grandson, the 12th earl, was created marquess in 1789. He left no son, but the marquessate was again revived in 1825 for Ulick, 14th earl, who was lord privy seal and was created Baron Somerhill, in the United Kingdom, in 1826. On the death of Hubert George, 2nd marquess (1832–1916), Ulick's son, all his honours became extinct, except the earldom of Clanricarde (*c.* 1800), which passed to his kinsman, the marquess of Sligo.

CLANRICARDE, ULICK DE BURGH (BOURKE or BURKE), 1st EARL OF (d. 1544), styled MacWilliam and Ne-gan or Na-gCeann (*i.e.*, "of the Heads," "having made a mount of the heads of men slain in battle which he covered up with earth"), was the son of Richard or Rickard de Burgh, lord of Clanricarde, by a daughter of Madden of Portumna, and grandson of Ulick de Burgh, lord of Clanricarde (1467–87), the collateral heir male of the earls of Ulster. Ulick de Burgh succeeded to the headship of his clan, exercised a quasi-royal authority and held vast estates in county Galway, in Connaught, including Loughry, Dunkellin, Kiltartan (Hilltaraght) and Athenry, as well as Clare and Leitrim. In March 1541, he wrote to Henry VIII, placing himself and his estates in the king's hands. The same year he was present at Dublin, when the act was passed making Henry VIII king of Ireland. In 1543, in company with other Irish chiefs, he visited the king at Greenwich, made full submission, undertook to introduce English manners and abandon Irish names, received a regrant of the greater part of his estates with the addition of other lands, was confirmed in the captainship and rule of Clanricarde and was created on July 1, 1543, earl of Clanricarde and baron of Dunkellin in the peerage of Ireland, with unusual ceremony. "The making of MacWilliam earl of Clanricarde made all the country during his time quiet and obedient," states Lord Chancellor Cusake in his review of the state of Ireland in 1553. He did not live long, however, to enjoy his new English dignities but died shortly after returning to Ireland about March 1544.

See R. Bagwell, *Ireland under the Tudors*, vol. i.; Gairdner's *Letters and Papers of Henry VIII.*

CLANRICARDE, ULICK DE BURGH (BOURKE or BURKE), MARQUESS OF (1604–1657 or 1658), son of Richard, 4th earl of Clanricarde, created in 1628 earl of St. Albans, and of Frances, daughter and heir of Sir Francis Walsingham, and widow of Sir Philip Sidney and of Robert Devereux, earl of Essex, was born in 1604. He was summoned to the House of Lords as Lord Burgh in 1628 and succeeded his father as 5th earl in 1635. He sat in the Short Parliament of 1640 and attended Charles I in the Scottish expedition. On the outbreak of the Irish rebellion Clanricarde had powerful inducements for joining the Irish—the ancient greatness and independence of his family, his devotion to the Roman Catholic Church, and strongest of all, the ungrateful treatment meted out by Charles I and Wentworth to his father, one of Elizabeth's most staunch adherents in Ireland, whose lands were appropriated by the crown and whose death, it was popularly asserted, was hastened by the harshness of the lord-lieutenant. Nevertheless at the crisis his loyalty never wavered. Alone of the Irish Roman Catholic nobility to declare for the king, he returned to Ireland, took up his residence at Portumna, kept Galway, of which he was governor, neutral, and took measures for the defense of the county and for the relief of the Protestants, making "his house and towns a refuge, nay, even a hospital for the distressed English." In 1643 he was one of the commissioners appointed by the king to confer with the Irish confederates and urged the wisdom of a cessation of hostilities in a document which he publicly distributed. He was appointed commander of the English forces in Connaught in 1644 and in 1646 was created a marquess and a privy councillor. He supported the same year the treaty between Charles I and the confederates, and endeavoured after its failure to persuade Preston, the general of the Irish, to agree to a peace; but the latter, being advised by Rinuccini, the papal nuncio, refused in December. Together with Ormonde, Clanricarde opposed the nuncio's policy; and the royalist inhabitants of Galway, having through the latter's influence rejected the cessation of hostilities arranged with Lord Inchiquin in 1648, he besieged the town and compelled its acquiescence. In 1649 he reduced Sligo. On Ormonde's departure in Dec. 1650 Clanricarde was appointed deputy lord-lieutenant, but he was not trusted by the Roman Catholics and was unable to stem the tide of the parliamentary successes. In 1651 he opposed the offer of Charles, duke of Lorraine, to supply money and aid on condition of being acknowledged "Protector" of the kingdom. In May 1652 Galway surrendered to the parliament, and in June Clanricarde signed articles with the parliamentary commissioners which allowed his departure from Ireland. In August he was excepted from pardon for life and estate, but by permits, renewed from time to time by the council, he was enabled to remain in England for the rest of his life, and in 1653 £500 a year was settled upon him by the Council of State in consideration of the protection which he had given to the Protestants in Ireland at the time of the rebellion. He died at Somerhill in Kent in 1657 or 1658 and was buried at Tunbridge.

The "great earl," as he was called, supported Ormonde in his desire to unite the English royalists with the more moderate Roman Catholics on the basis of religious toleration under the authority of the sovereign, against the papal scheme advocated by Rinuccini, and in opposition to the parliamentary and Puritan policy. There is no reason to doubt Clarendon's opinion of him as "a person of unquestionable fidelity . . . and of the most eminent constancy to the Roman Catholic religion of any man in the three kingdoms," or the verdict of Hallam, who describes him "as perhaps the most unsullied character in the annals of Ireland." (*See* also CLANRICARDE, EARL OF.)

BIBLIOGRAPHY.—See *Memoirs of the Marquis of Clanricarde* (1722, repr. 1744); *Memoirs of Ulick, Marquis of Clanricarde*, by John, 11th earl (1757); *Life of Ormonde*, by T. Carte (1851); S. R. Gardiner's *Hist. of the Civil War and of the Commonwealth; Cal. of State Papers, Irish*, esp. *Introd.* 1633–47 and *Domestic; Hist.* MSS. *Comm.*, MSS. *of Marq. of Ormonde* and *Earl of Egmont*. (P. C. Y.)

CLANVOWE, SIR THOMAS, English 14th century poet, author of *The Cuckoo and the Nightingale*, long attributed to Chaucer. Little is known of Clanvowe, whose name is last mentioned in 1404. He figured at the courts of Richard II and Henry IV, and was one of the 20 knights who accompanied John Beaufort to Barbary in 1390. His name was discovered on the best of the mss. by Professor Skeat in editing *The Book of Cupid, God of Love, or the Cuckoo and the Nightingale.*

The historic and literary importance of *The Cuckoo and the Nightingale* is great. It is the work of a poet who had studied the prosody of Chaucer with more intelligent care than either Occleve or Lydgate, and who therefore forms an important link between the 14th and 15th centuries in English poetry. Clanvowe writes

with a surprising delicacy and sweetness, in a five-line measure almost peculiar to himself. Professor Skeat points out a unique characteristic of Clanvowe's versification, namely, the unprecedented freedom with which he employs the suffix of the final *-e,* and rather avoids than seeks elision. *The Cuckoo and the Nightingale* was imitated by Milton in his sonnet to the nightingale, and was rewritten in modern English by Wordsworth.

See also a critical edition of the *Boke of Cupide* by Dr. Erich Vollmer (Berlin, 1898).

CLAPARÈDE, JEAN LOUIS RENÉ ANTOINE ÉDOUARD (1832–1870), Swiss naturalist, was born at Geneva on April 24, 1832. He belonged to a French family, some members of which had taken refuge in that city after the revocation of the Edict of Nantes. In 1852 he began to study medicine and natural science at Berlin, where he was greatly influenced by J. Müller, who was then working on the Echinoderms. The latter part of his stay at Berlin he devoted, along with J. Lachmann, to the study of the Infusoria and Rhizopods. In 1862 he was chosen professor of comparative anatomy at Geneva. He died at Siena on May 31, 1870. His *Recherches sur la structure des annélides sédentaires* was published posthumously in 1873.

CLAPPERTON, HUGH (1788–1827), Scottish traveller in central Africa, was born at Annan, Dumfriesshire, and after some years in the merchant service was impressed into the navy. In 1817 he returned home with the grade of lieutenant, and in 1820 accompanied Oudney and Denham in the Government expedition to Bornu. From Bornu they set out to explore the Niger country. After Oudney's death at Murmur (Jan. 1824) Clapperton proceeded along to Kano and Sokoto, returning by way of Zatia and Katsena to Kuka, where he met Denham. An account of the travels was published in 1826 under the title of *Narrative of Travels and Discoveries in Northern and Central Africa in the years* 1822–1824.

Immediately after his return Clapperton was raised to the rank of commander, and sent out with another expedition to Africa. He landed at Badagry in the Bight of Benin, and started overland for the Niger on Dec. 7, 1825, having with him his servant Richard Lander (*q.v.*), Captain Pearce, R.N., and Dr. Morrison, navy surgeon and naturalist. Before the month was out Pearce and Morrison were dead of fever. Clapperton continued his journey, and, passing through the Yoruba country, in Jan. 1826 he crossed the Niger at Bussa, where Mungo Park had died 20 years before. In July he arrived at Kano. Thence he went to Sokoto, intending afterwards to go to Bornu. The sultan, however, detained him, and he died of dysentery near Sokoto on April 13, 1827. Clapperton was the first European to make known from personal observation the semi-civilized Hausa countries, which he visited soon after the establishment of the Sokoto empire by the Fula.

In 1829 appeared the *Journal of a Second Expedition into the Interior of Africa,* etc., by the late Commander Clapperton, with a biographical sketch of the explorer by Lieut.-Col. S. Clapperton. Lander, who had brought back the journal of his master, also published *Records of Captain Clapperton's Last Expedition to Africa . . . with the subsequent Adventures of the Author* (2 vols. 1830).

CLAQUE, an organized body of professional applauders in the French theatres (Fr. *claquer,* to clap the hands). The hiring of persons to applaud dramatic performances was common in classical times, and the emperor Nero, when he acted, had his performance greeted by a chorus of 5,000 soldiers. Jean Daurat, the 16th century French poet, bought up a number of tickets for a performance of one of his plays and distributed them gratuitously to those who promised publicly to express their approbation. In 1820 an office was opened in Paris for the supply of *claquers,* and any number of them could be ordered in a way similar to the ordering of "extras" for a motion picture production of the present day. These people were usually under a *chef de claque,* whose duty it was to judge where their efforts were needed and to start the applause. The *commissaires* were scattered among the audience and called the attention of their neighbours to the good points of the play. The *rieurs* were those who laughed loudly at the jokes. The *pleureurs,* generally women, feigned tears, by holding their handkerchiefs to their eyes. The *chatouilleurs* kept the audience in a good humour, while the *bisseurs* simply clapped their hands and cried *bis! bis!* to secure encores.

CLARA, SAINT (1194–1253), foundress of the Franciscan nuns, was born of a knightly family in Assisi in 1194. At eighteen she was so impressed by a sermon of St. Francis that she was filled with the desire to devote herself to the kind of life he was leading. She obtained an interview with him, and to test her resolution he told her to dress in penitential sackcloth and beg alms for the poor in the streets of Assisi. Clara readily did this, and Francis, satisfied as to her vocation, told her to come to the Portiuncula arrayed as a bride. The friars met her with lighted candles, and at the foot of the altar Francis shore off her hair, received her vows of poverty, chastity and obedience, and invested her with the Franciscan habit, 1212. He placed her for a couple of years in a Benedictine convent in Assisi until the convent at St. Damian's, close to the town, was ready. Her two younger sisters, and, after her father's death, her mother and many others joined her, and the Franciscan nuns spread widely and rapidly (*see* CLARES, POOR). The relations of friendship and sympathy between St. Clara and St. Francis were very close, and there can be no doubt that she was one of the truest heirs of Francis's inmost spirit. After his death Clara threw herself wholly on the side of those who opposed mitigations in the rule and manner of life, and she was one of the chief upholders of St. Francis's primitive idea of poverty (*see* FRANCISCANS). She was the close friend of Brother Leo and the other "Companions of St. Francis," and they assisted at her death. For 40 years she was abbess at St. Damian's, and the great endeavour of her life was that the rule of the nuns should be purged of the foreign elements that had been introduced, and should become wholly conformable to St. Francis's spirit. She lived just long enough to witness the fulfilment of her great wish, a rule such as she desired being approved by the pope two days before her death on Aug. 11, 1253.

The sources for her life are to be found in the Bollandist *Acta Sanctorum* on Aug. 11, and sketches in such *Lives of the Saints* as Alban Butler's. *See* also Wetzer und Welte, *Kirchenlexicon* (2nd ed.), art. "Clara." (E. C. B.)

CLARE, the name of a famous English family. The ancestor of this historic house, "which played," in Freeman's words, "so great a part alike in England, Wales and Ireland," was Count Godfrey, eldest of the illegitimate sons of Richard the Fearless, duke of Normandy. His son, Count Gilbert of Brionne, had two sons, Richard, lord of Bienfaite and Orbec, and Baldwin, lord of Le Sap and Meulles, both of whom accompanied William the Conqueror to England. Baldwin, known as "De Meulles" or "of Exeter," received the hereditary shrievalty of Devon with great estates in the West Country, and left three sons, William, Robert and Richard, of whom the first and last were in turn sheriffs of Devon. Richard, known as "de Bienfaite," or "of Tunbridge," or "of Clare," was the founder of the house of Clare.

Richard derived his English appellation from his strongholds at Tunbridge and at Clare, at both of which his castle-mounds still remain. The latter, on the borders of Essex and Suffolk, was the head of his great "honour" which lay chiefly in the eastern counties. Appointed joint justiciar in the king's absence abroad, he took a leading part in suppressing the revolt of 1075. By his wife, Rohese, daughter of Walter Giffard, through whom great Giffard estates afterwards came to his house, he left five sons and two daughters. Roger was his heir in Normandy, Walter founded Tintern Abbey, Richard was a monk, and Robert, receiving the forfeited fief of the Baynards in the eastern counties, founded, through his son Walter, the house of FitzWalter (extinct 1432), of whom the most famous was Robert FitzWalter, the leader of the barons against King John. Of this house, spoken of by Jordan Fantosme as "Clarreaus," the Daventrys of Daventry (extinct 1380) and Fawsleys of Fawsley (extinct 1392) were cadets. One of Richard's two daughters married the famous Walter Tirel.

Gilbert, Richard's heir in England, held his castle of Tunbridge against William Rufus, but was wounded and captured. Under Henry I., who favoured the Clares, he obtained a grant of Cardi-

gan and carried his arms into Wales. Dying about 1115, he left four sons, of whom Gilbert, the second, inherited Chepstow, with Nether-Gwent, from his uncle, Walter, the founder of Tintern, and was created earl of Pembroke by Stephen about 1138; he was father of Richard Strongbow, earl of Pembroke (*q.v.*). The youngest son Baldwin fought for Stephen at the battle of Lincoln (1141) and founded the priories of Bourne and Deeping on lands acquired with his wife. The eldest son Richard, who was slain by the Welsh on his way to Cardigan in 1135 or 1136, left two sons, Gilbert and Roger, of whom Gilbert was created earl of Hertfordshire by Stephen.

It was probably because he and the Clares had no interests in Hertfordshire that they were loosely and usually styled the earls of (de) Clare. Dying in 1152, Gilbert was succeeded by his brother Roger, of whom Fitz-Stephen observes that "nearly all the nobles of England were related to the earl of Clare, whose sister, the most beautiful woman in England, had long been desired by the king" (Henry II.). He was constantly fighting the Welsh for his family possessions in Wales and quarrelled with Becket over Tunbridge castle. In 1173 or 1174 he was succeeded by his son Richard as third earl, whose marriage with Amicia, daughter and co-heir of William, earl of Gloucester, was destined to raise the fortunes of his house to their highest point. He and his son Gilbert were among the "barons of the Charter." Gilbert, who became fourth earl in 1217, obtained also, early in 1218, the earldom of Gloucester, with its great territorial "Honour," and the lordship of Glamorgan, in right of his mother; "from this time the house of Clare became the acknowledged head of the baronage." Gilbert had also inherited through his father his grandmother's "Honour of St. Hilary" and a moiety of the Giffard fief; but the vast possessions of his house were still further swollen by his marriage with a daughter of William (Marshal), earl of Pembroke, through whom his son Richard succeeded in 1245 to a fifth of the Marshall lands including the Kilkenny estates in Ireland. Richard's successor, Gilbert, the "Red" earl, died in 1295, the most powerful subject in the kingdom.

On his death his earldoms seem to have been somewhat mysteriously deemed to have passed to his widow Joan, daughter of Edward I.; for her second husband, Ralph de Monthermer, was summoned to parliament in right of them from 1299 to 1306. After her death, however, in 1307, Earl Gilbert's son and namesake was summoned in 1308 as earl of Gloucester and Hertford, though only sixteen. A nephew of Edward II. and brother-in-law of Gaveston, he played a somewhat wavering part in the struggle between the king and the barons. Guardian of the realm in 1311 and regent in 1313, he fell at Bannockburn.

The earl was the last of his mighty line, and his vast possessions in England (in over 20 counties), Wales and Ireland fell to his three sisters, of whom Elizabeth, the youngest, wife of John de Burgh, obtained the "Honour of Clare" and transmitted it to her son William de Burgh, 3rd earl of Ulster, whose daughter brought it to Lionel, son of King Edward III., who was thereupon created Duke of Clarence, a title associated ever since with the royal house. The "Honour of Clare," vested in the crown, still preserves a separate existence, with a court and steward of its own.

Clare College, Cambridge, derived its name from the above Elizabeth, "Lady of Clare," who founded it as Clare Hall in 1347.

Clare County in Ireland derived its name from the family, though whether from Richard Strongbow, or from Thomas de Clare, a younger son, who had a grant of Thomond in 1276, has been deemed doubtful.

Clarenceux King of Arms, an officer of the Heralds' college, derives his style, through Clarence, from Clare.

See J. H. Round's *Geoffrey de Mandeville, Feudal England, Commune of London,* and *Peerage Studies;* also his "Family of Clare" in *Arch. Journ.* lvi., and "Origin of Armorial Bearings" in *Ib.* li.; Parkinson's "Clarence, the origin and bearers of the title," in *The Antiquary,* v.; Clark's "Lords of Glamorgan" in *Arch. Journ.* xxxv.; Planche's "Earls of Gloucester" in *Journ. Arch. Assoc.* xxvi.; Dugdale's *Baronage,* vol. i., and *Monasticon Anglicanum;* G. E. C(okayne)'s *Complete Peerage.* (J. H. R.)

CLARE, JOHN (1793–1864), English poet, known as "the Northamptonshire Peasant Poet," was born at Helpstone, near Peterborough. He was the son of a farm-labourer, and when he was 12 or 13 began to work on a farm himself, attending a school in the evenings. At 16 he fell deeply in love with Mary Joyce, the daughter of a prosperous farmer, who forbade her to meet her lover. Clare never forgot this first love, and in his periods of insanity, long after Mary's death, he used to hold conversations with her, under the delusion that she still lived and was his wife. He tried his hand at many trades, was gardener at Burghley park, enlisted in the militia, and in 1817 worked as a lime-burner; from his last place he was discharged for spending his working hours in distributing copies of a prospectus of a book of his poems, and he was obliged to accept parish relief. The prospectus failed to attract subscribers, but luckily in 1817 a bookseller at Stamford, named Drury, noticed one of Clare's poems, "The Setting Sun," by chance, and befriended the author, introducing him to John Taylor, the publisher of Keats and Shelley. Taylor published Clare's *Poems Descriptive of Rural Life and Scenery* (1820), which attracted great attention, and his *Village Minstrel and other Poems* (1821). The poet was now comparatively prosperous with an annuity of £45. obtained by the patronage of Lord Exeter and other subscribers; but in 1820 he had married Patty Turner, and a growing family made his income inadequate. *The Shepherd's Calendar* (1827) met with little success, and Clare started farm labour again. Worry and overwork made him seriously ill. Earl Fitzwilliam gave him a new cottage and a piece of ground in 1832 but Clare could not settle down; gradually his mind gave way. He was still writing verse, but his last work, the *Rural Muse* (1835), was noticed by "Christopher North" alone. For some time he had shown signs of insanity; and in 1837, in spite of the efforts of his wife to prevent outside interference, he was removed to a private asylum. He seemed happy there, but after a time decided to go home, and set out to walk all the way. Then he was taken to the Northampton general lunatic asylum, where he remained, amusing himself by writing poetry, until his death.

BIBLIOGRAPHY.—The Oxford ed. of his *Poems* (1920), was ed. by Edmund Blunden and Alan Porter; his *Madrigals and Chronicles* by Edmund Blunden (1924). Both these eds. contain biographical introductions. *See* also F. Martin *The Life of John Clare* (1865); and J. L. Cherry *Life and Remains of John Clare* (1873).

CLARE, JOHN FITZGIBBON, 1ST EARL OF (1749–1802), lord chancellor of Ireland, the second son of John Fitzgibbon, was educated at Trinity college, Dublin, where he was highly distinguished as a classical scholar, and at Christ Church, Oxford, where he graduated in 1770. In 1772 he was called to the Irish bar. In 1778 he entered the Irish House of Commons as member for Dublin university, and at first gave a general support to the popular party led by Henry Grattan (*q.v.*). He was, however, from the first hostile to that part of Grattan's policy which aimed at removing the disabilities of the Roman Catholics; he endeavoured to impede the Relief bill of 1778 by raising difficulties about its effect on the Act of Settlement. As early as 1780 Fitzgibbon began to separate himself from the popular or national party by opposing Grattan's declaration of the Irish parliament's right to independence. His hostility to the Catholic claims, and his distrust of parliamentary reform as likely to endanger the connection of Ireland with Great Britain, made him a sincere opponent of the purposes which Grattan had in view. Grattan supported the appointment of Fitzgibbon as attorney-general in 1783, and in 1785 the latter highly eulogized Grattan's character and services to the country in a speech in which he condemned Flood's volunteer movement. He also opposed Flood's Reform bill of 1784; and from this time forward he was in fact the leading spirit in the Irish Government, and the stiffest opponent of all concession to popular demands. In 1784 the permanent committee of revolutionary reformers in Dublin, of whom Napper Tandy was the most conspicuous, invited the sheriffs of counties to call meetings for the election of delegates to attend a convention for the discussion of reform; and when the sheriff of the county of Dublin summoned a meeting for this purpose Fitzgibbon procured his imprisonment for contempt of court, and justified this procedure in parliament, though Lord Erskine declared it grossly illegal. In the course of the debates on Pitt's

commercial propositions in 1785, which Fitzgibbon supported in masterly speeches, he referred to Curran in terms which led to a duel between the two lawyers, when Fitzgibbon was accused of a deliberation in aiming at his opponent that was contrary to etiquette. His antagonism to Curran was life-long and bitter, and after he became chancellor his hostility to the famous advocate was said to have driven the latter out of practice. In Jan. 1787 Fitzgibbon introduced a stringent bill for repressing the Whiteboy outrages. His influence with the majority in the Irish parliament defeated Pitt's proposed reform of the tithe system in Ireland, Fitzgibbon refusing even to grant a committee to investigate the subject. On the regency question in 1789 Fitzgibbon, in opposition to Grattan, supported the doctrine of Pitt in a series of powerful speeches which proved him a great constitutional lawyer; he intimated that the choice for Ireland might in certain eventualities rest between complete separation from England and legislative union; and, while he exclaimed as to the latter alternative, "God forbid that I should ever see that day!" he admitted that separation would be the worse evil of the two.

In the same year Lord Lifford resigned the chancellorship, and Fitzgibbon was appointed in his place, being raised to the peerage as Baron Fitzgibbon. His removal to the House of Lords greatly increased his power. "He was," says Lecky, "by far the ablest Irishman who had adopted without restriction the doctrine that the Irish legislature must be maintained in a condition of permanent and unvarying subjection to the English executive." But the English ministry were now embarking on a policy of conciliation in Ireland. The Catholic Relief bill of 1793 was forced on the Irish executive by the cabinet in London, but it passed rapidly and easily through the Irish parliament. Fitzgibbon was opposed to the appointment of Lord Fitzwilliam (*q.v.*) as viceroy in 1795, and was probably the chief influence in procuring his recall; and it was Fitzgibbon who first put it into the head of George III. that the king would violate his coronation oath if he consented to the admission of Catholics to parliament. When Lord Camden, Fitzwilliam's successor in the viceroyalty, arrived in Dublin on March 31, 1795, Fitzgibbon's carriage was violently assaulted by the mob, and he himself was wounded; and in the riots that ensued his house was also attacked. In June 1795 he was created earl of Clare. On the eve of the rebellion he warned the Government to take stringent measures to prevent an outbreak; but he was neither cruel nor immoderate and was inclined to mercy in dealing with individuals. He attempted to save Lord Edward Fitzgerald (*q.v.*) from his fate by giving a friendly warning to his friend, and promising to facilitate his escape from the country. After the rebellion he threw his great influence on the side of clemency.

In Oct. 1798 Lord Clare, who since 1793 had been convinced of the necessity for a legislative union between Great Britain and Ireland, and was equally determined that the union must be unaccompanied by Catholic emancipation crossed to England and pressed his views on Pitt. In 1799 he induced the Irish House of Lords to throw out a bill for providing a permanent endowment Maynooth. On Feb. 10, 1800, Clare in the House of Lords moved the resolution approving the union in a long and powerful speech, in which he reviewed the history of Ireland since the Revolution, attributing the evils of recent years to the independent constitution of 1782, and speaking of Grattan in language of deep personal hatred. He was not aware of the assurance which Cornwallis had been authorized to convey to the Catholics that the union was to pave the way for emancipation, and when he heard of it after the passing of the act he bitterly complained that Pitt and Castlereagh had deceived him. After the union Clare became more violent than ever in his opposition to any policy of concession in Ireland. He died on Jan. 28, 1802.

Lord Clare was the first Irishman since the Revolution to hold the office of lord chancellor of Ireland. As a politician there is no doubt that his bitter and unceasing resistance to reasonable measures of reform did infinite mischief by inflaming the passions of his countrymen, driving them into rebellion, and perpetuating their political and religious divisions.

See W. E. H. Lecky, *History of Ireland in the Eighteenth Century* (1892); J. R. O'Flanagan, *The Hires of the Lord Chancellors and Keepers of the Great Seal in Ireland* (1870); *Cornwallis' Correspondence*, ed. by C. Ross (1859); Charles Phillips, *Recollections of Curran and Some of his Contemporaries* (1822); Henry Grattan, *Memoirs of the Life and Times of the Right Honble. Henry Grattan* (1839–46); Lord Auckland *Journal and Correspondence* (1861); Charles Coote, *History of the Union of Great Britain and Ireland* (1802).

CLARE, a county in the province of Munster, Eire, bounded north by Galway Bay and Co. Galway, east by Lough Derg, the river Shannon, and counties Tipperary and Limerick, south by the estuary of the Shannon, and west by the Atlantic Ocean. The area is 1,231 sq.mi. Pop. (1936) 89,879.

In the eastern mountains two masses of Old Red Sandstone with Silurian cores stand out, the more southerly of which, Slieve Bernagh, rises to a height of 1,746 ft. These masses are flanked by Carboniferous limestone which occupies the north and east of the county. The south-west is composed of Millstone Grit and Coal Measures which extend some distance into the interior. There are many lakes in the central lowlands and bogs are frequent on the higher land. In the southern part, along the banks of the Fergus and Shannon, are bands of rich low grounds called corcasses, of various breadth, indenting the land in a great variety of shapes. They are composed of deep rich loam, and are distinguished as the black corcasses, adapted for tillage, and the blue, used more advantageously as meadow land. The coast is rocky, and occasionally bold precipitous cliffs rise to a considerable height. There are numerous bays around the coast but Liscannor Bay provides the only safe anchorage on the Atlantic side. The River Fergus flows into the estuary of the Shannon, the creeks and bays of which render navigation safe in all winds.

The county, especially on the higher areas of the east and north, is very rich in dolmens. There still exist above a hundred fortified castles, mostly small, several of which are inhabited. Raths or encampments are to be found in every part. They are generally circular, composed either of large stones without mortar or of earth thrown up and surrounded by one or more ditches. The abbeys and other religious houses number more than twenty. Five round towers are to be found in various stages of preservation at Scattery Island, Drumcliffe, Dysert O'Dea, Kilnaboy and Inniscaltra (Lough Derg). The cathedral of the diocese of Killaloe is at the town of that name.

The county, together with part of the neighbouring district, was anciently called Thomond, that is, North Munster. Settlements were effected by the Danes, and in the 13th century by the Anglo-Normans, but without permanently affecting the possession of the district by its native proprietors. In 1543 Murrogh O'Brien submitted to Henry VIII., and received the title of earl of Thomond, on condition of adopting English dress, manners and customs. In 1565 this part of Thomond was added to Connaught, and made one of the six new counties into which that province was divided by Sir Henry Sidney. It was named Clare, the name being traceable either to Richard de Clare (Strongbow), earl of Pembroke, or to his younger brother, Thomas de Clare, who obtained a grant of Thomond from Edward I. in 1276. Towards the close of the reign of Elizabeth, Clare was detached from the government of Connaught and given a separate administration; but it was included with Connaught in Cromwell's schemes and suffered greatly as a result of his policy. At the Restoration it was united to Munster.

Metals and minerals have not been found in sufficient abundance to encourage commercial exploitation. The principal metals are lead, iron and manganese. The Milltown lead mine in the barony of Tulla is probably one of the oldest mines in Ireland and formerly there must have been a very rich deposit. Copper pyrites occurs in several parts of Burren in small quantity. Coal exists in Labasheeda on the right bank of the Shannon, but the few and thin seams are not productive. The nodules of clay-ironstone in the strata that overlie the limestone were mined and smelted as late as 1750. Within ½ mi. of the Milltown lead mine are natural vaulted passages of limestone. The lower limestone of the eastern portion of the county has been found to contain several very large deposits of argentiferous galena. Flags, easily quarried, are procured near Kilrush, and thinner flags near Ennistimon. Slates are

quarried in several places, the best being those of Broadford and Killaloe. Very fine black marble is obtained near Ennis; it takes a high polish, and is free from the white spots with which the black Kilkenny marble is marked.

The soil and surface of the county are in general better adapted for grazing than for tillage. Agriculture is in a backward state, and little acreage is devoted even to the principal crops of oats and potatoes. Cattle, sheep, poultry and pigs, however, all receive considerable attention. Owing to the mountainous nature of the county, nearly one-seventh of the total area is quite barren.

There are no extensive manufactures, although flannels and friezes are made for home use, and hosiery of various kinds, chiefly coarse and strong, is made around Ennistimon and other places. There are several fishing stations but the rugged nature of the coast and the rough sea greatly hinder fishermen. Near Pooldoody is the great Burren oyster bed called the Red Bank. Crabs and lobsters are caught in the Bay of Galway. In addition to the Shannon salmon fishery, eels abound in every rivulet, and form an important article of consumption.

The Great Southern railway line from Limerick to Sligo intersects the centre of the county. From Ennis a branch runs to Ennistimon where it turns south and serves such watering-places as Milltown Malbay, Kilkee and Kilrush. Killaloe is the terminus of a railway branch near the site of the Shannon Power Scheme (*see* SHANNON). Clare has 5 members in Dáil Eireann.

CLAREMONT, a town of Sullivan county, New Hampshire, U.S.A., in the western part of the State, on the Connecticut river, at the mouth of Sugar river; served by the Boston and Maine railroad. The area is 6 sq.mi. Pop. (1940) 12,144. The falls of Sugar river (223 ft. within the town limits) furnish power for large factories, making shoes, paper, cotton and woollen goods and mining and quarrying machinery. Claremont is the shopping centre of an industrial region—mainly machine tool—including Springfield and Windsor, Vt., Newport, Lebanon and Lake Sunapee, N.H. First settled in 1762, the town was organized in 1764. It was named after Lord Clive's country place.

CLARENCE, DUKES OF. The early history of this English title is identical with that of the family of Clare, earls of Gloucester, who are sometimes called earls of Clare, of which word Clarence is a later form. The first duke of Clarence was Lionel of Antwerp (*see* below), third son of Edward III., who was created duke in 1362, and whose wife Elizabeth was a direct descendant of the Clares, the "Honour of Clare" being among the lands which she brought to her husband. When Lionel died without sons in 1368 the title became extinct; but in 1412 it was revived in favour of Thomas (*see* below), the second son of Henry IV. The third creation of a duke of Clarence took place in 1461, and was in favour of George (*see* below), brother of the king Edward IV. When this duke, accused by the king, was attainted and killed in 1478, his titles and estates were forfeited. There appears to have been no other creation of a duke of Clarence until 1789, when William, third son of George III., was made a peer under this title. Having merged in the Crown when William became king of Great Britain and Ireland in 1830, the title of duke of Clarence was again revived in 1890 in favour of Albert Victor (1864–92), the elder son of King Edward VII., then prince of Wales, only to become extinct for the fifth time on his death in 1892. (*See* EDWARD VII.)

LIONEL OF ANTWERP, duke of Clarence (1338–1368), third son of Edward III., was born at Antwerp on Nov. 29, 1338. Betrothed when a child to Elizabeth (d. 1363), daughter and heiress of William de Burgh, 3rd earl of Ulster (d. 1332), he was married to her in 1352; but before this date he had entered nominally into possession of her great Irish inheritance. Having been named as his father's representative in England in 1345 and again in 1346, Lionel was created earl of Ulster, and joined an expedition into France in 1355, but his chief energies were reserved for the affairs of Ireland. Appointed governor of that country, he landed at Dublin in 1361 and in November of the following year was created duke of Clarence, while his father made an abortive attempt to secure for him the Crown of Scotland. His efforts to secure an effective authority over his Irish lands were only moderately successful; and after holding a parliament at Kilkenny, which passed the celebrated statute of Kilkenny in 1367, he threw up his task in disgust and returned to England. He married Violante, daughter of Galeazzo Visconti, lord of Pavia at Milan in June 1368. Some months were then spent in festivities, during which Lionel was taken ill at Alba, where he died on Oct. 7, 1368. His only child Philippa, a daughter by his first wife, married in 1368 Edmund Mortimer, 3rd earl of March (1351–81), and through this union Clarence became the ancestor of Edward IV. The poet Chaucer was at one time a page in Lionel's household.

THOMAS, duke of Clarence (*c.* 1388–1421), who was nominally lieutenant of Ireland from 1401–13, and was in command of the English fleet in 1405, acted in opposition to his elder brother, afterwards King Henry V., and the Beauforts during the latter part of the reign of Henry IV.; and was for a short time at the head of the government, leading an unsuccessful expedition into France in 1412. But when Henry V. became king in 1413 no serious dissensions took place between the brothers, and as a member of the royal council Clarence took part in the preparations for the French war. He was with the English king at Harfleur, but not at Agincourt, and shared in the expedition of 1417 into Normandy, during which he led the assault on Caen. On Henry's return to England in 1421, the duke remained in France as his lieutenant, and was killed at Beaugé whilst rashly attacking the French and their Scottish allies on March 22, 1421. He left no legitimate issue, and the title again became extinct.

GEORGE, duke of Clarence (1449–1478), younger son of Richard, duke of York, was born in Dublin on Oct. 21, 1449. Soon after his elder brother became king as Edward IV. in March 1461, he was created duke of Clarence, and his youth was no bar to his appointment as lord-lieutenant of Ireland in 1462. Clarence came under the influence of Richard Neville, earl of Warwick, and in July 1469 was married at Calais to the earl's elder daughter Isabella, although he had been a suitor for the hand of Mary of Burgundy. With his father-in-law he supported the rebels in the north of England. When their treachery was discovered Clarence fled to France. Returning to England with Warwick in Sept. 1470, he witnessed the restoration of Henry VI., when the crown was settled upon himself in case the male line of Henry's family became extinct. But a public reconciliation between the brothers took place when the king was besieging Warwick in Coventry, and Clarence then fought for the Yorkists at Barnet and Tewkesbury. After Warwick's death in April 1471 Clarence appears to have seized the whole of the vast estates of the earl, and in March 1472 was created by right of his wife earl of Warwick and Salisbury. The Warwick estates were eventually divided between Clarence and his younger brother Richard, duke of Gloucester (Richard III.) who married Warwick's younger daughter Anne. Clarence now sought to marry, as his second wife, Mary of Burgundy, now duchess. To this marriage Edward IV. objected. He became convinced that Clarence was aiming at his throne. The duke was thrown into prison, and in Jan. 1478 the king unfolded the charges against his brother to the parliament. He had slandered the king; had received oaths of allegiance to himself and his heirs; had prepared for a new rebellion; and was in short incorrigible. Both houses of parliament passed the bill of attainder, and the sentence of death which followed was carried out on Feb. 17 or 18, 1478. It is uncertain what share Gloucester had in his brother's death; but soon after the event the rumour gained ground that Clarence had been drowned in a butt of malmsey wine. Two of the duke's children survived their father: Margaret, countess of Salisbury (1473–1541), and Edward, earl of Warwick (1475–99), who passed the greater part of his life in prison and was beheaded in Nov. 1499.

On the last named *see* W. Stubbs, *Constitutional History*, vol. iii. (1895); C. W. C. Oman, *Warwick the Kingmaker* (1891); Sir J. H. Ramsay, *Lancaster and York* (1892).

CLARENDON, EDWARD HYDE, 1ST EARL OF (1609–1674), English statesman and the historian of the Great Rebellion, son of Henry Hyde of Dinton, Wiltshire, was born on Feb. 18, 1609. He entered Magdalen hall, Oxford, in 1622 (having been refused a demyship at Magdalen college), and graduated B.A. in 1626. In 1625 he entered the Middle Temple. At the university

his abilities were more conspicuous than his industry, and at the bar his time was devoted more to general reading and to the society of eminent scholars and writers than to the study of law treatises. Among his friends were included Ben Jonson, Selden, Waller, Hales, and especially Lord Falkland.

In 1629 he married Anne, daughter of Sir George Ayliffe, who died six months afterwards; and secondly, in 1634, Frances, daughter of Sir Thomas Aylesbury, Master of Requests. In 1633 he was called to the bar and quickly obtained a good practice. His marriages had gained for him influential friends, and in Dec. 1634, he was made keeper of the writs and rolls of the common pleas. He was returned to the Short Parliament in 1640 as member for Wootton Bassett. The flagrant violations and perversions of the law which characterized the 12 preceding years of absolute rule drove Hyde into the ranks of the popular party. He assailed the jurisdiction of the earl marshal's court, and in the Long Parliament, in which he sat for Saltash, renewed his attacks and practically effected its suppression. In 1641 he served on the committees for enquiring into the status of the councils of Wales and of the north, and took an important part in the proceedings against the judges. He supported Strafford's impeachment and did not vote against the attainder, though he made subsequently an unsuccessful attempt through Essex to avert the capital penalty. Hyde's allegiance, however, to the church of England was as staunch as his support of the law, and was soon to separate him from the popular party. He showed special energy in his opposition to the Root and Branch bill, and, though made chairman of the committee on the bill on July 11 in order to silence his opposition, he caused by his successful obstruction the failure of the measure. By the beginning of the second session he was regarded as one of the king's ablest supporters in the Commons. He opposed the demand by the parliament to choose the king's ministers, and also the Grand Remonstrance, to which he wrote a reply published by the king.

He now definitely, though not openly, joined the royal cause, and refused office in Jan. 1642, with Colepeper and Falkland in order to serve the king's interests more effectually. Charles undertook to do nothing in the Commons without their advice. Nevertheless a few days afterwards, without their knowledge and by the advice of Lord Digby, he attempted the arrest of the five members, a resort to force which reduced Hyde to despair, and which indeed seemed to show that things had gone too far for an appeal to the law. He persevered, nevertheless, in his legal policy, joined the king openly in June, and continued to compose the king's answers and declarations in which he appealed to the "known Laws of the land" against the arbitrary and illegal acts of a seditious majority in the parliament, his advice to the king being "to shelter himself wholly under the law . . . presuming that the king and the law together would have been strong enough for any encounter." Hyde's appeal had great influence, and gained for the king's cause half the nation. It by no means, however, met with universal support among the royalists, Hobbes jeering at Hyde's love for "mixed monarchy," and the courtiers expressing their disapproval of the "spirit of accommodation" which "wounded the regality." It was destined to failure because Charles was simultaneously carrying on another and an inconsistent policy, listening to very different advisers, such as the queen and Digby, and resolving on measures without Hyde's knowledge or approval.

In spite of Clarendon's efforts war broke out. He was expelled from the House of Commons on Aug. 11, 1642, and was one of those excepted later from pardon. He was present at Edgehill, though not as a combatant, and followed the king to Oxford, residing at All Souls college from Oct. 1642, till March, 1645. On Feb. 22 he was made a privy councillor and knighted, and on March 3 appointed chancellor of the exchequer. He was an influential member of the "Junto" which met weekly to discuss business before it was laid before the council. (*See* CABINET, THE.) At the Uxbridge negotiations in Jan. 1645, where he acted as principal manager on the king's side, he tried to win individuals by promises of places and honours. He promoted the assembly of the Oxford parliament in Dec. 1643 as a counterpoise to the Long Parliament. Hyde's policy and measures, however, all failed. They had been weakly and irregularly supported by the king, and were fiercely opposed by the military party, who were urging Charles to trust to force and arms alone and eschew all compromise and concessions. Charles fell now under the influence of persons devoid of all legal and constitutional scruples.

Hyde's influence was much diminished, and on March 4, 1645, he left the king for Bristol as one of the guardians of the prince of Wales and governors of the west. After Hopton's defeat on Feb. 16, 1646, at Torrington, Hyde accompanied the prince, on March 4, to Scilly, and on April 17, for greater security, to Jersey. He strongly disapproved of the prince's removal to France by the queen's order and of the schemes of assistance from abroad, refused to accompany him, and signed a bond to prevent the sale of Jersey to the French supported by Jermyn. He refused to compound for his own estate. While in Jersey he resided first at St. Helier and afterwards at Elizabeth Castle with Sir George Carteret. He composed the first portion of his *History* and kept in touch with events by means of an enormous correspondence. In 1648 he published *A Full answer to an infamous and traitorous Pamphlet* . . . , a reply to the resolution of the parliament to present no more addresses to the king and a vindication of Charles.

On the outbreak of the second Civil War Hyde left Jersey (June 26, 1648) to join the queen and prince at Paris. He landed at Dieppe, sailed from that port to Dunkirk, and thence followed the prince to the Thames, where Charles had met the fleet, but was captured and robbed by a privateer, and only joined the prince in September after the latter's return to The Hague. He strongly disapproved of the king's concessions at Newport. When the army broke off the treaty and brought Charles to trial he endeavoured to save his life, and after the execution drew up a letter to the several European sovereigns invoking their assistance to avenge it. Hyde strongly opposed Charles II.'s ignominious surrender to the Covenanters, the alliance with the Scots, and the Scottish expedition, desiring to accomplish whatever was possible there through Montrose and the royalists, and inclined rather to an attempt in Ireland. His advice was not followed and he gladly accepted a mission with Cottington to Spain to obtain money from the Roman Catholic powers, and to arrange an alliance between Owen O'Neill and Ormonde for the recovery of Ireland, arriving at Madrid on Nov. 26, 1649. The defeat, however, of Charles at Dunbar and the confirmation of Cromwell's ascendancy influenced the Spanish Government against them, and they were ordered to leave in Dec. 1650. Hyde arrived at Antwerp in Jan. 1651, and in Dec. rejoined Charles at Paris after the latter's escape from Worcester. He now became one of his chief advisers, accompanying him in his change of residence to Cologne in Oct. 1654 and to Bruges in 1658, and was appointed lord chancellor on Jan. 13, 1658. His influence was henceforth maintained in spite of the intrigues of both Romanists and Presbyterians, as well as the violent and openly displayed hostility of the queen, and was employed unremittingly in the endeavour to keep Charles faithful to the Church and Constitution, and in the prevention of unwise concessions and promises which might estrange the general body of the royalists. In 1656, during the war between England and Spain, Charles received offers of help from the latter power provided he could gain a port in England, but Hyde discouraged small isolated attempts. He expected much from Cromwell's death. The same year he made an alliance with the Levellers, and was informed of their plots to assassinate the protector, without apparently expressing any disapproval. (*Clarendon State Papers,* iii. 316, 325, 341, 343.) He was well supplied with information from England (*Hist. mss. Comm.: mss. of F. W. Leyborne-Popham,* 227) and guided the action of the royalists with great ability and wisdom during the interval between Cromwell's death and the Restoration, urged patience, and advocated the obstruction of a settlement between the factions contending for power and the fomentation of their jealousies, rather than premature risings.

The Restoration was a complete triumph for Hyde's policy. In his history he lays no stress on his own great part in it, but it was owing to him that the Restoration was a national one, by the consent and invitation of parliament representing the whole people

and not through the medium of one powerful faction enforcing its will upon a minority, and that it was not only a restoration of Charles but a restoration of the monarchy. By Hyde's advice concessions to the inconvenient demands of special factions had been avoided by referring the decision to a "free parliament," and the declaration of Breda reserved for parliament the settlement of the questions of amnesty, religious toleration, and the proprietorship of forfeited lands.

Hyde entered London with the king and immediately obtained the chief place in the Government, retaining the chancellorship of the exchequer till May 13, 1661, when he surrendered it to Lord Ashley. He took his seat as speaker of the House of Lords and in the court of chancery on June 1, 1660. On Nov. 3, 1660, he was made Baron Hyde of Hindon, and on April 20, 1661, Viscount Cornbury and earl of Clarendon, receiving a grant from the king of £20,000 and at different times of various small estates and Irish rents. By the marriage of his daughter Anne to James, duke of York, celebrated in secret in Sept. 1660, he became related to the royal family and the grandfather of two English sovereigns—Queen Mary and Queen Anne.

A rare occasion now offered itself of settling the religious question on a broad principle of comprehension or toleration; for the monarchy had been restored not by the supporters of the Church alone but largely by the influence and aid of the Nonconformists and also of the Roman Catholics, who were all united at that happy moment by a common loyalty to the throne. Clarendon appears to have approved of comprehension but not of toleration. He had already in April 1660 sent to discuss terms with the leading Presbyterians in England, and after the Restoration offered bishoprics to several, including Richard Baxter. He drew up the royal declaration of October, promising limited episcopacy and a revised prayer-book and ritual, which was subsequently thrown out by parliament, and he appears to have anticipated some kind of settlement from the Savoy Conference which sat in April 1661. The failure of the latter proved perhaps that the differences were too great for compromise, and widened the breach. The parliament immediately proceeded to pass, between 1661 and 1665, the series of narrow and tyrannical measures against the dissenters known as the Clarendon Code; the Corporation act, the Act of Uniformity, the Conventicle act, and the Five-Mile act. Though not the originator of the Conventicle act or of the Five-Mile act, Clarendon recorded his approval (*Continuation,* 511, 776) and he ended by taking alarm at plots and rumours and by regarding the great party of Nonconformists, through whose co-operation the monarchy had been restored, as a danger to the state whose "faction was their religion." (Lister's *Life of Clarendon,* ii. 295; *Hist. mss. Comm.: Various Collections,* ii. 379.)

Meanwhile Clarendon's influence and direction had been predominant in nearly all departments of State. He supported the exception of the actual regicides from the Indemnity, but only ten out of the 26 condemned were executed, and Clarendon, with the king's support, prevented the passing of a bill in 1661 for the execution of 13 more. He upheld the Act of Indemnity against all the attempts of the royalists to upset it. The conflicting claims to estates were left to be decided by the law. The confiscations of the usurping Government accordingly were cancelled, while the properly executed transactions between individuals were necessarily upheld. There can be little doubt that the principle followed was the only safe one in the prevailing confusion. The settlement of the Church lands which was directed by Clarendon presented equal difficulties and involved equal hardships. In settling Scotland, Clarendon's aim was to uphold the Cromwellian union. He proposed to establish a council at Whitehall to govern Scottish affairs, and sought to restore episcopacy through the medium of Archbishop Sharp. His influence, however, ended with the ascendancy of Lauderdale in 1663. In Ireland, while anxious for an establishment upon a solid Protestant basis, he urged "temper and moderation and justice" in securing it. He supported Ormonde's wise and enlightened Irish administration, and opposed the prohibition of the import of Irish cattle into England, incurring thereby great unpopularity. He was a member of the council for foreign plantations, and one of the eight lords proprietors of Carolina in 1663; and in 1664 sent a commission to settle disputes in New England. In the department of foreign affairs he had less influence. In 1664 he demanded, on behalf of Charles, French support, and a loan of £50,000 against disturbance at home, and thus initiated the ignominious system of pensions and dependence upon France. But he was the promoter neither of the sale of Dunkirk on Oct. 27, 1662, the author of which seems to have been the earl of Sandwich (*Hist. mss. Comm.: mss. of F. W. Leyborne-Popham,* 250), nor of the Dutch war. He attached considerable value to the possession of Dunkirk, but when its sale was decided he conducted the negotiations and effected the bargain. He had concluded a treaty for the settlement of disputes with Holland on Sept. 4, 1662. But when hostilities were declared on Feb. 22, 1665, Clarendon gave his support to the war, asserted the extreme claims of the English Crown over the British seas, and contemplated fresh cessions from the Dutch and an alliance with Sweden and Spain. According to his own account he initiated the policy of the Triple Alliance (*Continuation,* 1066), but it seems clear that his inclination towards France continued in spite of French intervention in favour of Holland; and he took part in the negotiations for ending the war by an undertaking with Louis XIV. implying neutrality, while the latter seized Flanders. The crisis in this feeble foreign policy and in the general official mismanagement was reached in June 1667, when the Dutch burned several ships at Chatham.

The whole responsibility for the national calamity and disgrace was unjustly thrown on the shoulders of Clarendon. He was unpopular among all classes: among the royalists on account of the Act of Indemnity, among the Presbyterians because of the Act of Uniformity. Every kind of maladministration was currently ascribed to him, of designs to govern by a standing army, and of corruption. He was credited with having married Charles purposely to a barren queen in order to raise his own grandchildren to the throne, with having sold Dunkirk to France, and his magnificent house in St. James's was nicknamed "Dunkirk House," while on the day of the Dutch attack on Chatham the mob set up a gibbet at his gate and broke his windows. He was disliked by the royal mistresses, whose favour he did not condescend to seek, and whose presence often aroused his reproaches. Surrounded by such general and violent animosity, Clarendon's only hope could be in the support of the king. But Charles, long weary of the old chancellor's rebukes, was especially incensed at this time owing to his failure in securing Frances Stuart (la Belle Stuart) for his seraglio—a disappointment which he attributed to Clarendon—and was now alarmed by the hostility which his administration had excited. He did not scruple to sacrifice at once the old adherent of his house and fortunes. By the direction of Charles, James advised Clarendon to resign before the meeting of parliament, but in an interview with the king on Aug. 26, Clarendon refused to deliver up the seal unless dismissed. On Aug. 30 he was deprived of the great seal, for which the king received the thanks of the parliament on Oct. 16. On Nov. 12 his impeachment was brought up to the Lords, but the latter refused to order his committal, on the ground that the Commons had only accused him of treason in general without specifying any particular charge. Clarendon wrote humbly to the king asking for pardon and that the prosecution might be prevented, but Charles had openly taken part against him, and, though desiring his escape, would not order or assist his departure for fear of the Commons. Through the bishop of Hereford, however, on Nov. 29 he pressed Clarendon to fly, promising that he should not during his absence suffer in his honour or fortune. Clarendon embarked the same night for Calais, where he arrived on Dec. 2. The Lords immediately passed an act for his banishment and ordered the petition forwarded by him to parliament to be burnt.

The rest of Clarendon's life was passed in exile in various parts of France. His sudden banishment entailed great personal hardships. On arriving at Calais he fell dangerously ill; and Louis XIV., anxious to propitiate England, sent him peremptory and repeated orders to quit France. At Evreux, on April 23, 1668, he was the victim of a murderous assault by English sailors, who

attributed to him the non-payment of their wages. For some time he was not allowed to see any of his children; even correspondence with him was rendered treasonable by the Act of Banishment.

Clarendon bore his troubles with great dignity and fortitude. He found consolation in religious duties, and devoted a portion of every day to the composition of his *Contemplations on the Psalms* and of his moral essays. He now finished his *History* and his *Autobiography*. Soon after reaching Calais he had written, on Dec. 17, 1667, to the university of Oxford, desiring as his last request that the university should believe in his innocence and remember him, though there could be no further mention of him in their public devotions, in their private prayers. (*Clarendon St. Pap.* iii., suppl. xxxvii.) He entertained to the last hopes of obtaining leave to return to England, but his petitions were not even answered or noticed. He died at Rouen on Dec. 9, 1674. He was buried in Westminster Abbey at the foot of the steps leading to the Henry VII. chapel. He left two sons, Henry, 2nd earl of Clarendon, and Lawrence, earl of Rochester, and a daughter Anne, duchess of York; a third son, Edward, having predeceased him.

As a statesman Clarendon had obvious limitations and failings. He brought to the consideration of political questions an essentially legal but also a narrow mind, conceiving the law, "that great and admirable mystery," and the constitution as fixed, unchangeable, and sufficient for all time, in contrast to Pym, who regarded them as living organisms capable of continual development and evolution; and he was incapable of comprehending and governing the new conditions and forces created by the civil wars. His character, however, and therefore, to some extent, his career bear the indelible marks of greatness. He maintained his self-respect and dignity at a licentious court, and his integrity in an age of almost universal corruption. His industry and devotion to public business were rendered all the more conspicuous by the negligence, inferiority in business, and frivolity of his successors. As lord chancellor Clarendon made no great impression in the court of chancery. His early legal training had long been interrupted, and his political preoccupations probably rendered necessary the delegation of many of his judicial duties to others. As chancellor of Oxford university, Clarendon promoted the restoration of order and various educational reforms. In 1753 his manuscripts were left to the university by his grandson Lord Cornbury, and in 1868 the money gained by publication was spent in erecting the Clarendon laboratory, the profits of the *History* having provided in 1713 a building for the university press adjoining the Sheldonian theatre, known since the removal of the press to its present quarters as the Clarendon building.

As a writer and historian Clarendon occupies a high place in English literature. His great work, the *History of the Rebellion,* is composed in the grand style. A characteristic feature is the wonderful series of well-known portraits, drawn with great skill and liveliness and especially praised by Evelyn and by Macaulay. The book is overloaded, however, with State papers, misplaced and tedious in the narrative. The published *History* is mainly a compilation of two separate original manuscripts, the first being the history proper, written between 1646 and 1648, with the advantage of a fresh memory and the help of various documents and authorities, and ending in March, 1644, and the second being the *Life,* extending from 1609–60, but composed long afterwards in exile and without the aid of papers between 1668 and 1670. The value of any statement, therefore, in the published *History* depends chiefly on whether it is taken from the *History* proper or the *Life*. In 1671 these two manuscripts were united by Clarendon with certain alterations and modifications making Books i.–vii. of the published *History,* while Books viii.–xv., were written subsequently, and, being composed for the most part without materials, are generally inaccurate, with the notable exception of Book ix., made up from two narratives written at Jersey in 1646, and containing very little from the *Life*. The inaccuracies are due not to wilful misrepresentation, but to failure of memory and to the disadvantages under which the author laboured in exile. In general, Clarendon, like many of his contemporaries, failed signally to comprehend the real issues and principles at stake in the great struggle, laying far too much stress on personalities and never understanding the real aims and motives of the Presbyterian party.

BIBLIOGRAPHY.—1. *Editions of the History:* The work was first published in 1702–04 from a copy of a transcript made by Clarendon's secretary, with a few unimportant alterations, and was the object of a violent attack by John Oldmixon for supposed changes and omissions in *Clarendon and Whitelocke compared* (1727) and again in a preface to his *History of England* (1730), repelled and refuted by John Burton in the *Genuineness of Lord Clarendon's History Vindicated* (1744). The history was first published from the original in 1826; the best edition being that of 1888 edited by W. D. Macray and issued by the Clarendon Press. *The Lord Clarendon's History . . . Compleated,* a supplement containing portraits and illustrative papers, was published in 1717, and *An Appendix to the History,* containing a life, speeches, and various pieces, in 1724. The *Sutherland Clarendon* in the Bodleian library at Oxford contains several thousand portraits and illustrations of the *History. The Life of Edward, earl of Clarendon . . . (and the) Continuation of the History . . .* the first consisting of that portion of the *Life* not included in the *History,* and the second of the account of Clarendon's administration and exile in France, begun in 1672, was published in 1759, the *History of the Reign of King Charles II. from the Restoration . . .,* published about 1755, being a surreptitious edition of this work, of which the latest and best edition is that of the Clarendon Press of 1857.

2. *Other works:* Among Clarendon's other works may be mentioned *A Brief View . . . of the dangerous . . . errors in . . . Mr. Hobbes's book entitled "Leviathan"* (1676); *The History of the Rebellion and Civil War in Ireland* (1719); *Essays moral and entertaining on the various faculties and passions of the human mind (pr. 1815, and in British Prose Writers,* vol. i., 1819); a large number of declarations and manifestos in various collections of tracts and several anonymous tracts, a list of which will be found in the authorities quoted below.

3. *Correspondence:* Clarendon's correspondence, amounting to over 100 volumes, is in the Bodleian library at Oxford, and other letters are to be found in *Additional mss.* in the British Museum. Selections have been published under the title of *State Papers Collected by Edward, earl of Clarendon* (Clarendon State Papers) between 1767 and 1786, and the collection has been calendared up to 1657 in 1869, 1872, 1876. Other letters of Clarendon are to be found in Lister's *Life of Clarendon, iii.; Nicholas Papers* (Camden Soc., 1886); *Diary* of J. Evelyn, *appendix;* Sir R. Fanshaw's *Original Letters* (1724); Warburton's *Life of Prince Rupert* (1849); Barwick's *Life of Barwick* (1724); *Hist. mss. Comm.* 10th Rep. pt. vi. pp. 193–216, and in the *Harleian Miscellany.*

4. *Life: See* Clarendon's autobiographical works and Letters enumerated above, and the ms. collection in the Bodleian library. The Lives of Clarendon by T. H. Lister (1838) and by C. H. Firth in the *Dict. of Nat. Biography* (with authorities there collected) completely supersede all earlier accounts.

See also S. R. Gardiner, *History of England, of the Civil War and of the Commonwealth* (1886–1901); a series of articles by C. H. Firth in the *Eng. Hist. Review* (1904) and *Edward Hyde, earl of Clarendon, as Statesman, Historian, and Chancellor of the University* (1909), by the same author; Sir Henry Craik, *The Life of Edward, earl of Clarendon* (1911).

CLARENDON, GEORGE WILLIAM FREDERICK VILLIERS, 4TH EARL OF (in the Villiers line) (1800–1870), British diplomatist and statesman, the eldest son of George Villiers, who was the youngest son of the 1st earl of the new creation, and Theresa, only daughter of the first Lord Boringdon, was born in London on Jan. 12, 1800. He was educated at Christ's hospital and St. John's college, Cambridge, and became an attaché at the British embassy in St. Petersburg in 1820, where he remained until he was appointed a commissioner of customs in 1823, an office he held until his appointment as British minister at Madrid in 1833. At Madrid he distinguished himself by the skill with which he conducted the difficult negotiations arising out of the Spanish Succession question (*see* SPAIN: *History*) in which he supported the Liberal Government of Isabella II. In 1838 his services were rewarded by the G. C. B. and in the same year he succeeded his uncle as 4th earl; he married Katherine, daughter of the first earl of Verulam, in 1839. In Lord Melbourne's Administration (1840–1841) Lord Clarendon held office as lord privy seal and chancellor of the duchy of Lancaster; but he disagreed with Palmerston's Egyptian and French policy. For five years Clarendon formed one of the opposition to Peel's Government, but when Russell became prime minister in 1846, Clarendon entered the Cabinet as president of the Board of Trade. He twice refused the viceroyalty of India and once the governor-generalship of Canada, and it was with very great reluctance that at Russell's urgent request he undertook in 1847 the lord-lieutenancy of

Ireland. He remained in Ireland until 1852 and guided that country with great skill and sympathy through one of the worst crises in her history (*see* IRELAND: *History*). On the formation of Aberdeen's Coalition Ministry in 1853 Clarendon attained his ambition by becoming secretary of State for Foreign Affairs. Almost from the outset of his tenure of office he found himself confronted with a renewed outbreak of the old Turko-Russian trouble in the Near East that led to the Crimean War (*see* ENGLISH HISTORY) and the Congress of Paris. Clarendon's diplomacy was directed to securing peace on an equable basis and to forcing Austria either to maintain her neutrality or participate actively in the war on the Allied side. His influence over the emperor Napoleon was of incalculable value to the Allies in keeping that unreliable monarch faithful to the alliance, and he won for himself an international prestige by his skilful handling of the congress. Through his support Cavour was enabled to bring the Italian question before Europe, and he was personally responsible for the greatest work accomplished by the congress, the Declaration laying down the rules of maritime warfare. Personal rivalry between Clarendon and Lord John Russell led to the exclusion of the former from the reconstituted Ministry of 1859, and it was not until 1864 that he again held office, this time as chancellor of the duchy of Lancaster. On Palmerston's death in 1865 Clarendon once more returned to the Foreign Office, where he remained until his death on June 27, 1870.

The three outstanding achievements of Clarendon's life were his handling of the Spanish Succession question, his conduct of negotiations during the Crimean War and his services to international law in obtaining the consent of the Congress of Paris to the Maritime Declaration. His final tenure of the Foreign Office was distinguished by his able conduct of affairs during the critical days of the Schleswig-Holstein question, the Austro-Prussian war of 1866, the Alabama question and the troubled days preceding the outbreak of the war between France and Prussia which he feared but did not live to see. Singularly handsome, a man of great courtesy and distinction of manner, cultivated and witty, Clarendon can hardly be reckoned among the greatest of English statesmen. Yet that his was no mean ability is revealed by Bismarck's striking statement that had Clarendon lived, "he would have prevented the war" (*i.e.*, the Franco-Prussian War) and by so doing destroyed Bismarck's life work.

See Sir Herbert Maxwell, *The Life and Letters of the Fourth Earl of Clarendon* (2 vols., London, 1913); Algernon Cecil, *British Foreign Secretaries* (1927). (I. F. D. M.)

CLARENDON, HENRY HYDE, 2ND EARL OF (1638–1709), English statesman, eldest son of the historian, was born on June 2, 1638, and succeeded to the title on his father's death in 1674. James II. made him lord-lieutenant of Ireland (Sept. 1685) with a commission to carry out his design of replacing Protestants in high positions in Ireland by Roman Catholics. He was recalled in Jan. 1687. At the time of the revolution he played a vacillating part, but opposed the settlement of the crown on William and Mary, and remained a non-juror all his life. On June 24, 1690, he was arrested, by order of his niece Queen Mary, on a charge of plotting against William, and though liberated for a time, was again imprisoned in Jan. 1691 on the evidence of Richard Graham, Lord Preston. He was released in July of that year, and from that time until his death, on Oct. 31, 1709, lived in retirement.

His public career had been neither distinguished nor useful, but it seems natural to ascribe its failure to small abilities and to the conflict between personal ties and political convictions which drew him in opposite directions, rather than, following Macaulay, to motives of self-interest. He was a man of some literary taste, a fellow of the Royal Society (1684), the author of *The History and Antiquities of the Cathedral Church . . . continued by S. Gale* (1715), and he collaborated with his brother Rochester in the publication of his father's *History* (1702–04).

He was succeeded by his only son, Edward (1661–1724), as 3rd earl of Clarendon; and, the latter having no surviving son, the title passed to Henry, 2nd earl of Rochester (1672–1753), at whose death without male heirs it became extinct in the Hyde line. (For the other Clarendon line, *see* above.)

CLARENDON, CONSTITUTIONS OF, a body of English laws issued at Clarendon in 1164, by which Henry II. endeavoured to settle the relations between church and state. They purported to declare the usages on the subject in the reign of Henry I. They were never accepted in full by the clergy and after Becket's murder Henry II. was unable to maintain them all. Of the 16 provisions the one which provoked the greatest opposition was that which declared in effect that criminous clerks were to be summoned to the king's court, and from there, after formal accusation and defence, sent to the proper ecclesiastical court for trial. If found guilty they were to be degraded and sent back to the king's court for punishment. Another provision, which in spite of all opposition obtained a permanent place in English law, declared that all suits, even between clerk and clerk, concerning advowsons and presentations should be tried in the king's court. By other provisions appeals to Rome without the licence of the king were forbidden. None of the clergy was to leave the realm, nor were the king's tenants-in-chief and ministers to be excommunicated or their lands interdicted without the royal permission. Pleas of debt, whether involving a question of good faith or not, were to be in the jurisdiction of the king's courts. Two interesting provisions, to which the clergy offered no opposition, were: (1) if a dispute arose between a clerk and a layman concerning a tenement, which the clerk claimed as free-alms (frankalmoign) and the layman as a lay-fee, it should be determined by the recognition of 12 lawful men before the king's justice whether it belonged to free-alms or lay-fee, and if it were found to belong to free-alms then the plea was to be held in the ecclesiastical court, but if to lay-fee, in the court of the king or of one of his magnates; (2) a declaration of the procedure for election to bishoprics and royal abbeys, generally considered to state the terms of the settlement made between Henry I. and Anselm in 1107.

BIBLIOGRAPHY.—J. C. Robertson, *Materials for History of Thomas Becket*, Rolls Series (1875–85); Sir F. Pollock and F. W. Maitland, *History of English Law before the Time of Ed. I.* (1898), and F. W. Maitland, *Roman Canon Law in the Church of England* (1898); the text of the Constitutions is printed by Stubbs in *Select Charters* (1913). (G. J. T.)

CLARES, POOR, otherwise **CLARISSES,** Franciscan nuns, so called from their foundress, St. Clara (*q.v.*). She was professed by St. Francis in the Portiuncula in 1212, and two years later she and her first companions were established in the convent of St. Damian at Assisi. The nuns formed the "Second Order of St. Francis," the friars being the "First Order," and the Tertiaries (*q.v.*) the "Third." Before Clara's death in 1253, the Second Order had spread all over Italy and into Spain, France and Germany; in England they were introduced *c.* 1293 and established in London, outside Aldgate, where their name of Minoresses survives in the Minories; there were only two other English houses before the Dissolution. St. Francis gave the nuns no rule, but only a "Form of Life" and a "Last Will," each only five lines long, and coming to no more than an inculcation of his idea of evangelical poverty. Something more than this became necessary as soon as the institute began to spread; and during Francis's absence in the East, 1219, his supporter Cardinal Hugolino composed a rule which made the Franciscan nuns practically a species of unduly strict Benedictines, St. Francis's special characteristics being eliminated. St. Clara made it her life work to have this rule altered, and to get the Franciscan character of the Second Order restored; in 1247 a "Second Rule" was approved which went a long way towards satisfying her desires, and finally in 1253 a "Third," which practically gave what she wanted. This rule has come to be known as the "Rule of the Clares"; it is one of great poverty, seclusion and austerity of life. Most of the convents adopted it, but several clung to that of 1247. To bring about conformity, St. Bonaventura, while general (1264), obtained papal permission to modify the rule of 1253, somewhat mitigating its austerities and allowing the convents to have fixed incomes. This rule was adopted in many convents, but many more adhered to the strict rule of 1253. Indeed a counter-tendency towards a greater strictness set in, and a number of reforms were initiated, introducing an appalling austerity of life.

See Heimbucher, *Orden und Kongregationen* (1896), i. §§ 47, 48, who gives references to all the literature; and *Catholic Encyclopaedia*, art. "Clares."

CLARET is the type-name popularly applied to any dry, tart, light- or medium-bodied table wine of ruby red colour. Wines of this general type are the most widely-used mealtime wines in almost every wine-growing country. They range from high-quality wines, produced under ideal conditions from grapes of the noblest character, to very humble *vins ordinaires,* as common wines are called in France. They may rise to the challenge of many years of aging, improving all the while, or they may be at their best when fairly young.

The name originated with the English, to whom in the 12th century claret meant simply a red wine of lighter colour than the very dark wines of southern Europe. In the 12th and 13th centuries red and white wines were sometimes blended to produce claret. Gradually, however, the term came to be applied to the red wines of the Bordeaux vineyards, which were lighter in colour than those of the higher country toward the Pyrenees. When in 1152 the marriage of Henry of Anjou (later Henry II) and Eleanor of Aquitaine brought the whole of Aquitaine under English sovereignty, the merchants of Bordeaux acquired the rights of crown subjects; they used their privileges in London to promote the wine trade from Bordeaux at the expense of that from Rouen and elsewhere. Eventually an export tax was levied on wines at Bordeaux for the benefit of the king's house, and for this reason the English were encouraged to consume Bordeaux wines. Inasmuch as English rule over Aquitaine lasted three centuries, the use of Bordeaux red wines, or clarets, became firmly fixed. Claret is far now from the meaning of the French word "clairette," which refers to a white wine faintly tinged with red.

The greatest clarets of the Bordeaux region come, as a rule, from the two viticultural districts of Médoc and Graves, which lie along the left banks of the Gironde and the Garonne, respectively. There the best vineyards regularly yield wines capable of improving with age and in good years distinguished for their bouquet and balance. Even in these districts, however, there are many grades of clarets, ranging down through five official classes of better growths, or *crûs,* as determined by a jury in 1855, to such commoner ones as "bourgeois," "artisan" and "peasant."

Because in this region growing conditions vary widely from year to year, vintage years matter greatly to the producers of Bordeaux wines. Some of the most noted red wines grown in a favourable year in Médoc or Graves do not mature sufficiently to please the palate until they have aged ten years, and may improve steadily thereafter for a couple of decades or more. But even the most notable of them, grown in a poor year, may pass their zenith before they are seven. And many lesser wines, even in the good years, are sold to be drunk with meals much earlier.

The Cabernet Sauvignon, whose sweet, violet-odoured fruit grows in small, loose bunches, is the chief vine grown in the Bordeaux region to produce great clarets. However, nearly all vineyards have other grape varieties for claret, including the Carmenère, Gros-Cabernet, Malbec, Merlot and Petit Verdot.

Italy, Spain, Portugal and other countries of Europe have developed their own styles of claret, often from grapes nurtured through centuries on their own soils. In the newer lands, including the Americas, Australia and South Africa, adaptable grape varieties transplanted from those countries as well as from the Gironde are used. Thus in California the Cabernet Sauvignon is favoured in those parts where it can be grown under ideal conditions but some other varieties are more widely employed, including the more productive Zinfandel, probably of Hungarian origin, which produces a fresh, fruity wine not usually given to long aging. (*See* WINE.) (H. A. CW.)

BIBLIOGRAPHY.—André L. Simon, *Wine and the Wine Trade* (1921); Ed. Féret, *Bordeaux et ses vins classés per ordre de mérite* (Bordeaux, 1908); F. Malvezin, *Bordeaux: histoire de la vigne et du vin en Aquitaine depuis les origines jusqu'à nos jours* (1919); Wine Trade Record: *Clarets and Sauternes* (1920); H. Warner Allen, *The Wines of France* (1924); P. Morton Shand, *A Book of French Wines* (1928); Wine Advisory Board, San Francisco, *Wine Handbook Series,* ii (1943).

CLARETIE, JULES ARSÈNE ARNAUD (1840–1913), French writer, director of the Théâtre Français, was born at Limoges Dec. 3, 1840. He was dramatic critic to the *Figaro* and to the *Opinion nationale,* a newspaper correspondent during the Franco-German War, and during the Commune a staff-officer in the National Guard. In 1885 he became director of the Théâtre Français, and from that time devoted himself chiefly to its administration. He was elected a member of the Academy in 1888. He died in Paris on Dec. 23, 1913.

The long list of his works includes *Histoire de la révolution de 1870–71* (new ed., 5 vols., 1875–76); *Cinq ans après; l'Alsace et la Lorraine depuis l'annexion* (1876); some annual volumes of reprints of his articles in the weekly press, entitled *La Vie à Paris; La Vie moderne au théâtre* (1868–69); *Molière, sa vie et son oeuvre* (1871); *Histoire de la littérature française, 900–1900* (2nd ed. 1905); *Candidat!* (1887), a novel of contemporary life; *Brichanteau, comédien français* (1896); several plays, some of which are based on novels of his own; and the opera, *La Navarraise* based on his novel *La Cigarette,* and written with Henri Cain to the music of Massenet. *La Navarraise* was first produced at Covent Garden (June 1894) with Mme. Calvé in the part of Anita. His *Oeuvres complètes* were published in 1897–1904. *See* G. Grappe, *Jules Claretie* (1906).

CLARI, GIOVANNI CARLO MARIA (*c.* 1669–1745), Italian musical composer, born at Pisa, was the most celebrated pupil of Colonna, chapel-master of S. Petronio, at Bologna. He became *maestro di cappella* at Pistoia about 1712, at Bologna in 1720, and at Pisa in 1736. The works by which Clari distinguished himself preeminently are his vocal duets and trios, with a *basso continuo,* published between 1740 and 1747. These compositions, which combine graceful melody with contrapuntal learning, were much admired by Cherubini and also by Handel, who appropriated portions of them. Clari composed one opera, *Il Savio delirante,* produced at Bologna in 1695, and a large quantity of church music, several specimens of which have been printed in Novello's *Fitzwilliam Music.*

"CLARÍN": *see* ALAS, LEOPOLDO.

CLARINA, a modern instrument of the wood-wind class (although actually made of metal), a hybrid possessing characteristics of both oboe and clarinet. The clarina was invented by W. Heckel of Biebrich-am-Rhein, and has been used at Bayreuth, in *Tristan und Isolde,* as a substitute for the *Holztrompete* made according to Wagner's instructions.

CLARINDA, county seat of Page county, Iowa, U.S.A., on the Nodaway river, federal highway 71, state highway 3, and the Burlington railway. The population in the 1940 federal census was 4,905 (4,962 in 1930). The chief industries are coal mining, agriculture and manufacturing.

A state hospital for the insane, with a capacity for 1,200 patients, is located here. Clarinda was settled about 1853 and incorporated in 1866.

CLARINET, a wood-wind instrument having a cylindrical bore and played by means of a single-reed mouthpiece. The name is sometimes used in a generic sense to denote the whole family, which consists of the ordinary clarinet, corresponding to the violin, oboe, etc.; the alto clarinet in E; the basset horn (*q.v.*) in F; the bass clarinet (*q.v.*), and the pedal clarinet (*q.v.*).

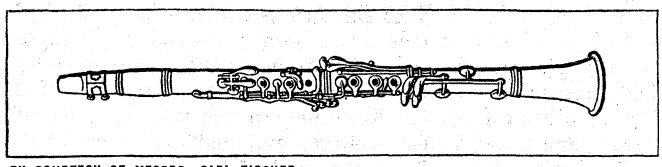
The mouthpiece of the clarinet, including the beating or single-reed common to the whole clarinet family, has the appearance of a beak with the point bevelled off and thinned at the edge to correspond with the end of the reed shaped like a spatula. The under part of the mouthpiece is flattened in order to form a table for the support of the reed, which is adjusted thereon with great nicety, allowing just the amount of play requisite to set in vibration the column of air within the tube.

A cylindrical tube played by means of a reed has the acoustic properties of a stopped pipe, *i.e.,* the fundamental tone produced by the tube is an octave lower than the corresponding tone of an open pipe of the same length, and overblows a twelfth; whereas tubes having a conical bore like the oboe, and played by means of a reed, speak as open pipes and overblow an octave. This forms the fundamental difference between the instruments of the oboe and clarinet families.

Wind instruments depending upon lateral holes for the production of their scale must either have as many holes pierced in

the bore as they require notes, or make use of the property possessed by the air-column of dividing into harmonics or partials of the fundamental tones. Twenty to twenty-two holes is the number generally accepted as the practical limit for the clarinet. The compass of the instrument is therefore extended through the medium of the harmonic overtones.

In order to facilitate, however, the production of the harmonic notes, a small hole, closed by means of a key and called the "speaker," is bored near the mouthpiece. By means of this small hole the air-column is placed in communication with the external



BY COURTESY OF MESSRS. CARL FISCHER

THE CLARINET, A MUSICAL INSTRUMENT WITH A SINGLE BEATING REED, DERIVED FROM THE CHALUMEAU OF THE MIDDLE AGES

atmosphere, a ventral segment is formed, and the air-column divides into three equal parts, producing a triple number of vibrations resulting in the third note of the harmonic series, at an interval of a twelfth above the fundamental.

The fundamental scale of the modern clarinet in C extends from E in the bass clef to B flat in the treble. The next octave and a half is obtained by opening the speaker key, whereby each of the fundamental notes is reproduced a twelfth higher, extending the range to F in alt, which ends the natural compass of the instrument, although a skilful performer may obtain another octave by cross-fingering.

History.—The single beating-reed associated with the instruments of the clarinet family was probably introduced into classic Greece from Egypt or Asia Minor. A few ancient Greek instruments are extant, five of which are in the British Museum. They are as nearly cylindrical as would be the natural growing reed itself. The probability is that both single and double reeds were at times used with the Greek aulos and the Roman tibia.

In the West, the instrument was, during the Carolingian period, identified with the tibia of the Romans until such time as the new western civilization ceased to be content to go back to classical Rome for its models, and began to express itself, at first naïvely and awkwardly, as the 11th century dawned. The name then changed to the derivatives of the Greek *kalamos,* assuming an almost bewildering variety of forms, of which the commonest are chalemie, chalumeau, schalmey, scalmeye, shawm, calemel.

At the beginning of the 18th century various important improvements in the mechanism of the instrument, in particular the invention of the very useful device of the speaker-key, were effected by J. Christian Denner (1655–1707), and after various subsequent developments the instrument was further improved during the 19th century by the Belgian makers Bachmann, the elder Sax, Albert and C. Mahillon and others. In England the clarinet has also passed through several progressive stages since its introduction about 1770, first at the hands of Cornelius Ward, and later, as a consequence of still more important improvements due to Richard Carte and others.

As regards music for the clarinet, Mattheson mentions clarinet music in 1713, although Handel, whose rival he was, does not appear to have known the instrument. Joh. Christ. Bach scored for the clarinet in 1763 in his opera *Orione,* performed in London, and Rameau had already employed the instrument in 1751 in a theatre for his pastoral entitled *Acante et Céphise.* Later, Mozart wrote for it in his Paris symphony, and since then it has of course long since taken its place as one of the most indispensable members of the orchestral family. Famous chamber works in which the instrument is employed are the clarinet quintets of Mozart and Brahms.

CLARK, ABRAHAM (1726–1794), American patriot and signer of the Declaration of Independence, was born in Elizabethtown, N.J., on Feb. 15, 1726. After receiving his education in mathematics and civil law, he engaged in conveyancing and surveying. Though he did not enter the professional practice of law, he gave legal advice gratuitously to his neighbours, earning the title, "the poor man's counsellor." He served as clerk of the New Jersey colonial assembly, and later was appointed high sheriff of Essex county. As an active Whig, he served on the committees of vigilance and public safety in his native State, and in June 1776 was appointed a representative to the general Congress, where he voted for separation from England and signed the Declaration of Independence. Eight times in the following 12 years he was elected a member of that body, and he was chosen a delegate to the Constitutional Convention in Philadelphia in 1787, but illness prevented his attendance. In Congress, on Wednesday, July 2, 1788, he made the motion by which the Federal Constitution became effective. The State legislature appointed him, in the winter of 1789–90, a commissioner to settle debts of New Jersey contracted during the Revolution, which duties he discharged until elected a member of the second Congress. This office he held until June 1794. He died at Elizabethtown, N.J., on Sept. 15, 1794.

See A. C. Hart, ed., *Abraham Clark* (San Francisco, 1923).

CLARK, CHAMP (1850–1921), American politician, was born in Anderson Co., Ky., on March 7, 1850. He first entered Kentucky university but finished his course at Bethany college in 1873. The following year he was elected president of Marshall college, West Virginia, and one year later was admitted to the bar. After 1880 his law office was in Bowling Green, Missouri. He was city attorney for Louisiana, Mo., and for Bowling Green from 1878 to 1881; and was prosecuting attorney for Pike Co., 1885–89, and then for three years was a member of the Missouri house of representatives. He was a member of congress from 1893 to 1895, and from 1897 to 1919, being speaker from 1911 to 1919. At the Democratic convention for the nomination of a presidential candidate held at Baltimore in 1912, he led on 27 ballots and on 8 had a clear majority, but not the necessary two-thirds. He was finally defeated by Woodrow Wilson of New Jersey. He died in Washington, D.C., on March 2, 1921.

CLARK, FRANCIS EDWARD (1851–1927), American clergyman, was born of New England ancestry at Aylmer, Province of Quebec, Canada, Sept. 12, 1851. He graduated at Dartmouth college in 1873 and at Andover theological seminary in 1876, and was pastor successively of the Williston Congregational church in Portland, Me., and of the Phillips Congregational church in South Boston, Mass. In Feb. 1881 he founded at Portland the Young People's Society of Christian Endeavour, which beginning as a small society in a single New England church, developed into a great interdenominational organization, which reported 80,000 societies and more than 4,000,000 members throughout the world. For many years he devoted himself to this work as president and finally president emeritus of the United Societies of Christian Endeavour and president of the World's Christian Endeavour Union, and as editor, and then honorary editor of the *Christian Endeavor World* until his death at Newton, Mass., on May 26, 1927.

Among his publications are *Looking Out on Life* (1883); *World Wide Endeavor* (1895); *Christian Endeavor Manual* (1903); and *Christian Endeavor in All Lands* (1906). *The Continent of Opportunity* (1909); *Old Home of New Americans* (1912); *The Holy Land of Asia Minor* (1914); *The Charm of Scandinavia* (with Sydney A. Clark) (1914); *Christ and the Young People* (1916); *In the Footsteps of St. Paul* (1917); *The Gospel of Out-of-Doors* (1920); *Memories of Many Men in Many Lands* (1923).

CLARK, GEORGE ROGERS (1752–1818), American frontier military leader, was born in Albemarle county, Virginia, on Nov. 19, 1752. When 19 years of age he left his home to become a surveyor of frontier lands along the Ohio river. This occupation was soon interrupted by an Indian outbreak known as Lord Dunmore's War (1774); and Clark, with the rank of captain, accompanied Dunmore in the punitive expedition. Peace brought renewed immigration, especially into Kentucky, and thither Clark followed as a surveyor for the Ohio company. His position enabled him from time to time to absorb choice portions of land for himself, and these interests soon led him to identify himself with the Kentuckians and devote much thought to their peculiar problems. When the American Revolution broke out Clark clearly perceived the vulnerability of the frontier, and the necessity of securing for Kentucky a government with military

authority and an organized militia if there was to be concerted defense against the British, or their allies, the Indians. Elected by a mass meeting of the pioneers to present their problems before the Virginia government, Clark attended the council and assembly at Williamsburg and diplomatically persuaded them to create a separate county of Kentucky and thereby become responsible for its defense. Clark returned with a supply of powder and assumed chief command of the frontier militia at a critical moment, for the Indians were already making raids against the settlers. Convinced that they were instigated and supported in their raids by British officers stationed in the forts north of the Ohio river, Clark worked out a plan of offensive operations that involved nothing less than a conquest of these forts. His plans were approved by Governor Patrick Henry and the council of Virginia and Clark was authorized to enlist troops. May 1778 found him at the falls of the Ohio with about 175 men. The expedition proceeded to Ft. Kaskaskia, on the Mississippi river, in what is now Illinois. This place and Cahokia, also on the Mississippi, near St. Louis, were defended by small British garrisons, which depended on the support of the French inhabitants. The French being willing to accept the authority of Virginia, both forts were easily taken. Clark gained the friendship of Father Gibault, the priest at Kaskaskia, and through his influence the French at Vincennes on the Wabash were induced to change their allegiance. Lieut. Governor Hamilton, the British commander at Detroit, recovered Vincennes, however, and went into winter quarters there. After an arduous march across flooded bottom land in freezing weather, Clark in Feb. 1779, surprised Hamilton and forced him to give up Vincennes, and surrender himself and his garrison as prisoners of war. The way was now open to Detroit, Clark's ultimate object, but it was deemed prudent to wait for reinforcements promised from Virginia in June. The delay was fatal; other occurrences delayed the reinforcements and scattered Clark's troops. Clark withdrew to Ft. Nelson which he had built at the falls of the Ohio, and made that his base for the rest of the war. In 1780 he aided in the defeat of a British expedition against the Spanish settlement of St. Louis; the same year he made a swift campaign against the Shawnee Indians and destroyed their towns, Chillicothe and Piqua. Clark, now appointed brigadier general of the western forces, again planned to move against Detroit and was promised supplies and reinforcements for the expedition from Virginia. Months went by and they did not come, for Virginia was bankrupt. Again in 1782 Clark took the offensive against the Shawnees, and while not entirely successful this last expedition saved the settlements from renewed Indian attacks and defeated British plans for an Indian alliance. When peace came in 1783 (treaty of Paris) Clark's conquests doubtless influenced the award of the country northwest of the Ohio to the United States. His offensive movements had also been of first importance in defending the vulnerable frontier from Indian raids and British expeditions. Clark and his men during all these years received no pay for their services and hardships. Furthermore Clark found himself responsible for all debts incurred for supplies, since Virginia, despite her promises, never reimbursed him. The rest of his life was shadowed by the constant demands of creditors. Clark was appointed an Indian commissioner after the war, and in 1786 he played a leading part in a treaty with the Shawnees. The same year he led an expedition against the "Wabash confederacy," his last military command. James Wilkenson, a traitor in the pay of Spain (unknown at that time), coveted Clark's office of Indian commissioner and his military command, and deliberately set out to misrepresent him. Forged papers and testimonials were forwarded to Governor Randolph of Kentucky charging Clark with constant drunkenness, military incapacity, and a treasonable design of leading a military expedition down the Mississippi against Spain. Wilkenson was entirely successful; he was appointed Indian commissioner in Clark's place, and the latter was relieved of his command. Disappointed at his country's ingratitude, Clark spent the rest of his life near Louisville in retirement, dying on Feb. 13, 1818. Historical research in recent years has exposed Wilkenson's perfidy, and emphasized the importance of Clark's exploits. His most ardent supporters have even called him "the Washington of the West."

BIBLIOGRAPHY.—The *George Rogers Clark Papers, 1771–1783,* ed. J. A. James, are contained in vol. viii and ix of the *Illinois Historical Collections* (Springfield, 1912 and 1926). Clark's own narrative of his campaigns is published in *The Captive of Old Vincennes* (Indianapolis, 1927), ed. M. M. Quaife. The best biography is Temple Bodley's *George Rogers Clark: His Life and Public Services* (Boston, 1926). *See* also W. H. English, *Conquest of the Country North-west of the River Ohio, 1778–1783* (1896), and the *Mississippi Valley Historical Review* for Sept. 1924; Frederick Palmer, *Clark of the Ohio: A Life of George Rogers Clark* (1929).

CLARK, JOHN BATES (1847–1938), often called the dean of American economists, was born in Providence, R.I., Jan. 26, 1847. He was educated at Brown university, Amherst college, Heidelberg and Zurich, and became imbued with the ideas of the German historical school. Returning to America, he taught at Carlton, Smith and Amherst colleges, and finally at Columbia university (1895–1923). The first period of his economic thought, influenced by the historical school, culminated in *The Philosophy of Wealth* (1885). In "revolt," as he said, "against the spirit of the old political economy," he rejected competition as the rule of distributive justice. Nevertheless, he outlined independently an "effective utility" theory of competitive value resembling that of Jevons and the Austrian school somewhat earlier.

A second period culminated in 1899 in his chief work, *The Distribution of Wealth,* marked by the rejection of the old categories of production factors, but ultra "classical" in accepting competitive price (which he called the "specific productivity" of agents) as the just rule of distribution. Despite some contemporary protests, Clark's views dominated economic theorizing in the United States for a generation, and left lasting effects in clearer conceptions of a "universal law of economic variation," of a price "system," and of the categories of productive agents.

Clark's later work is noteworthy for his original and practicable proposals for the correction of monopolistic abuses, presented in final form in *The Control of Trusts* (1912), but not yet fully realized in public policy. (F. A. F.)

CLARK, JOSIAH LATIMER (1822–1898), English engineer and electrician, was born on March 10, 1822, at Great Marlow, Bucks. In 1848 he became assistant engineer at the Menai Straits bridge under his elder brother Edwin (1814–94), the inventor of the Clark hydraulic lift graving dock. Two years later, when his brother was appointed engineer to the Electric Telegraph company, he again acted as his assistant, and subsequently succeeded him as chief engineer. In 1854 he took out a patent "for conveying letters or parcels between places by the pressure of air and vacuum," and later was concerned in the construction of a large pneumatic despatch tube between the general post office and Euston station, London. He also experimented on the propagation of the electric current in submarine cables, and in 1859 he was a member of the committee which was appointed by the government to consider the numerous failures of submarine cable enterprises. Latimer Clark paid much attention to the subject of electrical measurement, and besides designing various improvements in method and apparatus and inventing the Clark standard cell, he took a leading part in the movement for the systematization of electrical standards, which was inaugurated by the paper which he and Sir C. T. Bright read on the question before the British association in 1861. With Bright also he devised improvements in the insulation of submarine cables. He was a member of several firms engaged in laying submarine cables, in manufacturing electrical appliances, and in hydraulic engineering. He died in London on Oct. 30, 1898.

Clark's chief works are: *Electrical Measurement* (1868); and, with R. Sabine, *Electrical Tables and Formulae for Operators in Submarine Cables* (1871).

CLARK, THOMAS (1801–1867), Scottish chemist, was born at Ayr on March 31, 1801, and died at Glasgow on Nov. 27, 1867. He was professor of chemistry at Marischal college, Aberdeen, and is best known for his process for softening hard waters and his water tests, patented in 1841.

CLARK, WILLIAM (1770–1838), American soldier and explorer, the youngest brother of George Rogers Clark, was born

in Caroline county, Va., but early removed to Kentucky. He entered the U.S. army as lieutenant of infantry in 1792, and served under Gen. Anthony Wayne against the Indians in 1794. In 1803–06, with Meriwether Lewis, he commanded the famous exploring expedition from St. Louis to the mouth of the Columbia river and return, the first expedition to cross the continent within the limits of the United States. He was territorial governor of Missouri from 1813 to 1820, and superintendent of Indian affairs at St. Louis from 1822 until his death in 1838.

See the *Original Journals of the Lewis and Clark Expedition* (1905), edited by R. G. Thwaites, the best of several editions of the leader's journals; George Bird Grinnell, *Trails of the Pathfinders* (1911); "William Clark's Journal of General Wayne's Campaign, 1793–1794," *Mississippi Valley Hist. Rev.*, vol. i. p. 413–443 (Cedar Rapids, Iowa, 1914); and Floyd Duckworth Welch, *The Work of the Indian Agents in the Louisiana Purchase, 1804–1820* (St. Louis, Mo., 1926).

CLARK, WILLIAM GEORGE (1821–1878), English classical and Shakespearian scholar, was born at Barford Hall, Darlington, in March 1821 and died at York on Nov. 6, 1878. In 1853 Clark had taken orders, but left the church in 1870 after the passing of the Clerical Disabilities Act, of which he was one of the promoters. He established the Cambridge *Journal of Philology,* and co-operated with B. H. Kennedy and James Riddell in the production of the well-known *Sabrinae Corolla.* The work by which he is best known is the Cambridge Shakespeare (1863–66), containing a collation of early editions and selected emendations, edited by him at first with John Glover and afterwards with W. Aldis Wright. *Gazpacho* (1853) gives an account of his tour in Spain; his visits to Italy at the time of Garibaldi's insurrection, and to Poland during the insurrection of 1863, are described in *Vacation Tourists,* ed. F. Galton, i. and iii.

See H. A. J. Munro in *Journal of Philology* (viii., 1879); also notices by W. Aldis Wright in *Academy* (Nov. 23, 1878); R. Burn in *Athenaeum* (Nov. 16, 1878); *The Times* (Nov. 8, 1878); *Notes and Queries,* 5th series, x. (1878), p. 400.

CLARKE, ADAM (1762?–1832), British Nonconformist divine, was born at Moybeg, Co. Londonderry, Ireland, in 1760 or 1762. He completed his education at Kingswood school and in 1782 was appointed by Wesley minister to the Bradford (Wiltshire) circuit. He was a great preacher, and was three times (1806, 1814, 1822) chosen to be president of the conference. He served twice on the London circuit, the second period being extended considerably longer than the rule allowed, at the special request of the British and Foreign Bible Society, who had employed him in the preparation of their Arabic Bible. He found time in his busy life to study Hebrew and other Oriental languages, in order to qualify himself for the great work of his life, his *Commentary on the Holy Scriptures* (1810–26). In 1802 he published a *Bibliographical Dictionary* in six volumes, to which he afterwards added a supplement. He was selected by the Records Commission to re-edit Rymer's *Foedera,* a task which after ten years' labour (1808–18) he had to resign. He also wrote *Memoirs of the Wesley Family* (1823), and edited a large number of religious works. He died in London on Aug. 16, 1832.

His *Miscellaneous Works* were published in 1836, and a *Life,* by his son J. B. B. Clarke, appeared in 1833.

CLARKE, ALEXANDER ROSS (1828–1914), British geodesist, was born in Sutherlandshire on Dec. 16, 1828. He studied at the Royal Military academy, Woolwich, and in 1847 became a second-lieutenant in the Royal Engineers. In 1850 Clarke was posted to the Ordnance Survey at Southampton, and except for a break between 1851–54 he remained there until he retired in 1881.

When Clarke joined the Ordnance Survey the observations on the Principal Triangulation had just been completed, and he had the task of reducing and publishing the results. This was done in record time, and in 1858 appeared *Account of the Observations and Calculations of the Figure, Dimensions and Mean Specific Gravity of the Earth as Derived Therefrom.* Clarke was mainly responsible for a good deal of similar work carried out in co-operation with other countries. His work was remarkably accurate and rapid, considering the laborious methods of calculation and reduction in use at the time. In a specially-designed room he tested and compared the standards of length used by other countries and by the Colonies, publishing his observations in *Comparison of the Standards of Length of England, France, Belgium, Prussia, India and Australia* (1866).

Clarke gave an account of the observations which connected the English and French triangulations under the title of *Extension of the Triangulation of Great Britain into France and Belgium* (1863). He was the author of *Abstracts of Spirit Levelling in England, Wales and Scotland* (1861), *Geodesy* (1880), a standard work on this subject, which has been translated into many languages, and a number of papers in scientific journals. He was a member of many learned societies and was awarded the Royal Medal of the Royal Society in 1887. He had been made a Companion of the Bath in 1870. In 1881 Clarke was ordered to hold himself ready for service in Mauritius and preferred to retire rather than sever his connection with the Ordnance Survey. He lived a secluded life until he died on Feb. 11, 1914.

CLARKE, SIR ANDREW (1824–1902), British soldier and administrator, son of Col. Andrew Clarke, of Co. Donegal, Ireland, governor of West Australia, was born at Southsea, England, on July 27, 1824, and educated at King's school, Canterbury. He entered the army in 1844 as second-lieutenant in the Royal Engineers. He was appointed to his father's staff in West Australia, but was transferred to be A.D.C. and military secretary to the governor of Tasmania; and in 1847 he went to New Zealand to take part in the Maori War, and for some years served on Sir George Grey's staff. He was then made surveyor-general in Victoria, took a prominent part in framing its new constitution, and held the office of minister of public lands during the first administration (1855–57). From 1864–73 he was director of works for the navy, being responsible for great improvements in the naval arsenals and fortifications at home and abroad. In 1873 he became governor of the Straits Settlements. From 1875–80 he was minister of public works in India; and on his return to England in 1881, he was first appointed commandant at Chatham and then inspector-general of fortifications (1882–86). He died on March 29, 1902. Both as a technical and strategical engineer and as an Imperial administrator Sir Andrew Clarke was one of the ablest and most useful public servants of his time.

CLARKE, SIR CASPAR PURDON (1846–1911), English art expert, was born in London on Dec. 21, 1846, and educated privately at Sydenham and Boulogne. In 1862 he was trained as an architect in the art schools at South Kensington. In 1865 he entered the Office of Works, and in 1867 was attached to the works department of the South Kensington museum. He travelled extensively for the museum, purchasing objects of art, and at the same time carried on his profession as an architect. In 1883 he became keeper of the India museum at South Kensington, in 1892 keeper of the art collections, in 1893 assistant-director, and in 1896 director. In 1905 he became director of the Metropolitan Museum, New York, resigning in 1910. He was knighted in 1902. He died in London on March 29, 1911.

CLARKE, CHARLES COWDEN (1787–1877), English author and Shakespearian scholar, was born at Enfield, Middlesex, on Dec. 15, 1787. His father, John Clarke, was a schoolmaster, among whose pupils was John Keats. Charles Clarke taught Keats his letters, and encouraged his love of poetry. He knew Charles and Mary Lamb, and afterwards became acquainted with Shelley, Leigh Hunt, Coleridge and Hazlitt. Clarke became a music publisher in partnership with Alfred Novello, and married in 1828 his partner's sister, Mary Victoria (1809–98), the eldest daughter of Vincent Novello. In the year after her marriage Mrs. Cowden Clarke began her valuable Shakespeare concordance, which was eventually issued in 18 monthly parts (1844–45), and in volume form in 1845 as *The Complete Concordance to Shakespeare, being a Verbal Index to all the Passages in the Dramatic Works of the Poet.* This work superseded the *Copious Index to . . . Shakespeare* (1790) of Samuel Ayscough, and the *Complete Verbal Index . . .* (1805–07) of Francis Twiss. Charles Cowden Clarke published many useful books, and edited the text for John Nichol's edition of the British poets; but his most important

work consisted of lectures delivered between 1834 and 1856 on Shakespeare and other literary subjects. Some of the more notable series were published, among them being *Shakespeare's Characters, chiefly those subordinate* (1863), and *Molière's Characters* (1865). In 1859 he published a volume of original poems, *Carmina Minima*. For some years after their marriage the Cowden Clarkes lived with the Novellos in London. In 1849 Vincent Novello with his wife removed to Nice, where he was joined by the Clarkes in 1856. After his death they lived at Genoa at the Villa Novello. They collaborated in *The Shakespeare Key, unlocking the Treasures of his Style . . .* (1879), and in an edition of Shakespeare for Messrs. Cassell, which was issued in weekly parts, and completed in 1868. It was reissued in 1886 as *Cassell's Illustrated Shakespeare*. Charles Clarke died on March 13, 1877, at Genoa, and his wife survived him until Jan. 12, 1898. Among Mrs. Cowden Clarke's other works may be mentioned *The Girlhood of Shakespeare's Heroines* (1850–52), and a translation of Berlioz's *Treatise upon Modern Instrumentation and Orchestration* (1856).

See *Recollections of Writers* (1898), a joint work by the Clarkes containing letters and reminiscences of their many literary friends; and Mary Cowden Clarke's autobiography, *My Long Life* (1896). A charming series of letters (1850–61), addressed by her to an American admirer of her work, Robert Balmanno, was edited by Anne Upton Nettleton as *Letters to an Enthusiast* (Chicago, 1902).

CLARKE, EDWARD DANIEL (1769–1822), English mineralogist and traveller, was born at Willingdon, Sussex, on June 5, 1769, and educated at Tonbridge and Jesus college, Cambridge. In 1799–1803 he made an extended tour through the continent of Europe and afterwards to Egypt and Palestine. After the capitulation of Alexandria, Clarke was of considerable use in securing for England the statues, sarcophagi, maps, manuscripts, etc., which had been collected by the French savants. He returned home by way of Athens, Constantinople, Rumelia, Austria, Germany and France. On arriving in England Clarke made important donations to Cambridge university, including a colossal statue of the Eleusinian Ceres. He received the livings of Harlton and Yeldham and near the end of 1808 was appointed to the professorship of mineralogy in Cambridge, then first instituted. The mss. which he had collected in the course of his travels were sold to the Bodleian library. He was also appointed university librarian in 1817 and was one of the founders of the Cambridge Philosophical Society in 1819. He died in London on March 9, 1822.

The following is a list of his principal works: *Testimony of Authors respecting the Colossal Statue of Ceres in the Public Library, Cambridge* (1801–3); *The Tomb of Alexander, a Dissertation on the Sarcophagus brought from Alexandria, and now in the British Museum* (1805); *A Methodical Distribution of the Mineral Kingdom* (Lewes, 1807); *A Description of the Greek Marbles brought from the Shores of the Euxine Archipelago and Mediterranean and deposited in the University Library, Cambridge* (1809); *Travels in Various Countries of Europe, Asia and Africa* (1810–19; 2nd ed., 1811–23).

See Rev. W. Otter, *Life and Remains of E. D. Clarke* (London, 1824).

CLARKE, SIR EDWARD GEORGE (1841–1931), English lawyer and politician, son of J. G. Clarke, of Moorgate street, London, was born on Feb. 15, 1841. In 1859 he became a writer in the India office, but resigned in the next year, and became a law reporter. He obtained a Tancred law scholarship in 1861, and was called to the bar at Lincoln's Inn in 1864. He joined the home circuit, became Q.C. 1880, and a bencher of Lincoln's Inn in 1882. He appeared, among other cases, as counsel for Patrick Staunton in the Penge murder case (1877) for Mrs. Bartlett (1886), for Sir W. Gordon-Cumming in his slander action (in which Edward VII., then Prince of Wales, gave evidence), and for Dr. Jameson in 1896. He was knighted in 1886. He was returned as Conservative member for Southwark at a by-election early in 1880, but failed to retain his seat at the general election which followed a month or two later; he found a seat at Plymouth, however, which he retained until 1900. He was solicitor-general in the Conservative administration of 1886–92, but declined office under the Unionist government of 1895 when the law officers of the crown were debarred from private practice. The most remarkable, perhaps, of his speeches in the House of Commons was his reply to Mr. Gladstone on the second reading of the Home Rule Bill in 1893. In 1899 he resigned his seat on the question of the government's South African policy. At the general election in 1906 he was returned at the head of the poll for the city of London, but he offended a large section of his constituents by a speech against tariff reform in the House of Commons on March 12, and shortly afterwards he resigned his seat on grounds of health. He retired from the bar in 1914 and died in 1931.

He published a *Treatise on the Law of Extradition* (4th ed. 1903), four volumes of his political and forensic speeches; *The New Testament: The Authorized Version Corrected* (1913); *The Book of Psalms: the Prayer Book Version Corrected* (1915); and his autobiography, *The Story of My Life* (1918).

CLARKE, JAMES FREEMAN (1810–1888), American preacher and author, was born in Hanover (N.H.) on April 4, 1810. He graduated at Harvard college in 1829, and at the Harvard divinity school in 1833. He was then ordained as minister of a Unitarian congregation at Louisville (Ky.), and soon threw himself heart and soul into the national movement for the abolition of slavery, though he was never a "radical abolitionist." In 1839 he returned to Boston, where he and his friends established (1841) the "Church of the Disciples," which brought together a body of men and women active and eager in applying the Christian religion to the social problems of the day. Of this church he was the minister from 1841–50 and from 1854 until his death. He was also secretary of the Unitarian Association and in 1867–71 professor of natural religion and Christian doctrine at Harvard. From 1836–39 he was editor of the *Western Messenger,* a magazine which is now of value to collectors because it contains the earliest printed poems of Ralph Waldo Emerson, who was Clarke's personal friend. Most of Clarke's earlier published writings were addressed to the immediate need of establishing a larger theory of religion than that espoused by people who were still trying to be Calvinists, people who maintained what a good American phrase calls "hard-shelled churches." But it would be wrong to call his work controversial. In the great moral questions of his time he was a fearless and practical advocate of the broadest statement of human rights. He published but few verses, but at the bottom he was a poet. He was a diligent and accurate scholar, and among the books by which he is best known is one called *Ten Great Religions* (2 vols., 1871–83). Few Americans have done more than Clarke to give breadth to the published discussion of the subjects of literature, ethics and religious philosophy. Among his books are *Orthodoxy* (1866); *Every-Day Religion* (1886) and *Sermons on the Lord's Prayer* (1888). He died at Jamaica Plain (Mass.) on June 8, 1888.

His *Autobiography, Diary and Correspondence* edited by Edward Everett Hale, was published in 1891. (E. E. H.)

CLARKE, MARCUS ANDREW HISLOP (1846–1881), Australian author, was born in London on April 24, 1846, and died at Melbourne on Aug. 2, 1881. He emigrated about 1863 to Australia, where his uncle, James Langton Clarke, was a county court judge. He was at first a clerk in the Bank of Australasia, and then learned farming at a station on the Wimmera river, Victoria. He was already writing stories for the *Australian Magazine,* when in 1867 he joined the staff of the Melbourne *Argus*. He also became secretary (1872) to the trustees of the Melbourne public library, and later (1876) assistant librarian. He founded in 1868 the Yorick club, which soon numbered among its members the chief Australian men of letters. The most famous of his books is *For the Term of his Natural Life* (Melbourne, 1874), a powerful tale of an Australian penal settlement, which originally appeared in serial form in a Melbourne paper.

See *The Marcus Clarke Memorial Volume* (Melbourne, 1884), containing selections from his writings with a biography and list of works, edited by Hamilton Mackinnon.

CLARKE, MARY ANNE (*c.* 1776–1852), mistress of Frederick, duke of York, second son of George III., married before she was 18 a Mr. Clarke, a stonemason, whom she soon left. She became in 1803 the mistress of the duke of York, then commander-in-chief. The duke's promised allowance was not regularly paid, and to escape her financial difficulties Mrs. Clarke trafficked in her protector's position, receiving money from various promotion-seekers, military, civil and even clerical, in return

for her promise to secure them the good services of the duke. These proceedings caused a public scandal, and in 1809 Col. Wardle, M.P., brought eight charges of abuse of military patronage against the duke in the House of Commons, and a committee of inquiry was appointed, before which Mrs. Clarke herself gave evidence. The Duke of York was shown to have been aware of what was being done, but to have derived no pecuniary benefit himself. He resigned his appointment as commander-in-chief and terminated his connection with Mrs. Clarke, who subsequently obtained from him a considerable sum in cash and a pension as the price for withholding the publication of his numerous letters to her. Mrs. Clarke died at Boulogne on June 21, 1852.

See Elizabeth Taylor, *Authentic Memoirs of Mrs. Clarke* (1809); W. Clarke, "Life of Mrs. M. A. Clarke," in the *Annual Register*, vol. li. p. 61.

CLARKE, SAMUEL (1675–1729), English philosopher and divine, son of Edward Clarke, an alderman, who for several years was parliamentary representative of the city of Norwich, was born on Oct. 11, 1675, and educated at the free school of Norwich and at Caius college, Cambridge. The philosophy of Descartes was the reigning system at the university; Clarke, however, mastered the new system of Newton, and contributed to its extension by publishing in 1697 a Latin version of the *Traité de physique* of Jacques Rohault, which was used as a text-book till supplanted by the treatises of Newton himself. Having taken holy orders, he became chaplain to John Moore (1646–1714), bishop of Norwich, who later presented him to the rectory of Drayton near Norwich. He subsequently became chaplain in ordinary to Queen Anne, who in 1709 presented him to the rectory of St. James, Westminster, in which year he became a Doctor of Divinity. As Boyle lecturer, he dealt in 1704 with the *Being and Attributes of God,* and in 1705 with the *Evidences of Natural and Revealed Religion.* These lectures, first printed separately, were afterwards published together under the title of *A Discourse concerning the Being and Attributes of God, the Obligations of Natural Religion, and the Truth and Certainty of the Christian Revelation, in opposition to Hobbes, Spinoza, the author of the Oracles of Reason, and other Deniers of Natural and Revealed Religion.* During 1712 he published his celebrated treatise on *The Scripture Doctrine of the Trinity.* It is divided into three parts. The first contains a collection and exegesis of all the texts in the New Testament relating to the doctrine of the Trinity; in the second the doctrine is set forth at large, and explained in particular and distinct propositions; and in the third the principal passages in the liturgy of the Church of England relating to the doctrine of the Trinity are considered. This book involved Clarke in some trouble in the Convocation, which subsequently blew over.

In 1715 and 1716 he had a discussion with Leibniz relative to the principles of natural philosophy and religion, which was at length cut short by the death of his antagonist. A collection of the papers which passed between them was published in 1717 (*cf.* G. v. Leory, *Die philos. Probleme in dem Briefwechsel Leibniz und Clarke,* Giessen, 1893). He died on May 17, 1729.

See W. Whiston, *Historical Memoirs,* and the preface by Benjamin Hoadly to *Clarke's Works* (1738–42).

CLARKE, THOMAS SHIELDS (1860–1920), American artist, was born in Pittsburgh (Pa.), on April 25, 1860, and graduated at Princeton in 1882. He was a pupil of the Art Students' League, New York, and of the École des Beaux Arts, Paris, under J. L. Gérôme; later he entered the atelier of Dagnan-Bouveret, and, becoming interested in sculpture, worked for a while under Henri M. Chapu. As a sculptor, he received a medal of honour in Madrid for his "The Cider Press," now in Golden Gate Park, San Francisco, Calif., and he made four caryatids of "The Seasons" for the Appellate Court House, New York. He designed an "Alma Mater" for Princeton university, and a model is in the library. Among his paintings are his "Night Market in Morocco" (Philadelphia Art Club), for which he received a medal at the International Exposition in Berlin in 1891, and his "A Fool's Fool," exhibited at the Salon in 1887 and now in the collection of the Pennsylvania Academy of Fine Arts, Philadelphia. He died in New York city on Nov. 15, 1920.

CLARKE, WILLIAM BRANWHITE (1798–1878), British geologist, was born at East Bergholt, in Suffolk, on June 2, 1798. He received his early education at Dedham grammar school and in 1817 entered Jesus college, Cambridge; he was ordained, and became curate of Ramsholt, Suffolk. In 1839, after a severe illness, he left England for New South Wales, mainly with the object of benefiting by the sea voyage. He remained there, accepted a clerical charge, and came to be regarded as the "Father of Australian Geology." In 1841 he discovered gold, being the first explorer who had obtained it *in situ* in the country, finding it both in the detrital deposits and in the quartzites of the Blue mountains, and he then declared his belief in its abundance. In 1849 he made the first actual discovery of tin in Australia and in 1859 he made known the occurrence of the diamond. He was also the first to indicate the presence of Silurian rocks, and to determine the age of the coal-bearing rocks in New South Wales. In 1869 he announced the discovery of remains of *Dinornis* in Queensland. He was a trustee of the Australian museum at Sydney and an active member of the Royal Society of New South Wales. In 1860 he published *Researches in the Southern Goldfields of New South Wales.* He was elected F.R.S. in 1876, and in the following year was awarded the Murchison medal by the Geological Society of London. He died near Sydney on June 17, 1878.

CLARKSBURG, a city in the heart of the coal, oil and gas fields of West Virginia, U.S.A., on the West Fork river at the mouth of Elk creek; the county seat of Harrison county. It is on Federal highways 19 and 50, and is served by the Baltimore and Ohio Railroad. The population in 1920 was 27,869 (88·5% native white), and was 30,579 in 1940 by the federal census. The city lies on a plain 1,100 ft. above sea level, surrounded by beautiful hills, in a rich agricultural and grazing, as well as mining, region. It has a large wholesale and retail trade. Coal, natural gas and electric power are available for industrial uses, and the city has numerous manufactures, with an output in 1935 valued at $32,000,000. Products include glass, chinaware, carbon electrodes, zinc, boxes, crates, caskets, barrels, brick, tile, machinery, evaporated milk and other manufactures.

Clarksburg was settled in 1765, and was incorporated in 1785 by the general assembly of Virginia. It was named after George Rogers Clark. In 1917 the towns of Broad Oaks, Stealey Heights, Adamston and North View and several adjoining districts were consolidated with the old city of Clarksburg, which in 1910 had a population of 9,201. A new charter was adopted in 1921, establishing a council-manager form of government. In the next five years contagious diseases were practically eliminated, infant mortality was reduced far below the average for the country, a municipal playground system was developed, the best record in the State was established for the enforcement of the liquor laws, loss by fire was cut to a very low figure, public improvements costing $1,200,000 were made and the city debt was reduced by over $500,000. The bonded indebtedness of the city of Clarksburg in 1940 was $173,000. Clarksburg was the birthplace of "Stonewall" Jackson, of Nathan Goff and of John W. Davis.

CLARKSDALE, a city of northwestern Mississippi, U.S.A., on federal highways 61 and 49, 75 mi. S. by W. of Memphis; the county seat of Coahoma county. It is served by the Illinois Central railway. In 1900 the population was 1,773; in 1920, 7,552 (4,392 Negroes); and 10,043 in 1930 and 12,168 in 1940 by the federal census. It is an important cotton and mule market and has cotton-seed oil mills and other factories. The city was founded about 1830, and was first incorporated in 1882.

CLARKSON, THOMAS (1760–1846), English anti-slavery agitator, was born on March 28, 1760, in Wisbech, Cambs., the son of a schoolmaster. He was educated at St. Paul's school and St. John's college, Cambridge. Clarkson was first drawn to the subject of slavery by reading Benezet's *Historical Survey of New Guinea* (for a prize essay in 1785) on the question set by the vice-chancellor of the university: "Is it right to make men slaves against their will?" The English translation of the Latin of this prize essay, published in 1786, brought him into touch with William Dillwyn, Joseph Wood and Granville Sharp, and soon a com-

mittee of 12 was formed to do all that was possible to effect the abolition of the slave trade. Meanwhile Clarkson gained the sympathy of Wilberforce, Whitbread, Pitt, Grenville, Fox and Burke, and spent his days in travelling from port to port, gaining a mass of evidence which was partly embodied in his *Summary View of the Slave Trade, and the Probable Consequences of its Abolition.* In May 1788 Pitt introduced a parliamentary discussion on the subject, and Sir W. Dolben brought forward a bill, which was passed in the House of Commons on June 18, providing that the number of slaves carried in a vessel should be proportional to its tonnage. In the same year, Clarkson published an *Essay on the Impolicy of the Slave Trade,* but could only get nine men, personally acquainted with the facts of the trade, to promise to appear before the Privy Council. Wilberforce and the committee, however, had obtained other witnesses, and in May 1789 the former led a debate on the subject in the House of Commons, in which he was seconded by Burke and supported by Pitt and Fox.

At the outbreak of the French Revolution, Clarkson hoped that the French would sweep away slavery with other abuses; but the hope was vain, and after six months in Paris during which he enlisted the sympathies of Necker, Mirabeau and the Marquis de la Fayette, he returned to England and to his laborious search for further witnesses of the slave traffic. After his health gave way in 1794, Clarkson laid aside active work for writing, publishing in 1806 *Portraiture of Quakerism,* and, two years later, the *History of the Rise, Progress and Accomplishment of the Abolition of the Slave Trade by the Brit. Parliament.* The bill for the abolition had become law in 1807, and finally, in 1815, British diplomacy secured the condemnation of the trade by the other Great Powers. When the question of practical measures for its abolition was unsuccessfully discussed at the Congress of Aix-la-Chapelle in 1818, Clarkson personally presented an address to the emperor, Alexander I., who communicated it to the sovereigns of Austria and Prussia. In 1823 the Anti-Slavery Society was formed with Clarkson as its vice-president.

From this date until his death at Ipswich on Sept. 26, 1846, his chief works were *Thoughts on the Necessity for Improving the Condition of the Slaves in the British Colonies* (1823), and *American Slavery* (1845). His *Memoirs of William Penn* had appeared in 1813. *See* T. Elmes, *Thomas Clarkson* (1854).

CLARKSVILLE, a city of northern Tennessee, U.S.A., on the Cumberland river at the mouth of the Red river, 42 mi. N.W. of Nashville; the county seat of Montgomery county. It is on Federal highway 41, and is served by the Louisville and Nashville and the Tennessee Central railways and by river steamers. The population in 1930 was 9,242; 1940, 11,831. It is in a region of great scenic beauty, at the centre of the dark tobacco belt. It has a very large trade in both leaf and manufactured tobacco, and in purebred livestock and dairy products. There are flour mills, a snuff factory, mechanical rubber goods plant and other industries. Clarksville was settled in 1780, was named after Gen. George Rogers Clark and was chartered as a city in 1820. Dunbar's cave, an interesting cavern, is 3 mi. from the city.

CLASS commonly denotes any group or set of people or things. This is clear in the use of the term with reference to school and examination groupings. When applied to social groups the term is sometimes used in the same way, and sometimes in the sense of "the higher or wealthier class" (in contrast with the *mass* of the people). In logic, and in science generally, the term *class* is not synonymous with any limited *group.* It means a *kind;* and a kind may be, but is not usually, a limited group. In any case this reference is not to number at all. A class may be known only through a single specimen (as sometimes happens in palaeontology) or it may consist of an endless stream of individuals or groups of individuals. In biology this term *class* has a definite or fixed place in the classificatory scheme—it is one of the kinds into which a "kingdom" is divided, "kingdom" being the most comprehensive class in the biological series.

CLASS DAY, in American colleges and universities a day on which the members of the senior or graduating class celebrate the completion of their courses. The ceremony may take the form of a literary programme involving the reading of the class history or the class poem, the delivery of the class oration or the presentation of the class play; it may include, too, the planting of the class ivy or the class tree or the burning of books in a huge bonfire to signify liberation from class-room routine. Formal presentation of a memorial gift to alma mater, athletic contests, campus singing, receptions, banquets and other forms of entertainment reflecting the traditions of the institution may also characterize the event.

CLASSICAL EDUCATION. In the universities of Great Britain archaeology, anthropology, numismatics, epigraphy, psychology, philology and geography are recognized as essential to the classical scholar who would understand and describe clearly conditions of life in the ancient civilizations. Western Europe has learned to realize the measure of its debt to Greece and to estimate the nature of the legacy it has received from Imperial Rome. The precision of classical literature leads to a sense of proportion, a standard of values, a respect for the truth of words, and accuracy of thought. In the principal secondary schools classical studies are not losing ground (*see* PUBLIC SCHOOLS). As historical links exist with university foundations, the great public schools conserve the best traditions of classical scholarship. In the ordinary secondary schools Latin in taught as one of several competing subjects. Of new methods in use the following is one of the most interesting and most original.

The Direct Method.—The direct method of teaching foreign languages aims at connecting the foreign word, phrase or sentence directly with a thing, act or thought, without the intervention of English. When a certain number of words have been learned, new ones are explained by a paraphrase in the same language; and in the final stage, the literature is read and discussed in the original.

A working system has been devised by which this method can be applied to Latin and Greek. Time is saved, because the whole lesson is taken up with the language, attention is kept, because the language used is real to us instead of artificial; understanding is easy, because what we do or see, explains what is said. In proportion as we exclude English words from our minds, we come to think in the language, and a feeling for its idioms and turns of speech is soon developed. Since the vocabulary used is simple and deals with every-day and familiar life, the attention can be exercised on the peculiar inflections which distinguish the ancient languages.

Grammar is learned after use, not before, and is therefore less irksome. Short exercises are used, to illustrate grammar; they do no harm if they come in their proper place (after use) and in due proportion.

With the reading book, from the very first all is read aloud and explained in the same language, the explanations being written and learned. English is never used unless it cannot be helped. When the pupils are fit to read an author, they know enough to dispense with English. Formal translation from English into Latin or Greek, the most difficult of all exercises, is reserved for the last two years of school life. Whoever does not understand must ask. No one is blamed for not understanding; all are blamed for not asking.

In the reading lesson every line of the matter is read aloud; and very often the mere manner of reading shows whether the text has been understood, and if it has not, it can be explained simply by correct reading. By reading the memory is filled, the ear is taught, the taste is trained; the language, in short, is learned in the most effective way. So much so that verses of all sorts, lyrics included, are written with ease by imitation. But the real merit of this method lies in its effect on the learner. From the first stage to the last, the learners are willing to learn, and happy in learning. (C. BR.; W. H. D. R.)

The United States.—Classical education in the United States began with the founding of Harvard college and the Boston Latin school in about 1638. Following the English model (probably Cambridge) the only requirement for entrance to Harvard was the ability to read and speak Latin, and some knowledge of Greek forms, and this was also the aim of the Latin school. All lectures were in Latin, the curriculum consisted almost wholly of the

classics and students were required to speak Latin on the campus. The subsequent progress of classical education has been divided roughly into three periods: the pre-revolutionary period, the period to the close of the Civil War, and the modern period.

During the first period admission requirements remained much the same, as at Harvard, even arithmetic was not required until 1693, and then not universally. In the colleges the classics remained supreme, although arithmetic, geography and anatomy were included in the curriculum of William and Mary in 1693, and physics in that of Yale in 1701. Also the forerunner of the University of Pennsylvania, under the influence of Benjamin Franklin, made considerable provision for science, and an impressive programme in science and history was announced by Columbia in 1754, which, however, as not adhered to.

The middle period was one of great educational expansion. Many new colleges and secondary schools were founded, and the States began to make provision for higher public education in the State universities. Public high schools also began to multiply. The curricula of the colleges were greatly extended, and the appearance of new subjects in the requirements for entrance involved provision for them in the fitting schools. At first Greek and Latin, later Latin alone, were obligatory on all candidates for degrees, and while in some academies, notably those for girls, and in the State universities, the tendency was to greater freedom, still the general tone of education was cultural, interpreted as classical.

The modern period has been one of revolution, both in ideals and practices. The carrying out of the theory of universal education, and the rapid growth of industrialism demanded greater provision for vocational and scientific training. The public high schools still clung closely to the classical tradition but they showed the new influence in the great broadening of their curriculum. Where this was not done, vocational and trade schools discarded the classics for a more immediately practical training. In higher education, either separate scientific and technical schools were established, or increased provision was made for science in the colleges and universities, and modern languages and the social sciences vied with the natural sciences in pressing their claims.

Room for the new subjects could only be obtained at the expense of the classics. The first to be seriously affected was Greek, which, though vigorously defended, had by 1928 been eliminated almost entirely from the curriculum of the secondary schools, and was studied by very few undergraduates in college. Latin also was severely curtailed and at one time seemed likely to go the way of Greek. Since the World War, however, there has been some reaction in favour of Latin in the colleges and it has continued to hold a large place in the schools, partly because it is still an important requirement for entrance to college. It was estimated that over 1,000,000 pupils were studying Latin in the schools in 1928. It is not, however, the Latin of former days. Under the attacks of the new psychology and the advocates of practical studies the teaching of Latin, which formerly had been largely a mechanical preparation for entrance examinations, has now been adapted rather to the immediate needs of the pupils studying it. In 1920 the general education board arranged with the American Classical League to conduct an investigation of the classics (chiefly Latin) in the secondary schools. In the report, published in 1924, the aims of the teaching of Latin were set forth as follows: to read and understand Latin; to increase the pupil's ability to understand the Latin element in English, and to read, speak and write English; to develop historical and cultural background, correct mental habits and right attitudes towards social situations; to increase the ability to learn foreign languages; and to give an elementary knowledge of the principles of language structure. In the furtherance of these aims extensive recommendations were made as to curriculum and method of teaching. These have been very widely adopted and the text-books are rapidly being reconstructed to carry them out. As a result the outlook is bright for continued support of Latin, particularly in the secondary schools, as an important element in American education. (G. L.)

France.—In France during the greater part of the 19th century, the position of classics in secondary schools was supreme. They alone led to the baccalaureate:—sole entrance to the universities and the liberal professions. Towards the end of the century, a strong movement in favour of modern languages and science arose. In 1898 a parliamentary committee was appointed to inquire into the subject. They reported in 1899, but it was not till 1902 that their conclusions were embodied in the establishment of four alternative courses, a full classical, a Latin-modern languages, a Latin-science and a purely modern course, all of which led to the university. These courses remained unchanged for nearly 20 years, and during that period the classical candidates for the baccalaureate, who in 1904 numbered 3,337, fell to 2,775 in 1924. The Latin-modern rose from 1,217 to 5,964, the Latin-science from 2,229 to 5,241 and the science-modern languages from 2,742 to 5,241. Thus, while Greek declined, the students taking Latin increased more than twofold and amounted to over 70% of the candidates.

The World War brought its aftermath of discussion. In 1922 M. Bérard, the minister of public instruction, proposed to make Latin and Greek obligatory in the earlier stages, and to cut down the courses of two (classical or modern). A bitter struggle followed, in which the majority of expert opinion was against him. None the less, in May 1923 the President of the republic issued a decree embodying the proposals of M. Bérard, and requiring a certificate of proficiency in Latin and Greek from all future candidates for the baccalaureate. A year later the Ministry fell and was replaced by a Radical one. The two courses have been maintained, but classics are no longer obligatory for all, though as the curricula of the girls' schools have now been assimilated to those of the boys, a classical education is equally open to the former.

Germany.—In Germany up to the end of the 19th century, classics were likewise supreme. The full classical school, the Gymnasium, was with one or two exceptions the sole avenue to the university and liberal professions. In 1890, at the instance of the Kaiser, a conference was called in Prussia. Its conclusions, largely embodied in the curricula of 1892, reduced the number of hours given to classics and dethroned the latter in favour of the mother tongue, while the universities were thrown open to pupils from the Realgymnasium (Latin-modern school) and to a large extent to those from the Oberrealschule (modern studies school). Similar reforms had already been adopted by other German states. The next outstanding feature was the founding of Reformgymnasia, where the first language was French, Latin not being introduced till the fourth and Greek till the sixth year, both being taught intensively. This type was largely adopted in Prussia before the war. Classical studies have been open to girls since 1904, but the number taking them has not been very great. For education since the war, no statistics are available, but according to one authority, "the desertion of schools with Latin as a central subject is general." Others are less pessimistic and the prevailing opinion seems to be that the Reformschulen will ultimately be the future type of German classical education.

Italy.—Of the other European countries, the most interesting one from the classical standpoint of view is Italy. Here, thanks to the reforms of Gentile, there has been a strong reaction in favour of classics, and by the royal decrees of May and Nov. 1922, classical studies have been strengthened in the higher schools not only of the purely classical but also of the scientific type. Latin in fact is now obligatory in all secondary schools. Room for this increase has been found by cutting down the number of subjects and reducing the time given to mathematics; the main object of the reform being to replace the former encyclopaedic aim of the school by a cultural one based on direct knowledge of the classics. Latin is also a principal subject in the girls' high schools.

Belgium.—In Belgium again the position of classics appears to have improved. A committee was appointed after the War to consider the reform of the school syllabuses and the position of Greek. As a result, classics have been maintained in the Athénées Royales (high schools) and further Greek and Latin can be studied in those *écoles moyennes,* which are not within convenient distance of an athénée.

Norway.—In Norway, likewise, the classics have recovered ground. In 1896 Greek was entirely banished from secondary education; to-day it is included in one section of the higher schools (gymnasia), and can be studied by girls as well as boys.

Czechoslovakia.—The republic of Czechoslovakia has largely maintained the previous types of education, which were on German lines and as the system is co-educational, classical or Latin studies are equally open to girls.

Sweden.—In Sweden classics seem to have somewhat lost ground. The pupils following a full classical or Latin course, who ten years ago were in a majority, are now outnumbered by those taking modern studies. (C. Br.; W. H. D. R.)

Latin American Countries.—In Latin American countries less attention is given to study of classical languages than in other countries whose culture is derived from the classical heritage. In the first place secondary schools in most Latin American countries were established at a time of reaction against schools maintained by the teaching orders which had emphasized the classical basis in secondary education. Secondly, universities have consisted in the main of loosely associated faculties for professional preparation and are only just beginning to permit the study of liberal art subjects either in existing faculties of philosophy as in Buenos Aires, or in newly created faculties as in Santiago. In these the study of the classics may find encouragement in time. Thirdly, the secondary school curriculum has developed by an accretion of subjects and unlike the development in European countries and the United States, little provision has been made for options or for differentiated courses. Consequently, when the list of subjects to be carried became too burdensome, a solution was found by dropping those subjects, especially Latin, which the pupils found too difficult and whose utility was not recognized by the parents.

The situation in general may be illustrated from the practices of some of the leading Spanish American countries. In the Argentine a movement to make Latin an optional subject began as early as 1870 and was realized in 1886; in 1891 proposals began to be made to drop it and by 1901 it disappeared entirely except in three schools that enjoy special privileges of autonomy. Greek had disappeared as early as 1863. In Chile Latin ceased to be required for graduation from a secondary school in 1877 and gradually disappeared. In 1925 an inquiry elicited the opinion that room should be found in certain schools for the study of Latin with or without Greek. It is significant to note, however, that all students in the Instituto Pedagogico, the institution for training secondary school teachers, must take Latin, if they wish to become specialists in Spanish or any modern foreign language. In Uruguay Latin grammar was taught in the first two years of the secondary school course in 1889 but was dropped in 1909. Latin is required in Mexico of students who plan to enter the faculty of law of the university.

In Brazil the exception to the general practice may be found, for here Latin is required for four years of the six year secondary course and Greek survives in some schools on an optional basis.

The secondary school situation is reflected in the universities. The general absence of liberal arts faculties has been noted. The small number of professors of Latin or of Greek is to be found at the Universities of Buenos Aires and La Plata in the Argentine, in the Instituto Pedagogico of the University of Chile and in the University of Concepción in Chile, and in the private Colegio Mayor de Nuestra Señora del Rosario in Colombia. Latin, if not Greek, is still cultivated by the ecclesiastical orders and it is under the direction of their members that those who are interested in the classics may pursue their studies beyond the level of the secondary schools. (I. L. K.)

CLASSICS. "What need to speak of Democritus? . . . Who does not place this philosopher above Cleanthes, Chrysippus, and the others of later times? These appear to me to be fifth class as compared with him" (*qui mihi cum illo collati quintae classis videntur*). Thus Cicero, *Academics* ii. 23, 73. The expression "fifth class," natural and familiar as it sounds to a modern ear, has an interesting history. Among the constitutional reforms ascribed to Servius Tullius, the sixth king of Rome, was the division of the citizens into five *classes* according to the amount of their property as determined from time to time by a census. Hence the fifth *classis* denoted the lowest class of citizen from the point of view of wealth. It appears from Aulus Gellius, vi. 13, that the term *classicus* was applied only to the first or highest *classis:* "Not all those who were enrolled in the five classes were called *classici,* but only the men of the first class, who were rated at 125,000 *asses* or more. 'Below class' was the appellation given to those of the second or other classes rated at a lower sum. . . . This I have briefly noted because apropos of M. Cato's speech in support of the Voconian law the question is often asked what is meant by *classicus* and what by 'below class.'" When or by whom the term was first used in a metaphorical sense to denote an order of merit, we do not know. This extension is already implied in the *quintae classis* of Cicero. But the first extant example of *classicus* to denote the highest order of literary merit seems to be Aulus Gellius (2nd century A.D.) xix., 8, 15. Julius Caesar in his treatise *De Analogia* had laid down the doctrine that *quadrigae* (in the plural), even of a single chariot, is the only correct use, and conversely that *harena* (sand) is only used correctly in the singular. Gellius narrates a conversation on the matter with M. Cornelius Fronto, who supports the opinion of Caesar, and concludes with the words: "Now go, and when you have time see if you can find *quadrigae* in the singular, or *harena* in the plural, written by any of the elder orators and poets—I mean, by one who is a *classicus* and *assiduus* writer, not one who is *proletarius.*" *Assiduus* seems to have been applied more generally to members of the wealthier classes, being equivalent to *locuples* and indicating a person of property (Cic. *Rep.* ii. 22–40; *cf.* Aul. Gell. xvi. 10). *Proletarii,* on the other hand, were the poorest citizens who contributed nothing to the state but their offspring (*proles*); (*cf.* Aul. Gell. *l.c.*, Cic., *Rep.* ii. 22–40). In modern times the word "classic" is in common use of any author who has tholed the assize of the centuries, or even of one who in his own time is classed with those who have: Macaulay, *Boswell's Life of Johnson:* "What a singular destiny has been that of this remarkable man! To be regarded in his own age as a classic and in ours as a companion!" But the term "classics" has been long and widely used to denote more especially the literatures of ancient Greece and Rome, and in that sense it is employed here.

THE LITERATURE OF GREECE

Commencing with Homer, ancient Greek literature may be considered as extending down to Justinian (A.D. 527), thus covering a period of something like 14 centuries. Within this period it is usual to distinguish (1) the Classical period extending from Homer to the death of Alexander (323 B.C.), (2) the Alexandrine period from 323 B.C.–A.D. 100, (3) the Post-Alexandrine period A.D. 100–529. The Byzantine period from 529 to the capture of Constantinople by the Turks produced no Greek literature of first-rate importance.

The unique feature of Greek literature and one which lends it a unique interest, in addition to its intrinsic merit, is its originality. The Greeks invented all the great types of literature alike in poetry and in prose. Thus epic, lyric, elegy, tragedy, comedy in poetry; history, rhetoric, philosophy in prose—were all alike, as the very names declare, the invention of this extraordinarily gifted people. A people whose literature is based upon foreign models may devote themselves to the cultivation of the different types in any order of succession, or may cultivate the several types in the same age with equal enthusiasm. But the Greeks, having no models, discovered and developed the different forms in logical succession, one being evolved from the other according to the spiritual and social impulses of the time. Moreover, when any one form was developed to its full perfection, they seem to have passed on to another. Hence it is that in Greek literature more than in any other we can speak of a given age as the age, not of this individual writer or of that, but as the age of a particular form of literature.

Greek Poetry to 323 B.C.—Greek literature begins with the Homeric epic, represented for us by the *Iliad* and the *Odyssey.*

There is evidence enough in these poems that they are themselves not primitive in the sense of being a first pioneer effort in the writing of epic. The recurrent epithets and conventional formulae, nay, the very metre in which they are written, imply a long ancestry of poetic practice and experiment. What makes these two epics unique among the epics of all literature is that on the one hand they are sufficiently near the dawn of literature to have yet upon them the dew of the morning, to have all the directness and simplicity and naïveté which we associate with primitive poetry; and on the other hand they belong to a stage of development so far advanced as to have outlived the imperfection of form, and the triviality or vulgarity of thought which, in early poetry, are apt to offend the cultured reader. Moreover, they have developed at once a language and a metre—from what elements and by what stages developed we do not here enquire—which together constitute a vehicle for narrative epic such as no other people have ever possessed. And because of this union of a language uniquely suited to the metre, and a metre uniquely suited to the language, the union has resisted divorce. Down to the latest times, the same language and the same metre continued to be the one medium of Greek epic. The Romans borrowed the metre, but in Roman hands its character is entirely changed, and whatever other merits Roman epic may possess, they are assuredly quite other than the merits of Homeric epic. Attempts to transplant the hexameter (*q.v.*) into English were—for reasons which cannot be here elaborated—foredoomed to failure. And what has become the favourite medium for epic in English, viz., blank verse, suffers in comparison with the Homeric hexameter much in the same way as the Roman hexameter does in comparison with the Greek, a lack of lightness and mobility: defects which both in Roman epic and in English, find their compensation in certain other qualities which are, however, of value only from the point of view of poetry in general, assuredly not from the point of view of epic poetry in particular.

Alongside the Homeric type of *Epos, i.e.,* the epic of chivalry, which had for its subject the story of war and adventure in the heroic age, the *κλέα ἀνδρῶν* of *Iliad,* ix. 189, etc., the Greeks early developed quite another type of *Epos,* which had for its business to inculcate the traditional wisdom of the race. As Hesiod, the earliest of the didactic poets, belongs roughly to the Homeric age—in Greek tradition Homer and Hesiod are regularly coupled together and regarded as contemporaries: Herod ii. 53; Plato, *Rep.* 363 A; 377 D; 599 D; Aristoph., *Ran.* 1,033 *seq.*—he naturally chose for his didactic poems the Homeric hexameter. Two didactic poems are ascribed to Hesiod—the *Theogony* and the *Works and Days.* True to Greek custom the hexameter remained down to the latest times the recognized medium for didactic poetry. The *Theogony* of Hesiod may be regarded as the forerunner of the philosophical poems bearing the title Περὶ Φύσεως (On Nature), of which three were especially notable: (1) that of Xenophanes of Colophon, the founder of the Eleatic school of philosophy, in the second half of the 6th century, whose protest against the unworthy ideas of Homer and Hesiod regarding the gods is well known:

> πάντα θεοῖς ἀνέθηκεν Ὅμηρός θ' Ἡσίοδός τε
> ὅσσα παρ' ἀνθρώποισιν ὀνείδεα καὶ ψόγος ἐστίν . . .
> ὡς πλεῖστ' ἐφθέγξαντο θεῶν ἀθεμίστια ἔργα
> κλέπτειν μοιχεύειν τε καὶ ἀλλήλους ἀπατεύειν

("Homer and Hesiod ascribed to the gods everything that men think scandalous and shameful. . . . They recounted very many wrongful acts of the gods—theft, fornication and deception of each other."); (2) Parmenides of Elea, the most distinguished of the Eleatics (*c.* 504 B.C.); (3) Empedocles of Acragas (born *c.* 495 B.C.), whose poem was the direct model of the *De Rerum Natura* of Lucretius (Lucret. I. 726 *sqq.*). On the other hand Hesiod's *Works and Days* was the prototype of a long series of poems of the practical type, including the *Theriaca* and *Alexipharmaca* of Nicander of Colophon, the *Phaenomena* of Aratus, the *Halieutica* of Oppian the Cilician, the *Cynegetica,* attributed to Oppian, but the work of a later poet from Apameia in Syria—all of which are extant, and of the no longer extant *Halieutica* of Caecalus, Numenius, Pancrates, Poseidonius, as well as of the *Georgics* of Virgil, the *Cynegetica* of Grattius and Nemesianus in Latin.

To the epic age succeeds that of iambus and elegy. Iambus, as a literary form, although it had a long life, from Semonides of Amorgos (*c.* 625 B.C.) to Callimachus and Herondas in Alexandrine times, never achieved an important independent existence. The reason is sufficiently obvious. The iambus—a short syllable followed by a long (*see* IAMBIC)—as the chief component of ordinary prose speech is not of itself adequate to support an independent type of poetry. It is true that it does so in modern literature, as for example in English. But the mere name "blank verse" by which the iambic metre is usually described practically admits that "blank verse" differs from ordinary prose in either one of two ways. Either it betrays its poetic intention by an exactness of rhythm which is repugnant to prose, *i.e.,* by a rhythm the recurrences of which produce metre, or by the quite adventitious use of rhymed endings, "the invention," as Milton says, "of a barbarous age, to set off wretched matter and lame metre." But in any case the iambus as an independent form never attained first-rate importance in early times, nor does its recrudescence in Alexandrine times in any way suggest that it could ever be of great importance by itself. As we shall immediately see, in conjunction with lyric metres in tragedy and comedy it was able to find a place which could not have been taken either by the epic hexameter or by any other metre.

Elegy, on the other hand, consisting of alternate hexameters and pentameters (*qq.v.*) is the nearest approximation to epic. But there does not seem ever to have been the least danger in Greek of confusing the function of elegy with that of epic. The name ἔλεγος, ἐλεγεῖον, ἐλεγεῖα, ἐλεγεία is of quite uncertain origin, but everything tends to show that from the first it was essentially of a plaintive character, being regularly accompanied not by the lyre, the instrument of mirth, but by the flute, the instrument of mourning (ἔλεγοι οἱ πρὸς αὐλὸν ἀδόμενοι θρῆνοι, Didymus *ap.* schol. Aristoph., *Av.* 217; Pausan. x. 7.5; *cf.* Aesch., *Ag.* 990, *Eumen.* 332; Soph., *Tr.* 640 *sqq.;* Eurip., *Hel.* 85, *Iph. Taur.* 146, 1091; Ovid, *Ep.* xv. 7, *Amor.* iii. 9.3; Hor. *c.* i. 33.2). Who invented the form is not known (Hor. *A.P.* 77).

Quintilian, curiously enough, regards Callimachus as the chief elegiac poet, and Philetas of Cos as the second (x.1.58), and Propertius regards these two poets as his masters (v.1.1). In any case the Greeks, at a very early period, extended the range of elegy far beyond the dirge or lament to poems of war and of traditional wisdom. But they did not, like Ovid, use the elegiac metre as practically a substitute for the epic hexameter. The text of Theognis (of Nisaean Megara, *c.* 500 B.C.) in two books, is the longest elegy that has come down to us. It hangs together very loosely and is rather a series of elegies of varying length than a single poem. In the Alexandrine age we have various fragments of the *Aitia* of Callimachus and the whole (with one slight lacuna) of his Hymn entitled the *Bath of Pallas* (Λουτρὰ Παλλάδος) in 142 lines. But the type of elegy which was carried to the highest perfection by the Greeks was what is generally known as the epigram, a highly polished poem in elegiacs, varying in length from a single distich to half-a-dozen or more, and of very various content. This type makes up the great bulk of the collection known as the Greek Anthology (*q.v.*).

Next in order of development and, of course, to some extent coincident in point of time, we have lyric poetry or song, and this of two types—on the one hand the individual or personal song, and on the other the choral lyric. Of the first the remains are exceedingly meagre and, indeed, are chiefly confined to the fragments of Alcaeus and Sappho. Of the high merits of the latter the Greeks seem to have entertained no doubt, and modern critics—whether professed classical scholars or amateurs like Swinburne—have vied with one another in finding words of enthusiastic and extravagant eulogy.

Of choral lyric, on the other hand, we have very extensive remains, both as an independent literary form, and as an element of tragedy and comedy. Of the first our most important representative is Pindar, of whom, apart from considerable fragments,

we possess some 45 odes classed—not always correctly—as epinician odes, or odes in celebration of victors in the games (Olympian, Pythian, Nemean, Isthmian). We have also recovered in recent years (1896) a papyrus containing a certain amount of his junior contemporary Bacchylides, about six poems being practically complete. The manner in which these poets succeed in contriving that a poem which is in the first instance written to celebrate such an ephemeral event as a victory in the games should be of permanent appeal, is a very interesting literary study, which will be more fittingly discussed in connection with Pindar (*q.v.*).

The next important development is the drama, including, of course, both tragedy (with the Satyric drama) and comedy. While in all likelihood these two species of drama were of contemporaneous origin, tragedy was the earlier to attain a high degree of perfection: Aristotle's statement (*Poet.*, c. v., 1449ª36) of the comparatively late date at which comedy was not formally recognized by the State, is confirmed by epigraphic evidence from which it appears the comedy was not officially recognized by the State until 488–487 B.C., while Thespis, the father of Attic tragedy, is said to have produced his first tragedy in 534 B.C.

Tragedy is said by Aristotle to have originated *ἀπὸ τῶν ἐξαρχόντων τὸν διθύραμβον* ("with the leaders of the dithyramb," *Poet.* 4.1449ª10), and this seems to agree with the facts. The literary development of the dithyramb in honour of Dionysus is associated with the Dorian Corinth, and Greek tragedy on the face of it seems to be a combination of Doric choral song with Ionic dialogue. The great period of Attic tragedy is the 5th century B.C. and is mainly represented for us by the remains of the three great tragedians, Aeschylus (525–456 B.C.), Sophocles (496–406 B.C.) and Euripides (*c.* 480–406 B.C.) (*qq.v.*). We also possess Euripides' *Cyclops*, the only extant Satyric drama, the recently discovered *Ichneutai* of Sophocles being in a fragmentary form. The usual method of the production of tragedy in the 5th century was in the form of a trilogy of tragedies followed by a *δρᾶμα σατυρικόν* (Satyric drama). The relation of this last form of drama, in which the spirit is in the vein of comedy, while the chorus is a choir of satyrs, to tragedy is a subject of debate. Aristotle regards the satyric element as original (*Poet.* 4.1449ª19) which seems the more probable view. On the other hand it has been held, both in ancient and modern times, that the satyric element was not original. According to an old view it was superadded to tragedy by way of comic relief (Hor., *A.P.* 220 *sqq.*). Prof. Ridgeway, holding that tragedy originally was non-Dionysiac, but connected with the solemn commemoration of the dead, derives *saturoi* from *Satrae*, a Macedonian tribe, and holds that the introduction of the satyric element was coincident with the introduction of the worship of Dionysus at Athens towards the end of the 7th century B.C.

Comedy originated, according to Aristotle, *ἀπὸ τῶν τὰ φαλλικὰ (ἐξαρχόντων) ἃ ἔτι καὶ νῦν ἐν πολλαῖς τῶν πόλεων διαμένει νομιζόμενα*, "with the leaders of the phallic songs which still survive in many cities as an institution" (*Poet.* 4.1449ª 11). This again seems a very probable account, the name *κωμῳδία* being derived, not from *κώμη*, village, but from *κῶμος*, a company of revellers (Arist., *Poet.* 3.1448ª36 ff). These phallic songs were sung (Aristoph., *Ach.* 261, "And I will follow and sing the phallic song,") by lewdly dressed processionalists, *phallophoroi*, and the intention was by mimetic symbolism to promote fertility (Athen. 621 E. For their dress and procedure *cf.* Athen. 622 B). Similar customs exist even at the present day, *e.g.*, in Macedonia.

The Alexandrine scholars distinguished Attic comedy into Old (*παλαία*) and New (*νέα*), the further distinction of Middle (*μέση*) comedy dating only from the time of Hadrian. For us the only poet of the Old Comedy of whom a complete play is extant is Aristophanes (*q.v.*, *c.* 446–385 B.C.).

We note some features which belong to the earliest stages of comedy. We notice first the frequency with which the chorus, from which the comedy takes its name, represents some species of animal. Similarly we hear of plays by Magnes entitled *Birds, Frogs, Gall-wasps* (*cf.* Aristoph. *Eq.* 522 *seq.*). It is impossible to doubt that tragedy in the same way got its name from the fact that the chorus was represented as He-goats (*τράγοι*), or that the Satyric drama was also named from its chorus of He-goats (*σάτυροι*, *cf.* שְׂעִירִים) Is. 13.21. Puck = Bock (Ger.) = Buck (Eng.). Then we have the *Parabasis* or address to the spectators, also primitive, as is the *Agon* or debate between two opponents. The later plays of Aristophanes show a considerable divergence from the earlier. The three earliest plays—*Acharmians, Knights, Wasps*—have a fully developed *Parabasis*, while in three of the later plays—*Lysist., Eccl., Plutus*—the *Parabasis* has completely disappeared. Similarly with the place of the chorus in general. Thus in the *Plutus* the office of the chorus is confined to dialogue, and there are no choral songs. The later plays thus exhibit tendencies which are carried still farther in the New Comedy. Menander (*q.v.*, *c.* 323–293 B.C.), though his date falls in the Alexandrine period, has nothing to do with the Alexandrines: he declined the invitation of Ptolemy I. to go to Alexandria and remained in Athens. The characteristic feature of his comedy seems to have been faithful representation of life (*cf.* Syrian. in Hermog. 2 p.23 8 Rabe). Although his scanty remains have been greatly augmented in recent years by discovery of papyri, we still have no complete play. The word *Χοροῦ* appears after *Epitrepontes* 201: otherwise, Chorus, *Agon, Parabasis* have completely disappeared.

Greek Prose to 323 B.C.—While prose doubtless preceded poetry, prose as a developed literary form is later than poetry. Hence the history of Greek prose down to 323 B.C. is a much shorter story than that of Greek poetry in the same period. If we take the three great literary types of prose to be history—the novel or romance, when it is developed is merely fictitious history, *cf.* Bacon, *Advanc. of Learning* ii.: "Poetry . . . in respect of matter is nothing else but feigned history, which may be styled as well in prose as in verse"—oratory, philosophic essay or dialogue—the natural order of development is history (including the fable or apologue, and the speech as subsidiary elements), oratory, philosophic prose.

Three *historians* in this period are represented by complete works. First we have the *History* of Herodotus (*q.v.*, *c.* 484–425 B.C.). His conception of the function of history is clearly stated in his opening paragraph: *Ἡροδότου Ἁλικαρνησέος ἱστορίης ἀπόδεξις ἥδε, ὡς μήτε τὰ γενόμενα ἐξ ἀνθρώπων τῷ χρόνῳ ἐξίτηλα γένηται, μήτε ἔργα μεγάλα τε καὶ θωυμαστά, τὰ μὲν Ἕλλησι, τὰ δὲ βαρβάροισι ἀποδεχθέντα, ἀκλεᾶ γένηται, τά τε ἄλλα καὶ δι' ἣν αἰτίην ἐπολέμησαν ἀλλήλοισι.* "This is the history of Herodotus of Halicarnassus, published in order that what has happened may not be forgotten of men by the passing of time, and that the great and admirable actions of the Greeks and the barbarians may not become unappreciated, and in particular the reasons for the war between them." His object is thus simply to prevent the achievements of the past from being obliterated by time; he has no notion that a knowledge of the past should have any bearing either on the conduct of the present or the anticipation of the future. As to his conception of the duty of the historian, we need only note that he travelled widely and used all the sources of information open to him, whether monumental or oral. In matters of dispute, he endeavours to state both sides of the question, but with refreshing candour he warns the reader that he does not affirm the truth of either side (ii. 123, vii. 152). On any view Herodotus must always be regarded as one of the most charming of historians. His air of candour and naïveté (Quintil. x. 1.73) heightened by the archaic suggestion of the dialect (Ionic) in which he writes and the simple structure of his composition (*λέξις εἰρομένη*), his digressions, his picturesqueness give him an irresistible appeal.

Thucydides of Athens (*q.v.*, *c.* 460–*c.* 396 B.C.) wrote a *History of the Peloponnesian War*, now divided into eight books. He tells us (i. 1) that he commenced to write his *History* as soon as the war began, as he foresaw that it was likely to be a greater and more important war than any that had yet taken place, an opinion founded on the fact that both the Athenians and the Lacedaemonians were at the height of their power, while the other Greek States were likely to range themselves on the side of one or other of the protagonists in the conflict. His failure in 424 to save Amphipolis led to his going into exile, a circumstance which

gave him the opportunity to study the war from both sides (v.26). His conception of the function of history differs markedly from that of Herodotus. His idea is that a knowledge of the past is the best guide to the future (i. 22). Two peculiarities of his *History* must be noted. First the annalistic order of treatment. That is to say, instead of treating an episode of the war as a whole, he narrates events *κατὰ θέρος καὶ χειμῶνα, i.e.*, after the form of a diary—all the events of a particular summer are grouped together, however unconnected they may be, and these are then followed by the events of the ensuing winter. Another remarkable feature is the use of set speeches composed in a highly elaborate form—showing the exaggerated use of the antithesis which characterized early Greek rhetoric. His own account of the conception of these speeches is given in i. 22: "as to the speeches delivered by the several combatants either when they were about to go to war, or when they were already involved in it, it was difficult both for me in the case of speeches which I heard myself, and for those who reported to me speeches from other quarters, to remember the exact words. I have written what it seemed the various speakers would have said if they spoke to the purpose, while keeping as close as possible to the general sense of what was actually said."

The third of the historians is Xenophon of Athens (*q.v., c.* 431–*c.* 355 B.C.). His *Hellenica* in seven books continues the history of Greece from the point reached by Thucydides (411 B.C.) down to the battle of Mantineia in 362 B.C. His *Anabasis* in seven books describes the expedition of Cyrus, the Persian prince, against his elder brother Artaxerxes II. In this expedition 10,000 Greek mercenaries took part. When Cyrus fell in the battle of Cunaxa (401 B.C.) and the Greek leaders were put to death by Tissaphernes, Xenophon caused new leaders to be chosen, including himself. The main part of the *Anabasis* describes the retreat of the Greek mercenaries. Other strictly historical works by Xenophon are his essay upon Agesilaus, king of Sparta; an essay on *Athenian Revenues;* another on *Lacedaemonian Polity.*

The art of *rhetoric* was a development of the 5th century, the pioneer professional teachers of Oratory of whom we chiefly hear being Corax of Syracuse, his pupil Tisias and Gorgias of Leontini (whose style we can infer from the extant fragments). The Alexandrine canon recognized ten Attic orators: (1) Antiphon (*q.v., c.* 480–411 B.C.) of whom we possess three Tetralogies, each consisting of four speeches, and three speeches in real cases. The interest of these speeches is twofold, first as examples of early forensic oratory, and secondly, all being concerned with cases of murder, as throwing light upon some intimate matters of Athenian social life which would otherwise be obscure; (2) Andocides (*q.v.,* born *c.* 440), under whose name four speeches are extant; (3) Lysias (*q.v.*), son of a Syracusan *μέτοικος,* of whom 34 speeches are extant. Simple and unaffected in style, they throw a flood of light on Athenian domestic and social life; (4) Isocrates (*q.v.,* 436–338 B.C., when "that dishonest victory at Chaeronea, fatal to liberty, Kill'd with report that old man eloquent"), of whom we have 21 orations. His interest is chiefly stylistic; he greatly influenced Cicero and through him modern prose style; (5) Isaeus (*q.v., fl. c.* 360 B.C.), of whom we have 12 speeches (11 and 12 being incomplete). All the speeches, except No. 12, deal with the testamentary disposition of property and are of inestimable value for the knowledge of Attic private law; (6) Demosthenes (*q.v.,* b. 384 B.C.), under whose name we have 69 orations (not all, however, being orations, and not all genuine), the greatest oratory of antiquity (Quintil. x. 1.76). While his fame rests especially on the *Philippics, Olynthiacs, De Falsa Legatione,* and, above all, the *De Corona,* many of the other speeches are of high merit, while his private forensic speeches are extremely valuable for the information they afford, particularly in regard to the operations of commerce in ancient Greece; (7) Aeschines (*q.v.,* b. 390 B.C.), the great rival of Demosthenes, of whom we have three orations; (8) Lycurgus (*q.v.,* born *c.* 390 B.C.): one speech extant; (9) Hypereides (*q.v.,* born *c.* 390 B.C.), of whom we have fragments of six speeches, recovered since 1847 from papyri; (10) Deinarchus (*q.v.,* born *c.* 360 B.C.): three speeches extant.

Philosophic prose is represented by Plato (*q.v.,* b. 427 B.C. on the seventh of the month Thargelion, a day afterwards celebrated annually by the Platonic school—d. 348–7 [his will is quoted Diog. L. iii. 41]), under whose name we have 42 dialogues, besides some dozen letters. Some of the dialogues (in all of which, except the *Laws,* Socrates is an interlocutor) are certainly spurious, others of doubtful authenticity. All we need note here is that in Plato Greek prose attains its supreme perfection, a grace and ease and flexibility, capable of every emotion of which the soul is capable, such as perhaps no other prose in any language has attained. And this, coupled with sublimity and beauty of thought, with power to strengthen those hopes of men which aspire to immortality and seem to promise it, will ensure that such works as the *Apology,* the *Phaedrus,* the *Phaedo,* the *Republic,* will always remain among the most precious heritages of humanity.

Aristotle (*q.v.,* 384–332 B.C.) has left such an immensity of writing that here we can do no more than indicate his chief works under their appropriate headings: 1. Logic: *Topica, Analytica;* 2. Natural Science (for which his position as tutor to Alexander no doubt gave him special advantages): *Historia Animalium, De Partibus Animalium;* 3. Psychology and Metaphysics: *De Anima, Metaphysica;* 4. Ethics: *Nicomachean Ethics;* 5. Politics: *Politics, Respublica Atheniensium;* 6. Literature: *Poetics, Rhetoric.*

For convenience we may here include Aristotle's successor as head of the Peripatetic school, Theophrastus of Eresos (*c.* 372–287 B.C.), of whose writings we possess only: 1. *Historia Plantarum* (Περὶ φυτῶν ἱστορίας). 2. *De causis plantarum* (Περὶ φυτῶν αἰτιῶν). 3. *Characters* (χαρακτῆρες), and a few short pieces such as *De Signis* (Περὶ σημείων), which was apparently one of the sources used by Aratus for that part of the *Phaenomena* (733–1154) which is called Διοσημίαι, and some smaller fragments.

The Alexandrine Age, 323 B.C.–A.D. 100.—1. Before reviewing the Alexandrine *poets* individually, it is worth while to note certain characteristics of the Alexandrine poetry in general. In the first place it is no longer an original poetry like that of the Classical period, but imitative. One symptom of this is that quite different kinds of poetry are cultivated by the same poet. Next it is a learned poetry for the most part, and makes its appeal in the first place to a learned audience—being full of learned allusions, strange or archaic or dialectic words (γλῶσσαι) which had little meaning for the ordinary man. Again, as in all learned poetry, the mere knowledge of the work of an earlier poet impels the imitator in the search for novelty to sacrifice simplicity. What is meant can be well seen by comparing Homer's description of the abode of the gods in *Odyssey* vi. 42 *sqq.* with the successive imitations by Lucretius, Tennyson, Swinburne and again Tennyson. And the need for extreme elaboration tends to the cult of the short and highly polished poem rather than of the longer poem in which such uniformly high polish would make an excessive demand alike on the poet and on his reader. Again we note that the passion of love becomes now not a subsidiary, but a leading motive. Finally we notice a tendency—not perhaps unconnected with the growth of large cities—to take for theme the happiness of the simple peasant's life.

Callimachus (born *c.* 310 B.C.) is represented by six Hymns (five in hexameters, one in elegiacs), and by a large number of fragments in a variety of metres. Recent discoveries of papyri have added considerably to our knowledge of his work (especially the Αἴτια and Ἴαμβοι). He is the champion of the short poem (Athen. 72 A). On the other hand his contemporary and rival, Apollonius Rhodius, attempted in his *Argonautica* in four books (5,835 lines) to revive the long epic (*cf.* Callim. *Hymn* ii. 106, with Apollon. Rh. iii. 932 *seq.*). The didactic epic is revived by Aratus of Soli in Cilicia (born *c.* 315 B.C.) in his *Phaenomena* (1,154 lines), an astronomical poem, sometimes called Φαινόμενα καὶ Διοσημίαι because it falls into two well marked divisions—sometimes considered to be distinct poems—1–732 describing the relative position of the stars in the heavens and their risings and settings, 733–1154 dealing with weather signs in general. The poem, which was greatly praised in later times (Ovid, *Amor.* i.15.6) and was translated by Cicero, contains two passages of unusual beauty, the *Prooemium,* from which St. Paul quotes

(Acts xvii. 28: "As certain also of your own poets have said, 'For we are also his offspring' ") and the lines (96–136) which tell how Justice forsook the earth. Nicander (born *c.* 200 B.C.) continued the didactic epic in a series of poems of which two are extant: *Theriaca* (958 lines), on the bite of venomous beasts, and *Alexipharmaca* (630 lines), on antidotes. Neither of them has any poetic value.

We hear of a *Pleiad* of eminent tragedians of the time of Ptolemy Philadelphos, but we have no extant comedy or tragedy. Lycophron, one of the *Pleiad,* has left us, besides a few short fragments of tragedy, a poem of notorious difficulty called *Alexandra, i.e.,* Cassandra. Elegy is largely cultivated, the most famous elegist being Philitas (Philetas) of Cos (*c.* 300 B.C.), whose name is also associated with that of Callimachus by Propertius (iv.1.1).

The one important new poetic development of the period is the bucolic idyll associated with the names of Theocritus (born *c.* 305 B.C. in Syracuse, *cf. A.P.* ix. 434, Athen. 284 A) and the later Bion and Moschus (probably 2nd century B.C.). This type of poetry, a short poem in hexameters dealing with country life, and especially with herdsmen, goatherds and shepherds, became the model for the *Bucolics* of Virgil, and through him of all later pastoral poetry. The beautiful lament for Bion (= Mosch. *Id.*), the authenticity of which some now deny, was the model for Virg. *Bucol.* X., Milton's "Lycidas," and Shelley's "Adonais." The curious type of poetry called a mime, which has apparently some affinity with the idyll, is now represented by the eight mimes of Herondas (discovered in Egypt, 1890). The papyrus ms. obtained from the Fayum is in the possession of the British Museum.

2. The *prose literature* of the Alexandrine age is, for the most part, a learned literature. All branches of learning were cultivated with assiduity. The work of the Alexandrines in the department of literary criticism is discussed in a later part of this article. Their work in science—particularly mathematics and astronomy—hardly concerns us here. But a word must be said of three writers of this time who are of more general interest. Polybius (*q.v., c.* 201–120 B.C.) of Megalopolis in Arcadia, composed his *Histories* (Ἱστορίαι) in 40 books, of which only the first five are extant in their entirety, but we know the plan of the whole work. Polybius has none of the graces of style, his virtues being those of accuracy in detail and sound judgment. Strabo (*q.v., c.* 63 B.C.–A.D. 19) of Amaseia in Pontus, wrote a historical work (Ὑπομνήματα ἱστορικά) in 43 books, which dealt cursorily with the period before Polybius, and in detail with the period after Polybius (Suid. *s.* Πολύβιος): of this only fragments are preserved (*Frag. Histor. Gr.* iii. 490 *sqq.*). But his *Geography* (Γεωγραφικά), is preserved almost entire. Quite apart from its value as a contribution to the study of geography, his work is of extraordinary interest to the general student from the multitude of incidental information which it gives with regard to the various peoples mentioned in the course of the treatise. Plutarch (*q.v., c.* A.D. 46–120) of Chaeroneia in Boeotia, was a many sided polymath, most of whose works are fortunately extant. They fall into two groups, the *Parallel Lives* (probably mostly the work of his later life) and the series of popular essays called collectively *Moralia* (Ἠθικά). The *Parallel Lives* (Βίοι Παράλληλοι) consist of a series of biographies (46 extant) of eminent historical characters, a distinguished Greek being coupled with a distinguished Roman, to whom he seemed, in point of career, to bear some resemblance, each couple of biographies being followed by a *Comparison* (Σύγκρισις), in which the two are compared. The order of the biographies as given in the mss. is not that of our ordinary editions, which is based upon the Aldine edition and is without ms. authority, but partly follows chronological order. This arrangement, however, is not Plutarch's: thus, *e.g.,* we know from Plutarch himself (*Theos.* 1) that the *Lives* of Lycurgus and Numa were written before those of Theseus and Romulus. The *Moralia* is an immense collection (7 vols. in Teubner ed.) of essays on the widest variety of topics, ethical (these in the majority—hence the general title), historical, scientific. Though not profound, Plutarch is generally interesting, and the incidental allusions are often of the greatest value.

ROMAN LITERATURE

The story of Roman literature is a comparatively short one. Its whole lifetime is not equal to that single epoch of Greek literature which we call the Alexandrine age. Again, while the literature of Greece exhibits a completely independent development, Roman literature is at every point based upon Greek models. A consequence of this is that, while Greek literature shows a logical development, that of Rome develops more or less fortuitously. While, then, Greek literature is best presented in the order of evolution of the several literary types, there is no such reason for adopting the same method in summarizing the content of Roman literature, and the most convenient method of presentation is the chronological.

Roman literature may be said to begin about the middle of the 3rd century B.C., and it is conveniently divided into three periods: (1) the Republican age, 250–27 B.C.; (2) the Augustan age, 27 B.C.–A.D. 14; (3) the Imperial age, A.D. 14–524.

The Republican Age.—An account of the origins of Roman literature and of its representatives will be found under LATIN LITERATURE: here, where our object is merely to present a conspectus of the extant literature, the earliest period from which nothing but detached fragments survive, may be dismissed with a reference to the articles on Livius Andronicus (*c.* 284–204 B.C.), C. Naevius from Campania (d. Utica 201 B.C.), Q. Ennius (239–169 B.C.), M. Pacuvius (b. 220 B.C.) and L. Accius (b. 170 B.C.).

Far more important from our point of view are two poets who wrote comedies only. T. Maccius Plautus (*q.v.*) of Sarsina, in Umbria (*c.* 251–184 B.C.), is represented by 21 extant comedies—the so-called *fabulae Varronianae* (Aul. Gell. iii. 3. 3). They are all translated more or less closely from the Greek (*cf. Trin.* prol. 18 *Huic Graece nomen est Thensauro fabulae: Philemo scripsit: Plautus vortit barbare, Nomen Trinummo fecit,* and *Asin.* prol. 10).

P. Terentius Afer (*c.* 190–159 B.C.) of Carthage became the slave of Terentius Lucanus, whose name he took on manumission. Six of his comedies are extant. His chief model was Menander: *cf.* Caesar's lines *ap.* Sueton. *Vit. Ter. "Tu quoque tu in summis, O dimidiate Menander / Poneris et merito, puri sermonis amator: / Lenibus atque utinam scriptis adiuncta foret vis / Comica, ut aequato virtus polleret honore / Cum Graecis neque in hac despectus parte iaceres: / Unum hoc maceror et doleo tibi desse, Terenti."* ("You too, even you, half-Menander, are ranked among the highest and rightly, lover of pure Latin; but I wish your smooth verse had comic power, that its virtue might be equally honoured with the Greek and you were not despised in this respect. Terence, I am hurt and pained to find you lack this one thing.") The merit and demerit of Terence, as here stated by Caesar, are precisely what strikes the modern student—the purity of his Latin and his lack of force. In the economy of his comedies, we note an innovation in that the prologue no longer has the function of introducing the play, but serves—much like the Parabasis in Aristophanes—as a vehicle of criticism (*cf., e.g., Adelph.* prol. 15 *seq.; Heaut.* prol. 22).

The earliest work in Latin prose which is extant entire is the *De Agri Cultura* of M. Porcius Cato (*q.v.,* 234–149 B.C.), a mere compendium of precepts on agriculture. His *Res Rusticae* (three books) is also the only complete work extant of M. Terentius Varro (*q.v.,* 116–27 B.C.), the most learned Roman of his time, who in his long life produced an extraordinary variety of works. His agricultural treatise is an immense advance on that of Cato in point of style. Of Varro's work *De Lingua Latina* in 25 books, only 5–10 are extant.

In the hands of Varro's younger contemporary, M. Tullius Cicero (*q.v.,* 106–43 B.C.), Latin prose style attains its highest perfection. Cicero's literary activity is amazing. Apart from his speeches (of which 58 are extant), we have several treatises on rhetoric, a great number of works on philosophy—largely written in the last two or three years of his life and particularly after the death of his daughter Tullia, and finally his correspondence: letters (1) *Ad Familiares* (16 books, 62–43 B.C.), (2) *Ad Quintum Fratrem* (3 books, 60–54 B.C.), (3) *Ad Atticum* (16 books, 68–44 B.C.), (4) *Ad M. Brutum* (2 books 43 B.C.). The letters, written

as they are in a completely intimate and informal manner, constitute an extraordinarily important commentary on the events of his time and, revised in relation to those events, form a very interesting psychological study. C. Julius Caesar (*q.v.*, 102–44 B.C.) wrote a treatise, *De Analogia* (two books), which one would have liked to see, and a tragedy *Oedipus*, which one would have liked to see still more. We possess, however, his *Commentarii de bello Gallico*, seven books, covering the years 58–52 B.C., and *Commentarii de bello civili*, three books, covering the years 49–48 B.C. The *Bellum Alexandrinum* is probably by A. Hirtius, who also added an eighth book to the *Bellum Gallicum*. The authors of the *B. Hispaniense* and *B. Africanum* are unknown. G. Sallustius Crispus (86–34 B.C.) of Amiternum, wrote the *De Catilinae coniuratione* and the *Bellum Iugurthinum*, both extant, and *Historiae*, covering the years 78–67 B.C., of which we have some fragments.

Poetry in this period is represented by two names of the first rank. T. Lucretius Carus (*q.v.*, *c.* 99–*c.* 55 B.C.) expounds the philosophy of Epicurus in his *De Rerum Natura* (six books), the title being a translation of Περὶ Φύσεως, the title of poems by Xenophanes, Parmenides, Empedocles. He had a high reputation in antiquity. Virgil, who was greatly influenced by him and refers to him (without naming him) in a famous passage of the *Georgics* ii. 490, *Felix qui potuit rerum cognoscere causas Atque metus omnes et inexorabile fatum Subiecit pedibus strepitumque Acherontis avari*, is preferred to him by Quintilian (X. 1.86 *seq.*), on grounds which merely concern the student of oratory, and this preference has been supported by the general judgment, but not a few good judges would reverse the verdict. The strictly philosophical passages no longer appeal, but in the more popular passages, such as the Prooemium (i. 1–43), the eulogy of Epicurus (iii. 1–30), on the folly of fearing death (iii. 892–910), his passionate earnestness (*docti furor arduus Lucreti*, Stat. *Silv.* ii. 7.76), coupled with genuine poetic imagination and a real gift for poetic expression, affects the modern reader perhaps more than anything in Virgil. C. Valerius Catullus (*q.v.*, b. at Verona [Catull. lxvii. 34, Mart. xiv. 195, Ov., *Am.* iii. 15.7] 84–d. *c.* 54 B.C.), the greatest of Roman lyric poets, is represented by 116 poems in a variety of metres, hendecasyllables, iambic, trimeters (including scazons), sapphics, priapean, phalaecean, asclepiadean, hexameters, elegiacs, iambic tetrameter catalectic, galliambic (lxiii). Most of his poetry shows strong marks of Greek influence, and several poems are translations from the Greek: *e.g.*, li. (from Sappho), lxvi. (from the lost *Hair of Berenice* of Callimachus). His hexameters and elegiacs—though sometimes extremely effective, as in his lines at his brother's grave (ci.)—show much less grace and ease than his hendecasyllabic and priapean poems. Apart from technique he has the two chief gifts of the lyric poet—depth of feeling ("Tenderest of Roman poets nineteen hundred years ago"—Tennyson) and simplicity.

The Augustan Age, 27 B.C.–A.D. 14.—P. Vergilius Maro (70–19 B.C., *see* VIRGIL), generally regarded as the greatest of Roman poets, is represented by (1) *Bucolica* (*Eclogae*) ten poems in which Theocritus is imitated or even translated. Of these, only ii., iii., v., vii. and viii. are strictly pastoral, the pastoral setting in others being merely a framework, while in iv. (the so-called Messianic Eclogue) there is nothing of the pastoral at all; (2) *Georgica*, in four books (i. Agriculture, ii. Tree culture, iii. Cattle-rearing, iv. Bee-keeping). The *Georgics* contain some of Virgil's best poetry, *e.g.*, the praise of Italy, ii. 136–176; the eulogy of country life, ii. 458–540; the story of Orpheus and Eurydice, iv. 453–527; (3) *Aeneis*, in 12 books, the great national epic of Rome which, after ten years' work, was still unfinished (witness the "pathetic half-lines," the occasionally uncompleted hexameters) at his death, and was published by L. Varius against the expressed wishes of the poet. Virgil was a slow and careful writer (Quintil. x. 3.8, *cf.* Donat., *Vita Verg.* ix., Aul. Gell. xvii. 10.2). This very care and elaboration probably rather militates against the essentially epic virtues, and it is not so much as a whole that the poem appeals, at any rate to the modern world, as in certain supreme passages in which the poet rises above his immediate theme and which are really in the nature of digressions. Q. Horatius Flaccus (65–8 B.C., *see* HORACE), born at Venusia, was the son of a freedman (*cf.* Hor. *Sat.* i. 6.6; 45, 86). After the battle of Philippi (44 B.C.) he returned to Rome where presently he became a member of the circle of Maecenas. His extant work is of two quite different classes—lyrical (*Odes, Epodes, Carmen Saeculare*) and poems in hexameters (*Satires, Epistles, De Arte Poetica*). The *Satires* (*saturae* or *Sermones*) in two books, written between 41 and 30 B.C., deal lightly with the foibles and follies of social life, and the *Epistles*, 20–13 B.C., in two books, are very much in the same style as the *Satires*, with a greater preponderance of literary themes, which is emphasized in the epistle which bears a separate title: *On the Art of Poetry*. It is upon his lyrical poems that the fame of Horace as a poet really rests (Quintil. x. 1.96), and his success is due, not to any rare and high gift of poetic inspiration, but to his capacity for expressing with unsurpassed felicity, the common thoughts which touch most nearly the common heart of humanity. Albius Tibullus (*q.v.* d. 19 B.C. while still young) belonged to the circle of M. Valerius Messalla Corvinus, and was on friendly terms with Horace, who addressed to him *Carm.* i. 33 and *Ep.* i. 4, and Ovid (*cf.* Ov. *Tr.* iv. 10.51, and the beautiful elegy on Tibullus, Ov. *Amor* iii. 9). We possess four books of elegies under his name, but Bk. iii. is by "Lygdamus," a pseudonym for some undetermined poet; iv. 1 (panegyric on Messalla) is by some unknown author, while iv. 7–12 are by Sulpicia, a poetess of the time of Tibullus. To call him "polished and elegant" as Quintilian does (x. 1.93) hardly does justice to his tender grace.

Sextus Aurelius Propertius (*q.v.*, born *c.* 49 B.C. in Umbria, probably at Asisium [Assisi], where the name Propertius occurs in inscriptions) is represented by four books of elegies. Propertius has an irregular strength which is in marked contrast to the equable polish of Tibullus, and in the matter of form his pentameters have an elasticity and freedom which make the elegiac distich in his hands almost a new metre. Bk. iv. 11—the concluding elegy in our collection—is an excellent example of his mature style. P. Ovidius Naso (b. Sulmo 43 B.C.—died *c.* A.D. 18, *see* OVID) has left us a great variety of work. His undoubted poetic qualities are rather obscured by the amazing polish and facility of his versification. There remain but two poets of the Augustan age who need be mentioned here, both writers of didactic epic. Grattius, a contemporary of Ovid (Ov. *Ep. ex. Pont.* iv. 16.34), wrote the *Cynegetica*, a treatise on hunting after the Greek model, of which 541 lines are extant. Manilius, of whom nothing is known except what can be inferred from his poem—he must have written after A.D. 9, because in i. 898 he refers to the defeat in that year of Varus in the Teutoburg forest—wrote *Astronomica* (in five books), which is extant.

The prose writers of the Augustan age include only one name of first importance. T. Livius (59 B.C.–A.D. 17, *see* LIVY), was born at Patavium (Padua, *cf.* Mart. i. 61.3). In Rome he enjoyed the friendship of Augustus in spite of his admiration of Pompey (Tac. *Ann.* iv. 34). We hear of philosophical works and semi-philosophical dialogues written by him (Senec. *Ep.* 100.9), but his fame rests on his history of Rome (*Historiae ab urbe condita*) down to his own day (it was actually carried as far as 9 B.C.). The work was in 142 books, of which there are extant 35, viz., i.–x. (down to 293 B.C.), xxi.–xlv. (218–167 B.C.). The lost books are represented by *Periochae* (summaries of contents) composed *c.* 4th century A.D., which we possess for all except 136 and 137. An Oxyrhynchus papyrus preserves some excerpts from Bks. 37–40; 48–55. Livy, deficient as he was in technical equipment, is not exactly a scientific historian, but he is at least an honest one. In style he is nearer Cicero (*cf.* Quintil. x. 1.39) than Sallust. His language (despite Asinius Pollio's reproach of *Patavinitas*, Quintil. i. 5.56; viii. 1.3, the reference of which is obscure), with its somewhat poetical colouring, is splendidly adapted to his task (Quintil. i. 1.101). Other minor prose writers are Pompeius Trogus, L. Annaeus Seneca of Corduba (Cordova), and Vitruvius Pollio (*qq.v.*).

The Imperial Age.—Under Tiberius in A.D. 30, C. Velleius Paterculus wrote for M. Vicinius (consul in that year) his *Historia Romana*, a sketch of Roman history in two (extant) books. A contemporary writer of first importance, L. Annaeus Seneca (A.D. 3–65), son of the elder Seneca, has left us nine tragedies imitated from the Greek, and numerous prose philosophical

writings. M. Annaeus Lucanus (A.D. 39–65), nephew of the foregoing, is represented by an epic in ten books *De Bello Civili*, on the civil war between Pompey and Caesar. More rhetorical than poetical, Lucan has some memorable lines. Aulus Persius Flaccus (A.D. 34–62), is the author of six satires, mainly on the literary life of his time and on quasi-philosophical subjects. T. Calpurnius Siculus, in the reign of Nero, has left us seven eclogues full of adulation of Nero; the anonymous poem *De Laude Pisonis* is also now attributed to him. L. Iunius Moderatus Columella, contemporary with Seneca, is the author of 12 books *De Re Rustica* in prose except the tenth book which is in hexameters. Next we have a group of four poets: P. Papinius Statius (b. between A.D. 40 and 45, died *c.* 98) author of two epics—*Thebais* and *Achilleis*—and a collection of poems in various metres with the general title *Silvae*. Valerius Flaccus in the time of Vespasian, to whom his poem is dedicated, wrote the *Argonautica* in eight books. The matter is mainly taken from the *Argonautica* of Apollonius Rhodius and the style is a rhetorical imitation of Virgil. *T. Catius Silius Italicus* (d. 101) in the reigns of Nero, Vitellius and Vespasian, wrote an epic *Punica* (17 books). His poem, the matter of which is mainly taken from Livy, is highly rhetorical and has little poetical merit. A much more brilliant poet is M. Valerius Martialis (born *c.* A.D. 40, d. shortly after 100), represented by 14 books of epigrams, some being of remarkable beauty.

C. Plinius Secundus (*c.* A.D. 23–79) in 77 presented Titus with his *Naturalis Historia* (in 36 books). Quite devoid of style and of no independent authority, the work is of considerable importance as preserving information from authorities now lost. M. Fabius Quintilianus (*c.* A.D. 35–95) is the author of the *Institutio Oratoria* in 12 books, book X. containing a sort of comparative sketch of Greek and Roman literary history, which includes very happy critiques of the leading Greek and Roman writers. The greatest prose writer of the Imperial age is C. Cornelius Tacitus (*c.* A.D. 54–*c.* 118); we have his *Dialogus de Oratoribus, Agricola* (A.D. 98) *Germania* (about the same date), *Histories* (A.D. 69–96), *Annals* (probably written after A.D. 116). C. Plinius Caecilius Secundus (61–*c.* 114), nephew of the elder Pliny, is represented by nine books of letters, and in addition by the historically very important *Panegyricus* on Trajan and the correspondence with Trajan (including the extraordinarily important letters 96 and 97, dealing with the trial of the early Christians). C. Suetonius Tranquillus, who, under Hadrian, held the office of imperial secretary (*ab epistulis*), wrote the lives of the emperors (*De Vita Caesarum*) from Caesar to Domitian. We have also his treatise *De Grammaticis et de Rhetoribus,* originally part of a larger work, *De Viris Illustribus,* of which the extant *Vitae* of Terence, Horace, Lucan, Passienus Crispus, and the elder Pliny are fragments. D. Iunius Iuvenalis (b. Aquinum, probably A.D. 67) has left 15 satires written under Trajan and Hadrian. Juvenal is a master of vivid phrase: *e.g.,* his account of street dangers in *Sat.* iii. 264 *sqq.* So his single lines are memorable: *"facit indignatio versum"* (i. 79), *"mens sana in corpore sano"* (x. 356), *"maxima debetur puero reverentia"* (xiv. 47). We must dismiss the remaining authors summarily—with again a reference to their separate biographical articles and the article LATIN LITERATURE: M. Cornelius Fronto (2nd century A.D.); Aulus Gellius (born *c.* 130); L. Apuleius (b. at Madaura, in Africa, A.D. 114); the *Pervigilium Veneris,* by an author unknown; Ammianus Marcellinus (born *c.* 332); Decimus Magnus Ausonius (born at Bordeaux *c.* 300); Claudius Claudianus (born at Alexandria, died 404); Aurelius Prudentius Clemens, the first great Christian poet; C. Lollius Apollinaris Sidonius (*c.* 430–480), and lastly, Boethius (born *c.* 480, executed 524).

HISTORY OF SCHOLARSHIP

Pre-Alexandrine.—The history of classical scholarship goes back to a date so early that it is hardly possible to fix a superior limit. As soon as a philosopher began to criticize a literary work (*e.g.,* Xenophanes on Homer and Hesiod), so soon scholarship in the widest sense may be said to have begun. Philosophic speculation soon raised the question of the relation of the name to the thing named, or, in other words, directed attention to the true or inner meaning of words, the ἐτυμολογία, as opposed to the conventional meaning, and thus founded the science of etymology. Directly connected with this was the question of the right use of language, ὀρθοέπεια, with which the name of Protagoras (born *c.* 485 B.C.) was especially connected (Plato, *Phaedr.* 267 C.). This again naturally led to a consideration of the function of words in a sentence and thus to the evolution of a grammatical terminology. Plato already distinguished ὄνομα and ῥῆμα, not so much as noun and verb, but as subject and predicate (*cf.* Plato *Sophist.* 261; "There are two sorts of intimation of being given by the voice. . . . That which indicates action we call a verb . . . and the other, which is an articulate mark set on those who do the actions, we call a noun" *cf. Cratyl.* 425 A., Aristoph. *Nub.* 681 *sqq.*) Aristotle distinguished ὄνομα, ῥῆμα, ἄρθρον (*Poet.* xxi.7), σύνδεσμος (*Rhet.* iii., 5.2, etc.)—noun, verb, article, conjunction.

Alexandrine Period, 300–1 B.C.—Alexandria (for description *cf.* Strabo 793 *sqq.*) was founded by Alexander the Great in 331 B.C. After his death it became the capital of Egypt and the seat of the Ptolemaic dynasty. Under Ptolemy Soter (323–285 B.C.) and Ptolemy Philadelphus (285–247 B.C.) the two libraries and the museum of Alexandria became the greatest centre of literature and learning in the world.

The first librarian was Zenodotus of Ephesus (*c.* 325–260 B.C.). As librarian he classified the epic and lyric poets, the tragedians being classified by Alexander Aetolus, the comedians by Lycophron. As a scholar he made a critical recension of the *Iliad* and the *Odyssey,* founded on numerous mss., and compiled a Homeric glossary (Ὁμηρικαὶ Γλῶσσαι). He seems also to have dealt with the text of Hesiod, Anacreon and Pindar. As a critical scholar he seems to have erred on the side of too great subjectivity.

The poet Callimachus, who did much in the way of making catalogues (πίνακες), is often said to have succeeded Zenodotus as librarian, but there is no evidence for the statement (*cf. Callimachus,* Loeb ed. p. 6 *sqq.*). The next librarian of whom we hear is Eratosthenes of Cyrene (born *c.* 275 B.C.), who became librarian *c.* 235. A man of many-sided learning (hence called by his admirers *pentathlos,* while his detractors called him *Beta,* implying that he was second-best in all departments, but first in none), he wrote on geography, mathematics, astronomy, chronology. We are here concerned only with his work in classical scholarship, in which his chief production was a treatise on Old Attic Comedy (περὶ τῆς ἀρχαίας κωμῳδίας). His successor in the librarianship was Aristophanes of Byzantium, who became librarian in 195 B.C. He edited Homer, Pindar, Euripides, Aristophanes. He also elaborated a system of critical signs (obelus, sigma, antisigma) and accentuation, divided the strophes of the lyric poets into κῶλα ("limbs") and made an epitome of Aristotle's *Natural History* (ed. Lambros 1885). His successor, Aristarchus of Samothrace (*c.* 217–145 B.C.), enjoyed still greater fame and became for later antiquity the type of the philologist (Cic. *Ad. Att.* i 14.3). He published two editions of Homer, in which he followed the admirable principle, Ὅμηρον ἐξ Ὁμήρου σαφηνίζειν (explaining Homer by Homer), edited Hesiod, and concerned himself also with the text of the lyric poets, the tragedians, Herodotus, and Aristophanes, writing both continuous commentaries (ὑπομνήματα) and treatises on special questions (συγγράμματα). Aristarchus was the first to recognize the eight parts of speech (Quintil. i. 4.20) ὄνομα (noun), ῥῆμα (verb), ἀντωνυμία (pronoun), ἐπίρρημα (adverb), μετοχή (participle), ἄρθρον (article), σύνδεσμος (conjunction), πρόθεσις (preposition).

His pupil, Dionysius Thrax (*c.* 170–90 B.C.), wrote a Greek grammar, Τέχνη Γραμματική, which retained its vogue down to the Renaissance and has been the ultimate model of all modern grammars (ed. Uhlig, Leipzig, 1884). Didymus, on account of his industry surnamed χαλέντερος (copper-guts), wrote on Homer, Hesiod, Pindar, Bacchylides, the comedians, the Attic orators, and Thucydides.

Post-Alexandrine Period, 1 B.C.–1350.—Dionysius of Halicarnassus (who lived at Rome from 30 B.C. onwards) wrote a number of valuable works on literary criticism: *Letters to Ammaeus I. and II., De Compositione Verborum, De Oratoribus Antiquis, Letter to Pompeius,* etc. A very valuable treatise *On the*

Sublime (Περὶ ὕψους) is extant, probably of the 1st century A.D. Apollonius Dyscolus (*c.* 130) wrote a valuable treatise on syntax in four (extant) books. The most valuable feature of the scholarship of this period is a series of works on lexicography and kindred subjects by Moeris, Phrynichus, Harpocration, Pollux, Hesychius, Stephanus, Suidas, Photius, and the 12th century *Etymologicum Magnum.* Mention should be made of the *Deipnosophistae* of Athenaeus (2nd century) which preserves much curious information and is the source of most of the extant fragments of the Greek comic poets. Libanius (*c.* 314–393) is the author of a Life of Demosthenes and of Arguments to his speeches. With him we must close the tale of classical scholarship for nearly 1,000 years.

The Revival of Learning or the Italian Period 1350–1527.—A general account of the Renaissance is beyond the scope of this article and we can merely mention some of the leading names. Francesco Petrarca (1304–74) and Giovanni Boccaccio (1313–75) have an interest only as pioneers, being interested in Greek, but not themselves expert Greek scholars. Manuel Chrysoloras (1350–1415), a Greek immigrant, taught Greek in Florence (1396–1400). It was at the instigation of another Greek, Gemistus Plethon (1355–1452), that Cosmo de'Medici founded an academy for the study of Plato. His pupil, Joannes Bessarion (1403–72), a native of Trebizond, came to Italy in 1439 with the Greek emperor in an endeavour to unite the Greek and Roman churches. Thereafter he joined the Roman Church, becoming presently bishop of Frascati. He died at Ravenna in 1472, bequeathing his collection of mss. to Venice (St. Mark's Library). Theodorus Gaza (*c.* 1400–*c.* 1478), of Thessalonica, taught Greek for a time at Ferrara, afterwards in Rome and Naples. His Greek grammar was printed by Aldus Manutius at Venice in 1495, and he was also the author of translations of Aristotle, Aelian, Theophrastus *De Plantis,* and of Dionysius, *De Comp. Verborum.* Demetrius Chalcondylas (1428–1511) edited Homer (*ed. princeps,* 1488), Isocrates, Suidas. Laurentius Valla (1407–57) translated Homer, Herodotus, Thucydides. But the greatest philologist of the Renaissance was Petrus Victorius (1499–1584), who edited Sophocles, Isaeus, Aristotle's *Rhetoric, Poetics, Ethics, Politics,* Cicero, Terence, Sallust, Varro's *De Re Rustica.* Lastly, among famous collectors of mss. may be mentioned Poggio Bracciolini (1380–1459), who discovered a great number of Latin mss., and Giovanni Aurispa (*c.* 1370–1459), who, in 1423, brought to Venice 238 mss. including *Venetus A.* of the *Iliad* and the *Codex Laurentianus* (10th century, now in Florence) of Aeschylus, Sophocles and Apollonius Rhodius.

The Greek grammar (Ἐρωτήματα) of Constantius Lascaris printed at Milan by Paravisinus in 1476, was the first book to be printed wholly in Greek.

Later Periods.—*The French Period,* 1530–1700, is characterized by an interest more in the content than the form of the classical authors. Leading names are Budaeus (1457–1540), Robert (1503–59) and Henri Etienne (1528–98); and Turnebus (1512–65), Casaubon (1559–1614), Joseph Justus Scaliger (1540–1609), Du Cange (1610–88) (*qq.v.*).

The English and Dutch Period (18th century) is a period of comprehensive scholarship—of historical and literary as well as verbal criticism. The leading English scholars are Richard Bentley (1662–1742) and Richard Porson (1759–1808) (*qq.v.*), while in the Netherlands the chief names are Ezechiel Spanheim (1629–1710), the two Burmanns (the elder 1668–1741, the younger 1714–78) (*qq.v.*), Hemsterhuis (1685–1766) (*q.v.*), Valckenaer (1715–85), Wyttenbach (1746–1820) (*q.v.*).

The German Period is inaugurated by F. A. Wolf (1759–1824) (*q.v.*), whose *Prolegomena* to Homer was published in 1795. In this period we have two distinctive types of scholarship—the historical and antiquarian on the one hand and the critical and grammatical on the other. Leading representatives of the former are B. G. Niebuhr (1776–1831), August Boeckh (1785–1867), K. O. Müller (1797–1840), Otto Jahn (1813–69), Theodor Mommsen (1817–1903) (*qq.v.*) and of the latter G. Hermann (1772–1848), Immanuel Bekker (1785–1871) (*qq.v.*), and Lobeck (1781–1860).

Present Day.—It would perhaps be invidious to mention the names of distinguished scholars either recently gone from us or still living, but a few words may be said of certain features which characterize classical scholarship of the present day.

The most notable development of modern times has been undoubtedly the increased interest in archaeology, in the widest sense, which has been witnessed in the last 100 years, and more particularly in the last half century. As this is written, it is almost exactly a century since the foundation of the Archaeological Institute in Rome (1829). The French schools in Athens and Rome were founded respectively in 1846 and 1873, those of the United States in 1882 and 1895, the British schools in 1883 and 1901. Everywhere, ancient sites have been and are being excavated—Troy, Delphi, Mycenae, Tiryns, Sparta, Olympia, Epidaurus, Dodona, Delos, Crete have yielded results beyond all expectation—while the recovery of papyri from Egypt has not merely restored to us a considerable body of ancient Greek literature, such as Aristotle's *Constitution of Athens* (1891), Herondas (1891), Bacchylides (1897)—to mention only some examples—but has thrown a valuable light on the true nature of New Testament Greek.

The study of one department of archaeology, namely that of anthropology, and in particular of primitive ritual and religion, has strongly influenced the study of classics. There was a time when the attention of scholars was perhaps too exclusively devoted to the literary aspects of the classical writers—to textual criticism and the study of form. As a natural consequence the labours of successive generations were confined to the great literary masterpieces of antiquity, while comparatively little study was given to writers of inferior genius who, nevertheless, preserve for us antiquarian and anthropological information of the first importance. Moreover, much that even in the best authors was either overlooked or misunderstood, has taken a new meaning in the light of the comparative study of the beliefs and institutions of primitive man. It is hardly too much to say that archaeological and anthropological discovery and speculation have been a fruitful and vivifying development of classical studies in recent years.

But the interest in "pure scholarship" which has long been a distinctive feature of the study of classics in this country is still fully maintained. The practice of composition in Greek and Latin, which for long occupied a leading place in our school and university education, appears to have somewhat retrograded, and the art of verse composition in particular seems to be falling into some neglect. On the other hand, there has been in the last 50 years an increasing interest in the art of translation from the classics, and an increasing demand for translations which should be at once accurate in point of scholarship and acceptable from the point of view of literary form. This has been the aim successfully pursued by many scholars writing independently, while it is the professed purpose of such a series as the Loeb in the United States and the Budé series in France.

Although the classics no longer enjoy their old monopoly in education, the study of the Greek and Latin writers seems to flourish as vigorously as it has done at any time, and at the present moment, so far as the evidence goes, the prospects of classical scholarship as an indispensable force in education appear to be singularly bright. *See* also GREEK LITERATURE; LATIN LITERATURE. (A. W. MA.)

CLASSIFICATION is the process of recognizing classes or kinds, each class or kind consisting of members having certain characteristics in common. The members may themselves be classes or they may be individuals. In a complete system of classification the lowest classes (in which only individual members can be distinguished) are subordinated to higher ones, and these again to others still higher until the most inclusive category with which the science in question is concerned is reached. In Logic, such an inclusive category or highest class is called a *summum genus,* and the lowest, *infima species;* each intermediate class is called a *genus* of the one below it, and a *species* of the one above. In the biological sciences the terms *genus* and *species* are not used in this relative sense, but denote certain definite classes in the biological scheme.

Classification is one method, probably the simplest method, of discovering order in the world. By noting similarities between numerous distinct individuals, and thinking of these individuals as forming one class or kind, the many are in a sense reduced to one, and to that extent simplicity and order are introduced into the bewildering multiplicity of Nature. In the history of every science classification is the very first method to be employed; but it is much older than science. Every name, indeed almost every word, of a language is the expression of some implicit classification; and language is older than science. The classifications expressed in ordinary language are, however, the result of practical needs rather than of scientific interests, so that science has to correct them even when it starts from them. The scientific classification of such things as coal, or whales, or sea-anemones, or of processes like rusting and breathing, is very different from the popular way of classing them.

Scientific classification seeks to formulate a scheme of mutually exclusive and collectively exhaustive categories based on the most important characteristics of the things concerned and on the actual relations between them. This is frequently a very difficult matter, as the history of biology shows. The more nearly a classification approaches the aforementioned ideal the better is its claim to be called a *natural* one; a classification that deviates from this ideal, as usually happens when it is made for some practical human purpose, is called *artificial* (*e.g.*, a herbalist's classification of herbs with reference to their medicinal uses). Border cases are especially apt to cause trouble. To this day there is uncertainty whether certain micro-organisms should be classed as plants or as animals. *Volvocinae* and the *Euglena viridis,* for example, have some of the characteristics of vegetables and also some of those of animals, so they are simply listed as "organisms" for the time being.

In one sense classification is the basic method of science. For science is mainly interested in general truths, that is, in truths relating to classes of things or events rather than to individual instances. Whatever other methods it may employ in discovering a certain truth, that truth is implicitly applied at once to the whole class of phenomena to which the instance in connection with which the discovery has been made belongs. This obviously assumes a correct classification of the phenomena in question.

Some classifications are based on evidence of common descent or biological kinship. Such are known as *phylogenetic* classifications.

BIBLIOGRAPHY.—J. S. Mill, *System of Logic* (1875 etc.); J. Venn, *Empirical Logic* (1907); A. Wolf, *Essentials of Scientific Method* (1928). (A. WO.)

CLASTIDIUM (mod. CASTEGGIO), a village of the Anamares in Gallia Cispadana, on the Via Postumia, 5 m. E. of Iria (mod. Voghera) and 31m. W. of Placentia, Italy. Here in 222 B.C. M. Claudius Marcellus defeated the Gauls and won the *spolia opima;* in 218 Hannibal took Clastidium and its stores of corn by treachery.

CLAUBERG, JOHANN (1622–1665), German philosopher, was born at Solingen, in Westphalia, and studied the Cartesian philosophy under John Raey at Leyden. He became (1649) professor of philosophy and theology at Herborn and subsequently at Duisburg, where he died. Clauberg was one of the earliest teachers of the new doctrines in Germany and an exact and methodical commentator on his master's writings. His theory of the connection between the soul and the body is in some respects analogous to that of Malebranche; but he is not therefore to be regarded as a true forerunner of Occasionalism, as he uses "Occasion" for the stimulus which directly produces a mental phenomenon, without postulating the intervention of God (H. Müller, *J. Clauberg und seine Stellung im Cartesianismus*). His view of the relation of God to his creatures is held to foreshadow the pantheism of Spinoza. All creatures exist only through the continuous creative energy of the Divine Being, and are no more independent of his will than are our thoughts independent of us. Clauberg's chief works are: *De conjunctione animae et corporis humani; Exercitationes centum de cognitione Dei et nostri; Logica vetus et nova; Initiatio Philosophi, seu Dubitatio Cartesiana;* a commentary on Descartes' *Meditations;* and *Ars etymologica Teutonum.*

A collected ed. of his philosophical works was pub. at Amsterdam (1691), with life by H. C. Hennin; *see* also E. Zeller, *Geschichte der deutschen Philosophie seit Leibnitz* (1873).

CLAUDE, JEAN (1619–1687), French Protestant divine, was born at La Sauvetat-du-Dropt near Agen. He was professor of theology at the Protestant colleges of Nîmes and of Montauban, but lost both posts on account of his intransigence. In 1666 he became pastor at Charenton near Paris, where he engaged in controversies with Pierre Nicole (*Réponse aux deux traités intitulés la perpétuité de la foi,* 1665), Antoine Arnauld (*Réponse au livre de M. Arnauld,* 1670), and J. B. Bossuet (*Réponse au livre de M. L'évêque de Meaux,* 1683). On the revocation of the edict of Nantes he fled to Holland, and received a pension from William of Orange, who commissioned him to write an account of the persecuted Huguenots (*Plaintes des protestants cruellement opprimés dans le royaume de France,* 1686). The English translation of this book and the original were publicly burnt by the common hangman by order of James II. on May 5, 1686, as containing "expressions scandalous to His Majesty the king of France."

See biographies by J. P. Nicéron and Abel Rotholf de la Devèze; E. Haag, *La France protestante,* vol. iv. (1884 ed.).

CLAUDE LORRAIN or **CLAUDE GELÉE** (1600–1682), French landscape-painter, was born at Chamagne in Lorraine. At the age of 12 he went to live at Freiburg in Baden with an elder brother. He afterwards went to Rome where he lived with the landscape painter, Augustin Tassi. In 1625 he travelled to Venice and through Tirol to his native country. Claude De Ruet, painter to the duke of Lorraine, kept him as assistant for a year; and he painted at Nancy the ceiling of the Carmelite church. In 1627 he returned to Rome where he earned the protection of Pope Urban VIII., and from about 1637 he rapidly rose into celebrity. Claude's landscapes are composed according to the classical traditions of the Italian school. He bathed his scenes in light and atmosphere. His figures, however, are very indifferent and he usually engaged other artists to paint them for him. In order to avoid a repetition of the same subject, and also to detect the very numerous spurious copies of his works, he made tinted outline drawings (in six paper books which he named *Libri di Verita*) of most of his pictures, with the name of the purchaser. This valuable work (now belonging to the duke of Devonshire) has been engraved and published. Claude died in Rome at the age of 82, on Nov. 21, 1682.

Many choice specimens of his genius may be seen in the National Gallery, London, in the Louvre, at the Doria palace in Rome and at private collections in Britain. The British Museum, the Louvre, and the Albertina contain fine collections of pen and ink drawings. Claude's engravings are much sought after.

See Sandrart, *Academia Artis Pictoriae* (1683); Baldinucci, *Notizie dei professori del disegno* (1844); Victor Cousin, *Sur Claude Gelée* (1853); M. F. Sweetser, *Claude Lorrain* (1878); Lady Dilke, *Claude Lorrain* (1884).

CLAUDEL, PAUL (1868–), French poet, dramatist and diplomat, was born Aug. 6, 1868 at Villeneuve-sur-Fin. He was educated at the Lycée Louis-le-Grand, and entered the consular service in 1892. The early part of his diplomatic career was spent in the East as consul at Foochow, Shanghai and Tientsin. As first secretary at Peking he gained a valuable acquaintance with Chinese life and thought. In 1921 he was made French ambassador at Tokyo after a series of European appointments and three years in Rio de Janeiro.

He was appointed ambassador at Washington (1927), and at Brussels (1933). The worldly wisdom which he had acquired in the course of his official duties did much to stimulate and colour his poetry and helped to make his style among the weightiest and richest in French literature. Though trained in the school of the Symbolists, and especially of Rimbaud, Claudel breaks away from them in certain essential particulars. His fundamental inspiration is catholicism—but the catholicism is the fruit of his own meditation and is, as it were, re-created. The cosmic breadth of his views, his deep metaphysical interest and his fine treatment of

both the grandiose and the commonplace derive from his close study of Aeschylus (whose *Oresteia* he has translated) of Dante and of Holy Writ. He has created his own style, a plastic versification founded on a meticulous study of the rhythm of word and pause. Of his purely lyrical works, the following are the principal: *Cinq Grandes Odes* (1910); *Le Cantate* (1914); *Corona Benignitatis Dei* (1915); *Feuilles des Saints* (1925); but his reputation will most surely rest on his plays; those of outstanding merit are: *Tête d'or; La Ville; L'Échange; La Jeune Fille Violaine* (pub. in 1901 under the title *L'Arbre*)—in which the influence of the Symbolists is clearly perceptible; *L'Annonce faite à Marie* (1912) and the great trilogy in which he has attempted to reproduce the moral drama of post-revolutionary days: *L'Otage* (1911); *Le Pain Dur* (1918); *le Père Humilié* (1919). Many of Claudel's chief works have been translated into English, *e.g., Connaissance de l'Est* (by T. Frances and W. R. Benét as "The East I Know"); and *L'Annonce faite à Marie* (by L. M. Still, 1916). *The Book of Christopher Columbus* appeared in 1930.

CLAUDET, ANTOINE FRANÇOIS JEAN (1797–1867), French photographer, was born at Lyons on Aug. 12, 1797. Having acquired a share in L. J. M. Daguerre's invention, he was one of the first to practise daguerreotype portraiture in England, and he improved the sensitizing process by using chlorine in addition to iodine, thus gaining greater rapidity of action. In 1848 he produced the photographometer, an instrument designed to measure the intensity of photogenic rays; and in 1849 he brought out the focimeter, for securing a perfect focus in photographic portraiture. He was elected F.R.S. in 1853, and in 1858 he produced the stereomonoscope, in reply to a challenge from Sir David Brewster. He died in London on Dec. 27, 1867.

CLAUDIA NOVA, VIA, an ancient road of Italy, 47m. in length, connecting the Via (Claudia) Valeria with the Via Caecilia and Via Salaria at Foruli, near Amiternum and thus linking together the road systems of north and south Italy. It was built by the emperor Claudius in A.D. 47. Its course and remains, as well as the ancient towns and buildings along it, are described by R. Gardner in *Journal of Roman Studies,* iii. (1913) 205–232.

CLAUDIANUS, CLAUDIUS (Anglicized, CLAUDIAN), Latin epic poet during the reign of Arcadius and Honorius. He was an Egyptian by birth, probably an Alexandrian. In A.D. 395 he appears to have come to Rome, and made his debut as a Latin poet by a panegyric on the consulship of Olybrius and Probinus. (In Birt's edition a complete chronological list of Claudian's poems is given, and also in J. B. Bury's edition of Gibbon (iii. app. i. p. 485), where the dates given differ slightly from those in the present article.)

In 396 appeared the encomium on the third consulship of the emperor Honorius, and the epic on the downfall of Rufinus, the unworthy minister of Arcadius at Constantinople, which was engineered by Stilicho. Claudian's poem appears to have obtained his patronage, or perhaps that of his wife Serena (*Epist.* 2). In 398 appeared his panegyric on the fourth consulship of Honorius, his epithalamium on the marriage of Honorius to Stilicho's daughter, and his poem on the Gildonic War, celebrating the repression of a revolt in Africa. To these succeeded his piece on the consulship of Manlius Theodorus (399), the unfinished invective against the Byzantine prime minister Eutropius in the same year, the epics on Stilicho's first consulship and on his repulse of Alaric (400 and 403), and the panegyric on the sixth consulship of Honorius (404). From this time all trace of Claudian is lost, and he is generally supposed to have perished with his patron Stilicho in 408. It may be conjectured that he must have died in 404, as he could hardly otherwise have omitted to celebrate Stilicho's destruction of the barbarian host led by Radagaisus in the following year. On the other hand, he may have survived Stilicho, as in the dedication to the second book of his epic on the *Rape of Proserpine* (which Birt, however, assigns to 395–397), he speaks of his disuse of poetry. From Augustine's allusion to him in the *De civitate Dei,* it may be inferred that he was no longer living at the date of the composition of that work, between 415 and 428.

Besides Claudian's chief poems, his lively Fescennines on the emperor's marriage, his panegyric on Serena, and the *Gigantomachia,* a fragment of an unfinished Greek epic, may also be mentioned. Several poems expressing Christian sentiments are spurious. It is probable that he was nominally a Christian, like his patrons Stilicho and Ausonius, although at heart attached to the old religion. He was honoured by a bronze statue in the forum, and Pomponius Laetus discovered in the 15th century an inscription (*C.I.L.* vi. 1710) on the pedestal, which, formerly considered spurious, is now generally regarded as genuine.

The revival of Latin poetry at so late a date, and by a poet of foreign birth is remarkable, and it is no less surprising that Claudian should have won fame by official panegyrics. As remarked by Gibbon, "he was endowed with the rare and precious talent of raising the meanest, of adorning the most barren, and of diversifying the most similar topics." This gift is especially displayed in his poem on the downfall of Rufinus. In his celebration of Stilicho's victories Claudian found a subject more worthy of his powers, and some passages, such as the description of the flight of Alaric, and of Stilicho's arrival at Rome, rank among the brightest ornaments of Latin poetry. Yet on the whole he lacks creative power, and his talent is rather that of the rhetorician than the poet.

BIBLIOGRAPHY.—The editio princeps of Claudian was printed at Vicenza in 1482; the editions of J. M. Gesner (1759) and P. Burmann (1760) are still valuable for their notes. The first critical edition was that of L. Jeep (1876–79), now superseded by the exhaustive work of T. Birt, with bibliography, in *Monumenta Germaniae Historica* (x., 1892; smaller ed. founded on this by J. Koch, Teubner series, 1893). Edition with English translation by Platmauer (Loeb series, 1922). There is a separate edition with commentary and verse translation of *Il Ratto di Proserpina,* by L. Garces de Diez (1889); the satire *In Eutropium* is discussed by T. Birt in *Zwei politische Satiren des alten Rom* (1888). There is a complete English verse translation of little merit by A. Hawkins (1817). *See* the articles by Ramsay in Smith's *Classical Dictionary* and Vollmer in Pauly-Wissowa's *Realencyclopädie der classischen Altertumswissenschaft,* iii. 2 (1899); also J. H. E. Crees, *Claudian as an Historian* (1908), the "Cambridge Historical Essay" for 1906 (No. 17); T. Hodgkin, *Claudian, the last of the Roman Poets* (1875). H. Schroff, *Claudians Gedicht vom Gotenkrieg* (1927) with bibliography.

CLAUDIUS, the name of a famous Roman gens. The by-form *Clodius* was regularly used for certain Claudii in late republican times, but otherwise the two forms were used indifferently. The gens contained a patrician and a plebeian family; the chief representatives of the former were the Pulchri, of the latter the Marcelli (*see* MARCELLUS). The following members deserve particular mention:—

1. APPIUS SABINUS INREGILLENSIS, or REGILLENSIS, CLAUDIUS, so called from Regillum (or Regilli) in Sabine territory, founder of the Claudian gens. His original name was Attus or Attius Clausus. About 504 B.C. he settled in Rome, where he and his followers formed a tribe. In 495 he was consul, and his enforcement of the laws of debt was one of the chief causes of the "secession" of the plebs to the Sacred Mount. *See* Suetonius, *Tiberius,* i.; Livy ii. 16–29; Dion. Halic. v. 40, vi. 23, 24.

2. CLAUDIUS, APPIUS, surnamed CRASSUS, a Roman patrician, consul in 471 and 451 B.C., and in the same and following year one of the decemvirs. At first he was conspicuous for his aristocratic pride and bitter hatred of the plebeians. Twice they refused to fight under him, and fled before their enemies. He retaliated by decimating the army. He was banished, but soon returned, and again became consul. In the same year (451) he was made one of the decemvirs who had been appointed to draw up a code of written laws. He managed, by courting the people, to secure his re-election for the year 450, and the new decemvirs, under his leadership, began a reign of terror. Matters were brought to a crisis by the affair of Virginia, the daughter of Virginius, a plebeian centurion. Claudius, desiring to possess her, got a client to swear falsely that she was the child of his slave, and judgment was given in his favour. To save her, Virginius killed her with his own hand. An insurrection was the result, and the people seceded to the Sacred Mount. The decemvirs were finally compelled to resign and Appius Claudius died in prison, either by his own hand or by that of the executioner. For a discussion of the character of Appius Claudius, *see* Mommsen's appendix to vol. i.

of his *History of Rome,* also Livy iii. 32–58; Dion. Halic. x. 59, xi. 3.

3. CLAUDIUS, APPIUS, surnamed CAECUS, Roman patrician and author. In 312 B.C. he was elected censor without having been consul. During his censorship, which he retained for five years, in spite of the lex Aemilia which limited the tenure of that office to 18 months, he filled vacancies in the senate with men of low birth, in some cases even the sons of freedmen (Diod. Sic. xx. 36; Livy ix. 30; Suetonius, *Claudius,* 24). He abolished the old free birth, freehold basis of suffrage. He enrolled the freedmen and landless citizens both in the centuries and in the tribes, distributing them through all the tribes and thus giving them practical control of the elections. In 304, however, the landless and poorer freedmen were limited to the four urban tribes, and the effect of Claudius's arrangement was annulled. Appius Claudius transferred the charge of the public worship of Hercules in the Forum Boarium from the Potitian gens to a number of public slaves. He further invaded the exclusive rights of the patricians by directing his secretary to publish the *legis actiones* (methods of legal practice) and the list of *dies fasti* (or days on which legal business could be transacted). Lastly, he gained enduring fame by the construction of a road and an aqueduct, which—a thing unheard of before—he called by his own name (Livy, ix. 29; Frontinus, *De Aquis,* 115; Diod. Sic. xx. 36). In 307 he was elected consul for the first time. In 298 he was interrex; in 296, as consul, he led the army in Samnium (Livy, x. 19). During the next year he was praetor, and he was once dictator. In spite of his political reforms, he opposed the admission of the plebeians to the consulship and priestly offices; his probable aim was to strengthen the power of the magistrates and lessen that of the senate. He was already blind and too feeble to walk, when Cineas, the minister of Pyrrhus, visited him, but so vigorously did he oppose every concession that all the eloquence of Cineas was in vain, and the Romans forgot past misfortunes in the inspiration of Claudius's patriotism (Livy, x. 13; Justin, xviii., 2; Plutarch, *Pyrrhus,* 19). The story of his blindness, however, may be merely a method of accounting for his cognomen. Tradition regarded it as a punishment for his transference of the cult of Hercules from the Potitii.

His speech against peace with Pyrrhus was the first that was transmitted to writing, and thereby laid the foundation of prose composition. He was the author of a collection of aphorisms in verse mentioned by Cicero (of which a few fragments remain), and of a legal work entitled *De Usurpationibus.* It is very likely also that he was concerned in the drawing up of the *Legis Actiones* published by Flavius. He also interested himself in grammatical questions, distinguished the two sounds R and S in writing, and did away with the letter Z.

See Mommsen's appendix to his *Roman History* (vol. i.); treatises by W. Siebert (1863) and F. D. Gerlach (1872), dealing especially with the censorship of Claudius.

4. CLAUDIUS, PUBLIUS, surnamed PULCHER, son of (3). He was the first of the gens who bore this surname. In 249 he was consul and appointed to the command of the fleet in the first Punic War. Instead of continuing the siege of Lilybaeum, he decided to attack the Carthaginians in the harbour of Drepanum, and was completely defeated. The disaster was commonly attributed to Claudius's treatment of the sacred chickens, which refused to eat before the battle. "Let them drink then," said the consul, and ordered them to be thrown into the sea. Having been recalled and ordered to appoint a dictator, he nominated a subordinate official, but the nomination was at once overruled. Claudius himself was accused of high treason and heavily fined. He must have died before 246, probably by his own hand. *See* Livy, *Epit.,* 19; Polybius, i. 49; Cicero, *De Divinatione,* i. 16, ii. 8; Valerius Maximus, i. 4, viii. 1.

5. CLAUDIUS APPIUS, surnamed PULCHER, Roman statesman and author. He served under his brother-in-law Lucullus in Asia (72 B.C.) and was commissioned to deliver the ultimatum to Tigranes, which gave him the choice of war with Rome or the surrender of Mithradates. In 57 he was praetor, in 56 propraetor in Sardinia, and in 54 consul with L. Domitius Ahenobarbus. Pompey reconciled him to Cicero, whose return from exile he had opposed. In 53 he became governor of Cilicia. During this period he carried on a correspondence with Cicero, whose letters to him form the third book of the *Epistolae ad Familiares.* Claudius resented the appointment of Cicero as his successor, avoided meeting him, and issued orders after his arrival in the province. On his return to Rome Claudius was impeached by P. Cornelius Dolabella, and was obliged to make advances to Cicero, since it was necessary to obtain witnesses in his favour from his old province. He was acquitted, and a charge of bribery against him also proved unsuccessful. In 50 he was censor, and expelled many of the members of the senate. When Caesar marched on Rome he fled from Italy. He was appointed by Pompey to the command in Greece, and died in Euboea about 48, before the battle of Pharsalus. He wrote a work on augury, the first book of which he dedicated to Cicero. *See* Orelli, *Onomasticon Tullianum.*

BIBLIOGRAPHY.—A full account of all the Claudii will be found in Pauly-Wissowa's *Realencyclopädie der classischen Altertumswissenschaft,* iii. 2 (1899). *See* also L. A. Constans, *Un Correspondant de Cicéron, Ap. Claudius Pulcher* (1921).

CLAUDIUS (TIBERIUS CLAUDIUS DRUSUS NERO GERMANICUS), Roman emperor A.D. 41–54, son of Drusus and Antonia, nephew of the Emperor Tiberius, and grandson of Livia, the wife of Augustus, was born at Lugdunum (Lyons) on Aug. 1, 10 B.C. He was kept in the background by (Suet. *Claud.* 4) Augustus Tiberius, owing to his physical infirmities and apparent weakness of intellect, and lived in retirement; it was probably at this time that he became dependent on the company of freedmen. Under Caligula he became more prominent, holding the consulship (A.D. 37) and other public posts; though he was the emperor's butt, many people at Rome must have realized that he might succeed. On the murder of Caligula, Claudius, though not of the Julian gens, was made emperor by the praetorians, who were rewarded with a large donative, and were probably increased in number.

Claudius, though abnormal, was by no means the idiot that our hostile sources would suggest. Despite his pedantry, he had a certain shrewdness, and wished to govern well. In the earlier part of his reign he extended the boundaries of the empire; Mauretania was subdued and annexed in 43, and in the same year Claudius himself took part in the famous expedition to Britain, which gave the Romans a footing in the south of the island; in 44 Judea, which had been entrusted to King Agrippa (*q.v.*), was made once more a province, and in 46 the same fate overtook the client kingdom of Thrace.

In his dealings with the provincials Claudius, despite senatorial opposition, reverted to Julius Caesar's liberal policy. We possess part of his speech proposing that the chieftains of the Aedui should be admitted to the senate (*see* the paraphrase of it in Tacitus *Annals*), and his edict conferring citizenship on the Anauni (Hardy, *Roman Laws and Charters* Oxford, 1912). A large number of municipia and colonies in the provinces owe their origin to Claudius.

The reign of Claudius is marked by the development of the emperor's personal service. There was an extension of procuratorial government in the provinces (*e.g.,* Thrace, Mauretania, and Judea) and provincial procurators were granted jurisdiction equal to that of the emperor in all cases relating to the fiscus. A definite scale of salaries was also instituted. But even more notable was the increased power of the emperor's freedmen, who, while they remained his personal servants, became, in practice, powerful ministers, and received great rewards and honour. (*See,* besides authorities below, Statius, *Silv.* iii. and v.) The rule of the freedmen, who, though efficient, were arrogant and corrupt, was resented by the nobility, but the practice was continued under later emperors, though not to the same extent.

Another grievance was the increased importance of the emperor's private court. Under Augustus and Tiberius its use had been restricted to certain cases of *majestas,* but Claudius had a passion for acting as judge; vast numbers of cases were heard *in camera,* and the emperor's methods seem often to have been capricious.

His public works include a new harbour at Ostia, the draining of the Fucine Lake, and the construction of two aqueducts (*Aqua*

Claudia and *Anio Novus*). His revival of the censorship and extension of the poemerium may be quoted rather as examples of his antiquarianism than as practically important. In 47 he celebrated the Ludi Saeculares.

In the latter part of his reign his government degenerated and he fell entirely under the influence of his favourites and his womenkind.

He had married (as his third wife) Messalina, who, in 47, if we are to believe Tacitus, actually went through a form of marriage with Silius, unknown to Claudius. Narcissus brought about her execution, and, at the prompting of Pallas, the *a nationibus*, Claudius married his niece Agrippina, a marriage which shocked Roman sentiment. She induced him to set aside his own son Britannicus and to adopt as heir Nero, her son by a former marriage. Claudius died suddenly in 54, poisoned, according to Tacitus, by Agrippina. He was deified, but Seneca's satire, the *Apocolocyntosis*, expresses the relief felt at his death.

Claudius wrote several historical works "magis inepte quam ineleganter," including his own autobiography, but all, unfortunately, are lost.

BIBLIOGRAPHY.—Ancient: The *Annals* of Tacitus, Bks. xi., xii. Suetonius and Dio Cassius. *See* also Seneca, *Consolatio ad Polybium*, and *Apocolocyntosis* (ed. Ball, 1902, with introduction and translation); Josephus, *Ant. Jud.* Modern: H. Lehmann, *Claudius und seine Zeit*, with introductory chapter on the ancient authorities (1858); Lucien Double, *L'Empereur Claude* (1876); A. Ziegler, *Die politische Seite der Regierung des Kaisers Claudius* (1885); H. F. Pelham in *Quarterly Review* (April, 1905), where certain administrative and political changes introduced by Claudius, for which he was attacked by his contemporaries, are discussed and defended; Merivale, *Hist. of the Romans under the Empire*, chs. 49, 50; H. Schiller, *Geschichte der römischen Kaiserzeit*, i., pt. i.; H. Furneaux's ed. of the *Annals* of Tacitus (introduction); E. G. Hardy, *Roman Laws and Charters* (Oxford, 1912) for the Edict de Civitate Anammorum; Bell, *Jews and Christians in Egypt* for the edict relating to Alexandria.

CLAUDIUS, MARCUS AURELIUS, surnamed GOTHICUS, Roman emperor A.D. 268–270, belonged to an obscure Illyrian family. On account of his military ability he was placed in command of an army by Decius; and Valerian appointed him general on the Illyrian frontier, and ruler of the provinces of the lower Danube. During the reign of Gallienus, he was called to Italy to crush Aureolus, and on the death of the emperor (268) was chosen as his successor. Shortly after his accession he routed the Alamanni on the Lacus Benacus (some doubt is thrown upon this); in 269 a great victory over the Goths at Naïssus in Moesia gained him the title of Gothicus. In the following year he died of the plague at Sirmium. He enjoyed great popularity, and appears to have been a man of ability and character.

His life was written by Trebellius Pollio, one of the *Scriptores Historiae Augustae; see* also Zosimus i. 40–43; Homo, *De Claudio Gothico* (1900); Pauly-Wissowa, *Realencyklopädie*, ii. 2458 *et seq.* (Henze).

CLAUDIUS, MATTHIAS (1740–1815), German poet, otherwise known by the *nom de plume* of Asmus, was born on Aug. 15, 1740, at Rheinfeld, near Lübeck, and studied at Jena. From 1771 to 1775 he edited a newspaper called the *Wandsbecker Bote* (*Wandsbeck Messenger*), in which he published a large number of prose essays and poems. He died on Jan. 21, 1815. In his later days Claudius became strongly pietistic.

BIBLIOGRAPHY.—Claudius's collected works were published under the title of *Asmus omnia sua secum portans, oder Sämtliche Werke des Wandsbecker Boten* (8 vols., 1775–1812; 13th ed., by C. Redich, 2 vols., 1902). His biography has been written by Wilhelm Herbst (4th ed., 1878). *See* also M. Schneidereit, *M. Claudius, seine Weltanschauung und Lebensweisheit* (1898).

CLAUS, ÉMILE (1849–1924), Belgian painter, was born at Vive Saint-Éloi, Flanders, on Sept. 27, 1849. Receiving early training at the Antwerp Academy of Fine Arts, Claus began as a traditionalist. Soon, however, he came under the influence of certain French painters who had determined to break from the rut, and he completely changed his style, in spite of the fact that he had achieved a certain reputation and his work was remunerative. He started to paint in high lights by the juxtaposition of pure colours. He settled at Astène, in a house on the banks of the Lys, which he called *Zonneschijn*. There he began to paint that beautiful series of views of meadows, gardens, fields, streams and roads.

During the World War Claus resided in London, and from the windows of a house on the Victoria Embankment painted views of the Thames, showing the changing effects of the light and the weather. In 1917 he accompanied the Queen of the Belgians to La Panne, and visited the devastated regions. In 1920 he returned to Astène and worked there until his death, on June 6 1924. He was the recipient of numerous Belgian and foreign honours. He is represented in the Luxembourg, Paris, and in galleries in Venice, Brussels, Antwerp, Ghent and Liège.

CLAUSEL (more correctly CLAUZEL), **BERTRAND,** COUNT (1772–1842), marshal of France, was born at Mirepoix (Ariège) on Dec. 12, 1772, and served in the first campaign of the French Revolutionary Wars as one of the volunteers of 1791. In June 1795, having distinguished himself repeatedly in the war on the northern frontier (1792–93) and the fighting in the eastern Pyrenees (1793–94), Clausel was made a general of brigade. In this rank he served in Italy in 1798 and 1799, in the expedition to S. Domingo in 1802, in Naples in 1806. In 1808–09 he was with Marmont in Dalmatia, and at the close of 1809 he was appointed to a command in the army of Portugal under Massena.

Clausel took part in the Peninsular campaigns of 1810 and 1811, including the Torres Vedras campaign, and under Marmont he did excellent service in re-establishing the discipline, efficiency, and mobility of the army. In the Salamanca campaign (1812) the result of Clausel's work was shown in the marching powers of the French, and at the battle of Salamanca, Clausel, who had succeeded to the command on Marmont being wounded, and had himself received a severe wound, drew off his army with the greatest skill. Early in 1813 Clausel was made commander of the army of the north in Spain, but he was unable to avert the great disaster of Vittoria. Under the supreme command of Soult he served through the rest of the Peninsular War with unvarying distinction. During the Hundred Days he was in command of an army defending the Pyrenean frontier. After Waterloo he escaped to America, being condemned to death in absence. He took the first opportunity of returning to aid the Liberals in France (1820), sat in the chamber of deputies from 1827 to 1830, and after the revolution of 1830 was at once given a military command. At the head of the army of Algiers, Clausel made a successful campaign, but he was soon recalled by the home government, which desired to avoid complications in Algeria. At the same time he was made a marshal of France (Feb. 1831). For some four years thereafter he urged his Algerian policy upon the chamber of deputies, and finally in 1835 was reappointed commander-in-chief. But after several victories, including the taking of Mascara in 1835, the marshal met with a severe repulse at Constantine in 1836. A change of government in France was primarily responsible for the failure, but public opinion attributed it to Clausel, who was recalled in Feb. 1837. He thereupon retired from active service and lived in complete retirement up to his death at Secourrieu (Garonne) on April 21, 1842.

CLAUSEN, SIR GEORGE (1852–1944), English painter, born in London, the son of a decorative artist. He attended the design classes at the South Kensington schools from 1867–73. He then worked in the studio of Edwin Long, R.A., and subsequently in Paris under Bouguereau and Robert-Fleury. His "Girl at the Gate" was placed in the Tate gallery. He became R.A. in 1908 and was knighted in 1927. His series of lectures to the students of the Royal Academy schools was published as *Six Lectures on Painting* (1904), and *Aims and Ideals in Art* (1906). He died at Cold Ash near Newbury, England, on Nov. 23, 1944.

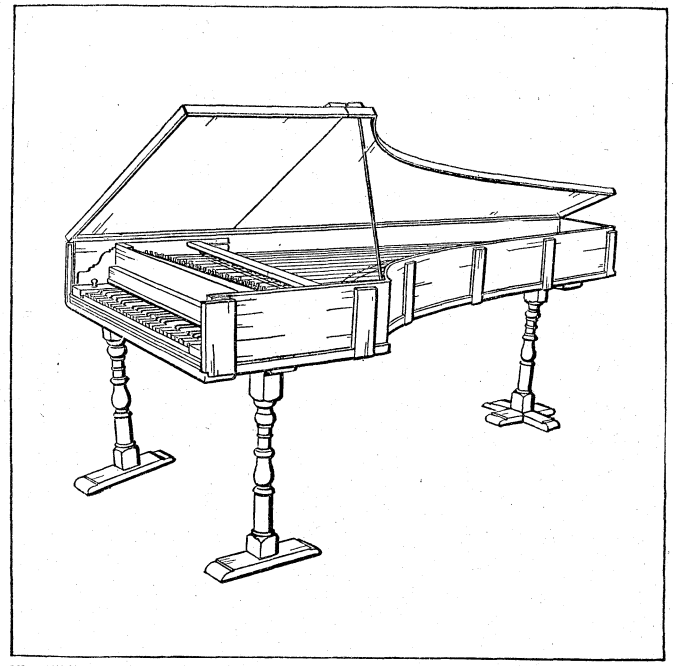
CLAUSEWITZ, KARL VON (1780–1831), Prussian general and military writer, was born at Burg, near Magdeburg, on June 1, 1780. His family, originally Polish, had settled in Germany at the end of the previous century. Entering the army in 1792, he first saw service in the Rhine campaigns of 1793–94, receiving his commission at the siege of Mainz. On his return to garrison duty he set to work so zealously to remedy the defects in his education caused by his father's poverty, that in 1801 he was admitted to the Berlin academy for young officers, then

directed by Scharnhorst. Scharnhorst, attracted by his pupil's industry and force of character, paid special attention to his training, and profoundly influenced the development of his mind. In 1803, on Scharnhorst's recommendation, Clausewitz was made "adjutant" (aide-de-camp) to Prince August, and he served in this capacity in the campaign of Jena (1806), being captured along with the prince by the French at Prenzlau. A prisoner in France and Switzerland for the next two years, he returned to Prussia in 1809; and for the next three years, as a departmental chief in the ministry of war, as a teacher in the military school, and as military instructor to the crown prince, he assisted Scharnhorst in the famous reorganization of the Prussian Army. In 1810 he married the countess Marie von Brühl.

On the outbreak of the Russian war in 1812, Clausewitz, like many other Prussian officers, took service with his country's nominal enemy. This step he justified in a memorial, published for the first time in the *Leben Gneisenaus* by Pertz (1869). At first adjutant to Gen. Phull, who had himself been a Prussian officer, he served later under Pahlen at Witepsk and Smolensk, and from the final Russian position at Kaluga he was sent to the army of Wittgenstein. It was Clausewitz who negotiated the convention of Tauroggen, which separated the cause of Yorck's Prussians from that of the French, and began the War of Liberation (*see* YORCK VON WARTENBURG; also Blumenthal's *Die Konvention von Tauroggen,* 1901). As a Russian officer he superintended the formation of the *Landwehr* of east Prussia (*see* STEIN, H. F. K.), and in the campaign of 1813 he served as chief of staff to Count Wallmoden. He conducted the fight at Göhrde, and after the armistice, with Gneisenau's permission, published an account of the campaign (*Der Feldzug von 1813 bis zum Waffenstillstand,* Leipzig, 1813). This work was long attributed to Gneisenau himself. After the peace of 1814 Clausewitz re-entered the Prussian service, and in the Waterloo campaign was present at Ligny and Wavre as Gen. Thielmann's chief of staff. This post he retained till 1818, when he was promoted major-general and appointed director of the *Allgemeine Kriegsschule.* Here he remained till in 1830 he was made chief of the 3rd Artillery Inspection at Breslau. Next year he became chief of staff to Field-marshal Gneisenau, who commanded an army of observation on the Polish frontier. After the dissolution of this army Clausewitz returned to his artillery duties; but on Nov. 18, 1831, he died at Breslau of cholera, which had proved fatal to his chief also, and a little previously, to his old Russian commander Diebitsch on the other side of the frontier.

His collected works were edited and published by his widow, who was aided by some officers, personal friends of the general, in her task. Of the ten volumes of *Hinterlassene Werke über Krieg und Kriegführung* (1832–37, later edition called *Clausewitz's Gesammte Werke,* 1874) the first three contain Clausewitz's masterpiece, *Vom Kriege,* an exposition of the philosophy of war. He produced no "system" of strategy, and his critics styled his work "negative" and asked *"Qu'a-t-il fondé?"* What he had "founded" was that modern strategy which, by its hold on the Prussian mind, carried the Prussian arms to victory in 1866 and 1870, and his philosophy of war became, not only in Germany but in many other countries, the basis of military studies. But it has been argued since the World War that his teaching contributed to the deadlock and costly attrition strategy of 1914–18 through its excessive emphasis on purely military factors, a tendency naturally exaggerated by his disciples. The English and French translations (Graham, *On War,* 1873; Neuens, *La Guerre,* 1849–52; or Vatry, *Théorie de la grande guerre,* 1899), with the German original, place the work at the disposal of students of most nationalities. The remaining volumes deal with military history: vol. 4, the Italian campaign of 1796–97; vols. 5 and 6, the campaign of 1799 in Switzerland and Italy; vol. 7, the wars of 1812, 1813 to the armistice, and 1814; vol. 8, the Waterloo campaign; vols. 9 and 10, papers on the campaigns of Gustavus Adolphus, Turenne, Luxemburg, Münnich, John Sobieski, Frederick the Great, Ferdinand of Brunswick, etc. He also wrote *Über das Leben und den Charakter von Scharnhorst* (printed in Ranke's *Historisch-politischer Zeitschrift,* 1832). A manuscript on the catastrophe of 1806 long remained unpublished. It was used by v. Höpfner in his history of that war, and eventually published by the Great General Staff in 1888 (French translation, 1903). Letters from Clausewitz to his wife were published in *Zeitschrift für preussische Landeskunde* (1876).

See von Meerheimb, *Karl von Clausewitz* (1875), also Memoir in *Allgemeine deutsche Biographie;* Schwartz, *Leben des General von Clausewitz und der Frau Marie von Clausewitz* (2 vols., 1877); Bernhardi, *Leben des Generals von Clausewitz* (10th Supplement, *Militär. Wochenblatt,* 1878).



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

THE CLAVICEMBALO, AN ITALIAN HARPSICHORD OF THE 16TH CENTURY

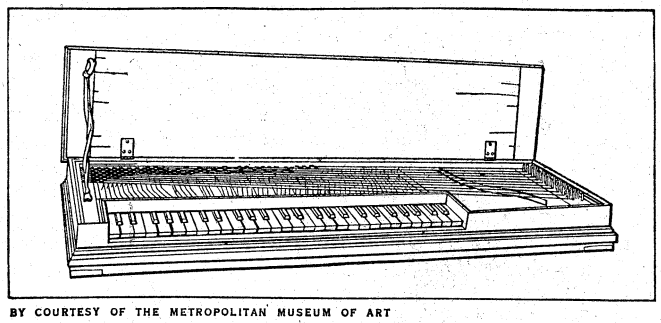
CLAUSIUS, RUDOLF JULIUS EMMANUEL (1822–1888), German physicist, was born at Köslin, in Pomerania. After attending the Gymnasium at Stettin, he studied at Berlin university from 1840 to 1844. In 1848 he took his degree at Halle, and in 1850 was appointed professor of physics in the royal artillery and engineering school at Berlin and *privatdocent* in the university. In 1855 he became an ordinary professor at Zürich Polytechnic, and professor in the University of Zürich. In 1867 he moved to Würzburg as professor of physics, and two years later was appointed to the same chair at Bonn, where he died. The work of Clausius, who was a mathematical rather than an experimental physicist, was concerned with many of the most abstruse problems of molecular physics. By his restatement of Carnot's principle he put the theory of heat on a truer and sounder basis, and he deserves the credit of having made thermodynamics a science; he enunciated the second law, in a paper contributed to the Berlin Academy in 1850, in the well-known form, "Heat cannot of itself pass from a colder to a hotter body." His results he applied to an exhaustive development of the theory of the steam-engine, laying stress in particular on the conception of entropy. The kinetic theory of gases owes much to his researches. He raised it, on the basis of the dynamical theory of heat, to the level of a theory, and he carried out many numerical determinations in connection with it, *e.g.,* of the mean free path of a molecule. Clausius also made an important advance in the theory of electrolysis, suggesting that molecules in electrolytes are continually interchanging atoms, the electric force not causing, but merely directing the interchange. This view found little favour until 1887, when it was taken up by S. A. Arrhenius, who made it the basis of the theory of electrolytic dissociation. In addition to many scientific papers he wrote *Die Potentialfunktion und das Potential* (1864) and *Abhandlungen über die mechanische Wärmetheorie* (1864–67).

CLAVECIN, the French for "clavicymbal" or "harpsichord" (Ger. *Clavicymbel* or *Dockenklavier*), an abbreviation of the

Flemish *clavisinbal* and Ital. *clavicimbalo*. *See* PIANOFORTE; HARPSICHORD; SPINET; VIRGINAL.

CLAVICEMBALO or **GRAVICEMBALO,** the Italian names for the clavicymbal or harpsichord. "Cymbal" (Gr. κύμβαλον, from κύμβη, a hollow vessel) was the old European term for the dulcimer, and hence its place in the formation of the word. *See* PIANOFORTE; HARPSICHORD; SPINET; VIRGINAL.

CLAVICHORD or **CLARICHORD,** a mediaeval stringed keyboard instrument, a forerunner of the pianoforte (*q.v.*), its



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

THE MEDIAEVAL CLAVICHORD, A FORERUNNER OF THE PIANO
This instrument differed from the harpsichord in that its strings were struck by tangents, instead of being plucked or twanged by quills. Its tone, though weak, was very delicate and sweet

strings being set in vibration by a blow from a brass tangent instead of a hammer as in the modern instrument.

The clavichord, derived from the dulcimer by the addition of a keyboard, has a long history, being mentioned as early as 1404 in Eberhard Cersne's *Rules of the Minnesingers*.

There were two kinds of clavichords—the fretted or *gebunden* and the fret-free or *bund-frei*. The term "fretted" was applied to those clavichords which, instead of being provided with a string or set of strings in unison for each note, had one set of strings acting for three or four notes, the arms of the keys being twisted in order to bring the contact of the tangent into the acoustically correct position under the string. The "fret-free" were chromatically-scaled instruments.

The first *bund-frei* clavichord is attributed to Daniel Faber of Crailsheim in Saxony about 1720. This important change in construction increased the size of the instrument, each pair of unison strings requiring a key and tangent of its own, and led to the introduction of the system of tuning by equal temperament upheld by J. S. Bach and practically illustrated by him in his immortal "Wohltemperirtes Clavier" ("Well-tempered Clavier") written expressly to encourage its adoption.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A 17TH CENTURY ITALIAN CLAVICYTHERIUM, OR CLAVIHARP, A VERTICAL SPINET

The tone of the clavichord, extremely sweet and delicate, was characterized by a tremulous hesitancy, which formed its great charm, though its very limited power rendered it unsuitable for use in large rooms or concert halls. Nevertheless, on account of the scope which it afforded for individual expression, it was a favourite instrument with all the best musicians in its day. Bach is said to have preferred it to the harpsichord, Mozart loved to play on it, while even Beethoven, though himself long accustomed to the pianoforte, spoke of it as the most expressive of all keyboard instruments.

CLAVICYTHERIUM, a name usually applied to an upright spinet (*q.v.*), the soundboard and strings of which were vertical instead of horizontal, being thus perpendicular to the keyboard; but it would seem that the clavicytherium proper is distinct from the upright spinet in that its strings are placed *horizontally*. In a unique specimen with two keyboards dating from the 16th or 17th century, which is in the collection of Baron Alexandre Kraus, what appear to be vibrating strings stretched over a soundboard perpendicular to the keyboard are in reality the wires forming part of the mechanism of the action. The instrument was probably of Italian or possibly South German origin and it may be noted that its name has also been applied at times to the upright harpsichord.

There is a very fine specimen of the so-called clavicytherium (really an upright spinet) in the Donaldson museum of the Royal College of Music, London, acquired from the Correr collection at Venice in 1885.

For the history of the clavicytherium considered as a forerunner of the pianoforte, *see* PIANOFORTE.

CLAVIE, BURNING THE, an ancient Scottish custom still observed at Burghead, a fishing village on the Moray firth, near Forres. The "clavie" is a bonfire of casks split in two, lighted on Jan. 12, corresponding to the New Year of the old calendar. One of these casks is joined together again by a huge nail (Lat. *clavus;* hence the term). It is then filled with tar, lighted and carried flaming round the village, and finally up to a headland upon which stands the ruins of a Roman altar, locally called "the Douro." It here forms the nucleus of the bonfire, which is built up of split casks. When the burning tar-barrel falls in pieces the people scramble to get a lighted piece with which to kindle the New Year's fire on their cottage hearth. The charcoal of the clavie is collected and is put in pieces up the cottage chimneys to keep spirits and witches from coming down.

CLAVIÈRE, ÉTIENNE (1735–1793), French financier and politician, was born in Geneva on Jan. 27, 1735. He was a political refugee in England, and in 1789 went to France, where he assisted Mirabeau on the *Courrier de Provence* and in the preparation of his speeches. Clavière also published some pamphlets under his own name, and through these and his friendship with J. P. Brissot, whom he had met in London, he became minister of finance in the Girondist ministry, from March to June 12, 1792. After Aug. 10 he was again given charge of the finances in the provisional executive council. He shared in the fall of the Girondists, and was arrested on June 2, 1793. On receiving notice (Dec. 8) that he was to appear on the next day before the revolutionary tribunal, he committed suicide.

CLAVIJO, RUY GONZALEZ DE (d. 1412), Spanish traveller, was born in Madrid. On the return of the Embassy from the court of Timur, Henry III. of Castille sent out another, which included Clavijo. They sailed from St. Mary Port, near Cadiz, on May 22, 1403, touched at the Balearic isles, Gaeta, Rhodes and Constantinople, went by the south coast of the Black sea to Trebizond, and proceeded inland by Erzerum, Tabriz, Teheran and Meshed to Samarkand, where they were favourably received. They returned successfully after great difficulties and reached Spain on March 1, 1406. Clavijo lived in Madrid and died on April 2, 1412. His narrative is the first important one of its kind in Spanish literature.

BIBLIOGRAPHY.—An English version of Clavijo's narrative, by Sir Clements Markham, was issued by the Hakluyt Society in 1859 (*Narrative of the Embassy of R . . . G . . . Clavijo to the Court of Timour*). For the identification of the places mentioned by Clavijo *see* Khanikof's list in *Geographical Magazine* (1874), and Sreznevski's *Annotated Index* in the Russian edition of 1881. A short account of Clavijo's life is given by Alvarez y Baena in the *Hijos de Madrid,* vol. ix. *See* also C. R. Beazley, *Dawn of Modern Geography,* iii.

CLAVIJO Y FAJARDO, JOSÉ (1726–1806), Spanish publicist, was born at Lanzarote (Canary islands). He settled in Madrid, became editor of *El Pensador,* and by his campaign against the public performance of *autos sacramentales* secured their prohibition in 1765. His work would long since have been forgotten were it not that it put an end to a peculiarly national form of dramatic exposition, and that his love affair with one of Beaumarchais' sisters suggested the theme of Goethe's first publication, *Clavigo.*

CLAVILUX, a keyed projection instrument which makes possible the use of light as a medium for aesthetic expression. It was invented by the American artist, Thomas Wilfred, who gave the new art of light its first comprehensible status with the theory that form, colour and motion are its three basic factors. The instrument consists of a number of projectors grouped before a large white screen and controlled from a keyboard that is either attached to the projectors or placed at a distance. The keys, which slide in grooves graduated from 0 to 100, are grouped in tiers, each comparable to a pipe-organ manual. A tier contains three sets of keys connected with the form, colour and motion-producing devices in the corresponding projector in which a strong beam of white light from an incandescent lamp, after passing through the three devices, is projected on the screen as one or more mobile images depending in form, colour and motion upon the positions and movements of the various keys. A skilled player may select to play a silent visual composition previously written by another artist and recorded by means of a special notation system. The instrument has also been used for visual accompaniments to music, dance and drama, in the latter instance permitting projected scenery and a much more delicate control of lighting than is possible by means of the electrician's switchboard. (T. Wi.)

CLAY, CASSIUS MARCELLUS (1810–1903), American politician, was born in Madison county, Ky., on Oct. 19, 1810. He was the son of Green Clay (1757–1826), a Kentucky soldier of the War of 1812 and a relative of Henry Clay. He was educated at Centre college, Danville, Ky., and at Yale, where he graduated in 1832. Influenced to some extent by William Lloyd Garrison, he became an advocate of the abolition of slavery. In 1835, 1837 and 1840 he was elected as a Whig to the Kentucky legislature, where he advocated a system of gradual emancipation. In 1845 he established, at Lexington, Ky., an anti-slavery publication known as *The True American,* but in the same year his office and press were wrecked by a mob, and he removed the publication office to Cincinnati, Ohio. In 1856 he joined the Republican Party, and wielded considerable influence as a Southern representative in its councils. In 1861 he was sent by President Lincoln as minister to Russia; in 1862 he returned to America to accept a commission as major-general of volunteers, but in 1863 was reappointed to his former post at St. Petersburg, where he remained until 1869. Disapproving of the Republican policy of reconstruction, he left the party, and in 1872 was largely instrumental in securing the nomination of Horace Greeley for the presidency. In the political campaign of 1884 he rejoined the Republican Party. He died at Whitehall, Ky., on July 22, 1903.

See his autobiography, *The Life, Memoirs, Writings and Speeches of Cassius Marcellus Clay* (Cincinnati, 1896); and *The Writings of Cassius Marcellus Clay* (edited with a "Memoir" by Horace Greeley, 1848).

CLAY, CHARLES (1801–1893), English surgeon, was born at Bredbury, near Stockport, on Dec. 27, 1801. He qualified at Edinburgh in 1823 and settled in Manchester as a consultant in 1839. In 1842 he first performed the operation of ovariotomy with which his name is associated, and in 1865 was able to show an analysis of 111 cases with a mortality slightly over 30%. Clay was a man of many interests and included geology, numismatics and book collecting among his pursuits. He died at Poulton-le-Fylde, near Preston, on Sept. 19, 1893.

CLAY, FREDERIC (1838–1889), English musical composer, was the son of James Clay, M.P., the celebrated whist authority. Born in Paris, he studied music under W. B. Molique in that city and under Moritz Hauptmann at Leipzig. With the exception of a few songs and two cantatas, *The Knights of the Cross* (1866) and *Lalla Rookh* (1877),—the latter of which contained his well-known song "I'll sing thee songs of Araby,"—his compositions were written for the stage, and have long since been forgotten. Two of them, *Ages Ago* (1869) and *Princess Toto* (1875) were written to libretti by W. S. Gilbert. Clay's last works, *The Merry Duchess* (1883) and *The Golden Ring* (1883), showed an advance upon his previous work, and rendered all the more regrettable the stroke of paralysis which crippled him physically and mentally during the last few years of his life.

CLAY, HENRY (1777–1852), American statesman and orator, was born in Hanover county, Va., on April 12, 1777, and died in Washington on June 29, 1852. His public life covered nearly half a century, and his name and fame rest entirely upon his own merits. He achieved his success despite serious obstacles. He was tall, rawboned and awkward; his early instruction was scant; but he read books, talked well, studied law under George Wythe, the teacher of Jefferson and Marshall, and so, after his admission to the bar at Richmond, Va., in 1797 and his removal next year to Lexington, Ky., he quickly acquired a reputation and a lucrative income from his law practice.

Thereafter, until the end of life, and in a field where he met, as either friend or foe, John Quincy Adams, Gallatin, Madison, Monroe, Webster, Jackson, Calhoun, Randolph and Benton, his political activity was wellnigh ceaseless. At the age of 22 (1799) he was elected to a constitutional convention in Kentucky; at 26, to the Kentucky legislature; at 29, while yet under the age limit of the U.S. Constitution, he was appointed to an unexpired term (1806–7) in the U.S. Senate, where, contrary to custom, he at once plunged into business as though he had been there all his life. He again served in the Kentucky legislature (1808–9), was chosen speaker of its lower house, and achieved distinction by preventing an intense and widespread anti-British feeling from excluding the common law from the Kentucky code. A year later he was elected to another unexpired term in the U.S. Senate, serving in 1810–11. At 34 (1811) he was elected to the U.S. House of Representatives and chosen speaker on the day of his entrance. During the 14 years following his first election, he was re-elected five times to the House and to the speakership; retiring for one term (1821–23) to resume his law practice and retrieve his fortunes. He thus served as speaker in 1811–14, in 1815–20 and in 1823–25. Once he was unanimously elected by his constituents, and once nearly defeated for having at the previous session voted to increase congressional salaries. From 1825 to 1829 he served as secretary of State in President John Quincy Adams's cabinet, and in 1831 he was elected to the U.S. Senate, where he served until 1842, and again from 1849 until his death. Between 1824 and 1848 he was a strong presidential candidate in nearly every campaign.

One of the chief sources of Clay's immediate popularity when first elected to the House in 1811, was his championship of the War of 1812 with Great Britain, which his influence, more than that of any other man, precipitated. While not, perhaps, an altogether advantageous or necessary war, it won the youthful nation the respect of European nations, and a greater independence of them than she had hitherto known. Clay was sent to Ghent as one of the peace commissioners, and signed the treaty, though reluctantly, for he was disappointed in the silence concerning the questions of impressment of American sailors, the fisheries, and the navigation of the Mississippi.

After the war Clay and Calhoun became the foremost champions of the Democratic Republican Party in Congress. Clay refused appointments as minister to Russia and to England, as well as the secretaryship of war under both Madison and Monroe that he might devote his attention to his congressional programme, the three most important features of which were the inauguration of internal improvements, the establishment of a national bank, and the levying of a tariff high enough to build up industries needed in time of war. As a protectionist Clay in 1824 again advocated high duties to relieve the prevailing distress, which he pictured in a brilliant and effective speech. In spite of the opposition of Webster, Calhoun and other prominent statesmen, Clay succeeded in enacting a tariff so high that the people of the Southern States denounced it as a "tariff of abominations." When it overswelled the revenue in 1832 he favoured reducing the rates on all articles not competing with American products, but the new measure reduced the revenue so little and provoked such serious threats of nullification and secession in South Carolina, that to prevent bloodshed and to forestall a free trade measure from the next Congress, Clay brought forward in 1833 a compromise measure for the gradual reduction of the tariff to a 20% ad valorem basis extending over a period of nine years. It lost Clay

the support of ardent protectionists but was hailed with favour by the people at large.

Clay's interest in internal improvements resulted naturally from his interest in western expansion and development. He supported the Federal financing or aiding of roads, canals and other schemes of transportation which would bind the east and west together. For a time he argued for the return to individual States of the receipts from all public lands sold within its borders.



BY COURTESY OF THE LEXINGTON CHAMBER OF COMMERCE

"ASHLAND," THE HOME OF HENRY CLAY IN LEXINGTON, KY.

This plan, together with many of his special projects, failed, but the general impetus of his oratory and argument was not lost.

Clay also interested himself passionately in the struggle of the South American nations for their independence. He made resounding speeches in the House in favour of the "eighteen millions of people struggling to burst their chains." He advocated an alliance in the two Americas to counterbalance the Holy Alliance of Europe and work against its designs. He was among the first to recommend recognition of the new nations by the United States, and consequently is still remembered with affection by them. Similarly, in 1824, he made an impassioned speech in favour of Greek independence and supported Webster's resolution for sending an agent or commissioner to that country.

But of all causes and questions, Clay's career was connected most intimately with that of slavery. When only 22 Clay had vainly urged an emancipation clause for the new constitution of Kentucky and never ceased to regret its failure. In 1820 he congratulated the new South American republics on having abolished slavery, pointing out that in this important point of progress they were in advance of the United States. The same year, however, threats of the Southern States to destroy the Union led him to advocate the "Missouri Compromise," which, while keeping slavery out of all of the rest of the territory included in the "Louisiana Purchase" north of Missouri's southern boundary, permitted it in that State. When the slave power became more aggressive in and after the year 1831, Clay defended the right of petition for the abolition of slavery in the District of Columbia, and opposed Calhoun's bill forbidding the use of the mails to "abolition" newspapers and documents. Though he favoured the freedom of the mails and press as regards slavery, he disliked the abolitionists and, because of their insistent, uncompromising demands, held them largely responsible for the hatred and strife which menaced the Union. Clay was lukewarm toward recognizing the independence of Texas lest it should aid the increase of slave territory. Yet he was so anxious to set himself right with the South that he prepared an elaborate speech for the purpose which received pro-slavery approval. His attitude resulted, as he himself declared, in the abolitionists denouncing him as slave-holder, and the slave-holder as an abolitionist. Such straddling undoubtedly was a prime factor in his loss of the presidency, which he always held in view. In 1844, for instance, while a candidate for the presidency, he announced himself against the annexation of Texas, but on other grounds than slavery. By not pronouncing definitely on the real issue he lost supporters from men of both pro-slavery and anti-slavery sentiments instead of winning them as he had hoped. His compromising spirit upon the question promised to bear fruit, however, when in the crisis of 1850 he was able to bring about the series of measures known collectively as the "Compromise of 1850." The situation was acute, the South was on the point of secession, statesmen were frantic, every way of alleviating the deadlock seemed to have failed. Clay, who had retired from the Senate several years before, was now an old and physically frail man, but had himself re-elected to that body where he could put forth and defend his measures. His speech was one of the ablest of his career. Webster in a notable speech seconded the measures as a last resort. Calhoun still bitterly opposed. A deadlock resulted because of the opposition of President Taylor to the plan, and was only removed upon the latter's death, whereupon Fillmore, friendly to the compromise, succeeded to his place. The compromise admitted California as a free State, organized Utah and New Mexico as territories without reference to slavery, and enacted a more efficient fugitive slave law. It was a noble climax to Clay's great career, but it did not, as he hoped, permanently save the Union from bloodshed. Its success was in the fact that it postponed the Civil War until the North had the immense growing power of the West as its ally. Clay did not live to see its failure, but died in 1852 at the height of his fame and popularity.

In one respect, however, Clay's whole political career had been a bitter disappointment, at least to the man himself. The nation never rewarded him with the highest office in its power to bestow, and which he so deeply coveted. This was in spite of the fact that for a generation he was the acknowledged leader of his party. One reason was that during the whole period sectional feeling was so strong that no leader of any one section could be elected. Peace had to be secured by choosing lesser men as compromise candidates. Another reason was Clay's own compromising nature which always won him enemies in both camps. His name was used comparatively early in connection with the presidency. He had hoped to be offered the office of secretary of State under Monroe in 1817, for at that time this official was regarded as next in line for the succession. Clay was greatly disappointed and pursued a policy of obstruction to the administration until the events culminating in the Missouri Compromise again led him to co-operate with Monroe. In 1824 Clay was a candidate with W. H. Crawford, Andrew Jackson and John Quincy Adams for the presidency. Choice between the two highest, Jackson and Adams, went to the House where Clay controlled the deciding vote. Though Jackson represented the West and its interests, to choose him would have meant the denial of all chances for himself in the following campaign, for the country would not be likely to choose two western leaders in succession. Temperamentally Clay was also opposed to Adams, but after a long conference he gave out that he would support the latter. Soon afterwards he accepted an appointment as secretary of State, under Adams, and Jackson's supporters immediately charged a corrupt bargain between the two. Historians generally feel that Clay sincerely favoured Adams, but ever after Clay was kept busy explaining and denying the allegation of a bargain. It made Jackson his bitter enemy for life. John Randolph of Virginia pressed the accusation until Clay hotly consented to a duel to defend his honour. Neither was hurt. Clay's action so alienated his western supporters that it also must be ascribed as one of the reasons why he never achieved the presidency. In fact when he finished his term as secretary of State he had to go home "to mend his fences" in order to ensure his re-election to Congress. It proved the most difficult and most important campaign of his life, for, had he failed, it would have meant the eclipse of his political career.

By his enemies Clay's compromises were often ascribed to timidity or to hedging for political purposes. They can just as truly be represented as the acts of a man of great human understanding and sympathies, anxious to enter into the point of view of others. There is every indication that they represent a philosophical attitude toward life. "All legislation, all government, all society is founded upon the principle of mutual concession, politeness, comity, courtesy . . . I bow to you today because you bow to me." Such were his words and sentiments. The compromises represent his greatest political achievements. As "the great pacificator" he occupies a place in the memory of his countrymen.

When not in Washington Clay's home was on his estate at Ashland, Kentucky. He took a great interest in its practical man-

agement and especially devoted himself to the breeding of beautiful Kentucky horses. He was an excellent rider. Though Clay repeatedly denounced slavery as an evil, tradition and habit allowed him to keep slaves on his own plantation. He treated them considerately and they were devoted to him. When very young Clay married Lucretia Hart, a cousin of Thomas Hart Benton. Five sons and six daughters were born to them. But misfortune seemed to hang over the family. All of the daughters died before the father. One son was killed in the Mexican War, and another became insane after an accident. Clay's acquaintances and friends were selected from all classes and occupations. His popularity with the people was immense, and he believed in them. Yet like many democratic leaders, notably his great western rival, Andrew Jackson, Clay was often arbitrary, autocratic and possessed of an irrepressible desire to rule. His imagination frequently ran away with his understanding while his imperious temper and ardent combativeness hurried him into disadvantageous positions. Great crowds always met him wherever he was to speak because of his matchless voice and fascinating personality. In public he was of magnificent bearing, possessing the true oratorical temperament, the nervous exaltation that makes the orator feel and appear a superior being, transfusing his thought, passion and will into the mind and heart of the listener. In private he was an excellent conversationalist, possessing a fund of pleasant humour. His never-failing courtesy, his agreeable manners and a noble and generous heart for all who needed protection against the powerful or the lawless endeared him to hosts of friends.

BIBLIOGRAPHY.—*See* Calvin Colton, *The Works of Henry Clay* (1857; new ed., 1898), the first three volumes of which are an account of Clay's life and times; Carl Schurz, *Henry Clay* (1887); T. H. Clay, *Henry Clay* (1910); Gamaliel Bradford, "Henry Clay," in *Virginia Quarterly Review,* Jan. 1928. Much material will be found in the standard histories of the period and in Thomas H. Benton's *Thirty Years View* (1861). No complete and critical biography yet exists.

CLAY, commonly defined as a fine-grained, almost impalpable substance, very soft, more or less coherent when dry, retentive of water and often plastic when wet; it has an "earthy odour" when breathed upon or moistened (from O. Eng. *claeg,* a word common in various forms to Teutonic languages, *cf.* Ger. *Klei*). The chemical composition of clay varies according to the finely divided mineral matter present; usually the latter consists essentially of hydrous silicates of aluminium, iron, and alkalies. The constituent particles are commonly less than ·005mm. in diameter and are often so small as to be colloidal. The upper limit of size in defining "clay" is taken by soil-analysts as ·002mm. diameter, but by geologists often as much as ·01mm. diameter. From the induration and alteration of clay are formed a number of rocks which collectively are known as "clay-rocks" or "pelitic rocks" (from Gr. πηλός, clay), *e.g.,* mudstone, shale, slate. In nature clays are rarely free from foreign ingredients, some of which are visible to the eye, but others only by means of the microscope. The economic value of many clays is dependent on their freedom from (or occasionally the presence of) certain impurities. The commonest of these are (1) organic matter, humus (exemplified by clay-soils with an admixture of peat, oil-shales, carbonaceous shales); (2) fossils (such as plants in the shales of the Lias and Coal Measures, and shells in clayey deposits of all ages); (3) carbonate of lime (rarely altogether absent but abundant in marls, which may be defined as calcareous clays, cement-stones and argillaceous limestones); (4) sulphide of iron, as pyrite or marcasite, either finely diffused and giving the clay a blackish or dark-grey colour which "weathers" brown (*e.g.,* London clay), or in nodules and concretions (*e.g.,* Gault, Kimmeridge clay); (5) oxides of iron, which stain the clay to bluish, greenish and grey tints when in the ferrous state, and bright red, brown, or yellow when in the ferric condition, hence red and yellow ochres; (6) sand and silt, which are particles of coarser grain, frequently of detrital silica (thus forming loams, arenaceous clays, argillaceous sandstones, etc.).

The principal constituent minerals of clays are hydrated oxides of aluminium (bauxite) and iron (laterite), hydrated silicates of aluminium (such as kaolinite), finely-divided micas, chlorites and similar micaceous minerals. Recent work on French marine clays of ages varying from Trias to Middle Tertiary has shown that the dominant mineral constituent is a hydrated silicate of aluminium magnesium, and potash, bravaisite, while kaolin is present in clays formed as residuals in fresh-water, or by pneumatolytic action.

A few of the most important clay rocks may be briefly described.

Brick and Tile Clays.—Almost any argillaceous material may be used for the manufacture of bricks and tiles. The colour and texture of the resulting products depend on the impurities in the clay, and also on the conditions of burning. The best materials for brick making contain a proportion of sandy and silty impurities (up to 30%) which prevent the clay showing too great a shrinkage on being fired. For tile making, less sandy material is desirable.

China-clay.—This is white, friable and earthy. It occurs as a result of decomposition of granite, porphyry and syenite, and occupies hollows or cavities, often of considerable depth. The crude material contains kaolinite (the pure hydrated silicate of aluminium), scaly white mica, quartz, tourmaline and other minerals. The kaolinite is produced by the action of heated gases which have escaped from the igneous rocks, on certain of the constituent minerals. Pure clay for commercial purposes is obtained by levigation of the crude product and repeated settlement in tanks.

Fire-clays.—These are those varieties which are refractory to heat. They are free from, or contain only small quantities of, alkalies and alkaline earths. They occur frequently in Carboniferous rocks, sometimes as under-clays of coal seams, or in association with lacustrine deposits of later age (*e.g.,* inferior oolite of Yorkshire). In addition to hydrated aluminium silicates, some varieties contain free hydrated alumina, when they are known as bauxitic fire-clays (*e.g.,* Ayrshire).

Boulder Clay.—This is formed by ice-action and consists usually of tough sandy clay, often unstratified, containing boulders of various sizes. The latter frequently display great variety in petrological character, are angular or rounded and sometimes marked with glacial striae.

Loess.—This is a fine calcareous clay deposited under the dry steppe or desert conditions which often followed the glaciation of a region. The loess occupies a world-wide fringing belt, lying beyond the margin of the glacial deposits, and in the main is regarded as formed of wind-borne material derived from the desiccated glacial clays.

Oil Shales.—While, as a result of drying and induration, clays which are homogeneous throughout yield *mudstones,* others split readily into leaflike plates or laminae parallel to their bedding and are termed *shales.* This laminated structure is accentuated by the presence of films of other substances such as sand, mica or vegetable débris. Shales occur frequently throughout the geological column, the most notable being those of the Carboniferous and Jurassic (*e.g.,* Kimmeridge shales). Some of them contain much organic material in the form of globular, yellow, apparently resinous bodies, and when distilled yield paraffin oil, wax, compounds of ammonia, etc. In New South Wales, Scotland, Esthonia, and parts of North America such oil-shales are worked on a commercial scale (*see* PETROLEUM).

Cave-Earth (terra rossa).—This is a type of reddish clay found in limestone caves, which represents the insoluble and thoroughly weathered impurities left behind on solution of the calcareous matter. Similar residual clays occur on the surface or in hollows in limestone-country (*see* also articles CAVE and LATERITE).

For Red Clay, Green and Blue Muds, etc., *see* OCEAN AND OCEANOGRAPHY. The article on SEDIMENTARY ROCKS should also be consulted. (P. G. H. B.)

CLAY CROSS, an urban district of Derbyshire, England, near the river Amber, on the L.M.S.R. and the Ashover light railway, 1½ mi. S. of Chesterfield. Pop. (1938) 8,156. Area 3.2 sq.mi. Coal miners and foundry workers form the majority of the population.

CLAYMORE (from the Gaelic *claidheamh mòr,* "great sword"), the old two-edged broadsword with cross hilt, of which the guards were usually turned down, used by the Highlanders of

Scotland. The name is also wrongly applied to the single-edged basket-hilted sword adopted in the 16th century and still worn as the full-dress sword in the Highland regiments of the British army.

CLAYS, PAUL JEAN (1819–1900), Belgian marine painter, was born at Bruges in 1819, and died at Brussels in 1900. A Fleming in his feeling for colour, Clays set his palette with clean, strong hues, and their powerful harmonies were in striking contrast with the rusty, smoky tones then in favour. If he was not a "luminist" in the modern use of the word, he deserves at any rate to be classed with the founders of the modern naturalistic school. Among his works are: "Dutch Boats in the Flushing Roads," in the National Gallery, London; "The Port of Antwerp," "Coast near Ostend," and a "Calm on the Scheldt," in the Brussels gallery; "The Meuse at Dordrecht" in the Antwerp museum; "The Open North Sea," in the Pinakothek at Munich; and "The Festival of the Freedom of the Scheldt at Antwerp in 1863," in the Metropolitan Museum of Fine Arts, New York.

See Camille Lemonnier, *Histoire des Beaux-Arts* (Brussels, 1887).

CLAYTON, JOHN MIDDLETON (1796–1856), American politician, was born in Dagsborough, Del., on July 24, 1796. He came of an old Quaker family long prominent in the political history of Delaware. He graduated at Yale in 1815, and in 1819 began to practise law at Dover, Delaware. Engaging in politics, he became in 1824 a member of the state house of representatives, and in 1826–28 was secretary of state for Delaware. In 1829 he was elected to the U.S. Senate by the anti-Jackson forces, and in 1835 was re-elected as a Whig, but resigned in 1836. In 1845 he again entered the Senate, where he opposed the annexation of Texas and the Mexican War. In March, 1849, he became secretary of state in President Taylor's cabinet. His brief tenure of the state portfolio, which terminated July 22, 1850, soon after Taylor's death, was notable chiefly for the negotiation with the British minister, Sir Henry Lytton Bulwer of the Clayton-Bulwer Treaty (*q.v.*). He was once more a member of the Senate from March, 1853, until his death at Dover, Del., Nov. 9, 1856. By his contemporaries Clayton was considered one of the ablest debaters and orators in the Senate.

See the memoir by Joseph P. Comegys in the *Papers* of the Historical Society of Delaware, No. 4 (Wilmington, 1882).

CLAYTON-BULWER TREATY, a famous treaty between the United States and Great Britain, negotiated in 1850 by John M. Clayton and Sir Henry Lytton Bulwer (Lord Dalling) in consequence of the situation created by the project of an interoceanic canal across Nicaragua, each signatory being jealous of the activities of the other in Central America. Great Britain had large and indefinite territorial claims in three regions—Belize or British Honduras, the Mosquito Coast and the Bay islands. On the other hand, the United States, without territorial claims, held in reserve, ready for ratification, treaties with Nicaragua and Honduras, which gave her a certain diplomatic vantage with which to balance the *de facto* dominion of Great Britain.

The treaty bound both parties not to "obtain or maintain" any exclusive control of the proposed canal, or unequal advantage in its use. It guaranteed the neutralization of such canal. It declared that, the intention of the signatories being not only the accomplishment of "a particular object"—*i.e.*, that the canal, then supposedly near realization, should be neutral and equally free to the two contracting powers—"but also to establish a general principle," they agreed "to extend their protection by treaty stipulation to any other practicable communications, whether by canal or railway, across the isthmus which connects North and South America." Finally, it stipulated that neither signatory would ever "occupy, or fortify, or colonize, or assume or exercise any dominion over Nicaragua, Costa Rica, the Mosquito Coast or any part of Central America," nor make use of any protectorate or alliance, present or future, to such ends.

The treaty was signed on April 19, and was ratified by both Governments; but before the exchange of ratifications Lord Palmerston, on June 8, directed Sir H. Bulwer to make a "declaration" that the British Government did not understand the treaty "as applying to Her Majesty's settlement at Honduras, or its dependencies." J. M. Clayton made a counter-declaration, which recited that the United States did not regard the treaty as applying to "the British settlement in Honduras commonly called British-Honduras . . . nor the small islands in the neighbourhood of that settlement which may be known as its dependencies"; that the treaty's engagements did apply to all the Central American States, "with their just limits and proper dependencies"; and that these declarations, not being submitted to the United States Senate, could of course not affect the legal import of the treaty. The interpretation of the declarations soon became a matter of contention. The phraseology reflects the effort made by the United States to render impossible a physical control of the canal by Great Britain through the territory held by her at its mouth—the United States losing the above-mentioned treaty advantages—just as the explicit abnegations of the treaty rendered impossible such control politically by either power. But Great Britain claimed that the excepted "settlement" at Honduras was the "Belize" covered by the extreme British claim; that the Bay islands were a dependency of Belize; and that, as for the Mosquito Coast, the abnegatory clauses being wholly prospective in intent, she was not required to abandon her protectorate. The United States contended that the Bay islands were not the "dependencies" of Belize, these being the small neighbouring islands mentioned in the same treaties; that the excepted "settlement" was the British-Honduras of definite extent and narrow purpose recognized in British treaties with Spain; that she had not confirmed by recognition the large, indefinite and offensive claims whose dangers the treaty was primarily designed to lessen; and that, as to the Mosquito Coast, the treaty was retrospective, and that the clause binding both not to "occupy" any part of Central America or the Mosquito Coast necessitated the abandonment of such territory as Great Britain was already actually occupying or exercising dominion over, and the complete abandonment of the British protectorate over the Mosquito Indians. It seems to be a just conclusion that when in 1852 the Bay islands were erected into a British "colony" this was a flagrant infraction of the treaty; that as regards Belize the American arguments were decidedly stronger, and more correct historically; and that as regards the Mosquito question, inasmuch as a protectorate seems certainly to have been recognized by the treaty, to demand its absolute abandonment was unwarranted, although to satisfy the treaty Great Britain was bound materially to weaken it.

In 1859–60, by British treaties with Central American States, the Bay islands and Mosquito questions were settled nearly in accord with the American contentions. But by the same treaties Belize was accorded limits much greater than those contended for by the United States. This settlement the latter power accepted without cavil for many years.

In 1880–84 a variety of reasons were advanced why the United States might justly repudiate at will the Clayton-Bulwer Treaty. The arguments advanced were quite indefensible in law and history, and although the position of the United States in 1850–60 was in general the stronger, that of Great Britain was even more conspicuously strong in the years 1880–84. In 1885 the former Government reverted to its traditional policy, and the Hay-Pauncefote Treaty of 1902, which replaced the Clayton-Bulwer Treaty, adopted the rule of neutralization for the Panama Canal.

See the collected diplomatic correspondence in I. D. Travis, *History of the Clayton-Bulwer Treaty* (Ann Arbor, Mich., 1899); J. H. Latané, *Diplomatic Relations of the United States and Spanish America* (Baltimore, 1900); T. J. Lawrence, *Disputed Questions of Modern International Law* (2nd ed., Cambridge, England, 1885); Sir E. L. Bulwer in 99 *Quarterly Rev.* 235–286, and Sir H. Bulwer in 104 *Edinburgh Rev.* 280–298.

CLAY-WITH-FLINTS, in geology, a name given to a deposit of stiff red, brown or yellow clay, containing many flints, whole or broken, with some round pebbles of hard rock. It covers large areas in south-eastern and southern England, usually lying on chalk. It is commonly considered to represent the insoluble residue of the chalk left by weathering (mainly solution), but may include deposits formed in other ways, of which the following have been suggested: (*a*) that it is the residue of patches of Tertiary strata which once extended more widely over the chalk

than at present. This is favoured by the presence of pebbles other than flint: (*b*) that it may be a glacial deposit, in fact, a boulder-clay or till, indicating an extension of the ice-sheet somewhat further than is usually believed. (*See* GLACIAL EPOCH.) These questions must be regarded as still undecided, but there can be little doubt that the insoluble residue theory is applicable over wide areas. (R. H. RA.)

CLAZOMENAE, an ancient town of Ionia and a member of the Ionian Dodecapolis (Confederation of Twelve Cities), on the Gulf of Smyrna, about 20 m. W. of that city. Though not in existence before the arrival of the Ionians in Asia, its original founders were largely settlers from Phlius and Cleonae. It stood originally on the isthmus connecting the mainland with the peninsula on which Erythrae stood; but the inhabitants, alarmed by the encroachments of the Persians, removed to one of the small islands of the bay, and there established their city. This island was connected with the mainland by Alexander the Great by means of a pier, the remains of which are still visible. During the 5th century it was for some time subject to the Athenians, but about the middle of the Peloponnesian war (412 B.C.) it revolted. After a brief resistance, however, it again acknowledged the Athenian supremacy, and repelled a Lacedaemonian attack. Under the Romans Clazomenae was included in the province of Asia, and enjoyed immunity from taxation. It was the birthplace of the philosopher Anaxagoras. It is famous for its painted terra-cotta sarcophagi, which are the finest monuments of Ionian painting in the 6th century B.C. (E. GR.)

CLEANING: *see* DRY CLEANING.

CLEANTHES (*c.* 301–232 or 252 B.C.), Stoic philosopher, was born at Assos in the Troad. He came to Athens, where he listened first to the lectures of Crates the Cynic, and then to those of Zeno the Stoic, supporting himself meanwhile by working all night as water-carrier to a gardener (hence his nickname φρεάντλης). On the death of Zeno in 263, he became the leader of the school. Among his pupils were his successor, Chrysippus, and Antigonus, king of Macedon.

Cleanthes produced very little that was original, though he wrote some 50 works, of which fragments have come down to us. The principal is the large portion of the *Hymn to Zeus,* which has been preserved in Stobaeus. He regarded the sun as the abode of God, the intelligent providence, or (in accordance with Stoic materialism) the vivifying fire or aether of the universe. Virtue, he taught, is life according to nature; but pleasure is not according to nature. The principal fragments of Cleanthes' works are contained in Diogenes Laertius and Stobaeus; some may be found in Cicero and Seneca.

See G. C. Mohinke, *Kleanthes der Stoiker* (Greifswald, 1814); C. Wachsmuth, *Commentationes de Zenone Citiensi et Cleanthe Assio* (Göttingen, 1874–75); A. C. Pearson, *Fragments of Zeno and Cleanthes* (1891); art. by E. Wellmann in Ersch and Gruber's *Allgemeine Encyklopädie;* R. Hirzel, *Untersuchungen zu Ciceros philosophischen Schriften,* ii. (1882), containing a vindication of the originality of Cleanthes; *Hymn of Cleanthes,* tr. E. H. Blakeney, "Texts for Students" series, vol. xxvi. (1921); A. B. Krische, *Forschungen auf dem Gebiete der alten Philosophie* (1840); also works quoted under STOICS.

CLEARCHUS, the son of Rhamphias, a Spartan general and condottiere. Born about the middle of the 5th century B.C., Clearchus was sent with a fleet to the Hellespont in 411 and became harmost of Byzantium. His severity, however, made him unpopular, and in his absence the gates were opened to the Athenians under Alcibiades (409). Subsequently appointed by the ephors to settle the affairs of Byzantium and to protect it from Thracian attacks, he made himself tyrant, and, when driven thence by a Spartan force, fled to Cyrus (*q.v.*). In the "expedition of the ten thousand," Clearchus led the Peloponnesians. On Cyrus's death Clearchus conducted the retreat, until, being treacherously seized with his fellow-generals by Tissaphernes, he was handed over to Artaxerxes and executed (Thuc. viii. 8, 39, 80; Xen., *Hellenica,* i. 3, 15-19; *Anabasis,* i. ii.; Diodorus xiv. 12, 19-26). Clearchus was a typical Spartan, an able and energetic soldier, but lacking refinement and humanity.

CLEARFIELD, a borough of Clearfield county, Pennsylvania, U.S.A., 35m. N. of Altoona, on the west branch of the Susquehanna river, at an altitude of 1,108 ft., in the central Pennsylvania coal field. It is on federal highway 322; is served by the Baltimore and Ohio, the New York Central and the Pennsylvania railways; and has an airport lighted by beacons. The population in 1930 was 9,221; in 1940 it was 9,372. It is the county seat, a wholesale distributing centre, and has various manufacturing industries, especially large firebrick, tile and sewer-pipe works, using the fire clay that abounds in the vicinity, metal industries and tanneries. Clearfield was so named because the first white settlers found it already cleared of timber. In 1805 it was chosen as the site for the county seat.

CLEARING HOUSE. When business houses or firms engaged in the same kind of activity have large dealings with each other it is an obvious convenience and economy to establish a mutual institution to enable them to set off their transactions with each other and to clear them, thus making it necessary to pay to each other at agreed times only such balances of account as are revealed by the clearance. Such institutions are called clearing houses, and they have been established in all great commercial nations for many branches of industry. The chief of them are Bankers' Clearing Houses (*q.v.*) and Railway Clearing Houses, which are described under RAILWAYS.

The London Stock Exchange Clearing House deals with transactions in stock, the clearing being effected by balance-sheets and tickets; the balance of stock to be received or delivered is shown on a balance-sheet sent in by each member, and the items are then cancelled against one another and tickets issued for the balances outstanding. The New York Stock Exchange Clearing House does similar work. The settlements on the Paris Bourse are cleared within the Bourse itself, through the Compagnie des Agents de Change de Paris.

For details concerning clearing house operations in the United States *see* Theodore Gilman, *A Graded Banking System Formed by the Incorporation of Clearing Houses under a Federal Law* (Boston, 1898); Jerome Thralls, *The Clearing House* (1916); Harvey White Magee, *A Treatise on the Law of National and State Banks, Including the Clearing House* (Albany, N.Y., 1921); and Walter Eaton Spahr, *The Clearing and Collection of Checks* (1926).

CLEARWATER, a city on the west coast of Florida, U.S.A., 22 mi. W. of Tampa; the county seat of beautiful Pinellas county, which occupies a small peninsula between the Gulf of Mexico and Old Tampa bay. It is served by the Atlantic Coast Line and the Seaboard Air Line railways. In 1900 the population was 343; in 1930, after annexations of territory brought the area to 17 sq.mi., it was 7,607; in 1940 it was 10,136 by the federal census. Clearwater is in a citrus fruit and market-gardening region, has fisheries of importance, and is a winter resort. A commission-manager form of government was adopted in 1923.

CLEAT, a wedge-shaped piece of wood fastened to ships' masts and elsewhere, to prevent a rope, collar or the like from slipping, or to act as a step; more particularly a piece of wood or metal with double or single horns used for belaying ropes. A "cleat" is also a wedge fastened to a ship's side to catch the shores in a launching cradle or dry dock. "Cleat" is also used in mining for the vertical cleavage-planes of coal. The word is common in various forms to many Teutonic languages, in the sense of a wedge or lump, *cf.* "clod" and "clot."

CLEATOR MOOR, a township and civil parish, Cumberland, England, 4¼ mi. S.E. of Whitehaven, served by the L.M.S.R. Pop. (1931) 6,582. The town lies in a coal and iron ore district, and the mines, together with metal works, employ almost the entire population. In consequence, it was severely depressed in the 1930s, unemployment among men being 52.8% in April 1934.

CLEAVERS or **GOOSE-GRASS,** *Galium Aparine* (family Rubiaceae), a common plant in hedges and waste places, with a long, weak, straggling, four-sided, green stem, bearing whorls of six to eight narrow leaves, ½ to 2 in. long, and, like the angles of the stem, rough from the presence of short, stiff, downwardly-pointing, hooked hairs. The small, white, regular flowers are borne, a few together, in axillary clusters, and are followed by the small, hispid, two-celled fruit, which, like the rest of the plant, readily

clings to a rough surface, whence the common name. The plant has a wide distribution throughout the north temperate zone, and is also found in temperate South America.

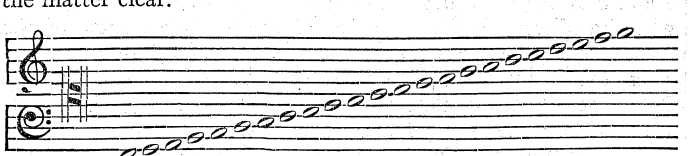
CLEBSCH, ALFRED (1833–1872), German mathematician, was born at Königsberg, Prussia, on Jan. 19, 1833. He was educated at Königsberg, and in 1858 was appointed to the chair of theoretical mechanics at Carlsruhe Polytechnic. In 1863 Clebsch went to the University of Giessen and in 1868 to Göttingen, where he remained until his death. His attention was turned to algebra and geometry after a study of Salmon's works. Clebsch worked at mathematical physics, the calculus of variation, partial differential equations of the first order, the general theory of curves; he applied Abelian functions to geometry and made use of determinants. In 1867 Clebsch, in conjunction with Carl Neumann, founded the *Mathematische Annalen.* He died of diphtheria on Nov. 7, 1872. Clebsch was the author of *Vorlesungen über Geometrie,* which was edited by Ferdinand Lindemann of Munich in 1875, and of *Theorie d. Elasticität fester Körper* (1862), which was translated into French by Saint-Venant.

CLEBURNE, a city of Texas, U.S.A., 30 mi. S. of Ft. Worth; the county seat of Johnson county. It is served by the Santa Fe railroad and is on federal highway 67 and state highways 171 and 174. The population was 12,820 in 1920, 11,539 in 1930 and was 10,558 in 1940 (91% native white) by the federal census. It is the trade centre of a diversified agricultural, live stock and industrial area and has large railroad shops. The industrial pay roll is about $2,000,000 annually; bank deposits increased by about $1,250,000 between 1930 and 1940. Cleburne was settled in 1867 and incorporated in 1871; it was named after Patrick Ronayne Cleburne (1828–64), a major general of the Confederate army, who was called "the Stonewall of the West."

CLECKHEATON, a parish, West Riding of Yorkshire, England, 5½ mi. S.E. of Bradford, on the L.M.S.R. Pop. (1931) 12,153. The industries comprise the manufacture of woollens, blankets, flannel, wire-card and machinery. Cleckheaton parish is in the Spenborough urban district, pop. (1938) 36,420.

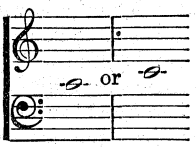
CLEETHORPES, a municipal borough (1936) and watering place in the parts of Lindsey, Lincolnshire, England; 2¼ mi. S.E. of Great Grimsby by a branch of the L.N.E.R. Pop. (1938) 28,730. Area 3.3 sq.mi. It faces eastward to the North sea, but its shore of fine sand, affording good bathing, actually belongs to the estuary of the Humber. The sea-wall forms a pleasant promenade. The suburb of New Clee connects Cleethorpes with Grimsby. The church of the Holy Trinity and St. Mary is principally Norman of various dates, but pre-conquest work appears in the tower. Cleethorpes is greatly favoured as a health resort by people from the midland counties, Lancashire and Yorkshire.

CLEF, in musical notation, is a sign used to indicate the position and pitch of the various notes represented on the stave. Three such signs are now in use,  (or ),  and , of which  stands for the note *c′*, otherwise middle C on the pianoforte,  for the F below and  for the G above. Hence when one of these notes is thus indicated, *e.g.*,  or , a key, or clef, is thereby provided from which all the others can be reckoned. A representation of the Great Stave of eleven lines, showing the position on it occupied by each clef sign, will make the matter clear.



From this it will be seen that the F (bass) and G (treble or violin) clefs are the lower and upper five lines respectively and that the C clef (variously known as the tenor or alto clef, according to the particular line on which it is placed) consists of five lines taken from the middle; for it should be explained further that "clef" signifies not only the individual sign but also the group of lines on which it stands, although strictly speaking "stave" is here the more accurate term.

In pianoforte, vocal and most other scores, only the F and G clefs are nowadays used, but the C clef is still retained for the viola and one or two other instruments, the choice of the particular clef used being governed, as it will be understood, by the pitch and compass of the instrument written for, the object aimed at being to include as much of the music as possible within the limits of a five-line stave. It will also be understood that in practice the middle line of the Great Stave is normally omitted, a short additional line known as a leger (or ledger) line being employed to take its place when the intermediate C is required—



It may be noted further that the clef signs as we now know them are simply much modified and conventionalized forms of the letters of the three notes which they stand for—F, C and G. (*See* MUSICAL NOTATION.)

CLEFT PALATE and **HARE-LIP,** in surgery. Cleft palate is a congenital cleavage in the roof of the mouth, and is frequently associated with hare-lip. Both conditions are due to faulty development and may be hereditary. The infant is prevented from sucking, and an operation is necessary. The most favourable time for operating is between the age of two weeks and three months, and if the cleft is closed at this early date, not only are the nutrition and general development of the child greatly improved, but the voice is probably saved from much of the unpleasant tone associated with a defective roof to the mouth. After the cleft in the palate has been effectually dealt with, the hare-lip can be repaired with ease and success.

Hare-lip.—In the hare the splitting of the lip is in the middle line, but in the human subject for developmental reasons it is on one or on both sides of the middle line. Though we are unable to explain why development should miss the mark in formation of the lip and palate, it is unlikely that maternal impressions have anything to do with it. As a rule, the supposed "fright" comes long after the ninth week of foetal life when the lips are developed. The best time for operating on a hare-lip depends upon circumstances, in a favourable case within the first few days of birth.

CLEISTHENES, the name of two Greek statesmen, (1) of Athens, (2) of Sicyon, of whom the first is far the more important.

(1) CLEISTHENES, the Athenian statesman, was the son of Megacles, the Alcmaeonid, and Agariste, daughter of Cleisthenes of Sicyon. The Alcmaeonidae had been in exile during the Peisistratid tyranny but gained the favour of Delphi by their munificence in the rebuilding of the temple, and their reinstatement was imposed by the oracle upon the Spartan king, Cleomenes (*q.v.*). Aristotle's *Constitution of Athens* treats the alliance of the Peisistratids with Argos, the rival of Sparta in the Peloponnese, as the chief ground for the action of Cleomenes who expelled Hippias in 511–510 B.C., leaving Athens once again at the mercy of the powerful families.

Cleisthenes, on his return, realized that Athens would not tolerate a new tyranny, nor were the other nobles willing to accept him as leader of an oligarchy. It was left for him to "take the people into partnership" as Peisistratus had in a different way done before him. Solon's reforms had failed, primarily because they left unimpaired the power of the great landed nobles. This evil of local influence Peisistratus had concealed by satisfying the nominally sovereign people that in him they had a sufficient representative. It was left to Cleisthenes to adopt the remedy of giving substance to the form of the Solonian constitution. His first attempts roused the aristocrats to a last effort; Isagoras appealed to the

Spartans to come to his aid. Cleisthenes retired on the arrival of a herald from Cleomenes, reviving the old question of the curse. The democrats, however, rose, and after besieging Cleomenes and Isagoras in the Acropolis, let them go under a safe-conduct, and brought back the exiles. We are not told when and how the ascendancy of Cleisthenes came to an end. It is stated that Cleisthenes, hard pressed in the war with Boeotia, Euboea and Sparta (Herod. v. 73), sent ambassadors to ask the help of Persia. Associated as he was with the democrats, the Peisistratid party, this is not improbable. The existence of a strong philo-medic party is clear from the story of the shield after the battle of Marathon, for which the Alcmaeonidae were blamed. (*See* G. B. Grundy, *Great Persian War,* ch. iv.) The gift and withdrawal of Athenian help in the Ionian War (498) is another indication of division of opinion in Athens. Aelian says that he was a victim to his own device of ostracism (*q.v.*); this may perhaps indicate that his political career ended in disgrace, a hypothesis which is explicable on the ground of this attempted Persian alliance.

Cleisthenes realized that the dead-weight which held the democracy down was the influence on politics of the clan unit with its religious associations. Therefore his prime object was to dissociate the clans and the phratries from politics, and to give the democracy a new electoral basis in which old associations and vested interests would become ineffective. His first step was to abolish the four Solonian tribes and create ten new ones. Each of the new tribes was subdivided into "demes" (roughly "townships"); this organization did not, except politically, supersede the system of clans and phratries whose old religious signification remained untouched. The new tribes, however, did not represent local interests. Further, the tribe names were taken from legendary heroes, and, therefore, contributed to the idea of a national unity; even Ajax, the eponym of the tribe Aeantis, though not really Attic, was famous as an ally (Herod. v. 66) and had been adopted as a national hero. Each tribe had its shrine and its particular hero-cult, which, however, was free from local association and the dominance of particular families. This national idea Cleisthenes further emphasized by setting up in the market-place at Athens a statue of each tribal hero.

The next step was the organization of the deme. Within each tribe he grouped demes (*see* below), each of which had its census-list kept by the demarch (local governor), who was elected popularly and held office for one year and presided over meetings affecting local administration and the provision of crews for the state-navy. According to the Aristotelian *Constitution of Athens,* Cleisthenes further divided Attica into three districts, Urban and Suburban, Inland (*Mesogaios*) and Maritime (*Paralia*), each of which was subdivided into ten *trittyes;* each tribe was composed of three trittyes, one in each of the three districts. The demes were arranged in ten groups but the number of demes in a tribe was not uniform. The trittyes might consist of one or several demes and the number of members of a deme varied greatly, though, at first, the division was local, *i.e.,* a deme consisted of its residents, the qualification became hereditary, a man belonging to his father's deme wherever he lived. Hence the distinction between resident demesmen and residents belonging to another deme (ἐγκεκτημένοι). The main purpose of the reform was to do away with the religious qualification of connection with clan or phratry and so facilitate the enfranchisement of new citizens. The artificial arrangement of the trittyes was intended to weaken the authority of the Eupatrid families in the tribes whose widely separated trittyes could not easily be brought under influence.

It has been asked whether we are to believe that Cleisthenes invented the demes. To this the answer is in the negative. The demes were undoubtedly primitive divisions of Attica. The most logical conclusion perhaps is that Cleisthenes, while he did create the demes which Athens itself comprised, did not create the country demes, but merely gave them definition as political divisions. Thus the city itself had six demes in five different tribes, and the other five tribes were represented in the suburbs and the Peiraeus. In the Cleisthenean system there was one great source of danger, namely that the residents in and about Athens must always have had more weight in elections than those in distant demes. Moreover a special class, the new commercial element in the citizenship devised by Solon and fostered by Cleisthenes, soon came to have a preponderating influence in the city and suburbs.

A second problem is the franchise reform of Cleisthenes. Aristotle in the *Politics* (iii. 2. 3 = 1275 b) says that Cleisthenes created new citizens by enrolling in the tribes "many resident aliens and emancipated slaves." But the Aristotelian *Constitution of Athens* asserts that he gave "citizenship to the masses." Μέτοικοι had been encouraged to settle in Athens by Solon and the grant of citizenship had been made to many skilled in trades and handicrafts. The Peisistratids, like the Etruscan dynasty at Rome, naturally favoured this commercial "plebs" as a support against the aristocrats. After their expulsion a revision of the citizen-roll had removed many or all of these as γένειμή καθαροί. Cleisthenes restored these and opened the way to citizenship to all satisfactory resident aliens, so strengthening the position of the democracy.

The Boulē (*q.v.*) was reorganized to suit the new tribal arrangement, and was known henceforward as the Council of the Five Hundred, fifty from each tribe, each fifty acting as an executive committee (πρυτάνεις) for one month. The system of ten tribes led in course of time to the construction of boards of ten to deal with military and civil affairs, *e.g.* the Strategi (*see* Strategus), the *Apodektai,* and others. Of these the former cannot be attributed to Cleisthenes, but on the evidence of Androtion it was Cleisthenes who replaced the *Kolakretai,* by the *Apodektai* ("receivers"), who were controllers and auditors of the finance department. *Kolakretai* were very ancient Athenian magistrates; they were again important in the time of Aristophanes (*Wasps,* 693, 724; *Birds,* 1541), and presided over the payment of the dicasts instituted by Pericles. The *Kolakretai* remained in authority over the internal expenses of the Prytaneum. A further change which followed from the new tribal system was the reconstitution of the army; this, however, probably took place about 501 B.C., and cannot be attributed directly to Cleisthenes. It has been said that the deme became the local political unit, replacing the naucrary. But the naucraries still supplied the fleet, and were increased in number from forty-eight to fifty.

The device of ostracism is the final stone in the Cleisthenean structure. An admirable scheme in theory, and, at first, in practice, it deteriorated in the 5th century into a mere party weapon.

Bibliography.—*Ancient:* Aristotle, *Constitution of Athens* (ed. J. E. Sandys), cc. 20–22, 41; Herodotus v. 63–73, vi. 131; Aristotle, *Politics,* iii. 2, 3 (=1275 b. for franchise reforms). *Modern:* Histories of Greece in general, especially J. B. Bury. A. H. J. Greenidge, *Handbook of Greek Constitutional History* (1896); Gilbert, *Greek Constitutional Antiquities* (Engl. trans. 1895); R. W. Macan, *Herodotus iv–vi.,* vol. ii. (1895), pp. 127–148; E. M. Walker in *Camb. Anc. Hist.* vol. iv. ch. vi. *The Reform of Cleisthenes. See* also Boule; Ecclesia; Ostracism; Solon.

(2) Cleisthenes of Sicyon (*c.* 600–570), grandfather of the above, became tyrant of Sicyon as the representative of the conquered Ionian section of the inhabitants. He emphasized the destruction of Dorian predominance by giving ridiculous epithets to their tribal units, which from Hylleis, Dymanes and Pamphyli become Hyatae ("Swine-men"), Choireatae ("Pig-men") and Oneatae ("Ass-men"). He also attacked Dorian Argos, and suppressed the Homeric "rhapsodists" who sang the exploits of Dorian heroes. He championed the cause of the Delphic oracle against the town of Crisa in the Sacred War (*c.* 590). Crisa was destroyed, and Delphi became one of the meeting-places of the Delphic amphictyony (*see* Amphictyony). The Pythian games were re-established with new magnificence, and Cleisthenes won the first chariot race in 582. He founded Pythian games at Sicyon, and built a new Sicyonian treasury at Delphi. His power was so great that when he offered his daughter Agariste in marriage, some of the most prominent Greeks sought the honour, which fell upon Megacles, the Alcmaeonid. The story of the rival wooers with the famous retort, "Hippocleides don't care," is told in Herod. vi. 125; *see* also Herod. v. 67 and Thuc. i. 18.

Cleisthenes is also the name of an Athenian pilloried by Aristophanes (*Clouds,* 354; *Thesm.* 574) as a fop and a profligate.

CLEITARCHUS, one of the historians of Alexander the Great, possibly a native of Egypt, or at least spent some time at

the court of Ptolemy Lagus. Quintilian (*Instit.* x. i. 74) credits him with more ability than trustworthiness, and Cicero (*Brutus,* ii.) accuses him of giving a fictitious account of the death of Themistocles. But his history was popular, and much used by Diodorus Siculus, Quintus Curtius, Justin and Plutarch.

The fragments, some thirty in number, chiefly preserved in Aelian and Strabo, will be found in C. Müller's *Scriptores Rerum Alexandri Magni* (in the Didot *Arrian,* 1846); monographs by C. Raun, *De Clitarcho Diodori, Curtii, Justini auctore* (1868), and F. Reuss, "Hellenistische Beiträge" in *Rhein. Mus.* lxiii. (1908), pp. 58–78.

CLEITHRAL, an architectural term applied to a Greek temple whose roof completely covered it; in contradistinction to hypaethral, applied to one partly or wholly open to the sky.

CLEITOMACHUS, Greek philosopher, was a Carthaginian, who came to Athens about the middle of the 2nd century B.C. at the age of 24. He studied principally under Carneades, whose views he adopted and propagated and whom he succeeded as chief of the New Academy in 129 B.C. Of Cleitomachus' works we possess scarcely anything but a few titles, among which are Περὶ ἐποχῆς (on suspension of judgment) and Περὶ αἱρέσεων (about philosophical sects). Cicero highly commends his works and admits his own debt in the *Academics* to the treatise Περὶ ἐποχῆς. Parts of Cicero's *De Natura* and *De Divinatione,* and the treatise *De Fato* are also in the main based upon Cleitomachus.

See E. Wellmann in Ersch and Gruber's *Allgemeine Encyclopädie;* R. Hirzel, *Untersuchungen zu Ciceros philosophischen Schriften,* i. (1877); Diog. Laërt. iv. 67–92; Cicero, *Acad. Pr.* ii. 31, 32, and *Tusc.* iii. 22.

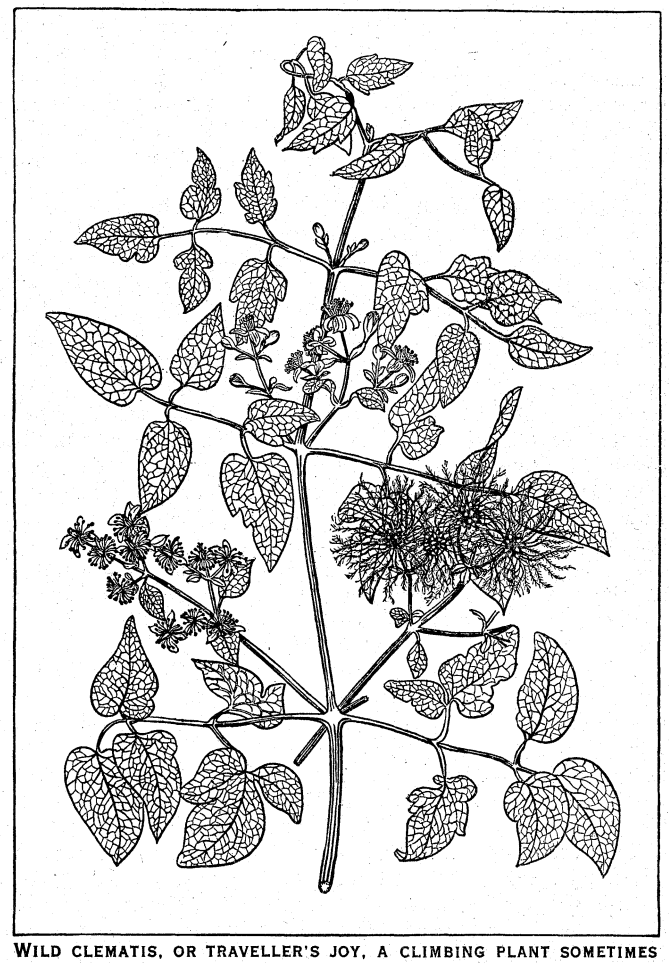
CLEITOR or **CLITOR,** a town of ancient Greece, stood in a fertile plain of Arcadia to the south of Mt. Chelmos, not far from a stream of its own name. In the neighbourhood was a fountain, the waters of which were said to deprive those who drank them of the taste for wine. The town was of considerable local importance and its inhabitants combined love of liberty with dominion over neighbours. It fought against Orchomenus in the Theban war and joined the other Arcadian cities in the foundation of Megalopolis. As a member of the Achaean League it was on several occasions the seat of the federal assemblies, and was besieged by the Aetolians in 220 B.C. It coined money till the time of Septimius Severus. Its ruins at Paleopoli are about 3 m. from a village that preserves the ancient name. The greater part of the walls with several semi-circular towers can be clearly made out; also three Doric temples and a small theatre.

CLELAND, WILLIAM (1661?–1689), Scottish Covenanting poet and soldier, son of a gamekeeper, was probably brought up on the marquess of Douglas's estate in Lanarkshire, and was educated at St. Andrews university. He joined the army of the Covenanters, was present at Drumclog and fought at Bothwell Bridge. He escaped to Holland, but in 1685 was again in Scotland at the time of the abortive invasion of the earl of Argyll. He escaped once more, to return in 1688 as agent for William of Orange. He was appointed lieutenant-colonel of the Cameronian regiment entrusted with the defence of Dunkeld, which they held against the fierce assault of the Highlanders on Aug. 26. This repulse of the Highlanders ended the Jacobite rising, but Cleland fell in the struggle. He wrote *A Collection of Several Poems and Verses* composed upon various occasions (published posthumously, 1697).

See *An Exact Narrative of the Conflict of Dunkeld . . . collected from several officers of the regiment* (1689).

CLEMATIS, a genus of vines and herbs of the crowfoot family (Ranunculaceae), containing 220 species and widely distributed. It is represented in England by *Clematis vitalba,* old man's beard or traveller's joy, a common plant on chalky or light soil. The plants are shrubby climbers with generally compound, opposite leaves, the stalk of which is sensitive to contact like a tendril, becoming twisted round suitable objects and thereby giving support to the plant. The flowers are arranged in axillary or terminal clusters; they have no petals, but white or coloured, often large sepals, and an indefinite number of stamens and carpels. They contain no honey, and are visited by insects for the pollen, which is plentiful. The fruit is a head of achenes, each bearing the long-bearded, persistent style, suggesting the popular name. This feathery style is an important agent in the distribution of the seed by means of the wind.

Inclusive of the sections *Viorna* and *Atragene,* which some botanists regard as separate genera, there are some 30 species of *Clematis* native to North America. Of these, the following representatives are more or less cultivated: the woodbine (*C. virginiana*), found from Nova Scotia to Manitoba and southward to



WILD CLEMATIS, OR TRAVELLER'S JOY, A CLIMBING PLANT SOMETIMES CULTIVATED TO ADORN GARDEN TRELLISES. THE FEATHERY STYLES OF THE FRUITS (ACHENES) FACILITATE DISPERSAL OF SEED BY THE WIND

Georgia and Tennessee; the western *C. ligusticifolia,* growing from North Dakota and Missouri westward to British Columbia and California; the purple virgin's bower (*C. verticillaris*), found from Hudson bay to Minnesota and south-eastward to Connecticut and Virginia; the scarlet virgin's bower (*C. texensis*), native to Texas; and the pipe-stem virgin's bower (*C. lasiantha*), of California and Oregon.

Several of the species, especially the large-flowered ones, are favourite garden plants, well adapted for covering trellises or walls, or trailing over the ground. Many garden hybrids are popular, among them *C. jackmani* and over fifty named varieties, of which Gipsyqueen, Ramona and Lady Northcliffe are popular.

See T. Moore and G. Jackman, *The Clematis as a Garden Flower;* J. E. Spingarn in Taylor's *The Garden Dictionary,* 1936.

CLEMENCEAU, GEORGES (1841–1929), French statesman, was born at Mouilleron-en-Pareds, Vendée, on Sept. 28, 1841. He adopted medicine as his profession. Interested in the progressive ideas of John Stuart Mill, he decided to investigate for himself the results of the application to affairs of democratic theory. He therefore embarked for the United States, taking with him Mill's *Auguste Comte and Positivism* to translate into French. He arrived in New York early in 1866 and remained there or in New England for three years, writing descriptions of American post-war conditions to the Paris *Temps* and teaching French in a girls' school at Stamford, Conn. In this way he passed

what he characterized as the three happiest years of his life. In 1869 he returned to Paris and after the revolution of 1870 he was nominated mayor of the 18th arrondissement of Paris (Montmartre). On Feb. 8, 1871, he was elected as a Radical to the National Assembly for the department of the Seine, and voted against the peace preliminaries. The execution of Generals Lecomte and Clément Thomas by their mutinous soldiers on March 18, which he vainly tried to prevent, brought him into collision with the central committee of the National Guard, and they ordered his arrest, but he escaped; he was accused, however, by various witnesses, at the subsequent trial (Nov. 29), of not having intervened when he might have done, and though he was cleared of this charge it led to a duel, for his share in which he was prosecuted and sentenced to a fine and a fortnight's imprisonment.

Meanwhile, on March 20, 1871, he had introduced in the National Assembly at Versailles, on behalf of his Radical colleagues, the bill establishing a Paris municipal council of 80 members; but he was not returned himself at the elections. He tried with the other Paris mayors to mediate between Versailles and the hôtel de ville, but failed, and accordingly resigned his mayoralty and his seat in the assembly, and temporarily gave up politics; but he was elected to the Paris municipal council on July 23, 1871, for the Clignancourt *quartier,* and retained his seat till 1876, passing through the offices of secretary and vice-president, and becoming president in 1875. In 1876 he stood again for the Chamber of Deputies, and was elected for the 18th arrondissement. He joined the extreme Left, and his energy and mordant eloquence speedily made him the leader of the Radical section. In 1877, after the *Seize mai* (*see* FRANCE: *History*), he took a leading part in resisting the anti-republican policy of which the *Seize mai* incident was a symptom, and in 1879 demanded the indictment of the Broglie ministry. In 1880 he started his newspaper, *La Justice,* which became the principal organ of Parisian Radicalism; and from this time onwards throughout Grévy's presidency his reputation as a political critic, and as a destroyer of ministries who yet would not take office himself, rapidly grew. He led the extreme Left in the Chamber. He was an active opponent of Jules Ferry's colonial policy and of the Opportunist party, and in 1885 his use of the Tongking disaster principally determined the fall of the Ferry cabinet. At the elections of 1885 he was returned both for his old seat in Paris and for the Var, selecting the latter. Refusing to form a ministry to replace the one he had overthrown, he supported the Right in keeping Freycinet in power in 1886, and was responsible for the inclusion of Gen. Boulanger in the Freycinet cabinet as war minister. When Boulanger (*q.v.*) showed his real colours, Clemenceau became a vigorous opponent of the Boulangist movement, though the Radical press and a section of the party continued to patronize the general.

By his exposure of the Wilson scandal (*see* GRÉVY) Clemenceau contributed to Grévy's resignation of the presidency in 1887, having declined Grévy's request that he should himself form a cabinet on the downfall of that of Rouvier; and he was primarily responsible, by advising his followers to vote neither for Floquet, Ferry nor Freycinet, for the election of an "outsider" as president in Carnot. But the split in the Radical party over Boulangism weakened his hands, and his relations with Cornelius Herz in the Panama affair involved him in the general suspicion. However, though he remained the leading spokesman of French Radicalism, his hostility to the Russian alliance so increased his unpopularity that in the election for 1893 he was defeated for the Chamber. Clemenceau now confined his political activities to journalism, his career being further overclouded by the Dreyfus case, in which he was an active supporter of Zola and an opponent of the anti-Semitic and Nationalist campaign. In 1900 he withdrew from *La Justice* to found a weekly review, *Le Bloc,* which lasted until March 1902. On April 6, 1902, he was elected senator for the Var, although he had previously continually demanded the suppression of the Senate. He sat with the Socialist Radicals, and vigorously supported the Combes ministry. In June 1903 he undertook the direction of the journal *L'Aurore,* which he had founded. In it he led the campaign for the revision of the Dreyfus affair, and for the separation of Church and State.

In March 1906 the fall of the Rouvier ministry, owing to the riots provoked by the inventories of church property, at last brought Clemenceau to power as minister of the interior in the Sarrien cabinet. The strike of miners in the Pas de Calais after the disaster at Courrières, leading to the threat of disorder on May 1, 1906, induced him to employ the military; and his attitude in the matter alienated the Socialist party, from which he definitely broke in his notable reply in the chamber to Jean Jaurès in June 1906. This speech marked him out as the "strong man" of the day in French politics; and when the Sarrien ministry resigned in October, he became premier. During 1907 and 1908 the new *entente* with England was cemented, and France played a great part in European politics, in spite of difficulties with Germany and attacks by the Socialist party in connection with Morocco (*see* FRANCE: *History*). But on July 20, 1909, Clemenceau was defeated in a discussion in the chamber on the state of the navy, and was succeeded as premier by Briand, with a reconstructed cabinet.

Two years later Clemenceau entered the Senate and became a member of its commissions for foreign affairs and the army. He could have had no better position for surveying European fluctuations and German activities; or for inquiry into the real condition of French armaments—this last his dominant concern. Convinced that Germany meant war, he was haunted by the fear that again France might be caught unprepared. The Senate, however, gave little opportunity for sounding the alarm. Accordingly, on May 5, 1913, appeared a new daily paper, *L'Homme Libre,* its editor—Georges Clemenceau. In its pages he waged daily battle for security and liberty. Though *L'Homme Libre* dealt every day with home politics and social problems, it returned always to the terrible theme of the German menace.

In the spring of 1913 the question of restoring the three years' term of conscript service suddenly arose. Clemenceau took an impassioned part in the debates on armaments. Then came Aug. 1914 and the World War. *L'Homme Libre* soon suffered at the hands of the Censor for Clemenceau's plain speaking. The whole youth of France must be mobilized. He denounced the shirkers, demanded technical efficiency, and attacked all incompetency, red tape, inadequate munition factories, with their shortage of guns and rifles, and badly-run hospitals. He made war in short, upon all who failed to realize that this was a conflict of supplies and organization, and upon every kind of apathy and feebleness. The result was that in Sept. 1914 *L'Homme Libre* was suppressed. Two days later, however, it reappeared as *L'Homme Enchaîné,* but wore its fetters lightly. For three months there was a daily struggle with the Censor. For some time not a week passed without articles being mutilated, but Clemenceau won and excisions became rare. Meanwhile in the Senate, Clemenceau agitated for more and still more guns, munitions, soldiers, for a judicious use of the available man-power and for a better equipped and better organized medical service.

But above all he strove to create the indomitable and desperate "will to victory." He was supported by other members of the army and foreign affairs commission, like Chéron, Doumer, Humbert, Berenger. The war dragged on; weariness, slackness and pacifism began to appear. Clemenceau was the first to draw public attention to that growing peril and it was at a public debate in the Senate on July 22, 1917, that he made his famous attack on Malvy, who had been Minister of the Interior since 1914. Clemenceau declared that Malvy had not treated revolutionaries with a firm enough hand. Malvy's justification was that he desired to "gain the confidence of the working-man"; but Clemenceau retorted that there was no comparison between those working-men who were loyally doing their duty to their country and a number of abject "defeatists."

Four months later Clemenceau came into power. He had never sought office and he knew that his task meant victory or death. When Clemenceau became premier the situation was miserable. The *moral* at the front was bad, and at home even worse. Resources were nearly at an end, and no solution whatever could be discerned. Poincaré realized that of all men Clemenceau was

the impersonation of the idea of war to the death. In his new Government Clemenceau himself took the portfolio of minister of war. He was 76 years of age when he formed his "victory cabinet" on Nov. 16, 1917, and thenceforward till Nov. 11, 1918, Clemenceau did in fact concentrate on war only. He made it clear that France was bent on absolute victory and would brook no half-measures. Those who spoke of wavering or yielding were immediately silenced; any one who obstructed the path to victory was ruthlessly removed. By these means Clemenceau restored the nation's self-confidence, and with it the conviction that its martyrdom would not be in vain. In March 1918 the Anglo-French line was broken through; Clemenceau joined in organizing the unity of command with Foch at the head. In May came the disaster of the Chemin des Dames; the French troops were driven back on the Marne, while the commander-in-chief was criticised. Three months later Clemenceau made Foch Marshal of France. During that long year of ceaseless effort Clemenceau's resolution remained unshaken. On Nov. 8, 1918, Erzberger was in the train of the Commander-in-chief of the allied armies. On the 11th the guns roared for the last time; the nightmare was over.

From Nov. 11, 1918, to June 28, 1919, Clemenceau devoted himself to the international settlement. The Peace of Versailles was in preparation, and this necessitated strenuous days of work and delicate negotiations. Up till now Clemenceau had merely had to contend with his enemies; now his task was to reconcile the interests of France with those of her friends. He defended her cause with enthusiasm and conviction, forcing his view alternatively on Lloyd George and President Wilson. Meanwhile Germany was disarming, and Clemenceau took care to supervise that disarmament. But the French parliament began to grow restless, for it saw itself put to one side in the peace negotiations. It therefore no longer regarded Clemenceau as indispensable. The great patriot, who was anxious to finish the work he had begun, did his best to smooth matters over. Momentous problems had to be solved; demobilization had to be faced, a general election was looming ahead, and the questions of Alsace-Lorraine and the liquidation of war stocks had to be settled. Clemenceau decided to deal simultaneously with these questions as of equal importance.

Peace was signed on June 28, and on Nov. 11 the new chamber was elected. Clemenceau counted on its support; for he believed that its members, many of them ex-soldiers, would have profited by the lesson of the war. Although he never stood as a candidate it is certain that he would have been ready to give the last years of his life by taking Poincaré's place at the Elysée, so that outside and above the changing Governments, he could have secured continuity in political action by a strict application of the 1919 treaties.

Poincaré left the Elysée but Deschanel was elected President of the French republic. And without doubt the Chambers had voted according to their hearts. Clemenceau had saved his country, but members could not forgive the fact that he had excluded them from the final work for victory. During the war he had undoubtedly worked alone; he felt that large assemblies were not made for action. Probably he would have admitted the commissions to the deliberations on the Treaty of Versailles if diplomatic obstacles had not intervened to prevent it. Clemenceau had also to face the hostility, not only of the clerical party of the Right who suspected him of indifference to the Vatican, but also that of the extreme Left, who were alienated by what they considered to be his militarism. Clemenceau thus met the fate which overtook other war ministers, and on Jan. 20, 1920, his cabinet fell, Millerand being summoned to office. He had earned the gratitude of his country and, returning to his beloved books, might well have sought repose; instead he sailed for India. After his journey he returned to Paris and to his books.

But it now appeared that the United States was endeavouring to dissociate herself from European affairs. Clemenceau was now 81 years old, but he sailed at once for America at the end of 1922. From town to town he carried the message of France to the citizens of the Union. He had no official mission, for he had neither asked anything nor received anything from the French Government. His progress was none the less triumphant. Once more he returned to Paris but not to rest. By the end of 1925 he was already writing two books; one on philosophy, *Au Soir de la Pensée* (1927), English translation, *In the Evening of my Thought* (1929), and the other on Demosthenes, *Demosthène* (1926, Eng. trans. by C. M. Thompson, 1926). He was at work upon his memoirs, *Grandeurs et Misères d'un Victoire* (1930), when he died in Paris on Nov. 24, 1929. (J. Mt.)

CLEMENCÍN, DIEGO (1765–1834), Spanish scholar and politician, was born at Murcia, and educated there at the Colegio de San Fulgencio. In 1807 he became editor of the *Gaceta de Madrid,* and in the following year was condemned to death by Murat for publishing a patriotic article; he fled to Cadiz, and under the Junta Central held various posts from which he was dismissed by the reactionary government of 1814. During the liberal régime (1820–23) Clemencín took office as colonial minister, was exiled till 1827, and in 1833 published the first volume of his edition (1833–39) of *Don Quixote.*

CLEMENS, SAMUEL L.: *see* TWAIN, MARK.

CLEMENT, the name of 14 popes and two anti-popes.

CLEMENT I., Saint, generally known as Clement of Rome, or CLEMENS ROMANUS (*fl. c.* A.D. 96), was one of the "Apostolic Fathers," and in the lists of bishops of Rome is given the third or fourth place—Peter, Linus (Anencletus), Clement. There is no ground for Origen's identification of him with the Clement of Phil. iv. 3. He may have been a freedman of T. Flavius Clemens, who was consul with his cousin, the emperor Domitian, in A.D. 95. He is commemorated on Nov. 23.

In *The Shepherd of Hermas* mention is made of one Clement whose office it is to communicate with other churches, and this function agrees well with what we find in the letter to the church at Corinth by which Clement is best known. The letter was occasioned by a dispute which had led to the ejection of several presbyters, and while it does not contain Clement's name, there is no reason for doubting the universal tradition which ascribes it to Clement, or the generally accepted date, *c.* A.D. 96. Though the Roman Church claims no superior rank, it is noteworthy that in the earliest document outside the canon which we can securely date, it comes forward as a peacemaker in the troubles of a church in Greece. Nothing is known of the cause of the discontent, and the dismissal of the presbyters is regarded by Clement as high-handed and unjustifiable. After praising the Corinthian Church, Clement enters upon a denunciation of vices and a praise of virtues, and illustrates his topics by copious citations from the Old Testament scriptures, a fact which points to his being a Christian of long standing. Near the end of the letter (it is twice the length of the Epistle to the Hebrews) he rebukes the present disorders. The letter closes with a long liturgical prayer, which almost certainly represents the intercession used in the Roman eucharists. He knows that the roots of the quarrel lie in a wrong condition of the Church's life, and his general exhortations are directed towards a reformation of manners. The most permanent interest of the epistle lies in its being a 1st century account of the grounds on which the Christian ministry rests. The orderliness of nature is appealed to as expressing the mind of its Creator. The orderliness of Old Testament worship bears a like witness; everything is duly fixed by God. Similarly in the Christian dispensation all is in order due.

We learn from the letter (i. 7) that the Church at Rome, though persecuted, was firmly held together by faith and love. The epistle was publicly read from time to time at Corinth, and by the 4th century this usage had spread to other churches. It is attached to the famous Alexandrian ms. (Codex A) of the New Testament, but this does not imply that it ever reached canonical rank. For the mass of early Christian literature that was gradually attached to Clement's name *see* CLEMENTINE LITERATURE.

The epistle was published in 1633 by P. Young from Cod. Alexandrinus, in which a leaf near the end was missing, so that the great prayer (cc. lv.–lxiv.) remained unknown. In 1875 (six years after J. B. Lightfoot's first edition) Bryennius (*q.v.*) published a complete text from a Constantinople ms. dated 1055 from which in 1883 he gave us the *Didachē.* In 1876 R. L. Bensly found a complete Syriac text in a ms. in the University library, Cambridge. Lightfoot made

use of these new materials in an Appendix (1877) (2nd ed. with excellent excursus and Eng. trans. in *The Apostolic Fathers* vol. i., 1890). Dom Morin discovered a Latin version (1894), probably of the 3rd century, which is a valuable addition to the authorities for the text. Its evidence is used in the edition by R. Knopf (Leipzig, 1899). *See* also W. Wrede, *Untersuchungen zum ersten Clemensbrief* (1891), and other literature cited in Herzog-Hauck's *Realencyklopädie.*

CLEMENT II. (Suidger) became pope on Dec. 25, 1046. He belonged to a noble Saxon family, was bishop of Bamberg, and chancellor to the emperor Henry III., who elevated him to the papacy. He was the first pope placed on the throne by the power of the German emperors, but his short pontificate was only signalized by the convocation of a council in which decrees were enacted against simony. He died on Oct. 9, 1047.

CLEMENT III. (Paolo Scolari), pope from 1187 to 1191, a Roman, and cardinal bishop of Palestrina, was chosen pope on Dec. 19, 1187. In 1189 he made peace with the emperor Frederick I. Barbarossa. He settled a controversy with William of Scotland concerning the choice of the archbishop of St. Andrews, and in March 1188 removed the Scottish Church from the legatine jurisdiction of the archbishop of York, thus making it independent of all save Rome. He annoyed Henry VI. of Germany by bestowing Sicily on Tancred.

See "Epistolae et Privilegia," in Migne, *Patrol. Lat.* 204, 1,253 ff.; *Neues Archiv für die ältere deutsche Geschichtskunde,* 2, 219; 6. 293; 14. 178–182; Jaffé, *Regesta Pontificum Romanorum,* tom. 2 (1888), 535 ff.; J. Geyer, *Papst Klemens III.* (Bonn, 1914).

CLEMENT IV. (Gui Foulques), pope from 1265 to 1268, son of a lawyer, was born at St. Gilles-sur-Rhône. He became a valued legal adviser of Louis IX. of France, and after the death of his wife took orders. In 1257 he was made bishop of Le Puy, in 1259 archbishop of Narbonne, and in 1261 cardinal bishop of Sabina. He was appointed legate in England in 1263, and before his return was elected pope at Perugia on Feb. 5, 1265. He invested the avaricious Charles of Anjou with the kingdom of Sicily, but subsequently came into conflict with him after the death of Manfred in Feb. 1266. When Conradin, the last of the Hohenstaufen, appeared in Italy the pope excommunicated him and his supporters. Clement died at Viterbo on Nov. 29, 1268, leaving a name unsullied by nepotism. As the protector of Roger Bacon he has a special title to the gratitude of posterity.

See A. Potthast, *Regesta Pontificum Romanorum,* vol. ii. (1875), 1,542 ff.; E. Jordan, Les Régistres de Clement IV. (1893 ff.); Herzog-Hauck, *Realencyklopädie;* J. Heidemann, "Papst Clemens IV.," in *Kirchengeschichtliche Studien,* 6. Band (Münster, 1903), and C. Nicholas, *Clément IV.* (Nîmes, 1910).

CLEMENT V. (Bertrand de Gouth), pope from 1305 to 1314, was born of a noble Gascon family about 1264. After studying at Toulouse, Orleans, and Bologna, he became a canon at Bordeaux, then vicar-general to his brother, the archbishop of Lyons, in 1295 bishop of Cominges, and in 1299 archbishop of Bordeaux. On June 5, 1305, he was chosen to succeed Benedict XI. From the beginning Clement V. was subservient to French interests. Among his first acts was the creation of nine French cardinals. Early in 1306 he modified those features of the bulls *Clerics Laicos* and *Unam sanctam,* which were offensive to the king. In March 1309 the entire papal court settled at Avignon, a fief of the king of Sicily. Thus began the 70 years "Babylonian captivity of the Church." In Oct. 1307 came the arrest of all the Knights Templar in France, whom the king had charged with heresy, immorality and abuses. Fearing that the State would proceed independently against the alleged heretics, Clement summoned the council of Vienne (*see* VIENNE, COUNCIL OF), which was unable to conclude that the Templars were guilty of heresy. The pope abolished the order, however, as it had outlived its usefulness. Its French estates were granted to the Hospitallers, but actually Philip IV. held them until his death.

In his relations to the empire Clement was an opportunist. He refused to favour the candidature of Charles of Valois, brother of Philip IV., lest France became too powerful; and recognized Henry of Luxemburg, whom his representatives crowned emperor at the Lateran in 1312. When Henry, however, came into conflict with Robert of Naples, Clement supported Robert and threatened the emperor with interdict. Henry's unexpected death was soon followed by that of the pope on April 20, 1314, at Roquemaure-sur-Rhône.

See *Regestum Clementis Papae V. ex Vaticanis archetypis cura et studio monachorum ord. Ben.* (Rome, 1885–92, 9 vols. and appendix); J. Gmelin, *Schuld oder Unschuld des Templerordens* (Stuttgart, 1893); J. Loserth, *Geschichte des späteren Mittelalters* (Munich, 1903); and A. Eitel, *Der Kirchenstaat unter Klemens V.* (Berlin, 1907); G. Lizerand, *Clément V.* (1911).

CLEMENT VI. (Pierre Roger), pope from May 7, 1342, to Dec. 6, 1352, was born at Maumont, Limousin, in 1291, joined the Benedictines as a boy, studied at Paris, and became successively prior of St. Baudil, abbot of Fécamp, bishop of Arras, chancellor of France, archbishop of Sens and archbishop of Rouen. He was made cardinal-priest of Sti Nereo ed Achilleo and administrator of the bishopric of Avignon by Benedict XII. in 1338. and four years later succeeded him as pope. Clement continued the struggle of his predecessors with the emperor Louis the Bavarian, excommunicating him in April 1346, and directing the election of Charles of Moravia, who received general recognition after the death of Louis in 1347, and put an end to the schism which had long divided Germany. Clement carried on fruitless negotiations for Church unity with the Armenians and with the Greek emperor, John Cantacuzenus. He tried to end the Hundred Years' War between England and France, but secured only a temporary truce. He excommunicated Casimir of Poland for marital infidelity and forced him to do penance. He successfully resisted encroachments on ecclesiastical jurisdiction by the kings of England, Castile and Aragon. He secured full ownership of the county of Avignon through purchase from Queen Joanna of Naples and renunciation of feudal claims by Charles IV. of France, and considerably enlarged the papal palace in that city. To supply money for his undertakings Clement revived the practice of selling reservations and expectancies, which had been abolished by his predecessor. Oppressive taxation, and unblushing nepotism were Clement's great faults. On the other hand, he was famed for his engaging manners, eloquence and theological learning. He died on Dec. 6, 1352.

See Baluzius, *Vitae Pap. Avenion.,* vol. i. (Paris, 1693); E. Werunsky, *Excerpta ex registris Clementis VI. et Innocentii VI.* (Innsbruck, 1885); F. Cerasoli, *Clemente VI. e Giovanni I. di Napoli—Documenti inedite* (1896, etc.); J. B. Christophe, *Histoire de la papauté pendant le XIV.e siècle,* vol. ii. (1853) and J. Gay, *Le Pape Clement VI. et Les Affaires d'Orient* (1904).

CLEMENT VII. (Giulio de' Medici), pope from 1523 to 1534, was the son of Giuliano de' Medici, assassinated in the Pazzi conspiracy at Florence. After the death of Lorenzo, Giulio in 1494 went into exile; but, on Giovanni's restoration to power, returned to Florence, of which he was made archbishop by his cousin, Pope Leo X., a special dispensation being granted on account of his illegitimate birth, followed by a formal declaration of the fact that his parents had been secretly married and that he was therefore legitimate. In 1513 he was made cardinal, and during the pontificate of Leo had practically the whole papal policy in his hands. On the death of Adrian VI. he was chosen pope (Nov. 18, 1523). It soon became clear, however, that Clement was only a good second in command, for though he was cultured and economical without being avaricious, he was essentially a man of narrow outlook and interests. Instead of bending his mind to the problem of the Reformation, he subordinated the cause of Catholicism to his interests as an Italian prince and a Medici; and even in purely secular affairs his timidity and indecision prevented him from pursuing a consistent policy.

His accession at once brought about a political change in favour of France. He wavered between the emperor and Francis I., concluding a treaty of alliance with the French king, and then after the defeat of Pavia making his peace with Charles (April 1, 1525), but breaking it again by countenancing Girolamo Morone's League of Freedom, which aimed to assert Italian independence. On the betrayal of this conspiracy Clement made a fresh submission to the emperor, only to follow this, a year later, by the Holy League of Cognac with Francis I. (May 22, 1526). Then followed the imperial invasion of Italy and Bourbon's sack of Rome (May 1527). The pope himself was besieged and compelled to ransom himself with 400,000 scudi, and to promise to convene a general

council to deal with Lutheranism. After the treaty of Cambrai on Aug. 3, 1529, Charles met Clement at Bologna and received from him the imperial crown and the iron crown of Lombardy, but the pope for some time exercised his temporal power in subservience to the emperor. Clement was now mainly occupied in urging Charles to arrest the progress of the Reformation in Germany and in efforts to elude the emperor's demand for a general council, which Clement feared lest the mode of his election and his legitimacy should be raised. Owing to his dependence on Charles V., Clement evaded Henry VIII.'s demand for the nullification of his marriage with Catherine and so brought about the breach between England and Rome. He died on Sept. 25, 1534.

See E. Casanova, *Lettere di Carlo V. a Clemente VII.* (Florence, 1893); Hugo Lämmer, *Monumenta Vaticana,* etc. (Freiburg, 1861); P. Balan, *Monumenta saeculi XVI. hist. illustr.* (Innsbruck, 1885); ib. *Mon. Reform. Luther* (Regensburg, 1884); *Stefan Ehses, Röm. Dokum. z. Gesch. der Ehescheidung Heinrichs VIII.* (Paderborn, 1893); *Calendar of State Papers* (London, 1869, etc.); J. J. I. von Döllinger, *Beiträge zur politischen, kirchlichen und Kulter-geschichte* (3 vols., Vienna, 1882); F. Guicciardini, *Istoria d'Italia;* L. von Ranke, *Die römischen Päpste in den letzten vier Jahrhunderten,* and *Deutsche Gesch. im Zeitalter der Reformation;* W. Hellwig, *Die politischen Beziehungen Clement's VII. zu Karl V., 1526* (Leipzig, 1889); H. Baumgarten, *Gesch. Karls V.* (Stuttgart, 1888); F. Gregorovius, *Geschichte der Stadt Rom,* vol. viii. p. 414 (2nd ed., 1874); P. Balan, *Clemente VII. e L'Italia de' suoi tempi* (Milan, 1887); E. Armstrong, *Charles the Fifth* (2 vols., 1902); M. Creighton, *Hist. of the Papacy during the Reformation* (London, 1882); H. M. Vaughan, *The Medici Popes* (1908); and *Cambridge Modern History,* vol. ii., chap. i., with bibl.

CLEMENT VII. (Robert of Geneva) (d. 1394), antipope, after occupying the episcopal sees of Thérouanne and Cambrai, became a cardinal. In 1378 he took part in the election of Pope Urban VI. at Rome, and was perhaps the first to express doubts as to the validity of that tumultuous election. When the cardinals resolved to regard Urban VI. as an intruder and the Holy See as still vacant, Robert of Geneva was elected pope on Sept. 20, 1378, and took the name of Clement VII. Thus originated the Great Schism of the West.

Clement was supported by Queen Joanna of Naples, several Italian barons and Charles V. of France, and he eventually succeeded in winning to his cause Scotland, Castile, Aragon, Navarre, a great part of the Latin East, and Flanders. To wrest Rome from his rival, Clement incited Louis, duke of Anjou, the eldest of the brothers of Charles V., to take arms in his favour, by the bait of a kingdom to be carved expressly out of the States of the Church and to be called the kingdom of Adria, coupled with the expectation of succeeding to Queen Joanna. These tempting offers gave rise to a series of expeditions into Italy of which the most decisive result was the assuring of Provence to the dukes of Anjou and afterwards to the kings of France.

Before his death (Sept. 16, 1394), Clement realized the impossibility of overcoming by brute force an opposition which was founded on the convictions of the greater part of Catholic Europe.

See N. Valois, *La France et le grand schisme d'occident* (1896).

CLEMENT VIII. (Ippolito Aldobrandini), pope from 1592 to 1605, was born at Fano in 1535. He became a jurist and in 1585 was made a cardinal. On Jan. 30, 1592, he was elected pope, to succeed Innocent IX. To emancipate the papacy from undue Spanish influence, Clement cultivated closer relations with France. In 1595 he granted absolution to Henry IV., and so removed the last objection to the acknowledgment of his legitimacy. The peace of Vervins (1598), which ended the opposition of Philip II. to Henry, was mainly his work. He remonstrated against the exclusion of the Jesuits from France, and obtained their re-admission. Upon the failure of the line of Este, Clement claimed the reversion of Ferrara and re-incorporated it into the States of the Church (1598). His hopes of recovering England through James I. were never realized. Under Clement the publication of the revised edition of the Vulgate, begun by Sixtus V., was finished; the Breviary, Missal and Pontifical revised; the Index was expanded; the Vatican library enlarged; and the Collegium Clementinum founded. Clement was an unblushing nepotist, but, on the other hand, promoted to the cardinalate such men as Baronius, Bellarmine and Toledo. He died on March 5, 1605.

See the contemporary *Vita* by Ciaconius (Rome, 1601); Francolini, *Ippolito Aldobrandini che fu Clemente VIII.* (Perugia, 1867); Ranke's *Popes* (Eng. trans. Austin), ii. 234 *seq.;* v. Reumont, *Gesch. der Stadt Rom.* iii. 2, 599 *seq.;* Brosch, *Gesch. des Kirchenstaates* (1880), i. 301 *seq.*

CLEMENT VIII. (Aegidius Muñoz), antipope from 1425 to July 26, 1429, was a canon at Barcelona until elected by three cardinals created by the antipope Benedict XIII. Clement was recognized by Alphonso V. of Aragon, who was hostile to Pope Martin V. on account of the latter's opposition to his claims to the kingdom of Naples. When Alphonso and Martin became reconciled, Clement abdicated and spent his last years as bishop of Majorca. He died on Dec. 28, 1446.

See L. Pastor, *History of the Popes,* vol. i. (1899); M. Creighton, *History of the Papacy,* vol. ii. (1899); and bibl. on MARTIN V.

CLEMENT IX. (Giulio Rospigliosi) was born in 1600, became successively auditor of the Rota, archbishop of Tarsus *in partibus,* and cardinal, and was elected pope on June 20, 1667. He effected a temporary adjustment of the Jansenist controversy; was instrumental in concluding the peace of Aix-la-Chapelle (1668); healed a long-standing breach between the Holy See and Portugal; aided Venice against the Turks, and laboured unceasingly for the relief of Crete, the fall of which hastened his death on Oct. 9, 1669.

See Oldoin, continuator of Ciaconius, *Vitae et res gestae summorum Pontiff. Rom.;* Palazzi, *Gesta Pontiff. Rom.* (Venice, 1687–88), iv. 621 *seq.* (both contemporary); Ranke, *Popes* (Eng. trans. Austin), iii. 59 *seq.;* and v. Reumont, *Gesch. der Stadt Rom.* iii. 2, 634 *seq.;* C. Terlinden, *Le Pape Clément IX.* (1904).

CLEMENT X. (Emilio Altieri) was born in Rome on July 13, 1590. Before becoming pope, on April 29, 1670, he had been auditor in Poland, governor of Ancona, and nuncio in Naples. His advanced age induced him to resign the control of affairs to his adopted nephew, Cardinal Paluzzi, who embroiled the papacy in disputes with the resident ambassadors, and incurred the enmity of Louis XIV., thus provoking the long controversy over the regalia (*see* INNOCENT XI.). Clement died on July 22, 1676.

See Guarnacci, *Vitae et res gestae Pontiff. Rom.* (Rome, 1751), (contin. of Ciaconius), i. 1 *seq.;* Palazzi, *Gesta Pontiff. Rom.* (Venice, 1687–88), iv. 655 *seq.;* and Ranke, *Popes* (Eng. trans. Austin), iii. 172 *seq.;* Bildt, *Christine de Suède et le Conclave de Clem. X.* (1906).

CLEMENT XI. (Giovanni Francesco Albani), pope from 1700 to 1721, was born in Urbino on July 22, 1649, and after filling various important offices in the Curia became pope on Nov. 23, 1700, succeeding Innocent XII. His private life and his administration were blameless, but it was his misfortune to reign in troublous times. In the war of the Spanish Succession he would willingly have remained neutral, but was forced first to recognize Philip V., then driven by the emperor to recognize the archduke, Charles. In the peace of Utrecht he was ignored; Sardinia and Sicily, Parma and Piacenza, were disposed of without regard to papal claims. When he quarrelled with the duke of Savoy, and revoked his investiture rights in Sicily (1715), his interdict was treated with contempt. Clement reaffirmed papal infallibility in matters of *fact* (1705), and in 1713 issued the bull *Unigenitus,* comdemning 101 Jansenistic propositions. (*See* JANSENISM and QUESNEL, PASQUIER.) He also forbade missionaries in China to "accommodate" their teachings to pagan notions in order to win converts. Clement was a generous patron of art and letters.

See Elci, *The Present State of the Court of Rome* (trans. 1706); Polidoro, *De Vita et Reb. Gest. Clem. XI.* (Urbino, 1727); Reboulet, *Hist. de Clem. XI. Pape* (Avignon, 1752); Guarnacci, *Vitae et res gest. Pontiff. Rom.* (Rome, 1751); Sandini, *Vitae Pontiff. Rom.* (Padua, 1739); Buder, *Leben u. Taten Clementis XI.* (Frankfurt, 1720–21); *Clementis XI. Opera Omnia* (Frankfurt, 1729); Pometti, "Studii sul pontificato di Clem. XI.," in the *Archivio della R. Soc. romana di storia patria,* vols. xxi.–xxiii. (1898–1900), and bibl. in Hergenröther, *Allg. Kirchengesch.* iii. 506 (1880).

CLEMENT XII. (Lorenzo Corsini), pope from 1730 to 1740, succeeded Benedict XIII. on July 12, 1730. Clement laboured for a union with the Greek Church, and was ready to facilitate the return of the Protestants of Saxony. His services to learning and art include the restoration of the Arch of Constantine, the enrichment of the Capitoline museum with antique marbles and inscriptions, and of the Vatican library with oriental manuscripts

(*see* ASSEMANI); and the embellishment of the city with many buildings. He died on Feb. 6, 1740.

See Guarnacci, *Vitae et res gestae Pontiff. Rom.* (Rome, 1751); Sandini, *Vitae Pontiff. Rom.* (Padua, 1739); Fabroni, *De Vita et Reb. Gest. Clementis XII.* (Rome, 1760); Ranke, *Popes* (Eng. trans. Austin), iii. 191 *seq.*; v. Reumont, *Gesch. der Stadt Rom.*, iii. 2, 653 *seq.*

CLEMENT XIII. (Carlo della Torre Rezzonico), pope from 1758 to 1769, was born in Venice on March 7, 1693, filled various important posts in the Curia, became cardinal in 1737, bishop of Padua in 1743, and succeeded Benedict XIV. as pope on July 6, 1758. He was a man of upright and pacific intentions, but his pontificate was anything but tranquil. The Jesuits, who had been expelled from Portugal, France, Spain, the Two Sicilies and Parma, turned to the pope as their natural protector; but his protests (*cf.* the bull *Apostolicum pascendi munus* of Jan. 1765) were unheeded (*see* JESUITS). A clash with Parma aggravated his troubles. The Bourbon kings espoused their relative's quarrel, seized Avignon, Benevento and Ponte Corvo, and demanded the suppression of the Jesuits (Jan. 1769). Clement consented to call a Consistory but died on Feb. 2, 1769.

See Augustin de Andrès y Sobiñas, . . . *el nacimiento, estudios y empleos de . . . Clem. XIII.* (Madrid, 1759); Ravignan's *Clement XIII. et Clement XIV.* (Paris, 1854) is partisan, but appends many interesting documents. *See* also the bibl. of Clement XIV. *infra.*; and that in Hergenröther, *Allg. Kirchengesch.* (1880), iii. 509.

CLEMENT XIV. (Lorenzo Ganganelli), pope from 1769 to 1774, son of a physician of St. Arcangelo, near Rimini, was born on Oct. 31, 1705, joined the Franciscans, and as regent of the college of S. Bonaventura, Rome, came under the notice of Benedict XIV., who made him consultor of the Inquisition. Clement XIII. made him a cardinal, and in May 1769 he was elected pope.

The outlook for the papacy was dark; Portugal was talking of a patriarchate; France held Avignon; Naples held Ponte Corvo and Benevento; Spain was ill-affected; Parma, defiant; Venice, aggressive; Poland meditating a restriction of the rights of the nuncio. Clement realized the imperative necessity of conciliating the Powers. He suspended the public reading of the bull *In Coena Domini,* so obnoxious to civil authority; resumed relations with Portugal; revoked the *monitorium* of his predecessor against Parma. But the Powers were bent upon the destruction of the Jesuits, and they had the pope at their mercy. Clement looked abroad for help, but found none. Even Maria Theresa, his last hope, suppressed the Order in Austria. Convinced that the peace of the Church demanded the sacrifice, Clement signed the brief *Dominus ac Redemptor,* dissolving the Jesuit Order, on July 21, 1773. The Powers at once gave proof of their satisfaction; Benevento, Ponte Corvo, Avignon and the Venaissin were restored to the Holy See. But it would be unfair to accept this as evidence of a bargain. Clement had formerly indignantly rejected the suggestion of such an exchange of favours. Whatever the guilt or innocence of the Jesuits, and whether their suppression were ill-advised or not, there appears to be no ground for impeaching the peace motives of Clement, or of doubting that he had the approval of his conscience.

The suppression of the Jesuits bulks so large in the pontificate of Clement that he has scarcely been given due credit for his praiseworthy attempt to reduce the burdens of taxation and to reform the financial administration, nor for his liberal encouragement of art and learning, of which the museum Pio-Clementino is a lasting monument.

Clement's was a deeply religious, refined and benevolent nature. He cherished high purposes, but instinctively shrank from conflict; he lacked the resoluteness and the stern courage that grapples with a crisis. He died from natural causes on Sept. 22, 1774.

See Theiner, *Clementis XIV. Epistolae et Brevia* (1852); Caraccioli's *Vie de Clément XIV.* (1775) (freq. trans.), is uncritical. St. Priest's *Hist. de la chute des Jésuites* (1846), represents Clement as lamentably weak; Cretineau-Joly's *Hist. . . . de la Comp. de Jésus* (1844) and his *Clément XIV. et les Jésuites* (1847), was outspoken and bitter and provoked Theiner's *Gesch. des Pontificats Clemens' XIV.* (Leipzig and Paris, 1852), a vigorous defence based upon original documents of the Vatican; Cretineau-Joly replied with *Le Pape Clément XIV.; Lettres au P. Theiner* (1852). *See* also v. Reumont, *Ganganelli, Papst Clemens XIV.* (Berlin, 1847); and Reinerding, *Clemens XIV. u. d. Aufhebung der Gesellschaft Jesu* (Augsburg, 1854). Hergenröther, *Allg. Kirchengesch.* (1880), iii. 510 *seq.* gives an extended bibliography.

CLÉMENT, FRANÇOIS (1714–1793), French historian, was born at Bèze, near Dijon. He became a Benedictine and wrote vols. xi. and xii. of the *Histoire littéraire de la France,* and edited (with Dom Brial) vols. xii. and xiii. of the *Recueil des historiens des Gauls et de la France.* The king appointed him to the committee for the publication of charters and other historical documents. Of his revision of the *Art de vérifier les dates* (ed. 1750 by Dom Clémencet), 3 vols. with indexes appeared from 1783 to 1792. Clément died at Paris on March 29, 1793.

CLÉMENT, JACQUES (1567–1589), murderer of the French king Henry III., was born at Sorbon in the Ardennes, and became a Dominican friar. His mind appears to have become unhinged by religious fanaticism, and he formed a plan to kill Henry III. Having obtained letters for the king, he left Paris on July 31, 1589, and reached St. Cloud, the headquarters of Henry, who was besieging Paris. While Henry was reading the letters Clément mortally wounded him with a dagger which had been concealed beneath his cloak. The assassin was killed on the spot by the king's attendants.

CLÉMENTEL, ÉTIENNE (1862–1936), French politician, was born on March 29, 1862, at Riom and educated there. He was elected a deputy in 1898 and became minister for the colonies in Rouvier's cabinet in 1905, afterwards occupying ministerial posts in departments where his knowledge of economics could find full play, the ministries of agriculture, colonies, finance, public works and marine. His collaboration was particularly valuable in organizing the supply of raw materials for the allied armies during the World War. By effecting the agreement for establishment of the inter-allied wheat executive with Walter Runciman in Nov. 1916, Clémentel helped to tide over a difficult situation. The creation of the inter-allied maritime transport council was due in great part to his energy, for, as early as Aug. 1917, he had occupied himself with drawing up a general inventory of his own country's requirements, an initiative quickly followed by the allied governments. After the armistice, Clémentel was chosen "Président fondateur" of the International Chamber of Commerce. He was elected senator for Puy de Dôme in 1918. His work at the London Conference of July 1924, which he attended as minister of finance in the Herriot cabinet, was greatly appreciated. He resigned office as minister of finance on April 3, 1925, on the ground of a difference with Herriot on the question of a fresh issue of notes by the Bank of France. In 1927 he was president of the finance committee of the Senate and also became a member of the committee on trade barriers of the International Chamber of Commerce. Among his writings may be mentioned: *L'Âme celtique* (1899) and *Un drame économique* (1914).

CLEMENTI, MUZIO (1752–1832), Italian pianist and composer, was born at Rome where his father was a jeweller. At nine he was appointed organist of a church and at fourteen he had written a mass which was performed in public. About 1766 Peter Beckford, cousin of the author of *Vathek,* brought Clementi to England, where his success both as composer and pianist was rapid and brilliant. In 1777 he was for some time employed as conductor of the Italian opera, but he soon afterwards left London for Paris. Here also his concerts were crowded by enthusiastic audiences, and the same success accompanied him on a tour about the year 1780 to southern Germany and Austria. At Vienna, which he visited between 1781 and 1782, he was received with high honour by the emperor Joseph II., in whose presence he met Mozart, and fought a kind of musical duel with him.

In May 1782 Clementi returned to London, where for the next twelve years he continued his lucrative occupations of fashionable teacher and performer at the concerts of the aristocracy. He took shares in the pianoforte business of a firm which went bankrupt in 1800. He then established a pianoforte and music business of his own, under the name of Clementi & Co. which was very successful. Other members were added to the firm, including Collard and Davis, and it was ultimately taken over by Collard,

Amongst his pupils on the pianoforte during this period may be mentioned John Field, the composer of the celebrated *Nocturnes*. In his company, Clementi paid, in 1804, a visit to Paris, Vienna, St. Petersburg [Leningrad], Berlin and other cities. While he was in Berlin, Meyerbeer became one of his pupils. He also revisited his own country, after an absence of more than thirty years. In 1810 Clementi returned to London, but refused to play again in public, devoting the remainder of his life to composition. Several symphonies belong to this period but none was published.

Of Clementi's playing in his youth, Moscheles wrote that it was "marked by a most beautiful *legato*, a supple touch in lively passages, and a most unfailing technique." Mozart may be said to have closed the old and Clementi to have founded the newer school of technique on the piano. Amongst Clementi's compositions the most remarkable are sixty sonatas for pianoforte, and the great collection of *Études* called *Gradus ad Parnassum*.

CLEMENTINE LITERATURE, the name generally given to the writings which at one time or another were fathered upon Pope Clement I. (*q.v.*), commonly called Clemens Romanus, who was early regarded as a disciple of St. Peter. Chief among them are: (1) The so-called Second Epistle; (2) two Epistles on Virginity; (3) the *Homilies* and *Recognitions*, with which may be classed the *Epistle of Clement to James;* (4) the *Apostolical Constitutions* (*q.v.*); and (5) five epistles forming part of the Forged Decretals (*see* DECRETALS). The present article deals mainly with the third group, to which the title "Clementine literature" is usually confined, owing to the stress laid upon it in the famous Tübingen reconstruction of primitive Christianity, in which it played a leading part; but later criticism has lowered its importance as its true date and historical relations have been progressively ascertained. (1) and (2) became "Clementine" only by chance, but (3) was so originally by literary device or fiction, the cause at work also in (4) and (5). But while in all cases the suggestion of Clement's authorship came ultimately from his prestige as writer of the genuine Epistle of Clement (*see* CLEMENT I.), both (3) and (4) were due to this idea as operative on Syrian soil; (5) is a secondary formation based on (3) as known to the West.

(1) *The Second Epistle of Clement.*—This is really the earliest extant Christian homily (*see* APOSTOLIC FATHERS). Its theme is the duty of Christian repentance, with a view to obedience to Christ's precepts as the true confession and homage which He requires. Its special charge is "Preserve the flesh pure and the seal (*i.e.*, baptism) unstained" (viii. 6). But the peculiar way in which it enforces its morals in terms of the Platonic contrast between the spiritual and sensuous worlds, as archetype and temporal manifestation, and the fact that the preacher seems to quote the *Gospel according to the Egyptians* (in ch. xii. and possibly elsewhere) as if familiar to his hearers, and indeed its literary affinities generally, all point to Alexandria as the original home of the homily, at a date about 120–140.

(2) *The Two Epistles to Virgins, i.e.,* to Christian celibates of both sexes. These are known in their entirety only in Syriac, and were first published by Wetstein (1752), who held them genuine. This view is now generally discredited, even by Roman Catholics like Funk, their best recent editor (*Patres Apost.*, vol. ii.). There is no trace of their use in the West. Their Syrian origin is manifest, the more so that in the Syriac ms. they are appended to the New Testament, like the better-known epistles of Clement in the Codex Alexandrinus. Special occasion for such hortatory letters may be discerned in their polemic against intimate relations between ascetics of opposite sex, implied to exist among its readers, in contrast to usage in the writer's own locality. Now we know that spiritual unions, prompted originally by highstrung Christian idealism as to a religious fellowship transcending the law of nature in relation to sex, did exist between persons living under vows of celibacy during the 3rd century in particular, and not least in Syria (*cf.* the case of Paul of Samosata, *c.* 265, and the Synod of Ancyra in Galatia, *c.* 314).

(3*a*) *The Epistle of Clement to James* (the Lord's brother). This was originally part of (3*b*), in connection with which its origin and date are discussed. But as known to the West through Rufinus' Latin version, it was quoted as genuine throughout the middle ages. It became the starting point of the most momentous and gigantic of mediaeval forgeries, the Isidorian Decretals, where it stands at the head of the pontifical letters, extended to more than twice its original length.

(3*b*) *The Homilies and Recognitions.*—"The two chief extant Clementine writings, differing considerably in some respects in doctrine, are both evidently the outcome of a peculiar speculative type of Judaistic Christianity, for which the most characteristic name of Christ was 'the true Prophet.' The framework of both is a narrative purporting to be written by Clement (of Rome) to St. James, the Lord's brother, describing at the beginning his own conversion and the circumstances of his first acquaintance with St. Peter, and then a long succession of incidents accompanying St. Peter's discourses and disputations, leading up to a romantic recognition of Clement's father, mother and two brothers, from whom he had been separated since childhood. The problems discussed under this fictitious guise are with rare exceptions fundamental problems for every age; and, whatever may be thought of the positions maintained, the discussions are hardly ever feeble or trivial. Regarded simply as mirroring the past, few, if any, remains of Christian antiquity present us with so vivid a picture of the working of men's minds under the influence of the new leaven which had entered into the world" (Hort, *Clem. Recog.*, p. xiv.). Recent criticism builds on the principle, which emerges alike from the external and internal evidence that both writings used a common basis or parent document. Towards the determination of its nature, origin and antecedents, two contributions of prime importance have been made. The earlier of these is by F. J. A. Hort, and was delivered in the form of lectures as far back as 1884, though issued posthumously only in 1901; the other is the elaborate monograph of Dr. Hans Waitz (1904).

External Evidence.—The evidence of ancient writers really begins, not with Origen, but with Eusebius of Caesarea, who in his *Eccl. Hist.* iii. 38, writes as follows: "Certain men have quite lately brought forward as written by him (Clement) other verbose and lengthy writings, containing dialogues of Peter, forsooth, and Apion, whereof not the slightest mention is to be found among the ancients, for they do not even preserve in purity the stamp of the Apostolic orthodoxy." Apion, the Alexandrine grammarian and foe of Judaism, whose criticism was answered by Josephus, appears in this character both in *Homilies* and *Recognitions*, though mainly in the former (iv. 6–vii. 5). Thus Eusebius implies (1) a spurious Clementine work containing matter found also in our *Homilies* at any rate; and (2) its quite recent origin. Next we note that an extract in the *Philocalia* of Origen is introduced as follows: "Yea, and Clement the Roman, a disciple of Peter the Apostle, after using words in harmony with these on the present problem, in conversation with his father at Laodicea in the *Circuits*, speaks a very necessary word touching this matter" (astrological divination). The extract answers to *Recognitions*, x. 10–13, but it is absent from our *Homilies*. Here we observe that (1) the extract agrees this time with *Recognitions*, not with *Homilies;* (2) its framework is that of the Clementine romance found in both; (3) the tenth and last book of *Recognitions* is here parallel to book xiv. of a work called *Circuits* (*Periodoi*). This last point leads on naturally to the witness of Epiphanius (*c.* 375), who, speaking of Ebionites or Judaizing Christians of various sorts, and particularly the Essene type, says (*Haer.* xxx. 15) that "they use certain other books likewise, to wit, the so-called *Circuits* of Peter, which were written by the hand of Clement. . . . In the *Circuits*, then, they adapted the whole to their own views, representing Peter falsely in many ways, as that he was daily baptized for the sake of purification, as these also do; and they say that he likewise abstained from animal food and meat, as they themselves also do." Now all the points here noted in the *Circuits* can be traced in our *Homilies* and *Recognitions*, though toned down in different degrees. The witness of the Arianizing *Opus Imperfectum in Matthaeum* (*c.* 400) is in general similar. Its usual form of citation is "Peter in Clement" (*apud Clementem*), and points to "Clement" as a brief title for the Clementine *Periodoi*.

It has been needful to cite so much of the evidence proving

that our *Homilies* and *Recognitions* are both recensions of a common basis, at first known as the *Circuits of Peter* and later by titles connecting it rather with Clement, its ostensible author, because it affords data also for the historical problems touching (*a*) the contents and origin of the primary Clementine work, and (*b*) the conditions under which our extant recensions of it arose.

(*a*) *The Circuits of Peter,* as defined on the one hand by the epistle of Clement to James originally prefixed to it and by patristic evidence, and on the other by the common element in our *Homilies* and *Recognitions,* may be conceived as follows. It contained accounts of Peter's teachings and discussions at various points on a route beginning at Caesarea, and extending northwards along the coast-lands of Syria as far as Antioch. During this tour he meets with persons of typically erroneous views, which it was presumably the aim of the work to refute in the interests of true Christianity, conceived as the final form of divine revelation—a revelation given through true prophecy embodied in a succession of persons, the chief of whom were Moses and the prophet whom Moses foretold, Jesus the Christ. The prime exponent of the spurious religion is Simon Magus. A second protagonist of error, this time of Gentile philosophic criticism directed against fundamental Judaism, is Apion, the notorious anti-Jewish Alexandrine grammarian of Peter's day; while the rôle of upholder of astrological fatalism (*Genesis*) is played by Faustus, father of Clement, with whom Peter and Clement debate at Laodicea. Finally, all this is already embedded in a setting determined by the romance of Clement and his lost relatives, "recognition" of whom forms the *dénouement* of the story.

There is no reason to doubt that such, roughly speaking, were the contents of the Clementine work to which Eusebius alludes slightingly, in connection with that section of it which had to his eye least verisimilitude, viz., the dialogues between Peter and Apion. Now Eusebius believed the work to have been of quite recent and suspicious origin. This points to a date about the last quarter of the 3rd century; and the prevailing doctrinal tone of the contents, as known to us, leads to the same result. The standpoint is that of the peculiar Judaizing Christianity due to persistence among Christians of the tendencies known among pre-Christian Jews as Essene. The Essenes, while clinging to what they held to be original Mosaism, yet conceived and practised their ancestral faith in ways which showed distinct traces of syncretism, or the operation of influences foreign to Judaism proper. They thus occupied an ambiguous position on the borders of Judaism. Similarly Christian Essenism was syncretist in spirit, as we see from its best-known representatives, the Elchasaites, of whom we first hear about 220, when a certain Alcibiades of Apamea in Syria (some 60m. south of Antioch) brought to Rome the *Book of Helxai*—the manifesto of their distinctive message (Hippol., *Philos.* ix. 13)—and again some 20 years later, when Origen refers to one of their leaders as having lately arrived at Caesarea (Euseb. vi. 38).

The *Periodoi* or *Circuits* must not be thought of as strictly Elchasaite, since it knew no baptism distinct from the ordinary Christian one. It seems rather to represent a later and modified Essene Christianity, already half Catholic, such as would suit a date after 250, in keeping with Eusebius's evidence. Confirmation of such a date is afforded by the silence of the Syrian *Didascalia,* itself perhaps dating from about 250, as to any visit of Simon Magus of Caesarea, in contrast to the reference in its later form, the *Apostolical Constitutions* (*c.* 350–400), which is plainly coloured (vi. 9) by the Clementine story. On the other hand, the *Didascalia* seems to have been evoked partly by Judaizing propaganda in north Syria. If, then, it helps to date the *Periodoi* as after 250, it may also suggest as place of origin one of the large cities lying south of Antioch, say Laodicea (itself on the coast about 30m. from Apamea), where the Clementine story reaches its climax. The intimacy of local knowledge touching this region implied in the narrative common to *Homilies* and *Recognitions* is notable, and tells against an origin for the *Periodoi* outside Syria (*e.g.,* in Rome, as Waitz and Harnack hold, but Lightfoot disproves, *Clem.* i. 55 f., 64,100, *cf.* Hort, p. 131). Further, though the curtain even in it fell on Peter at Antioch itself (our one complete ms. of the *Homilies* is proved by the *Epitome,* based on the *Homilies,* to be here abridged), the interest of the story culminates at Laodicea.

If we assume, then, that the common source of our extant Clementines arose in Syria, perhaps, *c.* 265, had it also a written source or sources which we can trace? Though Hort doubts it, most scholars (*e.g.,* Waitz, Harnack) infer the existence of at least one source, "Preachings (*Kerygmata*) of Peter," containing no reference at all to Clement. Such a work seems implied by the epistle of Peter to James and its appended adjuration, prefixed in our mss. to the *Homilies* along with the epistle of Clement to James. Thus the later work aimed at superseding the earlier, much as Photius suggests (*see* above). It was, then, to these "Preachings of Peter" that the most Ebionite features, and especially the anti-Pauline allusions under the guise of Simon still inhering in the *Periodoi* (as implied by *Homilies* in particular), originally belonged. The fact, however, that these were not more completely suppressed in the later work, proves that it, too, arose in circles of kindred, though largely modified, Judaeo-Christian sentiment (cf. *Homilies,* vii., *e.g.,* ch. 8). The differences of standpoint may be due not only to lapse of time, and the emergence of new problems on the horizon of Syrian Christianity generally, but also to change in locality and in the degree of Greek culture represented by the two works. A probable date for the "Preachings" used in the *Periodoi* is *c.* 200.

If the home of the *Periodoi* was the region of the Syrian Laodicea, we can readily explain most of its characteristics. Photius refers to the "excellences of its language and its learning"; while Waitz describes the aim and spirit of its contents as those of an apology for Christianity against heresy and paganism, in the widest sense of the word, written in order to win over both Jews (cf. *Recognitions,* i. 53–70) and pagans, but mainly the latter. In particular it had in view persons of culture, as most apt to be swayed by the philosophical tendencies in the sphere of religion prevalent in that age, the age of neo-Platonism. It was in fact designed for propaganda among religious seekers in a time of singular religious restlessness and varied inquiry, and, above all, for use by catechumens (cf. *Ep. Clem.* 2, 13) in the earlier stages of their preparation for Christian baptism. To such its romantic setting would be specially adapted, as falling in with the literary habits and tastes of the period; while its doctrinal peculiarities would least give offence in a work of the aim and character just described.

(*b*) That the *Periodoi* was a longer work than either our *Homilies* or *Recognitions* is practically certain; and its mere bulk may well, as Hort suggests, have been a chief cause of the changes of form. Yet *Homilies* and *Recognitions* are abridgments made on different principles and convey rather different impressions to their readers. The *Homilies* care most for doctrine, especially philosophical doctrine, and seem to transpose very freely for doctrinal purposes; the *Recognitions* care most for the story, as a means of religious edification, and have preserved the general framework much more nearly. They arose in different circles; indeed, save the compiler of the text represented by the Syraic ms. of A.D. 411 (who gives a selection of discourses from the *Homilies* after *Recognitions,* iii.), not a single ancient writer shows a knowledge of *both* books in any form. Both probably arose in Syria (so Lightfoot), but in circles varying a good deal in religious standpoint. *Homilies* was a sort of second edition, made largely in the spirit of its original and perhaps in much the same locality, with a view to maintaining and propagating the doctrines of a semi-Judaic Christianity (*cf.* bk. vii.), as it existed a generation or two after the *Periodoi* appeared. The *Recognitions,* in both recensions, as is shown by the fact that it was read in the original with general admiration not only by Rufinus but also by others in the West, was more Catholic in tone.

The Clementine literature throws light upon a very obscure phase of Christian development, that of Judaeo-Christianity, and proves that it embraced more intermediate types, between Ebionism proper and Catholicism, than has generally been realized. Incidentally, too, its successive forms illustrate many matters of belief and usage among Syrian Christians generally in the 3rd

and 4th centuries, notably their apologetic and catechetical needs and methods. Further, it discusses, as Hort observes, certain indestructible problems which much early Christian theology passes by or deals with rather perfunctorily; and it does so with a freshness and reality which we see to be not unconnected with origin in an age as yet free from the trammels of formal orthodoxy. The romance to which it owed much of its popular appeal, became, through the medium of Rufinus' Latin, the parent of the late mediaeval legend of Faust, and so the ancestor of a famous type in modern literature.

BIBLIOGRAPHY.—*See* Hans Waitz, "Die Pseudoklementinen" (*Texte u. Untersuchungen zur Gesch. der altchr. Literatur, neue Folge,* Bd. x. Heft 4), and A. Harnack, *Chronologie der altchr. Literatur* (1904), ii. 518f. In English, besides Hort's work, there are articles by G. Salmon, in *Dict. of Christ. Biog.*, C. Bigg, *Studia Biblica,* ii., A. C. Headlam, *Journal of Theol. Studies,* iii., and in Hastings' *Encyclopaedia of Religion and Ethics.*

CLEMENT OF ALEXANDRIA (*Clemens Alexandrinus*) was probably born about A.D. 150 of heathen parents in Athens. The earliest writer after himself who gives us any information with regard to him is Eusebius (d. 370). The only points on which his works now extant inform us are his date and his instructors. In the *Stromateis* ("Miscellanies"), while attempting to show that the Jewish scriptures were older than any writings of the Greeks, he invariably brings down his dates to the death of Commodus (192), a circumstance which at once suggests that he wrote in the reign of the emperor Severus, from 193 to 211 (see *Strom.* lib. i. cap. xxi. 140). We know nothing of his conversion except that it occurred, for his writings show a singularly minute acquaintance with the ceremonies of pagan religion, and there are indications that he himself had been initiated into some of the mysteries (*Protrept.* cap. ii. sec. 14). He attained the position of presbyter in the church of Alexandria (Eus. *H.E.* vi. 11, and Jerome, *De Vir. Ill.* 38), and became perhaps the assistant, and certainly the successor of Pantaenus in the catechetical school of that place. Among his pupils were Origen (Eus. *H.E.* vi. 7) and Alexander, bishop of Jerusalem (Eus. *H.E.* vi. 14). How long he continued in Alexandria, and when and where he died, are all matters of pure conjecture.

Clement occupies a profoundly interesting position in the history of Christianity. He is the first to bring all the culture of the Greeks and all the speculations of the Christian heretics to bear on the exposition of Christian truth. The list of Greek authors from whom he quoted occupies upwards of 14 of the 4to. pages in Fabricius's *Bibliotheca Graeca.* He is at home alike in the epic and the lyric, the tragic and the comic poets, his knowledge of the prose writers is very extensive, and he made a special study of the philosophers. Equally minute is his knowledge of the systems of the Christian heretics; and it is plain that he not merely read but thought deeply on the questions which the civilization of the Greeks and the various writings of poets, philosophers and heretics raised. It was, however, in the Scriptures, which he held contained the revelation of God's wisdom to men, that he was most deeply read, yet, notwithstanding the great biblical knowledge evidenced by his works, the modern theologian is disappointed to find in them very little of what he deems distinctively Christian. In fact Clement regarded Christianity as a philosophy. The ancient philosophers sought through their philosophy to attain to a nobler and holier life, and this also was the aim of Christianity. The difference between the two, in Clement's judgment, was that the Greek philosophers had only glimpses of the truth, that they attained only to fragments of the truth, while Christianity revealed in Christ the absolute and perfect truth. All the stages of the world's history were therefore preparations leading up to this full revelation, and God's care was not confined to the Hebrews alone. The worship of the heavenly bodies, for instance, was given to man at an early stage that he might rise from a contemplation of these sublime objects to the worship of the Creator. Greek philosophy in particular was the preparation of the Greeks for Christ. It was the schoolmaster or pedagogue to lead them to Christ. Clement varies in his statement how Plato got his wisdom or his fragments of the Reason; sometimes he thinks that they came direct from God, like all good things, but he is also fond of maintaining that many of Plato's best thoughts were borrowed from the Hebrew prophets; and he makes the same statement in regard to the wisdom of the other philosophers. But however this may be, Christ was the end to which all that was true in philosophies pointed. Christ himself was the Logos, the Reason. God the Father was ineffable. The Son alone can manifest Him fully. He is the Reason that pervades the universe, that brings out all goodness, that guides all good men. It was through possessing somewhat of this Reason that the philosophers attained to any truth and goodness; but in Christians he dwells more fully and guides them through all the perplexities of life. Photius, probably on a careless reading of Clement, argued that he could not have believed in a real incarnation. But the words of Clement are quite precise and their meaning indisputable. The real difficulty attaches not to the Second Person, but to the First. The Father in Clement's mind becomes the Absolute of the philosophers, not the Father of the Gospel at all. He believed in a personal Son of God who was the Reason and Wisdom of God; and he believed that this Son of God really became incarnate though he speaks of him almost invariably as the Word, and attaches little value to his human nature. The object of his incarnation and death was to free man from sin, to lead him into the path of wisdom, and thus in the end elevate him to the position of a god. But man's salvation was to be gradual. It began with faith, passed from that to love, and ended in full and complete knowledge. There could be no faith without knowledge; but the knowledge is imperfect, and the Christian has to do many things in simple obedience without knowing the reason. He has to move upwards continually until he at length does nothing that is evil and knows fully the reason and object of what he does. He thus becomes the true Gnostic, but he can become the true Gnostic only by contemplation and by the practice of what is right. He has to free himself from the power of passion; he has to give up all thoughts of pleasure; he must prefer goodness in the midst of torture to evil with unlimited pleasure; he must resist the temptations of the body, keeping it under strict control, and with the eye of the soul undimmed by corporeal wants and impulses, contemplate God the supreme good, and live a life according to reason. In other words, he must strive after likeness to God as he reveals himself in his Reason or in Christ. Clement thus looks entirely at the enlightened moral elevation to which Christianity raises man. He believed that Christ instructed men before he came into the world, and he therefore viewed heathenism with kindly eye. He was also favourable to the pursuit of all kinds of knowledge. All enlightenment tended to lead up to the truths of Christianity, and hence knowledge of every kind not evil was its handmaid. Clement had at the same time a strong belief in evolution or development. The world went through various stages in preparation for Christianity. The man goes through various stages before he can reach Christian perfection. And Clement conceived that this development took place not merely in this life, but in the future through successive grades. The Jew and the heathen had the gospel preached to them in the world below by Christ and His apostles, and Christians will have to pass through processes of purification and trial after death before they reach knowledge and perfect bliss.

Eusebius and Jerome give lists of the works which Clement left behind him. (1) Πρὸς Ἕλληνας λόγος ὁ προτρεπτικός, *A Hortatory Address to the Greeks;* (2) Ὁ Παιδαγωγός; *The Tutor* in three books; (3) Στρωματεῖς ("patchwork"), or *Miscellanies,* in 8 books; (4) Τίς ὁ σωζόμενος πλούσιος, *Who is the rich man that is saved?* (5) Ὑποτυπώσεις, *Adumbrations or Outlines* in 8 books; treatises on (6) *The Passover,* (7) *Fasting,* (8) *Slander,* (9) *Patience,* "for the newly baptised"; and (10) *On the Rule of the Church,* "for those who Judaise." Of these the first four have come down to us complete or nearly so. The *Address to the Greeks* contains an attack on the crudities and immoralities in the stories told of heathen deities, with an argument that the great thinkers and poets of Greece had recognized the unit and spirituality of the divine Being, and that fuller light had been revealed through the Hebrew prophets. In the *Paedogogus,* he explains how before the incarnation Christ

was gradually leading mankind to the Truth, and then explains how the Christian following the Logic or Reason ought to behave in the various circumstances of life. The contents of the *Miscellanies,* as the title indicates are very varied. Sometimes they discuss chronology, sometimes philosophy, sometimes poetry; but one object runs through all, to show what the true Christian Gnostic is, and what is his relation to philosophy. The tract *Who is the rich man that is saved?* is an admirable exposition of Mark x. 17–31. Clement argues that wealth, if rightly used, is not unchristian. Of the remaining books mentioned by Eusebius, we know that the *Adumbrations* was a short commentary on all the books of Scripture, including some apocryphal books; and we have two fragments of the book on the *Passover*. Of the others nothing is known. We have also fragments of two treatises, on *Providence* and on the *Soul,* not named by Eusebius.

BIBLIOGRAPHY.—C. Bigg, *Christian Platonists of Alexandria* (1886, 1913); F. J. A. Hort, *Six Lectures on the Ante-Nicene Fathers* (1895); E. de Faye, *Clement d'Alexandrie* (1898); J. Patrick, *Clement of Alexandria* (1914). W. R. Inge, "Alexandrian Theology," in J. Hastings, *Encyclopaedia of Religion and Ethics* (1908), gives an excellent summary account of the Alexandrine School. The standard edition of the collected works is O. Stählin, *Clemens Alexandrinus* (Leipzig, 1905). We have a valuable separate edition of *Miscellanies,* bk. vii., ed. F. J. A. Hort and J. B. Mayor (1902), and of the tract on Wealth by P. M. Barnard, *Texts and Studies,* vol. 2 (Cambridge, 1897). *See* also B. F. Westcott, "Clement of Alexandria" *Murray's Dictionary of Christian Biography* (1911).

CLEMENTS, FREDERIC EDWARD (1874–1945), American plant oecologist, was born in Lincoln, Neb., Sept. 16, 1874. He graduated in 1894 at the University of Nebraska from which in 1898 he received the degree of doctor of philosophy. From 1894 to 1906 he was instructor and associate professor of botany and in 1906–07 he was professor of plant physiology, at the University of Nebraska. He was professor of botany and head of the botanical department in the University of Minnesota from 1907 to 1917 when he was made associate in charge of oecological research in the Carnegie Institution of Washington. He conducted extensive investigations in oecology, palaeo-oecology, experimental evolution and climatology. Among his published works are: *The Phytogeography of Nebraska,* with Roscoe Pound (1898, 2nd ed., 1900); *Development and Structure of Vegetation* (1904); *Research Methods in Ecology* (1906); *Plant Physiology and Ecology* (1907); *Minnesota Mushrooms* (1910); *Rocky Mountain Flowers,* with Edith Clements (1913), *Plant Succession* (1916); *Plant Indicators* (1920); *The Phylogenetic Method in Taxonomy,* with H. M. Hall (1923); *Plant Succession and Indicators* (1927); and *Flower Families and Ancestors* (1927).

CLEOBULUS, one of the Seven Sages of Greece, a native and tyrant of Lindus in Rhodes. He was distinguished for his strength and his handsome person, for the wisdom of his sayings, the acuteness of his riddles, and the beauty of his lyric poetry. Diogenes Laërtius quotes a letter in which Cleobulus invites Solon to take refuge with him against Peisistratus; and this would imply that he was alive in 560 B.C. He is said to have held advanced views as to female education, and he was the father of the wise Cleobuline, whose riddles were not less famous than his own (Diogenes Laërtius, i. 89–93).

See F. G. Mullach, *Fragmenta Philosophorum Graecorum,* i.

CLEOMENES, the name of three Spartan kings of the Agiad line (Κλεομένης).

CLEOMENES I. was the son of Anaxandridas, whom he succeeded about 520 B.C. His chief exploit was his crushing victory near Tiryns over the Argives, some 6,000 of whom he burned to death in a sacred grove to which they had fled for refuge (Herodotus vi. 76–82). This secured for Sparta the undisputed hegemony of the Peloponnese. Cleomenes' interposition in the politics of central Greece was less successful. In 510 he marched to Athens with a Spartan force to aid in expelling the peisistratidae, and subsequently returned to support the oligarchical party, led by Isagoras, against Cleisthenes (*q.v.*). He expelled 700 families and transferred the government from the council to 300 of the oligarchs, but being blockaded in the Acropolis was forced to capitulate. On his return home he collected a large force, with the intention of making Isagoras despot of Athens, but the opposition of the Corinthian allies, and of his colleague, Demaratus, caused the expedition to break up after reaching Eleusis (Herod. v. 64–76; Aristotle, *Ath. Pol.* 19, 20). In 491 he went to Aegina to punish the island for its submission to Darius, but the intrigues of his colleague once again rendered his mission abortive. In revenge Cleomenes accused Demaratus of illegitimacy and secured his deposition in favour of Leotychides (Herod. vi. 50–73). But when it was discovered that he had bribed the Delphian priestess to substantiate his charge he was himself obliged to flee; he went first to Thessaly and then to Arcadia, where he attempted to foment an anti-Spartan rising. About 488 B.C. he was recalled, but shortly afterwards, in a fit of madness, he committed suicide (Herod. vi. 74, 75). Cleomenes seems to have received scant justice at the hands of Herodotus or his informants, and Pausanias (iii. 3, 4) does little more than condense Herodotus' narrative. In spite of some failures, largely due to Demaratus' jealousy, Cleomenes strengthened Sparta in the position, won during his father's reign, of champion and leader of the Hellenic race; it was to him, for example, that the Ionian cities of Asia Minor first applied for aid in their revolt against Persia (Herod. v. 49–51).

The chief ancient authority is Herodotus (v. and vi.). *See* E. M. Walker, *Cambridge Ancient History,* vol. iv., ch. vi., § 1, 4, 5, and ch. viii., § 8). For chronology *see* J. Wells, *Journal of Hellenic Studies* (1905), p. 193 ff., who assigns the Argive expedition to the outset of the reign, whereas nearly all historians have dated it in or about 495 B.C.

CLEOMENES II. was the son of Cleombrotus I., brother and successor of Agesipolis II. Nothing is recorded of his reign save the fact that it lasted for nearly 61 years (370–309 B.C.).

CLEOMENES III., the son and successor of Leonidas II., reigned about 235–219 B.C. He made a determined attempt to reform the social condition of Sparta along the lines laid down by Agis IV., whose widow, Agiatis, he married; at the same time he aimed at restoring Sparta's hegemony in the Peloponnese. After twice defeating the forces of the Achaean league in Arcadia, near Mount Lycaeum and at Leuctra, he strengthened his position by assassinating four of the ephors, abolishing the ephorate, which had usurped the supreme power, and banishing some 80 of the leading oligarchs. The authority of the council was also curtailed, and a new board of magistrates, the *patronomi,* became the chief officers of state. He appointed his own brother, Eucleidas, as his colleague in succession to the Eurypontid Archidamus, who had been murdered. His social reforms included a redistribution of land, the remission of debts, the restoration of the old system of training ἀγωγή and the admission of picked *perioeci* (*q.v.*) into the citizen body. As a general Cleomenes did much to revive Sparta's old prestige. He defeated the Achaeans at Dyme, made himself master of Argos, and was eventually joined by Corinth, Phlius, Epidaurus and other cities. But Aratus, whose jealousy could not brook to see a Spartan at the head of the Achaean league, called in Antigonus Doson, of Macedonia, and Cleomenes, after conducting successful expeditions to Megalopolis and Argos, was finally defeated at Sellasia, to the north of Sparta, in 222 or 221 B.C. He took refuge at Alexandria with Ptolemy Euergetes, but was arrested by his successor, Ptolemy Philopator, on a charge of conspiracy. Escaping from prison he tried to raise a revolt, but the attempt failed, and to avoid capture he put an end to his life. Both as general and as politician Cleomenes was one of Sparta's greatest men, and with him perished her last hope of recovering her ancient supremacy in Greece.

See Polybius ii. 45–70, v. 35–39, viii. 1; Plutarch, *Cleomenes; Aratus,* 35–46; *Philopoemen,* 5, 6; Pausanias ii. 9; Holm, *History of Greece,* iv. cc. 10, 15. (M. N. T.)

CLEON (d. 422 B.C.), Athenian politician during the Peloponnesian War, was the son of Cleaenetus, from whom he inherited a tannery. He was the first prominent representative of the commercial class in Athenian politics. He came into notice first as an opponent of Pericles, and in his opposition somewhat curiously found himself acting in concert with the aristocrats, who equally hated and feared Pericles. In 430, when the city was devastated by the plague, Cleon headed the opposition to the Periclean régime. Pericles was accused of maladministration of public money, with the result that he was actually found guilty

though he was re-elected in 429. The death of Pericles (429) left the field clear for Cleon. Hitherto he had only been a vigorous opposition speaker, a critic and accuser of state officials. He now came forward as the champion and leader of the democracy, and, was for some years undoubtedly the foremost man in Athens. He was gifted with natural eloquence and a powerful voice, and knew how to work upon the feelings of the people. He became the leader of the war party in opposition to Nicias and the moderates, who favoured a cautious strategy and an early peace.

In 427 when Mytilene, which had revolted, fell, Cleon proposed that all its citizens should be put to death, and the women and children enslaved. His policy was to hold down the empire, now a "tyranny," by naked force. His decree was passed, but rescinded next day, in time to save Mytilene.

In 425 he, when the Spartans were blockaded in Sphacteria, brought about the rejection of the terms offered by Sparta, and in the hope of securing a peace which should restore Athens' land-empire. He then reached the summit of his fame by capturing the Spartans on the island (*see* PYLOS). Much of the credit of this success, the most notable which the Athenians won during the Archidamian War, was due to the military skill of his colleague Demosthenes; but it was due to Cleon's determination that the Ecclesia sent out the additional force which was needed. About this time Cleon doubled the tribute of the allies (*see* DELIAN LEAGUE) and raised the pay of the Athenian jurors from two to three obols (Schol. Ar. *Wasps* 88). In 422, after the close of the armistice, Cleon, who was eager to continue the war, went to recover Thrace from Brasidas, but, after capturing several cities, was taken by surprise at Amphipolis, defeated and killed. With his death, the peace party at Athens gained power, and the Peace of Nicias was concluded. (*See* PELOPONNESIAN WAR).

Cleon is represented by Aristophanes and Thucydides in an extremely unfavourable light. But neither can be considered an unprejudiced witness. Aristophanes was not only opposed to Cleon's political programme, but bore him a personal grudge, having been prosecuted by the demagogue after the production of his *Babylonians*. Moreover, his treatment of Socrates should put us on our guard against accepting his evidence against Cleon. Thucydides had been exiled by a decree proposed by Cleon after the loss of Amphipolis.

BIBLIOGRAPHY.—For the literature on Cleon *see* C. F. Hermann, *Lehrbuch der griechischen Antiquitäten*, i. pt. 2 (6th ed. by V. Thumser, 1892), p. 709, and G. Busolt, *Griechische Geschichte*, iii. pt. 2 (1904), p. 988, note 3. Authorities:—(*a*) *Favourable to Cleon:* G. Grote, *Hist. of Greece*, c. 50, 54; J. B. Bury, *Hist. of Greece* i. (1902). (*b*) *Unfavourable:* C. Thirlwall, *Hist. of Greece*, c. 21; E. Curtius, *Hist. of Greece* (Eng. tr. iii. p. 112); H. Delbrück, *Die Strategie des Perikles* (1890); E. Meyer, *Forschungen zur alten Geschichte*, ii. p. 333 (Halle, 1899). The balance between the two extreme views is fairly held by J. Beloch, *Die attische Politik seit Perikles* (Leipzig, 1884), and *Griechische Geschichte*, i. p. 537; and by A. Holm, *Hist. of Greece*, ii. (Eng. tr.), c. 23, with the notes. *See* also A. B. West and D. B. Meritt, "Cleon's Amphipolitan Campaign" (*American Journal of Archaeology* xxix. 1925).

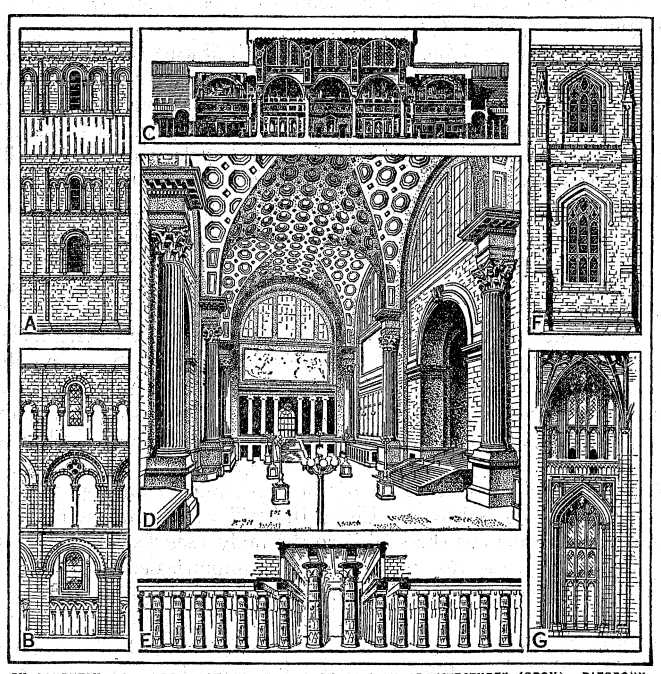
CLEOPATRA, the regular name of the queens of Egypt, in the Ptolemaic dynasty after Cleopatra, daughter of the Seleucid Antiochus the Great, wife of Ptolemy V., Epiphanes. The best-known was the daughter of Ptolemy XI, Auletes, born 69 (or 68) B.C. At the age of 17 she became queen of Egypt jointly with her younger brother Ptolemy Dionysus, whose wife, in accordance with Egyptian custom, she was to become. A few years later, deprived of all royal authority, she withdrew into Syria, and prepared to recover her rights by force of arms. At this juncture Julius Caesar followed Pompey into Egypt. The personal fascinations of Cleopatra induced him to undertake a war on her behalf, in which Ptolemy lost his life, and she was replaced on the throne with a younger brother, of whom, however, she soon rid herself by poison. In Rome she lived openly with Caesar as his mistress, until his assassination, when, aware of her unpopularity, she returned to Egypt. Subsequently she became the ally and mistress of Mark Antony (*see* ANTONIUS). Their connection was highly unpopular at Rome, and Octavian (*see* AUGUSTUS) declared war upon them and defeated them at Actium (31 B.C.). Cleopatra escaped to Alexandria, where Antony joined her. Having no prospect of ultimate success, she accepted Octavian's proposal that she should assassinate Antony, and enticed him to join her in a mausoleum which she had built in order that "they might die together." Antony committed suicide, in the mistaken belief that she had already done so. Octavian refused to yield to the charms of Cleopatra, who put an end to her life by applying an asp to her bosom, according to the common tradition, on Aug. 29, 30 B.C. With her ended the dynasty of the Ptolemies, and Egypt was made a Roman province. Cleopatra had three children by Antony, and by Julius Caesar, it is said, a son, Caesarion, who was put to death by Octavian.

For the history of Cleopatra *see* ANTONIUS; CAESAR, GAIUS JULIUS; PTOLEMIES. The life of Antony by Plutarch is our main authority; it is upon this that Shakespeare's *Antony and Cleopatra* is based. Her life is the subject of monographs by Stahr (1879, an *apologia*), and H. Houssaye, *Aspasie, Cléopâtre*, etc. (1879).

CLEOPATRA'S NEEDLES, the name popularly given to the two Egyptian obelisks presented to the British and American people respectively, and now standing on the Thames Embankment in London and in the Central Park of New York city. Originally set up by Thotmes or Tethmosis III. at Heliopolis about 1500 B.C., they were removed by Caesar Augustus to adorn the Caesareum at Alexandria about 14 B.C. and there remained until removed (in each case by private munificence) to their present positions in 1878 and 1880. Both are of rose-red Syene granite, covered with hieroglyphical inscriptions, and are estimated to weigh some 200 tons. (*See* OBELISK.)

CLEPSYDRA, the chronometer of the Greeks and Romans, which measured time by the flow of water (Gr. κλέπτειν, to steal, and ὕδωρ, water). In its simplest form it was an earthenware globe of known capacity, pierced at the bottom with several small holes, through which the water escaped. It was employed to set a limit to speeches in courts of justice, hence the phrases *aquam dare* (Pliny, *Ep.* 6. 2. 7), to give the advocate speaking time, and *aquam perdere* (Quint. 11. 3. 52), to waste time.

The clepsydra is said to have been known to the Egyptians. There was one in the Tower of the Winds at Athens; the turret on the south side of the tower is supposed to have contained the cistern which supplied the water. *See* classical dictionaries, *s.v.*



BY COURTESY OF SHARPE, "SEVEN PERIODS OF ENGLISH ARCHITECTURE" (SPON); D'ESPOUY, "MONUMENTS ANTIQUES" (MASSIN ET CIE); SIR BANISTER FLETCHER, "HISTORY OF ARCHITECTURE ON THE COMPARATIVE METHOD," EIGHTH ED. (1928) BATSFORD; ARCHITECTURAL BOOK PUB. CO.

EXAMPLES OF CLERESTORIES (SEE ARTICLE, CLERESTOREY ON NEXT PAGE)
A, B, exterior and interior, Peterborough cathedral, Romanesque clerestorey window at the top; C, Roman clerestorey, tepidarium, Baths of Titus; D, modern adaptation of Roman type, the Pennsylvania Station, New York; E, Egyptian clerestorey lighting, hypostyle hall, Karnak; F, G, exterior and interior, Winchester cathedral, showing larger Gothic clerestorey

CLERESTORY, CLERESTOREY or **CLEARSTORY,** in architecture, any wall of a room carried higher than the surrounding roofs so that windows can be pierced in it to light the room. In a large building, where interior walls are far from the outside of the building, some such method of lighting the central part becomes necessary, and the use of the clerestorey appears as early, at least, as the 18th dynasty in Egypt, under which the great hypostyle hall of the temple at Karnak was built. This had a central range of columns, higher than those on either side, to allow clerestoreys to be built of pierced stone slabs. In Roman architecture, many great halls were thus lighted, usually groined vaults over the central hall allowed of large semicircular windows being built above the side roofs; *e.g.,* S. Maria degli Angeli, at Rome (the tepidarium of the Baths of Diocletian) and the basilica of Constantine, at Rome. Similarly, the walls under the side arches of S. Sophia at Constantinople, are clerestorey walls. It was, however, in the Romanesque and Gothic churches of the middle ages, that the clerestorey idea received its most adequate expression. *See* p. 801 for illustrations of Clerestories. (*See* BYZANTINE AND ROMANESQUE ARCHITECTURE; GOTHIC ARCHITECTURE.)

CLERFAYT or **CLAIRFAYT, FRANÇOIS SEBASTIEN CHARLES JOSEPH DE CROIX,** COUNT OF (1733–1798), Austrian field marshal, entered the Austrian army in 1753. In the Seven Years' War he greatly distinguished himself, and in 1787 took part in the Turkish war. In 1792 he received the command of the Austrian contingent in the duke of Brunswick's army, and at Croix-sous-Bois his corps inflicted a reverse on the French. In the Netherlands he opened the campaign of 1793 with the victory of Aldenhoven and the relief of Maestricht, and on March 18 brought about the complete defeat of Dumouriez at Neerwinden. His victorious career was checked by the reverse at Wattignies, and in 1794 he was unsuccessful in West Flanders against Pichegru. Clerfayt succeeded the duke of Saxe-Coburg in the supreme command, but was quite unable to make head against the French, and had to recross the Rhine. In 1795, now field marshal, he commanded on the middle Rhine against Jourdan, whom he defeated at Höchst and Mainz. His action in concluding an armistice with the French not being approved by Thugut, he resigned the command, and became a member of the Aulic Council in Vienna. He died in 1798.

See von Vivenot, *Thugut, Clerfayt, und Würmser* (Vienna, 1869).

CLERGY, a collective term signifying strictly the body of "clerks," *i.e.,* men in holy orders (*see* CLERK); but extended in modern times so as to embrace all varieties of ordained Christian ministers, though in England the word "clergyman" is still mainly restricted to the clergy of the Established Church. In the Roman Catholic Church the word, which is the O.Fr. *clergie,* from Low Lat. *clericatus,* embraces the whole hierarchy of *clerici,* whether in holy or merely minor orders; it has also been loosely used to include the members of religious orders. The M.E. senses of "clerkship" and "learning" have long been obsolete.

In distinction to the "clergy" we find the "laity" (Gr. λαός, people), the great body of "faithful people" which, in nearly every conception of the Christian Church, stands in relation to the clergy as a flock of sheep to its pastor. This distinction was of early growth, and developed during the middle ages into lively opposition (*see* MONASTICISM; CHURCH HISTORY; PAPACY; INVESTITURE). The extreme claim of the great mediaeval popes, that the priest, as "ruler over spiritual things," was as much superior to temporal rulers as the soul is to the body (*see* INNOCENT III.) led logically to the vast privileges and immunities enjoyed by the clergy, which consisted mainly in exemption from public burdens, both as regarded person and pocket, and in immunity from lay jurisdiction. This last privilege extended to matters both civil and criminal; though, as Bingham shows, it did not (always and everywhere) prevail in cases of heinous crime (*Origines Eccles.* bk. v.).

This subjection of the clergy only to courts disposed by *esprit de corps* to judge leniently led to the penalties for criminous clerks being much lighter than those to which laymen were amenable; and this in turn led to the survival in England, long after the Reformation, of the legal fiction of benefit of clergy, used to mitigate the harshness of the criminal law.

CLERGY, BENEFIT OF, an obsolete but once very important feature in English criminal law. Benefit of clergy began with the claim on the part of the ecclesiastical authorities in the 12th century that every *clericus* should be exempt from the jurisdiction of the temporal courts and be subject to the spiritual courts alone. The issue of the conflict was that the common law courts abandoned the extreme punishment of death assigned to some offences when the person convicted was a *clericus,* and the church was obliged to accept the compromise and let a secondary punishment be inflicted. The term "clerk" or *clericus* always included a large number of persons in what were called minor orders, and in 1350 the privilege was extended to secular as well as to religious clerks; and, finally, the test of being a clerk was the ability to read the opening words of verse 1 of Psalm li., hence generally known as the "neck-verse." Even this requirement was abolished in 1705. In 1487 it was enacted that every layman, when convicted of a clergyable felony, should be branded on the thumb, and disabled from claiming the benefit a second time. The privilege was extended to peers, even if they could not read, in 1547, and to women, partially in 1622 and fully in 1692. The partial exemption claimed by the Church did not apply to the more atrocious crimes, and hence offences came to be divided into clergyable and unclergyable. According to the common practice in England of working out modern improvements, through antiquated forms, this exemption was made the means of modifying the severity of the criminal law. It became the practice to claim and be allowed the benefit of clergy; and when it was the intention by statute to make a crime really punishable with death, it was awarded "without benefit of clergy." The benefit of clergy was abolished by a statute of 1827, but as this statute did not repeal that of 1547, under which peers were given the privilege, a further statute was passed in 1841 putting peers on the same footing as commons and clergy.

For a full account of benefit of clergy *see* Pollock and Maitland, *History of English Law;* Stephen, *History of the Criminal Law of England;* E. Friedberg, *Corpus juris canonici* (*Leipzig,* 1879–81).

CLERGYMAN, an ordained minister of the Christian Church. In England the term is usually confined to the ministers of the established Church. Educational qualifications for this work vary with the different denominations, but the majority require at least two or three years of religious specialization beyond a four year college course, with a growing tendency towards higher standards in general to meet the challenges of modern thought and inquiry. Good health, intellectual ability, moral integrity, a desire to serve, breadth of knowledge and understanding, spiritual conviction, love of humanity and poise are some of the personal attributes necessary inasmuch as the clergyman serves variously as preacher, leader of worship, teacher, educator, pastor, social worker and executive.

CLERGY RESERVES, in Canada. By the act of 1791, establishing the provinces of Upper and Lower Canada, the British Government set apart one-eighth of all the crown lands for the support of "a Protestant clergy." These reservations, after being for many years a stumbling-block to the economic development of the province, and the cause of much bitter political and ecclesiastical controversy, were secularized by the Canadian parliament in 1854, and the proceeds applied to other purposes, chiefly educational. Owing to the wording of the imperial act, the amount set apart is often stated as one-seventh, and was sometimes claimed as such by the clergy.

CLERK, SIR DUGALD (1854–1932), Scottish civil engineer, was born at Glasgow on March 31, 1854. He was educated at the West of Scotland Technical college and the Andersonian college. He invented the Clerk cycle gas engine in 1877, improving it in 1878 (*see* INTERNAL COMBUSTION ENGINES), and became an authority on internal combustion engines. He also interested himself in motor engineering. During World War I he became director of engineering research to the Admiralty, and until 1919 was a member of the advisory committee for aeronautics to the Air Ministry, and also of the air inventions committee. In 1908 he was elected F.R.S., and in 1917 knighted. His works include *The Gas and Oil Engine* and many scientific papers.

CLERK, in its original sense, as used in the civil law, one who had taken religious orders of whatever rank, whether "holy" or "minor." In English ecclesiastical law, a clerk was any one who had been admitted to the ecclesiastical state, and had taken the tonsure. The application of the word in this sense gradually underwent a change, and "clerk" became more especially the term applied to those in minor orders, while those in "major" or "holy" orders were designated in full "clerks in holy orders." After the Reformation the word "clerk" was still further extended to include laymen who performed duties in cathedrals, churches, etc., *e.g.,* the choirmen, who were designated "lay clerks." Of these lay clerks or choirmen there was always one whose duty it was to be constantly present at every service, to sing or say the responses as the leader or representative of the laity. His duties were gradually enlarged to include the care of the church and precincts, assisting at baptisms, marriages, etc., and he thus became the precursor of the later *parish clerk.* In a somewhat similar sense we find *bible clerk, singing clerk,* etc. The use of the word "clerk" to denote a person ordained to the ministry is now mainly legal.

From the fact that in mediaeval times learning was chiefly the province of the clergy, they were engaged in nearly all occupations requiring knowledge of writing combined with some education and hence the word "clerk" came to its present indefinite signification of a writer in the employment of some one else. Older and more specific use of the word is to be traced in *clerk of the market, clerk of the petty bag, clerk of the peace, town clerk,* etc.

CLERKE, AGNES MARY (1842–1907), English astronomer and scientific writer, was born on Feb. 10, 1842, and died in London on Jan. 20, 1907. Her chief works were *A Popular History of Astronomy during the 19th Century* (1885, 4th ed. 1902); *The System of the Stars* (1890, 2nd. ed. 1905); and *Problems in Astrophysics* (1903). In 1903 she was elected an honorary member of the Royal Astronomical Society.

CLERKENWELL (klar'kĕn-wĕl), a district on the north side of the City of London, England, within the metropolitan borough of Finsbury (*q.v.*). It is so called from one of several wells or springs in this district, near which miracle plays were performed by the parish clerks of London. This well existed until the middle of the 19th century. Here was situated a priory, founded in 1100, which grew to great wealth and fame as the principal institution in England of the Knights Hospitallers of the Order of St. John of Jerusalem. Its gateway (1504), in St. John's Square, survived the suppression of the monasteries, and was the scene of Dr. Johnson's work in connection with the *Gentleman's Magazine.* In modern times the gatehouse again became associated with the Order, and is the headquarters of the St. John's Ambulance Association. An early English crypt remains beneath the neighbouring parish church of St. John, where the notorious deception of the "Cock Lane Ghost," in which Johnson took great interest, was exposed. Adjoining the priory was St. Mary's Benedictine nunnery, St. James's church (1792) marking the site. In the 17th century Clerkenwell became a fashionable place of residence. It has small watch-making and jeweller's industries, which have been long established here.

CLERMONT, a town of northern France, in the department of Oise, on the right bank of the Brèche, 41 mi. N. of Paris on the Northern railway to Amiens. The town was probably founded during the time of the Norman invasions and was a military post during the middle ages. It was several times taken and retaken during the Hundred Years' War, and the Wars of Religion. Population (1936) 5,943. The hill on which the town is built is surmounted by a keep of the 14th century, a relic of the once-famous fortress. The church dates from the 14th to the 16th centuries. The *hôtel-de-ville,* built by King Charles IV., who was born at Clermont in 1298, is the oldest in the north of France. The Promenade du Châtellier occupies the site of the old ramparts.

Clermont was at one time the seat of a countship, the lords of which were already powerful in the 11th century. Raoul de Clermont, constable of France, died at Acre in 1191, leaving a daughter who brought Clermont to her husband, Louis, count of Blois and Chartres. Theobald, count of Blois and Clermont, died in 1218 without issue, and King Philip Augustus, having received the countship of Clermont from the collateral heirs of this lord, gave it to his son Philip Hurepel, whose daughter Jeanne, and his widow, Mahaut, countess of Dammartin, next held the countship. It was united by St. Louis to the crown, and afterwards given by him (1269) to his son Robert, from whom sprang the house of Bourbon. In 1524 the countship of Clermont was confiscated from the constable de Bourbon, and later (1540) given to the duke of Orléans, to Catherine de' Medici (1562), to Eric, duke of Brunswick (1569), from whom it passed to his brother-in-law Charles of Lorraine (1596), and finally to Henry II., prince of Condé (1611). In 1641 it was again confiscated from Louis de Bourbon, count of Soissons, then in 1696 sold to Louis Thomas Amadeus of Savoy, count of Soissons, in 1702 to Françoise de Brancas, princesse d'Harcourt, and in 1719 to Louis-Henry, prince of Condé. From a branch of the old lords of Clermont were descended the lords of Nesle and Chantilly.

CLERMONT-FERRAND, a city of central France, capital of the department of Puy-de-Dôme, 113 m. W. of Lyons, on the P.L.M. railway. Pop. (1906) 44,113; (1936) 95,237. Clermont-Ferrand is situated on high ground on the western border of the fertile plain of Limagne. On the north, west and south it is surrounded by hills, with a background of mountains amongst which the Puy-de-Dôme stands out prominently. A small river, the Tiretaine, borders the town on the north. Since 1731 it has been composed of the two towns of Clermont and Montferrand.

Gergovia was the native centre in Auvergne but the Roman settlement known as Augustonemetum on the site of Clermont became so important as to be called later "The city of the Arverni." The present name is derived from Clarus Mons originally applied only to the citadel, but used for the town as early as the 9th century. During the disintegration of the Roman empire Clermont suffered from capture and pillage. Its history during the middle ages chiefly records the struggles between its bishops and the counts of Auvergne, and between the citizens and their overlord the bishop. It was the seat of seven ecclesiastical councils, held in the years 535, 549, 587, 1095, 1110, 1124 and 1130. In the council of 1095 Pope Urban II. proclaimed the first crusade. It figured in the wars against the English in the 14th and 15th centuries and in the religious wars of the 16th century. *Les Grands Jours de Clermont* (1665) was associated with the trial and execution of a member of the nobility who had tyrannized the district. Before the Revolution the town possessed the abbey of Saint Allyre, founded, it is said, in the 3rd century by St. Austremonius (St. Stremoine), the apostle of Auvergne and first bishop of Clermont, and the abbey of St. André, where the counts of Clermont were buried. The cathedral, a Gothic edifice, was begun in the 13th century. The stained glass dates from the 13th century. The church of Notre-Dame-du-Port is a typical example of the Romanesque style of Auvergne, dating chiefly from the 11th and 12th centuries. The exterior of the apse with its four radiating chapels, and its black and white decoration is the most interesting part. Among the old houses one, dating from the 16th century, was the birthplace of Blaise Pascal. Montferrand has several interesting houses of the 15th and 16th centuries, and a church of the 13th, 14th and 15th centuries. Clermont has several fine squares like the one erected by Bishop Jacques d'Amboise in 1515.

Clermont-Ferrand is the seat of a bishopric and a prefecture; it has tribunals of first instance and of commerce, a board of trade-arbitrators, and a chamber of commerce. It is a university town and has an important library, as well as the *Musée Lecoq* (natural history and geology) and the *Musée d'Art et d'Archéologie.* The town manufactures semolina and other farinaceous foods, confectionery, preserved fruit and jams, chemicals and heavy rubber goods, especially motor tires. Clothing is also important. Clermont is the chief market for the grain and other agricultural produce of Auvergne and Velay. Its waters are in local repute. On the bank of the Tiretaine there is a remarkable calcareous spring, the fountain of St. Allyre. About 1½ miles to the west lies the famous spa of Royat.

CLERMONT-GANNEAU, CHARLES SIMON (1846–1923); French Orientalist, the son of a sculptor of some repute,

was born in Paris, Feb. 19, 1846, and died Feb. 15, 1923. He laid the foundation of his reputation by his discovery (in 1870) of the "stele" of Mesha (Moabite Stone), which bears the oldest Semitic inscription known. In 1874 he was employed by the British Government to take charge of an archaeological expedition to Palestine, and was subsequently entrusted by his own government with similar missions to Syria and the Red sea. After serving as vice-consul at Jaffa from 1880 to 1882, he returned to Paris as "secrétaire-interprète" for oriental languages, and in 1886 was appointed consul of the first class. He subsequently accepted the post of director of the École des Langues Orientales and professor at the Collège de France. In 1889 he was elected a member of the Académie des Inscriptions et Belles Lettres, of which he had been a correspondent since 1880. In 1896 he was promoted to be consul-general, and was minister plenipotentiary in 1906. He was the first in England to expose the famous forgeries of Hebrew texts offered to the British Museum by M. W. Shapira in 1883, and in 1903 he took a prominent part in the investigation of the so-called "tiara of Saïtapharnes." This tiara had been purchased by the Louvre for 400,000 francs, and exhibited as a genuine antique, but was agreed to be of modern manufacture.

His chief publications, besides a number of contributions to journals, are:—*Palestine inconnue* (1886), *Études d'archéologie orientale* (1880, etc.), *Les Fraudes archéologiques* (1885), *Recueil d'archéologie orientale* (1885–1924), *Album d'antiquités orientales* (1897, etc.).

CLERMONT-L'HÉRAULT, a town of southern France in the department of Hérault, 10 mi. S.S.E. of Lodève. Pop. (1936) 5,098. The town is built on a hill crowned by an ancient castle and skirted by the Rhonel, a tributary of the Lergue. The church dates from the 13th and 14th centuries. Its woollen industry dates from the latter half of the 17th century. Tanning and leather-dressing are also carried on, and there is trade in wine. Among the public institutions are a tribunal of commerce, a chamber of arts and manufactures and a board of trade-arbitration. The town was several times taken and retaken in the religious wars of the 16th century.

CLERMONT-TONNERRE, STANISLAS MARIE ADELAIDE, COMTE DE (1757–1792), French politician, was born at Pont-à-Mousson on Oct. 10, 1757. Sent to the states-general in 1789 by the noblesse of Paris, he joined the Third Estate, and was elected president of the Constituent Assembly on Aug. 17, 1789. On the rejection by the Assembly of the scheme elaborated by the first constitutional committee, he attached himself to the party of moderate royalists, known as *monarchiens,* led by P. V. Malouet. His speech in favour of reserving to the crown the right of absolute veto under the new constitution drew down upon him the wrath of the advanced politicians of the Palais Royal; but he continued to advocate a moderate liberal policy, especially in the matter of removing the political disabilities of Jews and Protestants and of extending the system of trial by jury. In Jan. 1790 he collaborated with Malouet in founding the Club des Impartiaux and the *Journal des Impartiaux,* the names of which were changed in November to the Société des Amis de la Constitution Monarchique and *Journal de la Société,* etc., in order to emphasize their opposition to the Jacobins (Société des Amis de la Constitution). This club was denounced by Barnave in the Assembly (Jan. 21, 1791), and on March 28 it was attacked by a mob, whereupon it was closed by order of the Assembly. Clermont-Tonnerre was murdered by the populace during the rising of Aug. 9–10, 1792.

See *Recueil des opinions de Stanislas de Clermont-Tonnerre* (1791), the text of his speeches as published by himself; A. Aulard, *Les Orateurs de la Constituante* (1905).

CLERUCHY, a kind of colony of Athenian citizens planted in a conquered country. The settlers retained their status as citizens of Athens, and their allotments were politically part of Attic soil. These settlements were of three kinds: (1) where the inhabitants were extirpated and the settlers occupied the whole territory; (2) where the settlers occupied allotments in the midst of a conquered people; and (3) where the inhabitants gave up portions of land to settlers in return for certain pecuniary concessions. The primary object was unquestionably military, and in the later days of the Delian League (*q.v.*) the system was a precaution against disaffection on the part of the allies.

A secondary object of the cleruchies was to provide a source of livelihood to the poorer Athenians. Plutarch suggests that Pericles by this means rid the city of mischievous loafers; but it would appear that the cleruchs were selected by lot, and a wise policy would not entrust important military duties to wastrels. In 50 years about 10,000 cleruchs went out, so that the reduction of the citizen population was considerable.

The cleruchs were liable to military service and to that taxation which fell upon Athenians at home. They were not liable for the tribute paid by members of the Delian League; this follows from their status as Athenian citizens. In internal government the cleruchs adopted the Boulē and Assembly system of Athens itself; so we read of Polemarchs, Archons *eponumoi, Agoranomoi, Strategoi,* in various places. With local self-government there was combined a certain central authority in jurisdiction; the more important cases, particularly those between a cleruch and a citizen at home, were tried before the Athenian dicasts.

BIBLIOGRAPHY.—*See* G. Gilbert, *Constitutional Antiquities of Athens and Sparta* (Eng. trans., 1895); A. H. J. Greenidge, *Handbook of Greek Constitutional Antiquities* (1896); L. Whibley, *Companion to Greek Studies* (1916); for the Periclean cleruchs, *see* PERICLES; DELIAN LEAGUE.

CLERVAUX (*clara vallis*), a town in the northern province of Oesling, grand-duchy of Luxembourg, on the Clerf, a tributary of the Sure. Pop. (1935) 1,671. The old castle of the Lannoy family still exists. In 1798 the people of Clervaux specially distinguished themselves against the French establishment of conscription.

The survivors of this Kloppel-krieg ("cudgel war") were shot, and a fine monument commemorates them.

CLETUS, or **ANENCLETUS,** the third pope, who occupied the papal chair *c.* 79–91. According to Epiphanius and Rufinus, he directed the Roman Church with Linus, successor to St. Peter, during Peter's lifetime.

CLEVE (Clèves), a town of Germany in the Prussian Rhine province, formerly the capital of the duchy of its own name, 46 m. N.W. of Düsseldorf, 12 mi. E. of Nijmwegen, on the main Cologne-Amsterdam railway. Population 20,296.

The town was the seat of the counts of Cleve as early as the 11th century, but it did not receive municipal rights until 1242. The duchy of Cleve, which lay on both banks of the Rhine passed in 1368 to the counts of La Marck and was made a duchy in 1417, being united with the neighbouring duchies of Jülich and Berg in 1521. By the treaty of Xanten in 1614, Cleve passed to the elector of Brandenburg, being afterwards incorporated with the electorate by the elector, Frederick William. The part of the duchy on the left bank of the Rhine was ceded to France in 1795; the remaining portion in 1805. In 1815 it was restored to Prussia, except some small portions which were given to the kingdom of Holland. The town is built in the Dutch style, lying on three small hills in a fertile district near the frontier of Holland, about 2 m. from the Rhine, with which it is connected by a canal (the Spoykanal). The old castle of Schwanenburg is associated with the legend of the "Knights of the Swan," immortalized in Wagner's *Lohengrin.* The building has been restored in modern times to serve as a court of justice and a prison. The collegiate church (Stiftskirche) dates from about 1340. The Annexkirche, formerly a convent of the Minorites, dates from the middle of the 15th century. The chief manufactures are boots and shoes, tobacco and machinery; there is also some trade in cattle and in wine. There are mineral wells. It is a favourite summer resort.

CLEVEDON, watering place and urban district, Somersetshire, England, on the Bristol Channel, 15½ mi. W.S.W. of Bristol on a branch of the G.W.R. Pop. (1938) 7,754. Area 5 sq.mi. The cruciform church of St. Andrew has Norman and later portions. Clevedon Court is a mansion dating from the 14th century, though much altered in the Elizabethan and other periods. The town's popularity is due mainly to the fine scenery.

CLEVELAND, BARBARA VILLIERS, DUCHESS OF (1641–1709), mistress of the English king, Charles II., was the daughter of William Villiers, 2nd Viscount Grandison (d. 1643) by

his wife Mary (d. 1684), daughter of Paul, 1st Viscount Bayning. In April 1659 Barbara married Roger Palmer, who was created earl of Castlemaine two years later, and soon after this marriage her intimacy with Charles II. began. The king was probably the father of her first child, Anne, born in Feb. 1661, although the paternity was also attributed to one of her earliest lovers, Philip Stanhope, 2nd earl of Chesterfield (1633–1713). Mistress Palmer was made a lady of the bedchamber to Catherine of Braganza. Her house became a rendezvous for the enemies of Clarendon, and according to Pepys she exhibited a wild paroxysm of delight when she heard of the minister's fall from power in 1667. Her influence, which had been gradually rising, became supreme at court in 1667 owing to the marriage of Frances Stuart (la belle Stuart) (1648–1702) with Charles Stuart, 3rd duke of Richmond (1640–72). Accordingly, Louis XIV., instructed his ambassador to pay special attention to Lady Castlemaine, who had become a Roman Catholic in 1663.

In Aug. 1670 she was created countess of Southampton and duchess of Cleveland, with remainder to her first and third sons, Charles and George Palmer, the king at this time not admitting the paternity of her second son Henry. About 1670 her influence over Charles began to decline. She consoled herself meanwhile with other lovers, among them John Churchill, afterwards duke of Marlborough and William Wycherley; by 1674 she had been entirely supplanted at court by Louise de Kérouaille, duchess of Portsmouth. The duchess of Cleveland then went to reside in Paris, where she formed an intrigue with the English ambassador, Ralph Montagu, afterwards duke of Montagu (d. 1709) who lost his position through some revelations which she made to the king. She returned to England just before Charles's death in 1685. In July 1705 her husband, the earl of Castlemaine, whom she had left in 1662, died; and in the same year the duchess was married to Robert (Beau) Feilding (d. 1712), a union which was declared void in 1707, as Feilding had a wife living. She died at Chiswick on Oct. 9, 1709.

Her eldest son, CHARLES FITZROY (1662–1730), was created in 1675 earl of Chichester and duke of Southampton, and became duke of Cleveland, and earl of Southampton on his mother's death. Her second son, Henry (1663–90), was created earl of Euston in 1672 and duke of Grafton in 1675; by his wife Isabella, daughter of Henry Bennet, earl of Arlington, he was the direct ancestor of the later dukes of Grafton; the most popular and the most able of the sons of Charles II., he met his death through a wound received at the storming of Cork. Her third son, George (1665–1716), was created duke of Northumberland in 1683 and died without issue. Her daughters were Anne (1661–1722), married in 1674 to Thomas Lennard, Lord Dacre (d. 1715), who was created earl of Sussex in 1684; Charlotte (1664–1718), married in 1677 to Edward Henry Lee, earl of Lichfield (d. 1716); and Barbara (1672–1737), the reputed daughter of John Churchill, who entered a nunnery in France, and became by James Douglas, afterwards 4th duke of Hamilton (1658–1712), the mother of an illegitimate son, Charles Hamilton (1691–1754).

See G. S. Steinman, *Memoir of Barbara duchess of Cleveland* (1871) and *Addenda* (1874).

CLEVELAND (or CLEIVELAND), JOHN (1613–58), English poet and satirist, was born at Loughborough, and educated at Hinckley school under the Puritan, Richard Vines. At the age of 14 he entered Christ's college, Cambridge, and in 1634 was elected to a fellowship at St. John's. He opposed the candidature of Oliver Cromwell as M.P. for Cambridge, and on the triumph of the Puritan party removed (1643) to Oxford. His gifts as a satirist were already known and he was warmly received by the King, whom he followed (1645) to Newark. In that year he was formally deprived of his Cambridge fellowship as a "malignant." He was judge-advocate in the garrison at Newark, and under the governor defended the town until in 1646 Charles I. ordered the surrender of the place to Leslie.

His indignation when the Scots surrendered the King to the Parliament is expressed in "The Rebel Scot." Cleveland wandered over the country depending on the alms of the Royalists for bread, and in 1655 spent three months in Norwich gaol. He was released early in 1656, and found his way eventually to Gray's Inn, where Aubrey says he and Samuel Butler had a "club" every night. There he died on April 29 1658.

Cleveland's poems were more highly esteemed than Milton's by his contemporaries, and his popularity is attested by the very numerous editions of his works. His poems are therefore of great value as an index to the taste of the 17th century. His verse is frequently obscure and full of the far-fetched conceits of the "metaphysical" poets; but the energy of his invective leaves no room for obscurity in such pieces as "Smectymnuus, or the Club Divines," "Rupertismus" and "The Rebel Scot." His poem "On the Memory of Mr. Edward King," is included in the collection of verse which contained Milton's "Lycidas."

For a bibliographical account of Cleveland's poems *see* J. M. Berdan, *The Poems of John Cleveland* (New York, 1903), in which there is a table of the contents of 23 editions, of which the chief are: *The Character of a London Diurnal, with Several Select Poems* (1647); *Poems. By John Cleavland. With additions, never before printed* (1659); *J. Cleaveland Revived . . .* (1659), in which the editor, E. Williamson, says he inserted poems by other authors, trusting to the critical faculty of the readers to distinguish Cleveland's work from the rest; *Clievelandi Vindiciae . . .* (1677), edited by two of Cleveland's former pupils, Bishop Lake and S. Drake, who profess to take out the spurious pieces; and a careless compilation, *The Works of John Cleveland . . .* (1687), containing poems taken from all these sources.

CLEVELAND, STEPHEN GROVER (1837–1908), President of the United States from 1885 to 1889, and again from 1893 to 1897, was born, the fifth in a family of nine children, in Caldwell, Essex county, N.J., on March 18, 1837. His father, Richard F. Cleveland, a Presbyterian clergyman, was a descendant of Moses Cleveland, who emigrated from England to Massachusetts in 1635. The family removed to Fayetteville, N.Y., and afterwards to Clinton, N.Y. It was intended that young Grover should be educated at Hamilton college, but this was prevented by his father's death in 1852. After working several years he set out for Cleveland, O., but stopped near Buffalo, N.Y., to work for his uncle. In 1855 he became a clerk in a Buffalo law office and in 1859 was admitted to the bar. When the Civil War began, the three Cleveland brothers drew lots to see which should remain at home to support their mother; the lot fell to Grover, and when he was drafted he hired a substitute.

In 1863 he was appointed assistant district attorney of Erie county, of which Buffalo is the chief city. This was his first public office, and it came to him, as, apparently, all later preferments, without any solicitation of his own. Two years later (1865) he was the Democratic candidate for district attorney, but was defeated. In 1869 Cleveland was nominated by the Democratic Party for the office of sheriff, and, despite the fact that Erie county was normally Republican, was elected. The years immediately succeeding his retirement from the office of sheriff in 1873 he devoted to the practice of law, coming to be recognized as one of the leaders of the western New York bar. In the autumn of 1881 he was nominated by the Democrats for mayor of Buffalo. The city government had been characterized by extravagance and maladministration, and a revolt of the independent voters at the polls overcame the usual Republican majority and Cleveland was elected. As mayor he attracted wide attention by his independence and businesslike methods, and under his direction the various departments of the city government were thoroughly reorganized. His ability received further recognition when in 1882 he was nominated, by the strategy of his campaign managers, as candidate for governor. The Republican Party in the State was at that time weakened by quarrels within its ranks, and this advantage was greatly increased by the Republicans' nomination for governor of Charles J. Folger (1818–84), then secretary of the Treasury, about whose nomination the cry of Federal interference was raised as a result of the methods employed in securing his nomination. All this, together with the popularity of Cleveland, brought about Cleveland's election by the unprecedented plurality of 192,854. As governor, Cleveland's course was marked by the stern qualities he had displayed in his other public positions. The demands of party leaders were made subordinate to public interest. He promoted the passage of a good civil service law. All bills passed by the

legislature were subjected to the governor's laborious scrutiny, and the veto power was used without fear or favour.

In 1884 the Democratic Party had been out of power in national affairs for 23 years. In this year, however, the generally disorganized state of the Republican Party, weakened by the defection of a large group of Independents, known as "Mugwumps," gave the Democrats an unusual opportunity. Upon a platform which called for radical reforms in the administrative departments, the civil service and the national finances, Cleveland was nominated for president, despite the opposition of the Tammany delegation. The nominee of the Republican Party, James G. Blaine (*q.v.*), of Maine, had received the nomination only after a contest in which violent personal animosities were aroused. The campaign that followed was one of the bitterest political contests in American history. Cleveland was accused of favouring the South because he had avoided war service and his private life was attacked; on the other side Blaine was associated with certain political scandals in Washington. The result was close, but Cleveland carried New York and was elected by an electoral majority of 219 to 182.

Cleveland's first term was uneventful, but was marked by firmness, justice and steady adherence on his part to the principles which he deemed salutary to the nation. He was especially concerned in promoting a non-partisan civil service. He stood firmly by the "Pendleton bill" (1883), designed to classify the subordinate places in the service, and to make entrance and promotion depend upon competitive examination of applicants. It applied only to clerkships, but the president was authorized to add others to the classified service from time to time. He added 11,757 during his first term.

President Cleveland made large use of the veto power upon bills passed by Congress, vetoing or "pocketing" during his first term 413 bills, more than two-thirds of which were private pension bills. The most important bill vetoed was the Dependent Pension bill, a measure opening the door, by the vagueness of its terms, to frauds upon the Treasury. Many of these bills were supported by Democrats, and Cleveland's opposition further alienated party leaders. In 1887 there was a large and growing surplus in the Treasury. About two-thirds of the public revenue was derived from duties on imports, in the adjustment of which the doctrine of protection to native industry had a large place. Cleveland attacked the system with great vigour in his annual message of 1887. He did not propose the adoption of free trade, but the Administration tariff measure, known as the Mills bill, passed the House, and although withdrawn owing to amendments in the Republican Senate, it alarmed and exasperated the protected classes, among whom were many Democrats.

In the following year (1888) the Democrats renominated Cleveland, and the Republicans nominated Benjamin Harrison, of Indiana. The campaign turned on the tariff issue, and Harrison was elected, receiving 233 electoral votes to 168 for Cleveland who, however, received a popular plurality of more than 100,000. Cleveland then resumed the practice of law in New York.

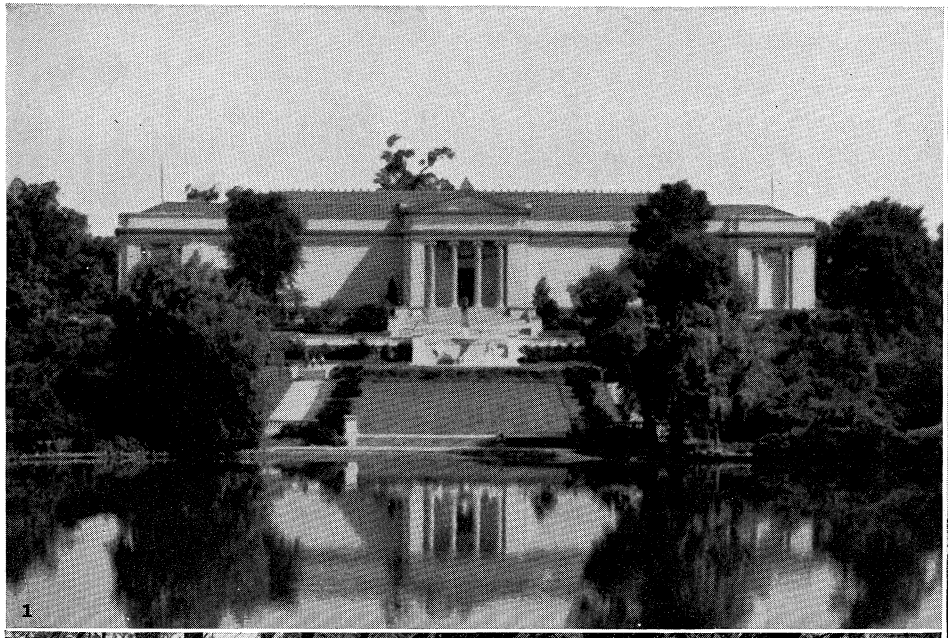
Congress had passed a law in 1878 requiring the Treasury department to purchase a certain amount of silver bullion each month and coin it into silver dollars to be full legal tender, and no date was fixed for this operation to cease, both parties being in favour of this policy. Cleveland had written a letter for publication before he became president, saying that a financial crisis of great severity must result if this coinage were continued and expressing the hope that Congress would speedily put an end to it. In 1890 Congress, controlled by the Republican Party, passed the McKinley bill, by which the revenues of the Government were reduced by more than $60,000,000 annually. At this same time expenditures were largely increased by liberal pension legislation, and the Government's purchase of silver bullion almost doubled by the provisions of the new Sherman Silver Purchase Act of 1890.

In 1892 Cleveland was nominated for president a third time in succession. President Harrison was nominated by the Republicans, who had lost strength due to the passage of the McKinley bill. Cleveland received 277 electoral votes and Harrison 145, and 22 were cast for James B. Weaver, of Iowa, the candidate of the "People's" party. Cleveland's second term embraced some notable events. The most important was the repeal of the silver legislation. Nearly $600,000,000 of "fiat money" had been thrust into the channels of commerce in addition to $346,000,000 of legal tender notes that had been issued during the Civil War. A reserve of $100,000,000 of gold had been accumulated for the protection of these notes. In April 1893 the reserve fell below this sum. President Cleveland called an extra session of Congress to repeal the silver law. The House promptly passed the repealing act. In the Senate there was a protracted struggle. The Democrats now had a majority of that body and they were more pro-silver than the Republicans. The president had undertaken to coerce his own party to do something against its will, and it was only by the aid of the Republican minority that the passage of the repealing bill was at last made possible (Oct. 30). The mischief, however, was not ended. The deficit in the Treasury made it inevitable that the gold reserve should be used to meet current expenses; holders of legal tender notes presented them for redemption; borrowing was resorted to by the Government; bonds were issued and sold to the amount of $162,000,000; the business world was in a state of constant agitation; commercial distress was widespread; wages were reduced in many employments, accompanied by labour troubles. The centre of disturbance was the Pullman strike at Chicago, whence the disorder extended to the Pacific coast, causing riot and bloodshed in many places. After waiting a reasonable time, as he conceived, for Gov. Altgeld of Illinois to act, Cleveland, on July 6, 1894, despite Gov. Altgeld's protest, directed the military forces of the United States to clear the way for trains carrying the mails. The rioters in and around Chicago were dispersed in a single day, and within a week the strike was broken.

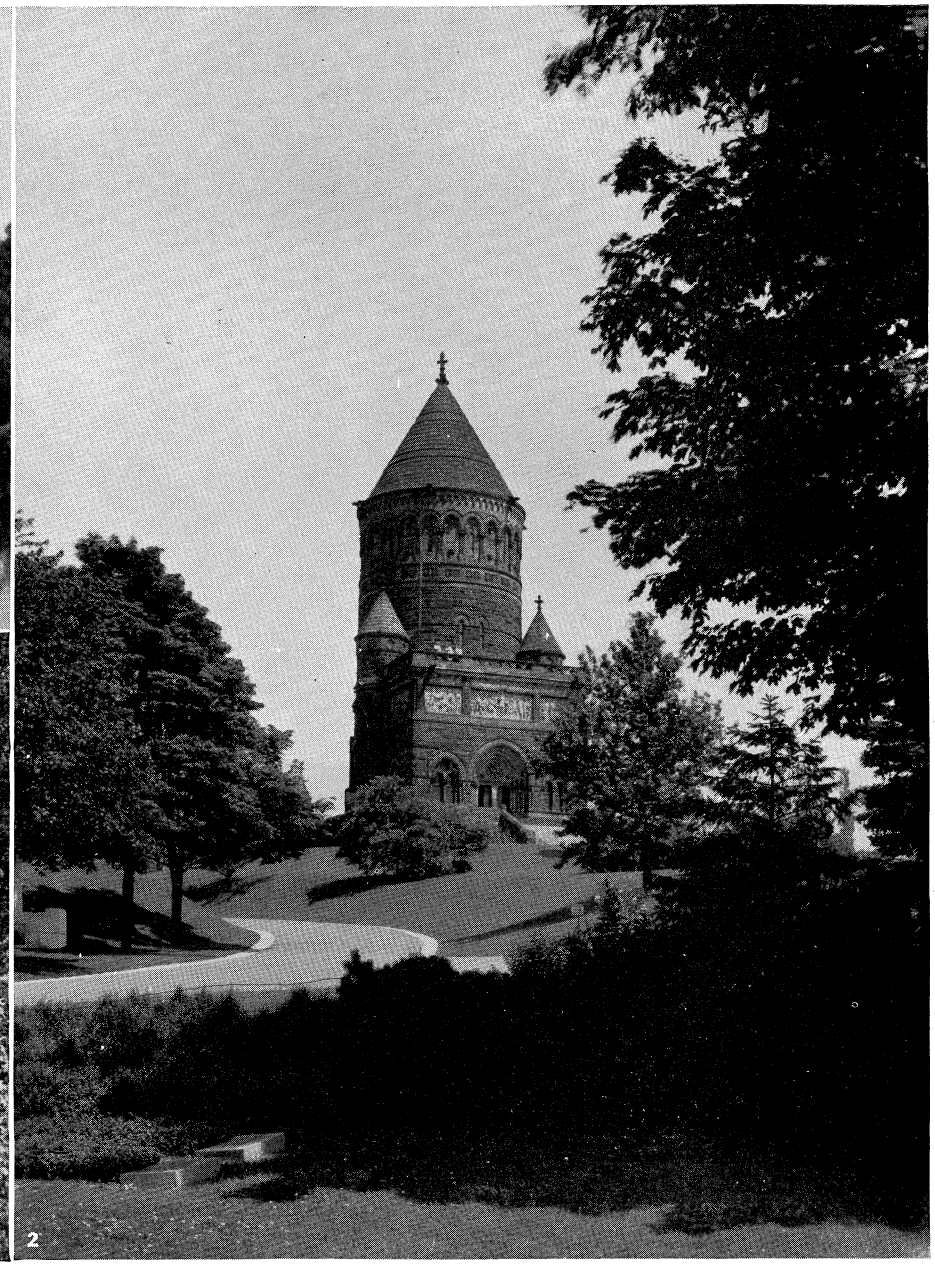
Another important event was the action of the Government regarding the question of arbitration between Great Britain and Venezuela (*q.v.*). On Dec. 17, 1895, President Cleveland sent to Congress a special message calling attention to Great Britain's action in regard to the disputed boundary line between British Guiana and Venezuela, and declaring the necessity of action by the United States to prevent an infringement of the Monroe Doctrine. Congress at once appropriated funds for an American commission to investigate the matter. The diplomatic situation became very acute for the moment. Negotiations with Great Britain ensued, and before the American commission finished its work Great Britain had agreed (Nov. 1896) to arbitrate on terms which safeguarded the national dignity on both sides.

Cleveland's independence and party difficulties were shown during his second term in his action in regard to the tariff legislation of his party in Congress. A tariff bill introduced in the House by William Lyne Wilson, of West Virginia, was so amended in the Senate through the instrumentality of Senator Arthur Pue Gorman and a coterie of anti-Administration Democratic senators that, although unwilling to veto it, the president signified his dissatisfaction with its too high rates by allowing it to become a law without his signature. He carried the fight with this group of senators to the Senate by letters in which he denounced their lack of support. Cleveland's second administration began by vigorous action in regard to Hawaii; he at once withdrew from the Senate the annexation treaty which President Harrison had negotiated, and started an attempt to restore the dethroned queen, Liliuokalani, but was not successful, owing to Hawaiian opposition.

During his second term Cleveland added no less than 44,004 places in the civil service to the classified list, bringing the whole number up to 86,932. Toward the end of this term the president became very much out of accord with his party on the free-silver question, in consequence of which the endorsement of the administration was withheld by the Democratic national convention at Chicago in 1896. In the ensuing campaign the president and his cabinet, with the exception of Hoke Smith (b. 1855), secretary of the interior, who resigned, gave their support to Palmer and Buckner, the national, or "Sound Money" Democratic nominees.







BY COURTESY OF (1, 2) THE CLEVELAND CHAMBER OF COMMERCE; PHOTOGRAPH, (3) EWING GALLOWAY

SCENES IN CLEVELAND

1. Cleveland Museum of Art. 2. Garfield Memorial, Lakeview cemetery. 3. Cherry blossoms in a city park



PHOTOGRAPH, AERIAL SURVEYS, INC.

CLEVELAND'S BUSINESS DISTRICT

Aeroplane view looking toward Lake Erie. with Terminal tower at extreme left

Cleveland's second term expired on March 4, 1897, and he then retired into private life, universally respected and constantly consulted, in the university town of Princeton, N.J., where he died on June 24, 1908. He was a trustee of Princeton university and Stafford Little lecturer on public affairs. Chosen in 1905 as a member of a committee of three to act as trustees of the majority of the stock of the Equitable Life Assurance company, he promoted the reorganization and the mutualization of that company, and acted as rebate referee for it and for the Mutual and New York Life insurance companies. He published *Presidential Problems* (1904), made up in part of lectures at Princeton university, and *Fishing and Hunting Sketches* (1906).

BIBLIOGRAPHY.—R. E. McElroy's authorized biography of Cleveland, *Grover Cleveland, the Man and the Statesman* (1923), is a comprehensive work. W. O. Stoddard's *Grover Cleveland* (1888; "Lives of the Presidents" series), and J. L. Whittle's *Grover Cleveland* (1896; "Public Men of Today" series), are judicious volumes; and "Campaign Biographies" (1884) were written by W. Dorsheimer, F. E. Goodrich, P. King and D. Welch; *Grover Cleveland, a Study in Political Courage* (1922) is interesting but perhaps too favourable, while the study of Cleveland by H. L. Stoddard in *As I Knew Them* (1927) takes a somewhat opposite viewpoint. A large amount of magazine literature has been devoted to President Cleveland's career. G. F. Parker had a series of articles in *The Saturday Evening Post* on Aug. 28, 1920, April 7, 1923, June 9, 1923, Nov. 10, 1923, March 29, 1924, under the titles "Grover Cleveland's Career in Buffalo," "Grover Cleveland's First Administration as President," "Grover Cleveland's Second Administration as President," "Grover Cleveland's Life in Princeton," and "Grover Cleveland's One Business Venture." *See* articles by Woodrow Wilson (*Atlantic Monthly*, vol. lxxix.: "Cleveland as President"); Carl Schurz (*McClure's Magazine*, vol. ix.: "Second Administration of Grover Cleveland"); William Allen White (*McClure's*, vol. xviii.; "Character Sketch of Cleveland"); Gamaliel Bradford (*Atlantic Monthly*, Nov. 1920: "Grover Cleveland"); Walter B. Stevens (*Missouri Historical Review*, Jan. 1927: "When Cleveland Came to St. Louis"); and Henry L. Nelson (*North American Review*, vol. clxxxviii.). Also Jesse L. Williams, *Mr. Cleveland: A Personal Impression* (1909); G. W. Parker, *Recollections of Grover Cleveland* (1909); C. H. Armitage, *Grover Cleveland as Buffalo Knew Him* (1927); G. C. Griffin, *Writings on American History* (1906–23).

CLEVELAND, a city and port of entry of the state of Ohio, U.S.A., and the county seat of Cuyahoga county, the sixth largest city in the United States. It is on Lake Erie, at the mouth of the Cuyahoga river about 260 mi. N.E. of Cincinnati, 357 mi. E. of Chicago and 623 mi. W. of New York. Pop. (1940) 878,336; (1930) 900,429, of whom 229,487 were foreign-born, 354,771 native-born but of foreign parentage (*i.e.*, having one or both parents foreign-born), and 71,899 Negroes. Of the 229,487 foreign-born, Czechs were predominant (34,695 or 15·1%), Poles (32,668 or 14·2%), Italians (23,524 or 10·3%), Germans (22,532 or 9·8%); Hungarians (19,073 or 8·3%); and Yugoslavs (18,326 or 7·9%).

The city commands pleasant views from its position on a plateau, which, at places on bluffs along the shore, has elevations of about 75 ft. above the lake level and rises gradually toward the southeast to 115 ft., and on the extreme east border to more than 200 ft. above the lake, or about 800 ft. above sea level; the surface has, however, been cut deeply by the Cuyahoga, which here pursues a meandering course through a valley about ½ mi. wide. The city's shoreline is 14.2 mi. long. The city has a land area of 73.1 sq.mi., much the greater part of which is east of the river. The streets are of unusual width (varying from 60 ft. to 132 ft.) and paved chiefly with asphalt and brick. For its many well shaded streets, Cleveland became known as the "Forest city." The municipality maintains an efficient forestry department. About ½ mi. from the lake and the same distance east of the river is the public square, or Monumental park in the business centre of the city. Thence the principal thoroughfares radiate. The river valley is spanned by several viaducts, of which the most noteworthy is the High Level bridge, with central span of 591 ft. in length and 96 ft. above water. The newer Main street bridge has a complete system of approaches. Lower Euclid avenue (the old country road to Euclid, O., and Erie, Pa.) is the centre of retail trade. This avenue, east of 12th street, was once bordered with handsome houses and spacious and beautifully ornamented grounds, and was famous as one of the finest residential streets in the country. Many houses remain, but the residential sections are elsewhere, in the suburban villages or cities of East Cleveland, Cleveland Heights, Shaker Heights and Lakewood. The building of the Union Terminal station has radically changed lower Superior avenue, once the retail commercial centre, for the south side from the public square westward has been vacated for buildings subsidiary to the railroad enterprises. In 1902 the city arranged for grouping its public buildings—in the so-called "Group plan." The courthouse and the city hall, separated by a park or mall, are on the edge of the plateau overlooking Lake Erie. The mall is 540 ft. wide and extends S. 1,500 ft. to the federal building and public library on Superior street. East on Sixth street, which leads to the city hall, are the board of education building and the public auditorium with 11,635 seats, housing also a Music hall and Little theatre. On the lower level near the lake is the stadium seating 78,189. The city has, besides, numerous fine office buildings, including that of the Society for Savings (an institution in which each depositor is virtually a stock-holder), the Williamson, the National City, the Guardian, the Union Trust, the Engineers Bank, the Federal Reserve Bank and Hanna buildings; the Union Terminal building, with its tower 720 ft. high, visible for many miles from the city; the Ohio Bell Telephone building, of the newer pyramidal type; the *Plain Dealer* newspaper building; the Cleveland Trust company's bank; the Museum of Art; Trinity cathedral (Episcopalian), the Church of the Covenant (Presbyterian), St. Agnes (Catholic), the Temple (Jewish), the Severance hall of the symphony orchestra, the Allen Memorial Medical library. In the public square is a soldiers' and sailors' monument consisting of a granite shaft rising from a memorial room to a height of 125 ft., and surmounted with a figure of Liberty; in the same park also, are a bronze statue of Moses Cleaveland, the founder of the city, and a bronze statue of Tom L. Johnson, a notable mayor. On a commanding site in Lake View cemetery is the Garfield memorial (finished in 1890) in the form of a tower (165 ft. high), designed by George Keller and built mostly of Ohio sandstone; in the base is a chapel containing a statue of Garfield, and several panels on which are portrayed various scenes in his life; his remains are in the crypt below the statue. A marble statue of Commodore Oliver H. Perry, erected in commemoration of his victory on Lake Erie in 1813, is in Gordon park. In Rockefeller park are twenty "cultural gardens" where are busts or statues of national heroes, including the Goethe-Schiller statue. On the University Circle is that (by Saint-Gaudens) of Marcus Alonzo Hanna (*q.v.*).

The 32 parks and parklands contain 2,129 ac., not including the airport of 942 ac. A chain of parks connected by driveways follows the picturesque valley of Doan brook, on the east border of the city. At the mouth of the brook, and on the lake front, is the beautiful Gordon park of 119 ac., formerly the private estate of William J. Gordon, but given by him to the city in 1893; from this extends up the Doan valley the large Rockefeller park, which was given to the city in 1896 by John D. Rockefeller and others, and which extends to and adjoins Wade park (86 ac., given by J. H. Wade) in which is the Museum of Art. Monumental park is divided into four sections (containing about 1 ac. each) by Superior avenue and Ontario street. There is also, under county authority, a system of metropolitan parks or "reservations," lying in river valleys on the borders of the county, in a half circle within a few miles of the city limits, and nearly touching Lake Erie on the east and west.

Education.—Cleveland has an excellent public-school system. A general state law, enacted in 1904, placed the management of school affairs in the hands of an elective council of seven members, five chosen at large and two by districts. This board has power to appoint a school director and a superintendent of instruction. The superintendent appoints the teachers, the director all other employees; appointments are subject to confirmation by the board, and all employees are subject to removal by the executive officials alone. The plan of education minimizes routine, replacing traditional programs by new curricula based upon a more scientific study of childhood and youth. Greater attention is also paid to the differing interests and capacities of groups of pupils. In 1940 there were 13 senior and 21 junior high-schools, and 110

schools for grades 1 to 6, in the city. The $15,663,784 spent was 13·7% of city expenses. Besides the public-school system there are many parochial schools; the university school, with an eight years' course; the Hathaway-Brown and the Laurel school for girls; the Western Reserve university, with its medical school (opened in 1843), the Franklin T. Backus Law school (1892), the dental department (1892), Adelbert college (until 1882 the Western Reserve college, founded in 1826 at Hudson, O.), Flora Stone Mather college (1888), Library school (1904), School of Pharmacy (incorporated in 1886, affiliated in 1908), the School of Applied Social Sciences (1916), the School of Nursing (1923), the Graduate school (reorganized in 1926); the Case School of Applied Science, founded in 1880 by Leonard Case (1820–80) and opened in 1881; Cleveland college, a downtown branch of the university, under a separate board of trustees, and affiliated also with the Case School of Applied Science; the Cleveland School of Art; John Carroll university, formerly St. Ignatius college (conducted by the Fathers of the Society of Jesus; incorporated 1890), which has an excellent meteorological observatory. In 1939–40 Western Reserve university had 744 instructors and 11,700 students, including extension courses and the summer session (830 in Adelbert college; 629 in Mather college; 425 in nursing; 91 in pharmacy; 265 in medical, 182 in law, 165 in dental and 97 in library school); and the Case School of Applied Science 104 instructors and 1,612 students. Educational work is carried on by the Museum of Art, through classes, lectures and special exhibitions and by the Museum of Natural History opened in 1922. The musical development of the city has been stimulated by the creation of a symphony orchestra and the organization of a school of music. The public library contained 2,112,129 volumes in 1940, the Western Reserve university libraries, 510,000, including the affiliated Case library (separately endowed, formerly a subscription library) and the Mather college library. The Cleveland Medical library contained 65,000, the library of the Western Reserve Historical society over 250,000 and the Cleveland Law library, in the courthouse, 75,000 volumes.

The city has a highly developed system of charitable and corrective institutions. A farm of approximately 2,000 ac., the Cleveland Farm Colony, 11 mi. from the city, takes the place of workhouses, and has many cottages in which live those of the city's poor who were formerly classed as paupers and were sent to poorhouses, and who now apply their labour to the farm and are relieved from the stigma that generally attaches to inmates of poorhouses. On the "farm" the city maintains an "infirmary village," a tuberculosis sanatorium, a detention hospital, a convalescent hospital and houses of correction. On a farm 22 mi. from the city is the boys' home (maintained in connection with the juvenile court) for "incorrigible" boys. The "cottage" plan has been adopted; each cottage is presided over by a man and wife whom the boys call father and mother. At an equal distance from the city but farther west is a girls' home, similarly administered. Besides the city hospital there are the Northern Ohio (for the insane, founded in 1855), Lakeside, St. Alexis, the Charity (the last managed by sisters of charity), Mount Sinai, St. Luke's, St. John's, Lutheran, Huron road and Maternity hospitals, and the Babies dispensary and hospital. A medical centre was begun through the grouping of the new buildings of the School of Medicine, built at a cost of $2,500,000, the Maternity hospital and Babies dispensary and hospital. To these there has been added the Lakeside hospital (removed from its downtown site), and its subsidiary buildings, for which a fund of over $8,000,000 was raised in 1927. A pathological institute has also been added, its cost borne by the general education board. The Goodrich House (1897), the Hiram House and Alta House are among the best equipped and most efficient social settlements in the country. Cleveland has also its orphan asylums, homes for the aged, homes for incurables and day nurseries, besides a home for sailors, homes for young working women and retreats for unfortunate girls. The many charitable organizations, Protestant and Catholic, are united in a Welfare Federation. There is also a Federation of Jewish Charities. Their support comes from endowment funds and from the community fund, created in 1919. The money for this fund is collected in annual "drives," the proceeds of which averaged each year for the first nine years $4,250,000. The principal newspapers of the city are the *Plain Dealer* (1841, independent), which in 1917 acquired the *Leader* (1847, Republican); the *Press* (1878, independent); and the *News* (1889, Republican). Bohemian, Hungarian and German dailies are published.

Municipal Enterprise.—Municipal ownership was a prominent issue in Cleveland during the mayoralty of Tom Loftin Johnson (1854–1911), a street railway owner, iron manufacturer, an ardent single-taxer, who was elected in 1901, and re-elected in 1903, 1905 and 1907. In transportation Johnson adopted the principle of service at cost, with the slogan "three-cent fare." The separate railways, with franchises expiring at different dates, had been consolidated into the Cleveland Electric Street railway corporation. As it was overcapitalized ($23,000,000), its managers considered the Johnson schemes visionary. His method of compulsion (the city not being empowered to own and operate street railways) was through the council's right to grant or refuse franchises, or by organizing rival companies, which should lease their lines to a municipal traction company acting on behalf of the public. The war began by the organization of the Forest City Railway company in Nov. 1906. By 1908 the railway corporation was forced to lease its property to the municipal holding company. But Johnson's power began to wane and in 1909 he was defeated for re-election. The railway system was put in the hands of receivers. The receivership was administered under Federal Judge Robert W. Tayler, and the result in 1910 was a franchise for 25 years to the (renamed) Cleveland Railway company, embodying the "Tayler" plan, which also called for service at cost and a fare of three cents. With rising costs, especially after the outbreak of the war of 1914–18, the fare had to be raised, partly because holders of the stock (radically deflated) were entitled to 6% dividends. With the depression which began in 1929, difficulties multiplied. In 1935 the franchise was not renewed, but the company had a right to a 15-year period of liquidation. Dividends ceased. Municipal ownership became (1941) the aim of the city administration. The municipality owns the waterworks, a small electric-light plant, the garbage plant and bath houses. The city water is pumped to reservoirs from two intakes situated a distance of 4½ mi. from the shore. The system has a delivery capacity of 315,000,000 gal. daily. The department served (1937) about 1,350,000 consumers through 2,713 mi. of main covering an area of 380 square miles. Two filtration plants have a capacity of 300,000,000 gal. which will be expanded to 500,000,000 by new construction. The municipal electric-lighting plant does not seriously compete with the private lighting company. The municipal garbage plant reduces 400 tons daily, while a new $12,000,000 sewage treatment plant treats 80,000,000 gal. daily.

Commerce.—To meet the demands of the rapidly increasing commerce the harbour has been steadily improved. In 1908 it consisted of two distinct parts, the outer harbour being the work of the federal government, and the inner harbour being under the control of the city. The outer harbour was formed by two breakwaters enclosing an area of 5 mi. long and 1,600 to 2,400 ft. wide; the main entrance, 700 ft. wide, lying opposite the mouth of the Cuyahoga river; the depth of the harbour ranges from 21 to 25 feet. The inner harbour comprises the Cuyahoga, the old river bed and connecting slips. The channel at the mouth of the river (325 ft. wide) is lined on the west side by a concrete jetty 1,440 ft. long, and on the east side by commercial docks, 1,602 ft. long. The river and the old river bed furnish about 13 mi. of safe dock frontage, the channel having been dredged for 6 mi. to a depth of 21 feet. This work is being extended by federal money.

Cleveland's rapid growth, both as a commercial and as a manufacturing city, is due largely to its situation between the iron regions of Lake Superior and the coal and oil regions of Pennsylvania and Ohio. Cleveland is a great railway centre and is one of the most important ports on the Great Lakes. The city is served by the New York Central, the New York, Chicago and St. Louis, the Pennsylvania, the Erie, the Baltimore and Ohio, and the Wheeling and Lake Erie railways and by steamboats to the principal ports on the Great Lakes. Cleveland is the largest ore mar-

ket in the world, and its huge ore docks are among its most interesting features; the annual receipts and shipments of coal and iron ore are enormous. It also handles large quantities of lumber and grain. The most important manufactures are iron and steel, automobile parts, electrical apparatus and supplies, machine tools, telescopes, sewing machines, printing presses, agricultural implements and various other commodities made wholly or chiefly from iron and steel. The value of automobile parts produced in 1937 was $84,132,915. More steel wire, wire nails, and bolts and nuts are made there than in any other city in the world (the total value for pig iron and steel, as classified by the census, was in 1937 $194,005,886; and the value of machinery and miscellaneous metal products in the same year was $106,540,088). The value of machine tools, in which Cleveland ranks second in the world, was $29,041,114.

The city of Cleveland makes much clothing (1937, $44,219,518), and is the site of one of the largest refineries of the Standard Oil group.

The output of Cleveland slaughtering and meat-packing houses in 1937 was valued at $35,016,060. The total value of factory products in that year was $996,935,327.

Government.—Since Cleveland became a city in 1836 it has undergone several important changes in government. The charter of that year placed the balance of power in a council composed of three members chosen from each ward and as many aldermen as there were wards, elected on a general ticket. From 1852 to 1891 the city was governed under general laws of the state which entrusted the more important powers to several administrative boards. Then, from 1891 to 1903, by what was practically a new charter, that which is known as the federal plan of government was tried; this centred power in the mayor by making him almost the only elective officer, by giving to him the appointment of his cabinet of directors—one for the head of each of the six municipal departments—and to each director the appointment of his subordinates. The federal plan was abandoned in 1903, a new municipal code coming into effect, which was in operation until 1909, when the Paine law established a board of control, under a government resembling the old federal plan. In accordance with the authority conferred by the home rule amendment of the state constitution, a charter, submitted by a special commission, was accepted by the citizens on July 1, 1913. This reduced the number of elected officers to the mayor and 25 councillors. By an amended charter, which took effect on Jan. 1, 1924, a manager system was introduced. This system was itself repealed in Nov. 1931 despite the advice of civic organizations. Under the amendment, a mayor and 33 councillors, one from each of the city's wards, are elected every odd year. The entire governmental set-up was re-organized at the same time with the establishment of three administrative departments—law, finance and utilities—and several special commissions, with the mayor the dominant figure. The city has profited greatly from the interest in municipal problems which has been shown by organizations of leading citizens. Especially has this been manifested by the Cleveland Chamber of Commerce and the Citizens' League, an organization of influential professional and business men, which, by issuing bulletins concerning candidates at the primaries and at election time, has done much for the betterment of local politics. The Cleveland Chamber of Commerce, an organization of over 1,600 business leaders, is a power for good in the city; besides its constant and aggressive work in promoting the commercial interests of the city, it was largely influential in the federal reform of the consular service; it studied the question of overcrowded tenements and secured the passage of a new tenement law with important sanitary provisions and fixed minimum air space; it urges and promotes home gardening, public baths, playgrounds, lunchrooms, etc., for employees in factories; and it was largely instrumental in devising and carrying out the so-called "Group plan" which created the lake-front area.

History.—A trading post was established at the mouth of the Cuyahoga river as early as 1786, but the place was not permanently settled until 1796, when it was laid out as a town by Moses Cleaveland (1754–1806), who was then acting as the agent of the Connecticut Land company, which in the year before had purchased from the state of Connecticut a large portion of the Western Reserve. In 1800 the entire Western Reserve was erected into the county of Trumbull and a township government was given to Cleveland; ten years later Cleveland was made the seat of government of the new county of Cuyahoga, and in 1814 it was incorporated as a village. Cleveland's growth was, however, very slow until the opening of the Ohio canal as far as Akron, in 1827; about the same time the improvement of the harbour was begun, and by 1832 the canal was opened to the Ohio river. Cleveland was thus connected with the interior of the state, for whose mineral and agricultural products it became the lake outlet. The discovery of iron ore in the Lake Superior region made Cleveland the natural meeting point of the iron ore and the coal from the Ohio, Pennsylvania and West Virginia mines; and the city's great commercial importance dates from this time. The building of railways during the decade 1850–60 increased this importance, and the city grew with great rapidity. The growth during the Civil War was partly due to the rapid development of the manufacturing interests of the city, which supplied large quantities of iron products and clothing to the federal government. The population of 1,076 in 1830 increased to 6,071 in 1840, 17,034 in 1850, 43,417 in 1860, 92,829 in 1870, and to 160,146 in 1880. Until 1853 the city was confined to the east side of the river, but in that year Ohio City, which was founded in 1807, later incorporated as the village of Brooklyn, and in 1836 chartered as a city (under the name Ohio City), was annexed. Other annexations followed: East Cleveland (a district east of the present 55th street, and not the suburban city of that name) in 1872, Newburg in 1873, West Cleveland and Brooklyn in 1893, Glenville and South Brooklyn in 1905, Collinwood in 1910 and West Park in 1923.

The most notable later events not mentioned elsewhere were the centennial celebration of 1896, the establishment of a successful community fund, the holding of the Socialist, Republican and Union national conventions in the summer of 1936, and the successful Great Lakes Exposition of 1936 and 1937.

BIBLIOGRAPHY.—*Annuals* of the Cleveland Chamber of Commerce (1865–); C. Whittlesey, *The Early History of Cleveland* (1867); J. H. Kennedy, *A History of the City of Cleveland* (1896); C. A. Urann, *Centennial History of Cleveland* (1896); C. E. Bolton, *A Few Civic Problems of Greater Cleveland* (1897); C. F. Thwing, "Cleveland, the Pleasant City," in Powell's *Historic Towns of the Western States* (1901); Charles Snavely, *A History of the City Government of Cleveland* (1902); C. C. Williamson, *The Finances of Cleveland* (1907); S. P. Orth, *A History of Cleveland* (1910); *City Record*, official publication of the City of Cleveland (1914–); E. M. Avery, *A History of Cleveland and its Environs*, vol. i. (1918); C. E. Kennedy, *Fifty Years of Cleveland* (1925). (H. E. B.)

CLEVELAND, a city of southern Tennessee, U.S.A., 29 mi. E.N.E. of Chattanooga, on federal highway 11 and the Southern railway; the county seat of Bradley county. The population in 1920 was 6,522; in 1930 it was 9,136; and in 1940 it was 11,351 by the federal census. There are manganese mines near by, and the city has over 30 factories, employing 3,000 persons and producing goods valued at $9,000,000 annually. During the Civil War Grant and Sherman for a time had headquarters here, in houses that are still standing. The battle of Ft. Hill was fought on the site of what is now Ft. Hill cemetery. Cleveland was settled about 1832 and was incorporated as a city in 1837. It was named after Col. Benjamin Cleveland, a commander at the battle of King's Mountain.

CLEVELAND HEIGHTS, a city of Cuyahoga county, Ohio, U.S.A., adjoining Cleveland on the east. It is a residential suburb, with a population of 2,955 in 1910, 50,945 in 1930 and in 1940, 54,992 by the federal census. It has a commission-manager form of government.

The village was incorporated in 1903 and in 1922 it became a city.

CLEVER, an adjective implying dexterous activity of mind or body, and ability to meet emergencies with readiness and adroitness. The etymology and the early history of the word are obscure. Some derive it, in the sense of "quick to seize," from M.E. *cliver* or *clivre*, a claw. This original sense probably survives in the frequent use of the word for nimble, dexterous, quick and skilful in the use of the hands, and so it is often applied to a

horse, "clever at his fences." The word has also been connected with O.E. *gléaw,* wise, which became in M.E. *gleu,* and is cognate with Scottish *gleg,* quick of eye.

CLEYNAERTS (CLENARDUS or CLÉNARD), **NICOLAS** (1495–1542), Belgian grammarian and traveller, was born at Diest, Brabant, on Dec. 5, 1495. Educated at the University of Louvain, he became a professor of Latin, which he taught by a conversational method. His *Institutiones in linguam graecam* (1530), and *Meditationes graecanicae* (1531) passed through a number of editions, and had many commentators. He maintained that the learner should not be puzzled by elaborate rules until he has obtained a working acquaintance with the language. In pursuit of a scheme for proselytism among the Arabs he travelled in 1532 to Spain, and tried in vain to gain access to the Arabic mss. in the possession of the Inquisition. Finally, in 1540, he set out for Africa to seek information for himself. He reached Fez, then a flourishing seat of Arab learning, but after 15 months of privation and suffering was obliged to return to Granada, and died in the autumn of 1542. He was buried in the Alhambra palace.

See his Latin letters to his friends in Belgium, *Nicolai Clenardi, Peregrinationum ac de rebus machometicis epistolae elegantissimae* (Louvain, 1550), and a more complete edition, *Nic. Clenardi Epistolarum libri duo* (Antwerp, 1561); also Victor Chauvin and Alphonse Roersch, "Étude sur la vie et les travaux de Nicolas Clénard" in *Mémoires couronnés* (vol. lx., 1900–01) of the Royal Academy of Belgium, which contains an extensive bibliography.

CLICHÉ. In the process of stereotype printing a matrix or mould is made in papier-mâché from the set type, and a solid casting is produced from this mould, which thus bears a surface of letters cast in relief, from which the actual prints are taken. The papier-mâché mould is called a cliché.

This term, representing as it does a mould for mechanical reproduction, has passed into use as an effective name for any hackneyed term or phrase. The cliché is the vice of the writer who trades in second-hand thought and expression; for him the sea becomes "the rolling wave," fire "the devouring element," and the sun "the orb of day."

CLICHTOVE, JOSSE VAN (d. 1543), Belgian theologian, educated at Louvain and Paris, became librarian of the Sorbonne. In 1519 he was elected bishop of Tournai, and in 1521 was translated to the see of Chartres. He is known as an antagonist of Luther. When Cardinal Duprat convened his Synod of Paris in 1528 to discuss the new religion, Clichtove was charged to collect and summarize the objections to the Lutheran doctrine. This he did in his *Compendium veritatum . . . contra erroneas Lutheranorum assertiones* (Paris, 1529). He died at Chartres on Sept. 22, 1543.

CLICHY, a manufacturing suburb of Paris. Pop. (1936) 56,475. It was, under the name of *Clippiacum,* a residence of the Merovingian kings. The church dates from the 17th century. The industries include the manufacture of starch, rubber, oil and grease, glass, chemicals and soap.

CLICKS, peculiar sounds of unknown origin, found in many languages. The German term *Schnalze* and the Afrikaans *klukken* are both attempts to give a descriptive name, but the English word *Click* is as onomatopoeic as any. The outstanding examples of click-speech are the Hottentot languages (Nama, !kora, Griqua, etc.) with four or five different clicks and those of the Bushmen of South Africa (!kung, kham, !ai, etc.), with as many as nine different clicks. From contiguity with the Hottentots and Bushmen several Bantu stocks have acquired clicks, which are alien to Bantu speech-systems. Such stocks are the Zulus and Kaffirs while the Damaras, (originally Bantu), have dropped their language entirely and speak only Hottentot. In the interior, Afrikaans (Cape Dutch), has even acquired clicks.

It seems fairly well established now, that clicks are by no means confined to these South African tongues. There are cases of their presence in the Melanesian languages of the Eastern Pacific, the Q of Codrington and Paterson representing a click-sound. Clicks never appear very far north of the equator and a definite "click-zone" can be found girdling the earth with, and south of, the equator. A recent study of the Quichua language of the Incas of Peru shows the existence of click-sounds, later rubbed down to simple gutturals, in the ancient tongue. The Aztec or Nahuatl tongue also had clicks and in the surviving Aztec spoken by Mexicans in the hills of the interior, the *tl,* final and initial, sounds exactly like a Hottentot dental click.

In the Nama speech (Standard Hottentot), there are four clicks, represented thus:

	Tindall	German system	International Phonetic Association
Dental . .	c	/	ǀ
Cerebral . .	q	!	ǃ
Palatal . .	v	≠	ǂ
Lateral . .	x	//	ǁ

In the Bushman languages (so far as classified, 16 in number) other clicks exist having such signs as:

Guttural ʃ Semi-labial ◻ Labial ʘ

The sounds must be heard; no description can do more than convey a general idea of their nature. The dental click, for example, is pronounced by pressing the flattened tip of the tongue against the front teeth at the gums and quickly withdrawing it. Early attempts to define and describe these sounds will be found in the works mentioned below.

See H. Tindall, *A Grammar of the Namaqua-Hottentot Language* (Cape Town, n.d.); J. L. Döhne, *Zulu-Kafir Dictionary* (Cape Town, 1857); Meinhof, *Lehrbuch der Namasprache* (1909); Leonhard, *Aus Namaland und Kalahari* (1905); N. Whymant, *The Zone of Clicks* (Tokyo, 1923). *See* also BUSHMAN LANGUAGES AND HOTTENTOTS.

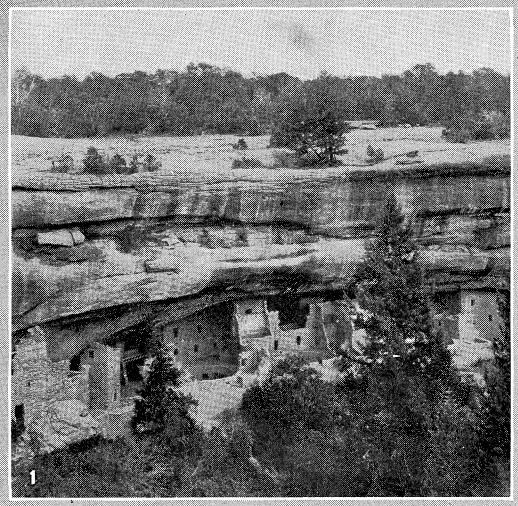
(A. N. J. W.)

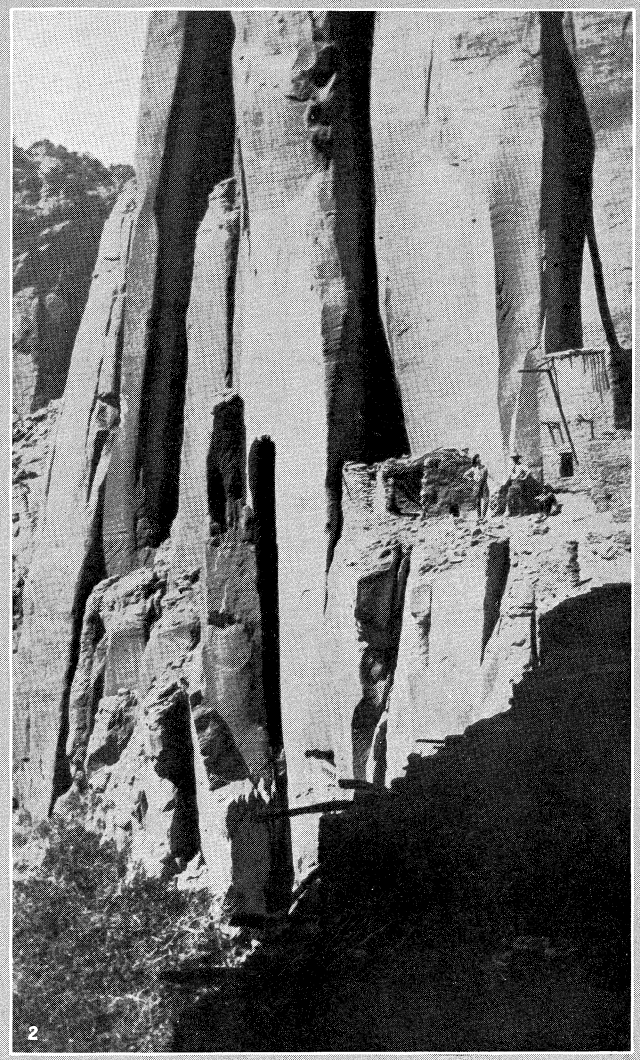
CLIFF-DWELLERS. Once believed to be a mysterious vanished race, the inhabitants of the cliff-dwellings in the south-western United States are now recognized as but Pueblo Indians of the prehistoric period characterized by black-on-white pottery; who, when under hostile pressure, lodged their homes and granaries on ledges under overhanging cliffs, where such were available; in other cases excavated horizontally into bluff faces, or built on steep-walled mesas. Their skeletal remains, artifacts, and masonry are identical with those of the same period found in ruins in canyon bottoms and valleys. The romantically inaccessible situation of the cliff ruins, however, is impressive. Among the best known are Cliff Palace and Spruce Tree House in Mesa Verde National Park, Colorado, and a series in Canyon de Chelly, Arizona.

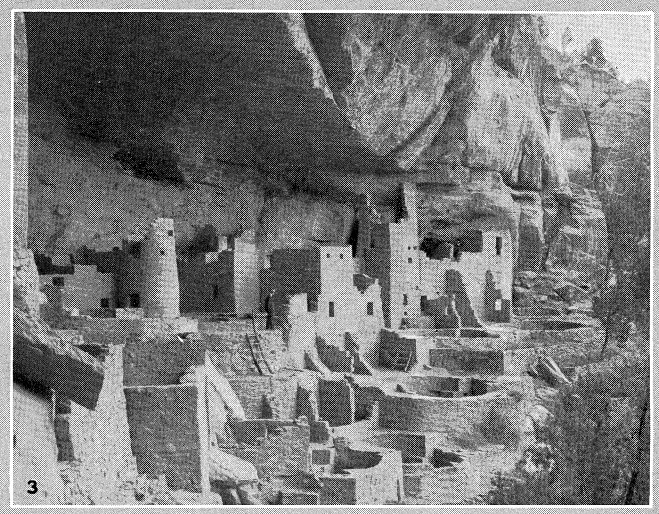
See Nordenskiöld, *Cliff Dwellings of the Mesa Verde* (1893).

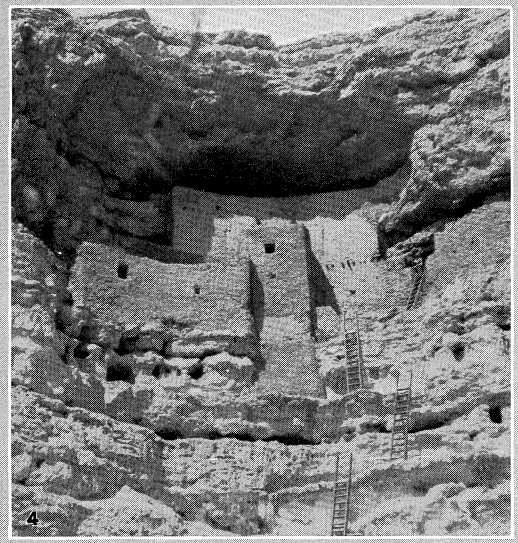
CLIFF-DWELLINGS, the general archaeological term for the habitations of certain primitive peoples, formed by utilizing natural recesses or shallow caverns in the faces of cliffs, sometimes with more or less modification to adapt them to the requirements of the buildings. They are to be distinguished from cave-dwellings, which, not necessarily high in cliff walls, usually were or are occupied in their natural state; and from rock-shelters, used for temporary shelter, for storage, as lookouts, and sometimes for sacrificial deposits and for burial of the dead. Dry caves have been used as habitations in all parts of the world, some of those in France and Spain dating from the earliest periods of human history. Caves are still inhabited in Tunis and in Central Africa, and as winter habitations by the Tarahumare and other Piman tribes of northern Mexico, who have modified the natural recesses by the addition of masonry windbreaks, storage-bins, etc. A class of cave-dwellers known as Basket-makers, of a culture older than that of the cliff-dwellers, lived in Utah, Colorado, Arizona and New Mexico; and another culture, known as Bluff-dwellers, occupied caves in the Ozark mountains of western Missouri-Arkansas. Other caves, such as Mammoth and Salts caves in Kentucky and Lovelock cave in Nevada, have yielded important artifacts of their primitive occupants.

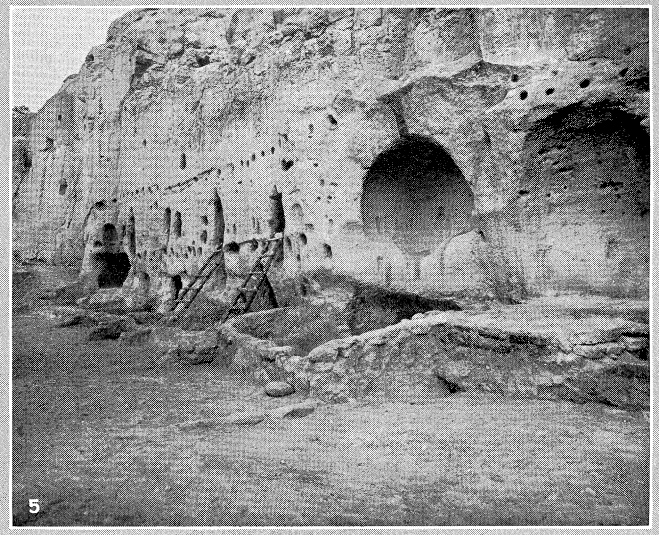
Eskimo of King island in Bering strait, Alaska, as late at least as 1881, occupied winter houses made by excavating the loose granite rocks to form niches in a steep slope and by walling up the front and sides with stones placed over a driftwood framework, access being had by a long covered passage leading to an











BY COURTESY OF (1) THE DENVER AND RIO GRANDE WESTERN RAILROAD COMPANY, (2) CHARLES L. BERNHEIMER, (3) THE UNION PACIFIC RAILROAD SYSTEM, (4) THE ATCHISON, TOPEKA AND SANTA FE RAILWAY, (5) THE MUSEUM OF NEW MEXICO, SANTA FE

CLIFF-DWELLINGS OF THE SOUTH-WESTERN UNITED STATES

1. Spruce Tree House, Mesa Verde National park, south-western Colorado, one of the largest Mesa Verde structures (216 feet long and 89 feet wide, containing 114 rooms and 8 kivas or assembly rooms). It is three storeys high in its loftiest part, and its chambers are round, rectangular or triangular to adapt themselves to the limited ground space which the dwelling occupies
2. The westerly edge of the Betátakin ruins, in the Navaho National Monument, in Arizona. These ancient stone houses are built more than a hundred feet above the canyon floor. Cliff-dwellings of this type extend over a wide area from southern Colorado as far south as the central part of Mexico
3. Cliff Palace, Mesa Verde National park. Among the Mesa Verde ruins have been found pottery remains; yucca sandals; woven cotton cloth; indications of reservoirs for irrigating; stone and bone implements; graves containing flexed skeletons; mummies; evidences of turkey domestication; and other mementos of the lives of the cliff-dwellers
4. Montezuma Castle, in Arizona. This cliff-dwelling, although distant from Mesa Verde, is similar to it, even in small details of construction
5. Cavate lodges of Puye, New Mexico, a type of cliff-dwelling consisting of communicating rooms excavated in the soft volcanic tuff of the cliffside, with terraced, flat-roofed houses built in front. These occur also along the Rio Verde in Arizona

opening in the floor. Ancient cliff-dwellings are found in the States of Chihuahua and Jalisco, Mexico, and especially in Colorado, Utah, Arizona and New Mexico, those in the Mesa Verde National park in southwestern Colorado being noted for the excellence of their architecture. It was once believed that the cliff-dwellers of southwestern United States were of a pre-Indian pygmy race, but archaeological study has shown the structures and the objects found in them to be unquestionably of Pueblo origin, contemporaneous with numerous mesa-top and valley ruins, the selection of their sites, made accessible only by hand-and-toe holes pecked in the cliff, having been due to hostile pressure. In the Mesa Verde canyons the largest and most noted cliff-dwellings are: Cliff Palace, consisting of about 150 secular rooms and 23 kivas or ceremonial chambers, together with various square and circular towers, all built in a very compact group and following the curving face of the recess for about 300 feet. Spruce-tree house, 216 ft. long and 89 ft. wide (114 rooms and 8 kivas), was three storeys high in its loftiest part; its chambers were built round, rectangular, or triangular according to the exigencies of the limited ground space. Balcony house (25 rooms) is named from a wide shelf extending along the front of two of the houses and is built on the projecting floorbeams. There are many other similar dwellings in the Mesa Verde canyons, some of which have been excavated; and on the summit of the mesa are massive related pueblo-like structures, used perhaps chiefly for ceremonial purposes, as well as many pit-houses. Other important cliff-dwellings of Arizona are Casa Blanca in Canyon de Chelly, Montezuma castle on Beaver creek of Verde river, and various examples (*e.g.*, Betátakin, Kitsil), in the Navaho National monument. Cliff-dwellings of this class extend from southern Colorado to central Mexico. Another type, known as cavate lodges, consists of groups of a few communicating rooms excavated in the friable volcano tuff of the cliffs, in front of which terraced houses of masonry with flat roofs were built. This class is common to the Puye and Rito de los Frijoles areas in northern New Mexico, and occurs also on the Rio Verde in Arizona.

See H. C. Mercer, *Hill Caves of Yucatan* (Philadelphia, 1896); Alice C. Cook, "Aborigines of the Canary Islands," *Amer. Anthropologist* (vol. II., no. 2, 1900); E. W. Nelson, "Eskimo about Bering Strait," *18th Rep.* Bur. Amer. Ethnology (pt. 1, 1899); A. F. Bandelier, *Archaeological Inst. Amer. Papers,* Amer. ser., pts. iii., iv. (Cambridge, 1890–92); W. H. Holmes, *Rep. U.S. Geol. Surv. of the Territories for 1876* (1879); W. H. Jackson, *ibid. 1874* (1876); E. A. Mearns, *Popular Sci. Mo.,* vol. 37 (1890); C. Mindeleff, in 13th and 16th *Rep. Bur. Amer. Ethnology* (1896–1897); F. H. Chapin, *Land of the Cliff Dwellers* (Boston, 1892); G. Nordenskiöld, *Cliff Dwellers of the Mesa Verde,* trans. by D. Lloyd Morgan (Stockholm and Chicago, 1893); *Holmes Anniversary Volume* (privately published, Washington, 1916); C. Lumholtz, *Unknown Mexico* (2 vols., 1902); A. Hrdlička, *Amer. Anthropologist* (vol. v., 1903); B. Cummings, *Bull. Univ. of Utah* (vol. iii., 1910); J. W. Fewkes, *Bull.* 41, 50, 51 and 70, Bur. Amer. Ethnology (1909–1919) and in various reports of the same Bureau; A. V. Kidder, *Introduction to the Study of Southwestern Archaeology* (New Haven, 1924, with extended bibliography); A. V. Kidder and S. J. Guernsey, *Bull.* 65, Bur. Amer. Ethnology (1919); J. L. Nusbaum, "A Basket-maker Cave in Kane county, Utah" with notes on the artifacts by A. V. Kidder and S. J. Guernsey, *Indian Notes and Monogr., Mus. Amer. Indian* (Misc. no. 29, 1922); Deric Nusbaum, *Deric in Mesa Verde* (1926, juvenile). (F. W. H.)

CLIFFORD, the name of a famous English family and barony, taken from the village of Clifford in Herefordshire.

ROBERT DE CLIFFORD (*c.* 1275–1314), one of the most powerful barons of his age, won great renown at the siege of Carlaverock Castle in 1300, and after taking part in the movement against Edward II.'s favourite, Piers Gaveston, was killed at Bannockburn. His son Roger, 2nd baron (1299–1322), shared in the rebellion of Thomas, earl of Lancaster, and was probably executed at York on March 23, 1322.

JOHN, the 9th baron (*c.* 1435–1461) earned the name of the "butcher," in the Wars of the Roses, in which he fought for Henry VI.; after the battle of Wakefield in 1460 he murdered Edmund, earl of Rutland, son of Richard duke of York. Shakespeare refers to this incident in King Henry VI., and also represents Clifford as taking part in the murder of York, though it is practically certain that York was slain in the battle. Clifford was killed at Ferrybridge on March 28, **1461,** and was afterwards attainted. His young son Henry, the 10th baron (*c.* 1454–1523), lived disguised as a shepherd for some years, hence he is sometimes called the "shepherd lord." On the accession of Henry VII. the attainder was reversed and he received his father's estate. He fought at Flodden in 1513, and died on April 23, 1523. He is the subject of two of Wordsworth's poems, "The White Doe of Rylstone" and the "Song at the Feast of Brougham Castle." Henry, the 11th baron, was created earl of Cumberland (*q.v.*) in 1525, and from this time until the extinction of the title in 1643 the main line of Cliffords was associated with this earldom.

On the death of George, 3rd earl of Cumberland, in 1605, the barony of Clifford, separated from the earldom, was claimed by his daughter Anne, countess of Dorset, Pembroke and Montgomery; and in 1628 a new barony of Clifford was created in favour of Henry, afterwards 5th and last earl of Cumberland. After Anne's death in 1676 the claim to the older barony passed to her daughter Margaret (d. 1676), wife of John Tufton, 2nd earl of Thanet, and her descendants, whose title was definitely recognized in 1691. After the Tuftons the barony was held with intervening abeyances by the Southwells and the Russells, and to this latter family the present Lord De Clifford belongs.

When the last earl of Cumberland died in 1643 the newer barony of Clifford passed to his daughter Elizabeth, wife of Richard Boyle, 2nd earl of Cork, and from the Boyles it passed to the Cavendishes, falling into abeyance on the death of William Cavendish, 6th duke of Devonshire, in 1858.

The barony of Clifford of Lanesborough was held by the Boyles from 1644 to 1753, and the Devonshire branch of the family still holds the barony of Clifford of Chudleigh, created in 1672.

See G. E. C.(okayne), *Complete Peerage,* vol. iii. new ed. (1913); and T. D. Whitaker, *History of Craven,* 3rd ed. (1878).

CLIFFORD OF CHUDLEIGH, THOMAS CLIFFORD, 1ST BARON (1630–1673), English lord treasurer, the son of Hugh Clifford of Ugbrook, near Exeter, was born on Aug. 1, 1630, matriculated at Exeter college in 1647, and entered the Middle Temple in 1648. He represented Totnes in the convention parliament of 1660 and in the parliament of 1661, and became a steady supporter of Arlington, in opposition to the chancellor, Clarendon. On the outbreak of the Dutch war in 1664 Clifford was appointed commissioner for the care of the sick and of prisoners; afterwards knighted and appointed ambassador to northern Europe, he served with the fleet in 1665 and 1666, and in Oct. 1667 was one of those selected by the Commons to prepare papers concerning the naval operations. In the same year he was made controller of the household, a privy councillor and a commissioner for the treasury and in 1668 treasurer of the household.

Clifford was an ardent Roman Catholic, a supporter of the royal prerogative, and of the French alliance as a means of forcing Romanism and absolute government on the country. As one of the Cabal ministry, therefore, he co-operated zealously with the king in breaking through the Triple Alliance and in effecting an understanding with France. He was the only minister, besides Arlington, entrusted with the secret treaty of Dover of 1670, which he signed as well as the ostensible treaty shown to all the members of the Cabal. In 1672, during the absence of Arlington and Coventry abroad, Clifford acted as principal secretary of state, and was chiefly responsible for the "stop of the exchequer" and probably also for the attack upon the Dutch Smyrna fleet. He was appointed that year a commissioner to enquire into the settlement of Ireland. On April 22 he was raised to the peerage, and on Nov. 28, by the duke of York's interest, was made lord treasurer. This excited the jealousy of Arlington, who had always aspired to that office, and he helped to secure Clifford's downfall by his support of the Test Act of 1673. On the passing of the bill Clifford, as a Roman Catholic, followed the duke of York into retirement. His resignation caused considerable astonishment, since he had never publicly professed his religion, and in 1671 had even built a new Protestant chapel at his home at Ugbrook. According to Evelyn, however, his conduct was governed by a promise previously given to James. He gave up the treasuryship and his seat in the privy council in June. On

July 3, 1673, he received a general pardon from the king. In August he said a last farewell to Evelyn, and in less than a month he died at Ugbrook. In Evelyn's opinion the cause of death was suicide, but his suspicions do not appear to have received any contemporary support. Clifford was one of the worst advisers of Charles II., but a sincere and consistent one. Evelyn declares him "a valiant, uncorrupt gentleman, ambitious, not covetous, generous, passionate, a most constant, sincere friend." He married Elizabeth, daughter of William Martin of Lindridge, Devonshire, by whom he had 15 children, four sons and seven daughters surviving him. He was succeeded as 2nd baron by Hugh, his fifth, but eldest surviving son.

See *Cambridge Modern History*, vol. v. (1908).

CLIFFORD, SIR HUGH, G.C.M.G.; G.B.E. (1866–1941), British colonial governor, son of Maj.-Gen. Sir H. H. Clifford, V.C., K.C.M.G., was born in London on March 5, 1866, and was educated at Woburn Park. In 1883 Clifford passed into the Malay States civil service, and, after executing a special mission towards the sultan of Pahang in 1887, became the governor's agent there. After filling several other administrative posts, he returned to Pahang as British resident during the years 1896–99. Four years later he became colonial secretary at Trinidad, and was transferred in the same capacity to Ceylon in 1907, where he remained until his appointment as governor of the Gold Coast in 1912. He was governor of Nigeria, 1919–25; Ceylon, 1925–27; and the Straits Settlements, 1927–29. Apart from his career in the colonial service, Sir Hugh Clifford made his name as a writer of distinction, his stories of the Malay peninsula being among the best of his works of fiction. He married as his second wife the novelist, Mrs. Henry de la Pasture. Among his numerous works may be mentioned the following: *Studies in Brown Humanity* (1898); *Bush-Whacking* (1901); *Malayan Monochromes* (1913) and *The Further Side of Silence* (1916). Sir Hugh also compiled with Sir Frank Swettenham a *Dictionary of the Malay Language*. He retired from the colonial service in 1929 and died Dec. 19, 1941.

CLIFFORD, JOHN (1836–1923), British Nonconformist minister and politician, son of a warp-machinist at Sawley, Derbyshire, was born on Oct. 16, 1836. He worked in a lace factory where he attracted the notice of Baptists, who sent him to the academy at Leicester and the Baptist college at Nottingham to be educated for the ministry. In 1858 he was called to Praed Street chapel, Paddington (London), and while officiating there he attended University college and pursued his education at the British Museum. He took his B.A. (1861), B.Sc. (1862), M.A. (1864), and LL.B. (1866), and in 1883 he was given an honorary D.D. by Bates college, U.S.A. At Praed Street chapel he obtained a large following, and in 1877 Westbourne Park chapel was opened for him. As a preacher, writer, propagandist, and ardent Liberal politician he became a power in the Nonconformist body. He was president of the London Baptist Association in 1879, of the Baptist Union in 1888 and 1899, and of the National Council of Evangelical Churches in 1898. His prominence in politics dates from 1903, in consequence of his advocacy of "passive resistance" by non-payment of taxes to the Education Act of 1902. Into this movement he threw himself with militant ardour, his own goods being distrained upon, with those of numerous other Nonconformists. The "passive resistance" movement, with Dr. Clifford as its chief leader, contributed to the defeat of the Unionist Government in Jan. 1906, and his efforts were then directed to getting a new act passed which should be undenominational. The rejection of Mr. Birrell's bill in 1906 by the House of Lords led Dr. Clifford and his followers to denounce the House of Lords, but as year by year went by, up to 1909, with nothing but failure on the part of the Liberal ministry to solve the education problem —failure due not to the House of Lords but to the inherent difficulties of the subject—"passive resistance" lost its interest. Dr. Clifford received a C.H. in 1921, and died on Nov. 20, 1923.

His chief writings are *The English Baptists* (1881); *The Christian Certainties*, 2nd ed. (1904); *The Ultimate Problems of Christianity* (1906). *See* C. T. Bateman: *John Clifford* (1904); D. Crane: *John Clifford* (1908); *Life and Letters*, ed. by Sir James Marchant (1924).

CLIFFORD, WILLIAM KINGDON (1845–1879), English mathematician and philosopher, was born on May 4, 1845, at Exeter, where his father was a leading citizen. He was educated at King's college, London, and at Trinity college, Cambridge, where he was elected fellow in 1868. In 1871 he was appointed professor of mathematics at University college, London, and in 1874 became fellow of the Royal Society. In 1875 he married Lucy, daughter of John Lane, of Barbados, well known under her married name as a novelist and dramatist. In 1876 Clifford, a man of high-strung and athletic, but not robust, physique, began to fall into ill-health, and after two voyages to the South, died, during the third, of pulmonary consumption at Madeira, on March 3, 1879, leaving his widow with two daughters. Mrs. W. K. Clifford (d. 1929) earned for herself a prominent place in English literary life as a novelist, and later as a dramatist. Her best-known story, *Mrs. Keith's Crime* (1885), was followed by several other volumes, the best of which is *Aunt Anne* (1893); and the literary talent in the family was inherited by her daughter Ethel (Lady Fisher Wentworth Dilke), a writer of some charming verse.

Clifford impressed all his contemporaries as a man of extraordinary acuteness and originality; he had also quickness of thought and speech, a lucid style, wit and poetic fancy, and social warmth. He was a mathematician of the front rank, and contrary to the excessively analytic tendency of the Cambridge mathematicians, "above all and before all a geometer." In his theory of graphs he made fruitful suggestions. He was interested in universal algebra, non-Euclidean geometry and elliptic functions, his papers "Preliminary Sketch of Bi-quaternions" (1873) and "On the Canonical Form and Dissection of a Riemann's Surface" (1877) ranking as classics. He also wrote "Classification of Loci" (1878), on algebraic forms and projective geometry.

As a philosopher Clifford's name is chiefly associated with two phrases of his coining, "mind-stuff" and the "tribal self." The latter gives the key to Clifford's ethical view, which explains conscience and the moral law by the development in each individual of a "self" which prescribes the conduct conducive to the welfare of the "tribe." Clifford was prominent in the battle between Darwinian science and Victorian theology.

His works, published wholly or in part after his death, are, *Elements of Dynamic* (1879–87); *Seeing and Thinking*, popular science lectures (1879); *Lectures and Essays* (introduction by Sir F. Pollock, 1879); *Mathematical Papers* (ed. R. Tucker, intro. by J. S. Smith, 1882); and *The Common Sense of the Exact Sciences*, completed by Professor Karl Pearson (1885).

CLIFFSIDE PARK, a borough of Bergen county, New Jersey, U.S.A., on the Palisades overlooking the Hudson river, about opposite 100th street in New York city. The railroad station is Weehawken (*q.v.*). It is a rapidly growing residential suburb, with a population of 5,709 in 1920; it was 15,267 in 1930 and 16,892 in 1940 by the federal census.

CLIFTON, watering-place and western residential suburb of Bristol, England, with stations on the G.W.R. and L.M.S.R. It occupies the lofty cliffs overhanging the river Avon (*q.v.*), at a height of 245 ft. above which Brunel's (*q.v.*) famous suspension bridge (1832–64), with a span of 702 ft., bestrides the gorge. The famous hot springs of Clifton (in Hotwells) to which the town owed its rise, issue from the foot of St. Vincent's rock (308 ft.), which abounds in fossils. The water has a temperature of about 76°. Immediately above the suspension bridge the Clifton Rocks funicular railway ascends from the quays by the riverside to the heights above. The Clifton and Durdham downs (both on the Gloucestershire side of the river and Bristol corporation property), form the principal pleasure grounds of Bristol, commanding a beautiful prospect over the irregularly built city, and over the well-wooded country.

Three ancient earthworks on Clifton down bear witness to an early settlement on the spot, and a church was in existence as far back as the time of Henry II, when it was bestowed by William de Clyfton on the abbot of the Austin canons in Bristol; but there is no surviving church older than the 18th century. Clifton gives name to a Roman Catholic bishopric. Clifton college, a public school, was founded in 1862.

CLIFTON, a town of Arizona, U.S.A., on the San Francisco river and the Southern Pacific railway, near the eastern boundary of the state; the county seat of Greenlee county. The population in 1940 was 2,668. It was formerly in the Morenci-Metcalf copper-mining district. Metcalf was abandoned and all the buildings removed. Morenci is the site of a $40,000,000 open-pit copper-mine development, to make available 270,000,000 tons of low-grade copper ore. Clifton was settled about 1870, and was incorporated in 1908. It is the oldest copper-mining camp in the State.

CLIFTON, a city of Passaic county, New Jersey, U.S.A. Its area is 11 sq.mi. It is served by the Lackawanna and the Erie railways. The population in 1930 was 46,875 and in 1940 it was 48,827. There are 50 major industries manufacturing textiles, steels, chemicals, aircraft appliances, etc. Production in 1940 was valued at $102,000,000. It has the city-manager form of government.

CLIFTON FORGE, a city of western Virginia, U.S.A., amid the superb scenery of the Allegheny mountains, on the Jackson river; in Allegheny county, but administratively independent of it. It is on federal highway 60, and is served by the Chesapeake and Ohio railway. The population in 1920 was 6,164, of whom 1,000 were Negroes; in 1940, it was 6,461 by the federal census. The city has railroad repair shops, is a distributing point for coal from the near-by fields, and is headquarters of the western division of the Virginia Public Service company. Clifton Forge, formerly called Williamson, was incorporated in 1884. The gap formed here by the river has been used for travel across the mountains ever since the days of the Indians. Douthat State Park is near by.

CLIMACTERIC, a critical period in human life (from the Gr. *κλιμακτήρ,* the rung or step of a ladder); in a medical sense, the period known as the "change of life," marked in women by the menopause. The word is also used of any turning-point in the history of a nation, a career, etc.

CLIMATE, ARTIFICIAL. The usual significance of the word climate is to indicate the result of all the solar and terrestrial influences or factors which affect animal or vegetable life. These factors include temperature and humidity; gaseous composition; pressure and movement of air; light intensity and quality. An artificial climate may be similarly defined as a more or less mechanical control of one or more of these factors in a comparatively restricted space independent of and in contrast to the natural climate at that particular location. In a broader sense the application of air conditioning to industrial processes might be included under the term artificial climate. In some processes such as the textile industries large quantities of energy, used in driving, spinning and weaving machinery, are liberated as heat in a relatively small space. Air conditioning is important in this case both to provide a liveable humidity and temperature for the employee, and a suitable temperature and humidity for working the fibre. (*See* AIR CONDITIONING.)

In a more restricted sense artificial climate, as it affects animal or vegetable life, has a more limited application. The mechanical control of temperature and humidity has been used in theatres, schools, churches and other similar public meeting places to insure the comfort and well-being of the audience at all seasons of the year. For this work it has been found that a temperature of about 75° F and a relative humidity of 55% is most comfortable for the average person in summer, while 70° F and 35 to 40% relative humidity are the most satisfactory in winter. In the crowded theatre the problem both summer and winter is to get rid of the heat generated. The average individual radiates sufficient energy as heat to raise the temperature of 30 cu.ft. of air approximately 9° F per minute. From this it is calculated that about 30 cu.ft. of air per person per minute is necessary. The incoming air is normally supplied at a temperature a few degrees lower than the optimum for comfort so that it can function in removing heat from the audience. The air intakes or positive pressure supply openings are usually placed in the ceiling of the room, while the exhaust duct or negative pressure openings are distributed more or less uniformly along the floor, beneath the seats. There is also need for humidification of air in dwelling houses in winter, as it has been shown that air taken from the outside at a temperature of 32° F or less and heated to 70° is, in general, much too low in humidity for human comfort. Mechanical devices for spraying or otherwise introducing additional water vapor in appreciable amounts are now used for this purpose.

Light has been used in the treatment of human diseases, since Finsen studied the effects of various regions of sunlight and artificial light sources during the years 1893 to 1904. More recently (1918–22) Huldschinsky, Hess and others have shown that the extreme ultra-violet region of sunlight (wave-length 312 to 290 millimicrons) is effective in the cure of the disease rickets, quite generally in animals, and particularly in human beings. Since this time the control of light intensity and quality along with air conditioning has been used in sanitaria and solaria for the treatment of specific diseases and as a general tonic, both physical and mental in its effects on the individual. Human patients have been treated at the Battle Creek sanitarium, Battle Creek, Mich., for several years with a typical installation of this sort. Four carbon arc lamps of about 22 amperes current consumption placed at a distance of 30in. from each patient are used in general irradiations at this institution. The air temperature is regulated to about 78° F and relative humidity is maintained at about 70%. The quality of light output of the carbon arc lamps can be altered within limits by using carbons impregnated or cored with different metallic salts. Carbons cored with cerium fluoride are commonly used in the production of a light source which approximates sunlight very closely, both in the visible and ultra-violet regions. More of the extreme ultra-violet beyond wave-length 290 millimicrons can be added by the addition of iron to the core material. Mercury vapour arcs in quartz tubes have also been generally used for irradiating human patients. This light source includes the extreme ultra-violet region which is not found in sunlight and has in addition several bright lines in the visible region and the near ultra-violet. It does not, however, approach sunlight in colour distribution.

The volume concentration of oxygen gas in air has been accurately regulated in hospital rooms designed for the treatment of pneumonia patients at the Rockefeller Institute for medical research, New York city. Oxygen is maintained at about 40% or about twice the normal concentration of the atmosphere in these rooms. The use of such an atmosphere is often successful in supplying sufficient oxygen to the lungs of a patient whose effective lung capacity has been greatly diminished by the disease. Artificial climate has been used at the Boyce Thompson institute for plant research, Yonkers, N.Y., and other similar institutions to study the effects of environmental factors on plant development, reproduction and other life processes. In such a study applied to plants the main factors considered are temperature, humidity and movement of air, carbon dioxide supply, light intensity and quality and day length. Most seed plants grow well within a temperature range of 60 to 80° F but the optimum temperature for growth varies with the species. It may also vary with carbon dioxide supply and light intensity since it has been observed that many plants will grow more rapidly at a higher temperature when carbon dioxide supply and light intensity are both increased. A relative humidity of 50 to 80% is favourable for many seed plants, but desert species exist in nature at a much lower humidity, and some aquatic plants live in a humidity which closely approximates complete saturation. Many common crop plants will increase in growth rate and amount of carbon fixed when solar light intensity is high, if the concentration of carbon dioxide in the atmosphere is increased. The normal concentration is approximately three volumes of this gas in 10,000 of air, while the rate of photosynthesis, or carbon fixation by green plants, increases at least up to 10 times this concentration. This fact was first applied commercially in Germany about 1917 when flue gases from the combustion of coal or coke were purified and the resulting carbon dioxide piped into greenhouses among growing plants. This method has also been used in outdoor plots to increase the concentration of the gas locally over sugar beet fields and other growing crops. More recently pure charcoal briquettes have been burned in open stoves placed inside greenhouses, as a source for carbon dioxide. Increases of 50% or more in the green weight of

plant tissue produced in a given time have been obtained in this way. The success of the method depends in part on light intensity since the plant uses the energy of light to synthesize carbohydrates from the carbon dioxide in the air and water, entering the plant from the soil. In the temperate zones during the winter months, light intensity is too low and day length too short for maximum photosynthesis of a number of plants. This can be overcome by the use of artificial light of a suitable intensity and quality for a few hours each night. Most seed plants grow well in greenhouses in the winter when daylight is supplemented with about six hours of artificial light each night. Longer light periods produce leaf injury or even death in a number of species. Many seed plants can be grown entirely with artificial light as a source of energy for photosynthesis. A room has been equipped for this work at the Boyce Thompson institute for plant research. This room is about 11ft. square and is illuminated by 25 1,500-watt incandescent type gas-filled lamps arranged in the ceiling so as to give equal distribution of light over the floor area. A false ceiling of glass over which water can be circulated is placed between the lamps and the chamber in which the plants are grown. This serves as a ray filter which absorbs the infra red or heat rays from the lamps. Both temperature and humidity are controlled in this room by standard air conditioning machinery. The refrigeration unit used to cool water for this work has a capacity of 15 tons of ice per 24 hours. The air conditioning system has sufficient capacity to maintain any temperature between 45° and 90° F, accurately regulated in the chamber under the bank of lamps. Carbon dioxide is delivered continuously into the growth chamber through a system of meters so as to maintain a concentration of about 30 parts in 10,000 of air. The effects of temperature, humidity, light intensity, quality and day length, and carbon dioxide supply can be studied in such an artificial climate during the entire life history of the plant.

Many plants grow very rapidly in an artificial climate. Some of the grains such as spring wheat and oats were grown from seed to head in 35 days. Red clover, a biennial in the present system of agriculture, grew from seed to flower in 38 days. Illumination values of the order of 300–1,000-foot candles are required for normal photosynthesis in plants. The light quality must be similar to sunlight, that is, it must contain both the red and blue regions of the spectrum. The gas-filled incandescent type of lamp is not an ideal source of light for plant growth, as it has too much red and infra red and insufficient blue. It has a distinct advantage, however, in that it is easily maintained over long periods of time. It should be noted that day length is an important consideration in the flowering of plants growing in artificial climates. As shown originally by Garner and Allard in 1920, some plants, such as the salvia and cosmos, flower on the short day lengths of fall, spring and winter. Other plants like the lettuce and radish, flower on the long days of summer. A third group, like the buckwheat, is not affected by day length and is, therefore, an everblooming type. These considerations apply equally well when plants are grown under artificial illumination. Day lengths of 15 hours or less usually cause flowering in short day plants, while day lengths greater than this cause flowering only in long day plants or in the everblooming types.

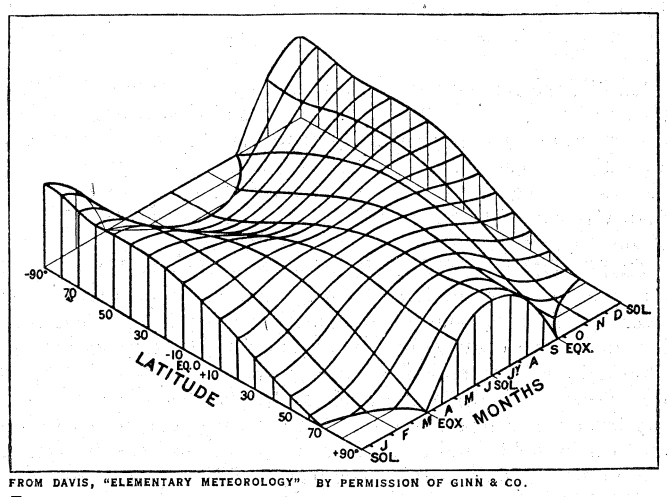
To date there has been no practical application of the growth of plants solely with artificial light in a mechanically controlled environment. Artificial light has been used commercially to supplement sunlight for a short time in forcing especially valuable flowers. With the advent of a more suitable light source and cheaper power, an application may be found in the future.

(J. M. A.)

See also DAYLIGHT, ARTIFICIAL; CLIMATE IN THE TREATMENT OF DISEASE; HELIOTHERAPY.

CLIMATE AND CLIMATOLOGY. The word *clima* (from Gr. κλίνειν, to lean or incline) was used by the Greeks for the supposed slope of the earth towards the pole, or for the inclination of the earth's axis. A change of *clima* then meant a change of latitude. The latter was gradually seen to mean a change in atmospheric conditions as well as in length of day, and *clima* thus came to have its present meaning. "Climate" is the average condition of the atmosphere. "Weather" denotes a single occurrence, or event, in the series of conditions which make up climate. The climate of a place is thus in a sense its average weather. Climatology is the study or science of climates; it is a branch of the science of meteorology (*q.v.*).

Climatic Elements and Their Treatment.—Climatology has to deal with the atmospheric conditions which affect human

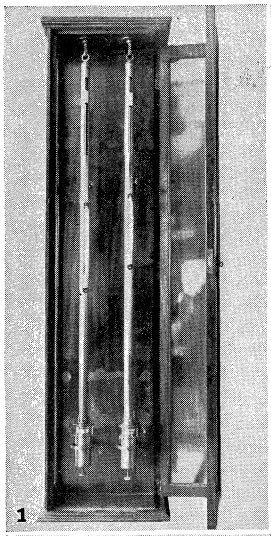


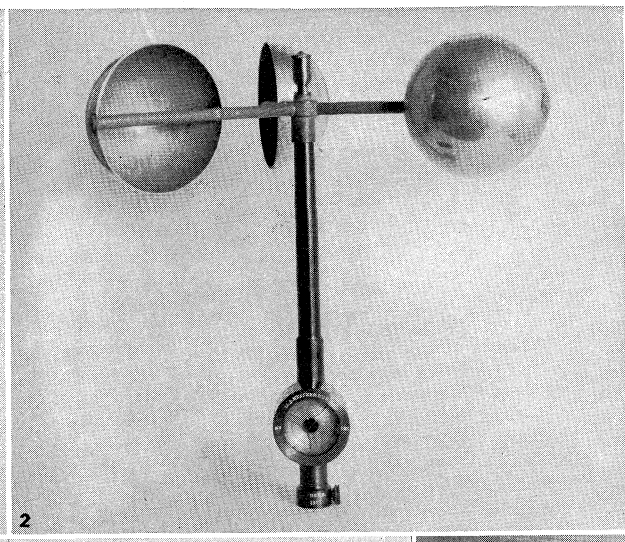
FROM DAVIS, "ELEMENTARY METEOROLOGY" BY PERMISSION OF GINN & CO.

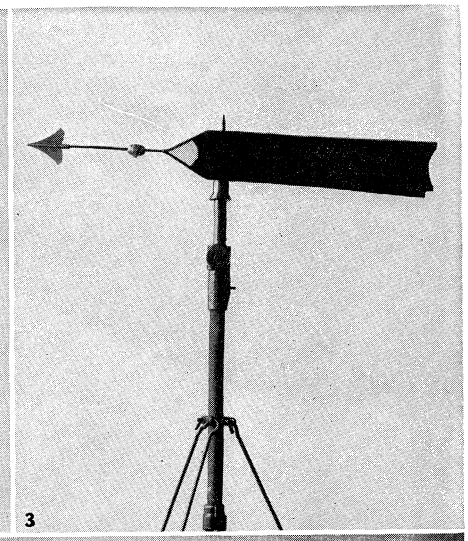
FIG. 1.—CLIMATOLOGY: DIAGRAM OF RELATIVE AMOUNTS OF INSOLATION RECEIVED AT DIFFERENT LATITUDES IN DIFFERENT MONTHS
Latitudes are shown on left margin, months on right, and values by the vertical distance above the plane of the two margins

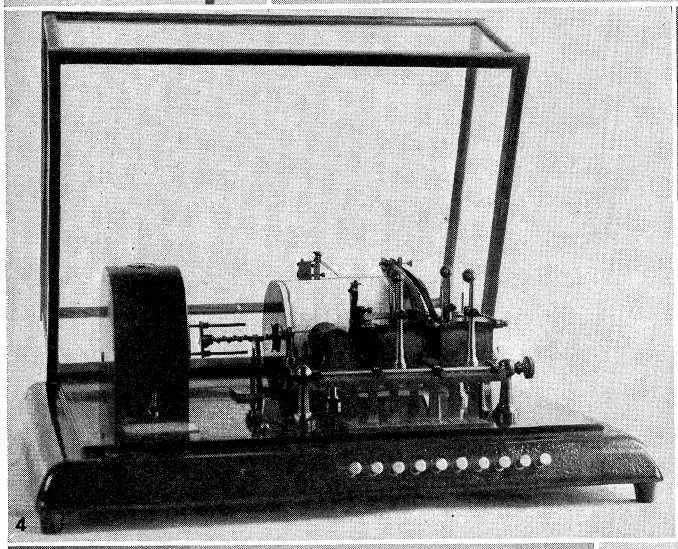
life, viz., temperature (including radiation); moisture (including humidity, precipitation and cloudiness); wind (including storms) and evaporation. Climate deals first with average conditions, but a satisfactory presentation of a climate must take account, also, of regular and irregular daily, monthly and annual changes, and of local departures, mean and extreme, from the average conditions. The mean minimum and maximum temperatures or rainfalls of a month or a season are important data. Further, a determination of the frequency of occurrence of a given condition, or of certain values of that condition, is important, for periods of a day, month or year, as for example the frequency of winds according to direction or velocity; or of different amounts of cloudiness. The probability of occurrence of any condition, as of rain in a certain month, is also a useful thing to know.

Solar Climate.—Climate, in so far as it is controlled solely by the amount of solar radiation which any place receives by reason of its latitude, is called solar climate. Solar climate alone would prevail if the earth had a homogeneous land surface, and if there were no atmosphere. The relative amounts of insolation received at different latitudes and at different times at the upper limit of the earth's atmosphere, *i.e.*, without the effect of absorption by the atmosphere, are shown in fig. 1 after Davis. The latitudes are given at the left margin and the time of year at the right margin. The values of insolation are shown by the vertical distance above the plane of the two margins. At the Equator, where the day is always 12 hours long, there are two maxima of insolation at the equinoxes, when the sun is vertical at noon, and two minima at the solstices when the sun is farthest off the Equator. The values do not vary much through the year because the sun is never very far from the zenith, and day and night are always equal. As latitude increases, the angle of insolation becomes more oblique and the intensity decreases, but at the same time the length of day rapidly increases during the summer, and towards the pole of the hemisphere which is having its summer, the gain in insolation from the latter cause more than compensates for the loss by the former. The double period of insolation above noted for the equator prevails as far as about lat. 12° N. and S.; at lat. 15° the two maxima have united in one, and the same is true of the minima. At the pole there is one maximum at the summer solstice, and no insolation at all while the sun is below the horizon. On June 21 the Equator has a day 12hr. long, but the sun does not reach the zenith, and the amount of insolation is therefore less

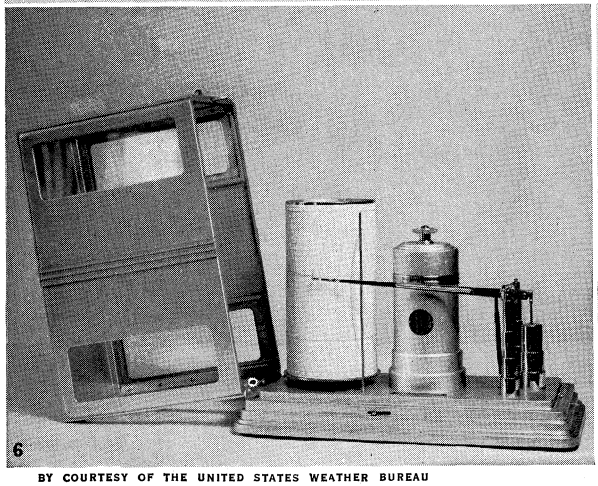


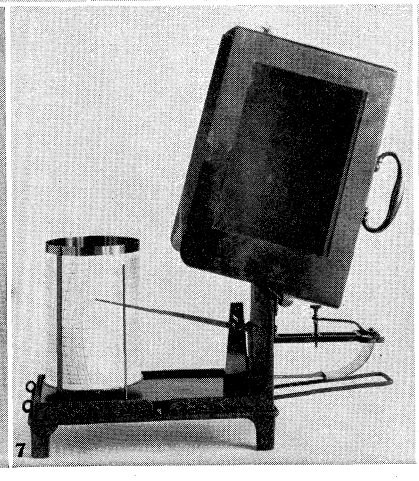


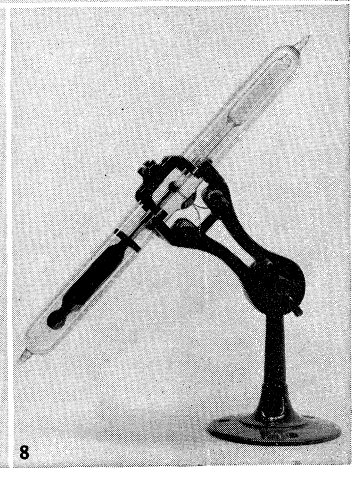












BY COURTESY OF THE UNITED STATES WEATHER BUREAU

INSTRUMENTS FOR DETERMINING CONDITIONS OF THE WEATHER

1. Mercurial barometer, invented by Torricelli in 1643. Each tube holds a column of mercury, which rises and falls according to pressure of surrounding air. 2. Anemometer, for measuring velocity of wind. Three cups attached to horizontal arms revolve at speed varying according to wind velocity. 3. Windvane or anemoscope, indicates direction of the wind. This 4-ft. vane may be connected with the recording instrument (fig. 4). 4. Weather recording register equipped to record changes at one-minute intervals. Instrument registers the velocity and direction of wind, rainfall in hundredths inches and the duration of sunshine. 5. Tipping bucket rain gauge, in parts. 6. Standard barograph or recording aneroid barometer, with cover removed. 7. Intermediate range thermograph which traces a continuous record of the temperature on a revolving drum. 8. Thermal sunshine recorder, electrically connected with recording instrument (fig. 4), determines duration of sunshine



BY COURTESY OF THE U.S. WEATHER BUREAU

LAUNCHING A RADIOSONDE, ROBOT WEATHER OBSERVER

A sounding balloon carries the radiosonde to heights of 10 to 15 mi. During the flight the instrument emits, at brief intervals, radio signals which are recorded by the station's ground equipment. By referring these recorded signals to a calibration chart the pressure, temperature and humidity of the atmosphere through which the instrument has been carried are obtained. An attached parachute retards the fall of the radiosonde to the ground after the balloon has burst

than at the equinox. On the northern tropic, however, the sun is vertical at noon, and the day is more than 12hr. long. Hence the amount of insolation received at this latitude is greater than that received at the equinox at the Equator. From the tropic to the pole the sun stands lower and lower at noon, and the value of insolation would steadily decrease with latitude if it were not for the increase in the length of day. Going polewards from the northern tropic on June 21, the value of insolation increases for a time, because although the sun is lower, the number of hours during which it shines is greater. A maximum value is reached at about lat. 43½°N. The decreasing altitude of the sun then more than compensates for the increasing length of day, and the value of insolation diminishes, a secondary minimum being reached at about lat. 62°. Then the rapidly increasing length of day towards the pole again brings about an increase in the value of insolation, until a maximum is reached at the pole which is greater than the value received at the Equator at any time.

On June 21 there are therefore two maxima of insolation, one at lat. 43½° and one at the north pole. From lat. 43½° N., insolation decreases to zero on the Antarctic circle, for sunshine falls more and more obliquely, and the day becomes shorter and shorter. Beyond lat. 66½° S. the night lasts 24 hours. On Dec. 21 the conditions in southern latitudes are similar to those in the northern hemisphere on June 21, but the southern latitudes have higher values of insolation because the earth is then nearer the sun. At the equinox the days are equal everywhere, but the noon sun is lower and lower with increasing latitude in both hemispheres until the rays are tangent to the earth's surface at the poles (except for the effect of refraction). Therefore, the values of insolation diminish from a maximum at the Equator to a minimum at both poles.

The earth's atmosphere weakens the sun's rays. The more nearly vertical the sun, the less the thickness of atmosphere traversed by the rays. The values of insolation at the earth's surface vary with the condition of the air as to dust, clouds, water vapour, etc. As a rule, even when the sky is clear, about one-half of the solar radiation is lost during the day by atmospheric absorption. The great weakening of insolation at the pole, where the sun is very low, is especially noticeable. The following table (after Angot) shows the effect of the earth's atmosphere (coefficient of transmission 0·7) upon the value of insolation received at sea-level.

Values of Daily Insolation at the Upper Limit of the Earth's Atmosphere and at Sea-Level

Lat.	Upper limit of atmosphere			Earth's surface		
	Equator	40°	N. pole	Equator	40°	N. pole
Winter solstice	948	360	0	552	124	0
Equinoxes	1000	773	0	612	411	0
Summer solstice	888	1115	1210	517	660	494

These values are relative only; during the present century the Astrophysical Observatory of the Smithsonian Institution of Washington, under the direction of C. G. Abbot, has estimated the actual intensity of the sun's radiation at the limit of the earth's atmosphere as 1·95 gramme-calories per sq.cm. per minute. (*See* RADIATION, RAYS.) This value is termed the "solar constant," though it varies within about five per cent. on either side of this mean value. The value of 1,000 on the above scale represents about 940 gramme-calories per sq.cm. of horizontal surface.

Physical Climate.—The distribution of insolation explains many of the large facts of temperature distribution; for example, the decrease of temperature from Equator to poles; the double maximum of temperature on and near the Equator; the increasing seasonal contrasts with increasing latitude, etc. But the regular distribution of solar climate between Equator and poles which would exist on a homogeneous earth, whereby similar conditions prevail along each latitude circle, is very much modified by the unequal distribution of land and water; by difference of altitude; by air and ocean currents, by varying conditions of cloudiness and so on. The uniform arrangement of solar climatic belts arranged latitudinally is interfered with, and what is known as *physical climate* results. According to the dominant control we have solar, continental and marine, and mountain climates. In the first-named, latitude is the essential; in the second and third, the influence of land or water; in the fourth, the effect of altitude.

Classification of the Zones by Latitude Circles.—The five familiar zones are the so-called torrid, the two temperate and the two frigid zones. The torrid zone is limited north and south by the Tropics of Cancer and Capricorn, the Equator dividing the zone into two equal parts. The temperate zones are limited towards the Equator by the Tropics, and towards the poles by the Arctic and Antarctic circles. The two polar zones are caps covering both polar regions, and bounded on the side towards the Equator by the Arctic and Antarctic circles. These are really zones of solar climate. The tropical zone has the greatest annual amount and the least annual variation of insolation. Its annual range of temperature is very slight. Beyond the Tropics the contrasts between the seasons rapidly become more marked. The polar zones have the greatest variation in insolation between summer and winter. They also have the minimum amount of insolation for the whole year; their summer is so short and cool that the heat is insufficient for most forms of vegetation, especially for trees. The temperate zones are intermediate between the tropical and the polar in the matter of annual amount and of annual variation of insolation. Temperate conditions do not characterize these zones as a whole. They are rather the seasonal belts of the world.

Temperature Zones.—The astronomical classification of the zones serves very well for purposes of simple description, but a glance at any isothermal chart shows that the isotherms do not coincide with the latitude lines. In fact, in the higher latitudes, the former sometimes follow the meridians more closely than they do the parallels of latitude. Hence it has been suggested that the zones be limited by isotherms rather than by parallels of latitude, and that a closer approach be thus made to the actual conditions of climate. Supan[1] has suggested limiting the hot belt, which corresponds to, but is slightly greater than, the old torrid zone, by the two mean annual isotherms of 68° F—an isothermal line which approximately coincides with the polar limits of the

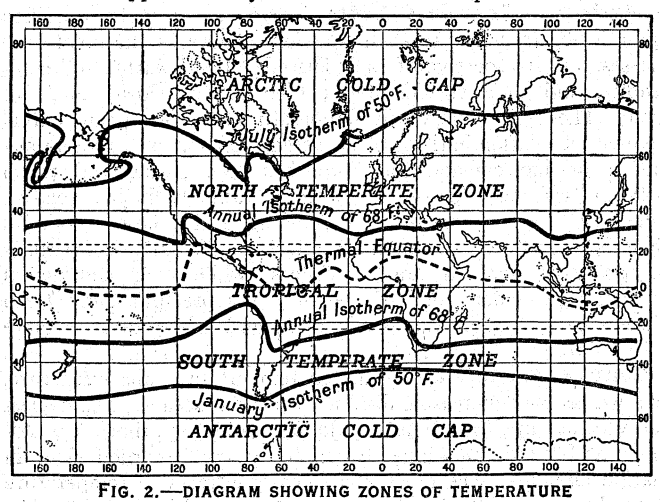


FIG. 2.—DIAGRAM SHOWING ZONES OF TEMPERATURE

trade-winds and with the natural distribution of palms. The limits of these zones, according to the most recent information, are shown in fig. 2. The hot belt widens somewhat over the continents, chiefly because there is a tendency towards an equalization of the temperature between Equator and poles in the oceans, while the stable lands acquire a temperature suitable to their own latitude. Furthermore, the unsymmetrical distribution of land in low latitudes of northern and southern hemispheres makes the hot belt

[1] A Supan, *Grundzüge der physischen Erdkunde* (Leipzig, 1896), 88–89. Also *Atlas of Meteorology*, Pl. 1.

extend farther north than south of the Equator. The polar limits of the temperate zones are fixed by the isotherm of 50° F for the warmest month. Summer heat is more important for vegetation than winter cold, and where the warmest month has a temperature below 50° F cereals and forest trees do not grow. The two polar caps are not symmetrical. Extended land masses in high northern latitudes carry the temperature of 50° F in the warmest month farther poleward there than is the case in high southern latitudes occupied by the oceans which warm less easily and are constantly in motion. Hence the southern cold cap, with equatorial limits at about lat. 50° S., is much larger than the northern polar cap. The northern temperate belt in which the great land areas lie is much broader than the southern belt, especially over the continents. These temperature zones emphasize the natural conditions of climate more than is the case in any subdivision by latitude circles, and they bear a fairly close resemblance to the old zonal classification of the Greeks.

Classification of Climates.—The best and most logical form of classification is one which takes account of all the different climatic elements. Such a scheme has been prepared by W. Köppen (*Die Klimate der Erde,* Berlin and Leipzig 1923) and assigns almost as much importance to rainfall as to temperature. Since the rainfall depends largely on prevailing winds, this classification also takes account of the zones of wind. Eight main zones are distinguished and divided and subdivided into a number of climatic provinces and smaller areas. Each subdivision is distinguished by a formula comprised of the main division followed by the initial letters of its characteristics: *e.g.,* the climate of Swakopmund is described as *BWkn,* which means a sub-tropical (B) desert (Wüste) climate with a cold (kalt) winter and frequent fog (Nebel). The eight zones are: A tropical rain zone with the coldest month usually above 64° F and rainfall above the limit of dryness (which varies according to the temperature and the seasonal distribution of rain); two zones of dry (steppe and desert) climate; two zones of warm temperate rain climate with the mean temperature of the coldest month between 64° and 27° F. (these include the "Mediterranean" and most of the "monsoon" climatic areas); a zone of "boreal" or snow and forest climate (with hot summers and cold winters below 27° F), which requires a large area of land and is consequently missing in the southern hemisphere; and two polar caps of "snow climate" with the mean temperature of the warmest month below 50° F.

Marine or Oceanic Climate.—Areas can also be classified climatically according to their position relative to the great land masses, and irrespective of their latitude. Land warms and cools readily, and to a considerable degree; water slowly and but little. The slow changes in temperature of the ocean waters involve retardation in times of occurrence of maxima and minima, and a marine climate, therefore, has cool spring and warm autumn, seasonal changes slight, a prevailingly higher relative humidity, a larger amount of cloudiness, and a heavier rainfall than is found over continental interiors. In middle latitudes oceans have distinctly rainy winters, while over continental interiors the colder months have minimum precipitation. Ocean air is cleaner and purer than land air and is generally in more active motion.

Continental Climate.—Annual temperature ranges increase, as a whole, with increasing distance from the oceans. The coldest and warmest months are usually January and July, times of maximum and minimum temperatures being less retarded than in marine climates. The greater seasonal contrasts in temperature over the continents than over the oceans are furthered by the smaller humidity and cloudiness over the former. Diurnal and annual changes of nearly all elements of climate, irregular as well as regular, are greater over continents than over oceans. Fig. 3 illustrates the annual march of temperature in marine and continental climates. Jacobabad in India (J), and Funchal on the island of Madeira (M) are representative continental and marine stations for a low latitude. Olekminsk in Siberia (Ol) and Lerwick in the Shetlands (L) are good examples of continental and marine climates of higher latitudes in the northern hemisphere.

Owing to distance from chief source of water vapour—the oceans—air over the larger land areas is drier and dustier than that over the oceans. Yet even in arid continental interiors in summer absolute vapour content is surprisingly large, and in the hottest months percentages of relative humidity may reach 20% or 30%; *e.g.,* in July, Luktschum with an average temperature of 90° and a relative humidity of 31 per cent. has more moisture in the air than Valentia with a temperature of 59° and a relative humidity of 83 per cent. Cloudiness, as a rule, decreases inland, and with this lower relative humidity, more abundant sunshine and higher temperature, the evaporating power of a continental climate in summer is much greater than that of the more humid, cloudier and cooler marine climate. Both amount and frequency of rainfall, as a rule, decrease inland, but conditions are very largely controlled by local topography and prevailing winds. Winds average somewhat lower in velocity, and calms are more frequent, over continents than over oceans. Seasonal changes of pressure over the former give rise to systems of inflowing and out-flowing, so-called continental, winds, sometimes so well developed as to become true monsoons. Extreme temperature changes over continents are the more easily borne because of the dryness of the air; because the minimum temperature of winter occurs when there is little or no wind, and because during the warmer hours of the summer there is the most air-movement.

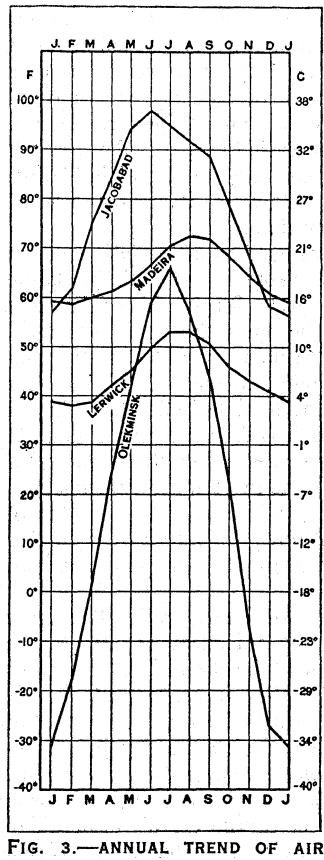


FIG. 3.—ANNUAL TREND OF AIR TEMPERATURE, SHOWING INFLUENCE OF CLIMATES IN LOW AND HIGH LATITUDES

Desert Climate.—Desert air is notably free from microorganisms. The large diurnal temperature ranges of inland regions, which are most marked where there is little or no vegetation, give rise to active convectional currents during the warmer hours of the day. Hence high winds are common by day, while the nights are apt to be calm and relatively cool. Diurnal cumulus clouds, often absent because of excessive dryness, are replaced by clouds of blowing dust. Excessive diurnal ranges of temperature cause rocks to split and break up. Wind-driven sand erodes and polishes the rocks. When the separate fragments become small enough they, in their turn, are transported by the winds and further eroded by friction during their journey. Rivers "wither" away, or end in brackish lakes.

Coast or Littoral Climate.—Between pure marine and pure continental types coasts furnish almost every grade of transition. Prevailing winds are here important controls. When these blow from the ocean, climates are marine in character, but when they are off-shore, a modified continental climate prevails, even up to the immediate sea-coast. The former have smaller range of temperature; the air is damp, and there is much cloud. All these marine features diminish with increasing distance from the ocean, especially when there are mountain ranges near the coast. In the Tropics, windward coasts are usually well supplied with rainfall, and temperatures are modified by sea breezes. Leeward coasts in the trade-wind belts offer special conditions. Here deserts often reach the sea, as on the western coasts of South America, Africa and Australia. Cold ocean currents, with prevailing winds along-shore rather than on-shore, are here hostile to cloud and rainfall, although the lower air is often damp, and fog is common in these regions.

Monsoon Climate.—Exceptions to the general rule of rainier eastern coasts in trade-wind latitudes are found in monsoon regions, as in India, for example, where the western coast gets much rain from the south-west monsoon. As monsoons often sweep over large districts, not only coast but interior, a separate group of monsoon climates is desirable. In India there are really three seasons—the cool winter, the hot transition, and the wet summer monsoon. Little precipitation occurs in winter, and that chiefly in the northern provinces. The winter monsoon is normally off-shore and the summer monsoon on-shore, but exceptional cases are found where the opposite is true, as in north-east Ceylon. In higher latitudes the seasonal changes of the winds, although not truly monsoonal, involve differences in temperature and in other climatic elements. The only well-developed monsoons on the coast of the continents of higher latitudes are those of eastern Asia. These are off-shore during the winter, giving dry, clear and cold weather; while the on-shore movement in summer gives cool, damp and cloudy weather.

Mountain and Plateau Climate.—Temperature decreases upwards at an average rate of 3° per 1,000ft., and for this reason and also because of their obstructive effects, mountains are important climatic factors. Mountains as contrasted with lowlands are characterized by decrease in pressure, temperature and absolute humidity; increased intensity of insolation and radiation; usually greater frequency of, and up to a certain altitude more, precipitation. The highest habitations are about 16,000ft. above sea-level, at which altitude pressure has about half its sea-level value. The intensity of the sun's rays is very great in the cleaner, drier and thinner mountain air. Vertical decrease of temperature is especially rapid during warmer months and hours; mountains are then cooler than lowlands. The inversions of temperature characteristic of the colder months, and of the night, give mountains the advantage of a higher temperature then. At such times cold air flows down the mountain sides and collects in the valleys, being replaced by warmer air aloft. Hence diurnal and annual ranges of temperature on the mountain tops of middle and higher latitudes are lessened and the climate in this respect resembles the marine. High enclosed valleys often show continental conditions of large temperature range and such valleys in Europe open to the north-east form local "Siberias." Plateaus, as compared with mountains at the same altitude, have relatively higher temperatures and larger temperature ranges. Altitude tempers heat in low latitudes. High mountain peaks, even on the Equator, can remain snow-covered all the year round.

No general law governs variations of relative humidity with altitude, but on the mountains of Europe winter is the driest season, and summer the dampest. At well-exposed stations there is a rapid increase in the vapour content soon after noon, especially in summer. The same is true of cloudiness, often greater on mountains than at lower levels, and usually greatest in summer when it is least in the lowlands. The higher Alpine valleys in winter have little cloud. This, combined with their low wind velocity and strong sunshine and the night temperature inversions, makes them winter health resorts. Owing to forced ascent of air over rising ground, rainfall usually increases with height up to a certain point, beyond which, owing to loss of water vapour, this increase stops. The zone of maximum rainfall averages about 6,000ft. to 7,000ft. in altitude in intermediate latitudes, being lower in winter and higher in summer. When there is a prevailing wind from one direction, the lee side of the mountains, and the neighbouring lowlands, are relatively dry, forming a "rain shadow." Mountains resemble marine climates in having higher wind velocities than continental lowlands. Mountain summits have a nocturnal maximum of wind velocity, while plateaus usually have a diurnal maximum.

THE TORRID ZONE

Climate and Weather.—Climatic features here are simple and uniform. Periodic phenomena, depending upon the daily and annual march of the sun, are dominant; non-periodic weather changes are wholly subordinate. In special regions only, and at special seasons, is the regular sequence interrupted by an occasional tropical cyclone. These cyclones are comparatively infrequent and generally bring very heavy rains; the devastation one may produce often affects the economic conditions for many years.

Temperature.—Mean temperature is very high, and very uniform over the whole zone, with little variation during the year. The mean annual isotherm of 68° F. is a rational limit at the polar margins of the zone, and the mean annual isotherm of 80° F. encloses the greater portion of the land areas, as well as much of the inter-tropical oceans. The warmest latitude circle for the year is not the equator, but latitude 10° N. The highest mean annual temperatures, shown by the isotherm of 85°F., are in Central Africa, in India, the north of Australia and Central America, but, with the exception of the first, these areas are small. The temperatures average highest where there is little rain. In June, July and August there are large districts in the south of Asia and north of Africa with temperatures over 90° F.

Over nearly all the zone mean annual range of temperature is less than 10° F., and over much of it, especially on the oceans, less than 5° F. Even near the margins of the zone the ranges are less than 25° F., as at Calcutta, Hongkong, Rio de Janeiro and Khartoum. Mean daily range is usually larger than mean annual; "night is the winter of the Tropics." Over parts of the Pacific and Indian oceans from Arabia to the Caroline islands and from Zanzibar to New Guinea, as well as on the Guiana coast, minimum temperatures do not normally fall below 68° F. Towards the margins of the zone, however, the minima on the continents fall to or even below 32° F. Maxima of over 120° F. occur over the deserts of northern Africa and a reading of 136° F. at Azizia in Tunis is the highest known shade temperature. A district where the mean maxima exceed 113° F. extends from the western Sahara to north-western India, and over Central Australia. Near the Equator the maxima are not so high; and inter-tropical oceans show remarkably small variations in temperature.

The Seasons.—In a true inter-tropical climate the seasons depend not on temperature, but on rainfall and the prevailing winds. Life is regulated in some cases almost wholly by rainfall. Although the rain is characteristically associated with a vertical sun, that season is not necessarily the hottest. Towards the margins of the zone, with increasing annual ranges of temperature, seasons in the extra-tropical sense gradually appear. The association of uniformly high heat and humidity at most low-level places near the Equator is very enervating, and energetic physical or mental activity is difficult or impossible for white men. The absence of a bracing cold winter is a great drawback and the uniformity of conditions makes one sensitive to slight changes of temperature. The drier interior regions are more healthy, and the most energetic natives are the desert dwellers.

Pressure, Winds and Rainfall.—Pressure is lowest near the equator, in the belt of doldrums. Here the pressure gradients are small, and calms, variable winds and heavy rain and thunderstorms prevail. This region is one of the rainiest in the world, averaging about 100in., and the sky is generally cloudy; it includes the dense forests of the Amazon and equatorial Africa. The doldrums extend from the Equator to about 10° N., but do not include any part of the southern hemisphere; on either side are the belts of trade winds, the north-east trade from about 10° to 30° N. and the south-east trade from about 0° to 25° S. The trades are extremely regular and stable and except where they strike windward coasts or high mountains they bring fine bracing weather. Over oceans the skies show small detached clouds (trade cumulus) but over the western and central parts of the continents the trade wind latitudes are desert—the Sahara and Arabia, Kalahari and the desert of Australia. The boundaries between the trade winds and the doldrums move north and south following the sun, giving a "winter" dry season and a "summer" rainy season, which near the equator is divided into two by a minor dry season shortly after the summer solstice. Monsoons occur on many of the tropical lands, the best known being those of southern and eastern Asia. In the northern summer the south-west monsoon, warm and moist, blows over the latitudes from about 10°

N. to and beyond the northern tropic, between Africa and the Philippines, giving rains over India, the East Indian archipelago and the eastern coasts of China. In winter, the north-east monsoon, the normal cold-season outflow from Asia, combined with the north-east trade, and generally cool and dry, covers the same district, coming from as far north as lat. 30° N. Crossing the Equator, these winds reach northern Australia and the western islands of the South Pacific as a north-west rainy monsoon, while this region in the opposite season has the normal south-east trade. Other monsoons are found in the Gulf of Guinea and in equatorial Africa. Wherever they occur they control the seasonal changes.

The regular occurrence and cool, clean air of the sea breeze make many districts habitable for white settlers. On not a few coasts the sea breeze is a true prevailing wind. The location of dwellings is often determined by exposure of a site to the sea breeze.

Local thunderstorms are frequent, have a marked diurnal periodicity, find their best opportunity in the equatorial belt of weak pressure gradients and high temperature, and are commonly associated with the rainy season, being most common at the beginning and end of the regular rains. In many places intense thunderstorms occur daily throughout the rainy season.

Cloudiness.—The average cloudiness of the tropics does not differ greatly from that in temperate regions. The mean, in tenths of sky covered, is shown by the following table:—

Latitude	30°–20° N.	20°–10° N.	10°N–0°.	0°–10° S.	10°–20° S.	20°–30° S.
Land .	3·4	4·0	5·2	5·6	4·6	3·8
Sea . .	4·9	5·3	5·3	5·0	4·9	5·3
Mean .	4·1	4·7	5·3	5·2	4·8	4·8

Both wholly clear and wholly overcast days are rare in the Tropics; the sky is more usually about half clouded.

CLIMATIC SUBDIVISIONS

The Equatorial Belt.—Within a few degrees of the Equator and when not interfered with by other controls, the annual curve of temperature has two maxima following the two zenithal positions of the sun, and two minima at about the time of the solstices. This equatorial type of annual march of temperature is illustrated in the three curves for Brazzaville, Batavia and Ocean island (fig. 4). The greatest range is shown in the curve for Brazzaville, inland in the Congo valley; the curve for Batavia illustrates insular conditions with less range, and that for Ocean island oceanic conditions with a range of only 0·5° F.

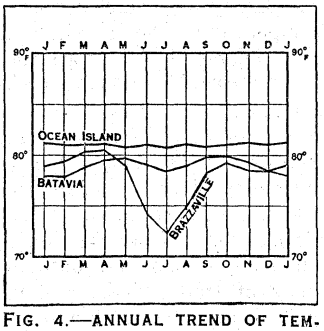


FIG. 4.—ANNUAL TREND OF TEMPERATURE FOR EQUATORIAL REGIONS
Heat for Brazzaville (Congo) is greatest

As the belt of rains swings back and forth across the Equator after the sun, there should be two rainy seasons with the sun vertical, and two dry seasons when the sun is farthest from the zenith, and while the trades blow. These conditions prevail on the Equator, and as far north and south of the Equator (about 10°–12°) as sufficient time elapses between the two zenithal positions of the sun for the two rainy seasons to be distinguished from one another. In this belt there is therefore normally no long dry season. The double rainy season is clearly seen in equatorial Africa and in parts of equatorial South America. The maxima lag somewhat behind the vertical sun, coming in April and November, and the first is the greater one. The minima are also unsymmetrically developed, and the so-called "dry seasons" are seldom wholly rainless. This rainfall type with double maxima and minima has been called the equatorial type, and is illustrated in the curves for Entebbe and Bogota (fig. 5). The annual totals are given. These double rainy and dry seasons are easily modified by other conditions, as by the monsoons of the Indo-Australian areas, so that there is no rigid belt of equatorial rains extending around the world. In South America, east of the Andes the distinction between rainy and dry seasons is often much confused. The annual variation of cloudiness is illustrated by the curve for Ocean island (Oc) in fig. 6, but the annual period varies greatly under local controls.

At greater distances from the Equator than about 10° or 12° the sun is still vertical twice a year within the Tropics, but the interval between these two dates is so short that the two rainy seasons merge into one, in summer, and there is also but one dry season, in winter. This is the so-called tropical type of rainfall, and is found where the trade belts are encroached upon by the equatorial rains during the migration of these rains into each hemisphere. It is illustrated in the curves for São Paulo, Brazil, and for the city of Mexico (fig. 5). The tropical type of rainfall occurs beyond the margins of the region of equatorial rainfall and as we go farther towards the lines of the tropics the rainy season shortens to four months or less, lowlands often become parched during the long dry season (winter), while life resumes activity when the rains return (summer). The Sudan receives rains, and its vegetation grows actively when the doldrum belt is north of the equator (May–August). But when the trades blow (December–March) the ground is parched and dusty. The Venezuelan *llanos* have a dry season in the northern winter, when the trade blows. The rains come in May–October. The *campos* of Brazil, south of the Equator, have their rains in October–April, and are dry the remainder of the year. The Nile overflow results from the rainfall on the mountains of Abyssinia during the northward migration of the belt of equatorial rains.

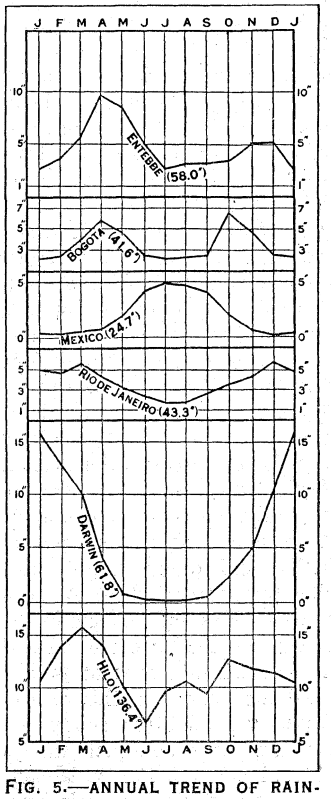


FIG. 5.—ANNUAL TREND OF RAINFALL IN TROPICS, TOTALS GIVEN IN INCHES

The so-called tropical type of temperature variation, with one maximum and one minimum, is illustrated in the accompanying curves for Wadi Halfa, in upper Egypt; Alice Springs, Australia; Nagpur, India; and St. Helena (fig. 7). The effect of the rainy season is often shown in a displacement of the time of maximum temperature to an earlier month than the usual one as at Nagpur.

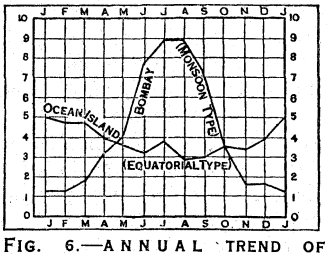


FIG. 6.—ANNUAL TREND OF CLOUDINESS IN TROPICS, WITH EFFECT OF MONSOON

Trade-Wind Belts.—The trade belts near sea-level have fair weather, steady winds, infrequent light rains or even an almost complete absence of rain, very regular, although slight, annual and diurnal ranges of temperature, and constancy and regularity of weather. The climate of ocean areas in the trade-wind belts is indeed the simplest and most equable in the world, the greatest extremes over these oceans being found to leeward of the larger lands. On the lowlands swept over by the trades, beyond the polar limits of the equatorial rain belt (roughly between lats. 20° and 30°), are most of the great deserts of the world. These deserts extend directly to the water's edge on the leeward western coasts of Australia, Africa and America. Ranges and extremes of temperature are much greater over continental interiors than

over oceans in trade-wind belts. Minima of 32° or less occur during clear, quiet nights, and daily ranges of over 50° are common. Midsummer mean temperature rises above 90°, with noon maxima of 110° or more in the non-cloudy, dry air of a desert day. The days, with high, dry winds, carrying dust and sand, with extreme heat, accentuated by absence of vegetation, are disagreeable, but the calmer nights, with active radiation under clear skies, are much more comfortable. Nocturnal temperatures are often low, and thin sheets of ice may form.

While the trades are drying winds as long as they blow strongly over the oceans, or over lowlands, they readily become rainy if cooled by ascent. Hence the windward eastern sides of mountains or bold coasts in the trade-wind belts are well watered, while the leeward sides, or interiors, are dry. Mountainous islands in the trades, like the Hawaiian islands, many of the East and West Indies, the Philippines, Borneo, Ceylon, Madagascar, Teneriffe, etc., show marked differences of this sort. The eastern coasts of Guiana, Central America, south-east Brazil, south-east Africa and eastern Australia are well watered, while the interiors are dry. South America in the south-east trade belt is not well enclosed on the east and the most arid portion is an interior district close to the eastern base of the Andes where the land is low. Even far inland the Andes again provoke precipitation along their eastern slopes and the narrow Pacific coastal strip to leeward of the Andes is a very pronounced desert from near the equator to about lat. 30° S. The cold ocean waters, with prevailing southerly (drying) winds alongshore, are additional factors causing this aridity. The rainfall associated with the conditions just described is known as the *trade* type, and has a maximum in winter when the trades are most active. In cases where the trade blows steadily throughout the year against mountains or bold coasts, as on the Atlantic coast of Central America, there is no real dry season. The curve for Hilo (mean annual rainfall 145·24 in.) on the windward side of the Hawaiian islands, shows typical conditions (*see* fig. 5).

Monsoon Belts.—In a typical monsoon region the rains follow the vertical sun, and therefore have a simple annual period much like that of the tropical type above described. This monsoon type of rainfall is well illustrated in the curve for Port Darwin in Australia (*see* fig. 5). This summer monsoon rainfall results from the inflow of a body of warm, moist air from the sea upon a land area, the rainfall being particularly heavy where the winds have to climb over high lands. In India, the precipitation is heaviest in Assam (where Cherrapunji, at the height of 4,455ft. in the Khasi hills, has a mean annual rainfall of between 400in. and 500in.), on the bold western coast of the peninsula (western Ghats) (120in. and over), and on the mountains of Burma (up to 226in.). In the rain-shadow of the western Ghats, the Deccan often suffers from drought and famine unless the monsoon rains are abundant and well distributed. The prevailing direction of the rainy monsoon wind in India is south-west; on the Pacific coast of Asia, it is south-east. This monsoon district is very large, including the Indian ocean, Arabian sea, Bay of Bengal, and adjoining continental areas; the Pacific coast of China, the Yellow and Japan seas and numerous islands from Borneo to Sakhalin on the north and to the Ladrone islands on the east. A typical temperature curve for a monsoon district is that for Nagpur, in the Deccan (fig. 7), and a typical monsoon cloudiness curve is given in fig. 6, the maximum coming near the time of the vertical sun, in the rainy season, and the minimum in the dry season.

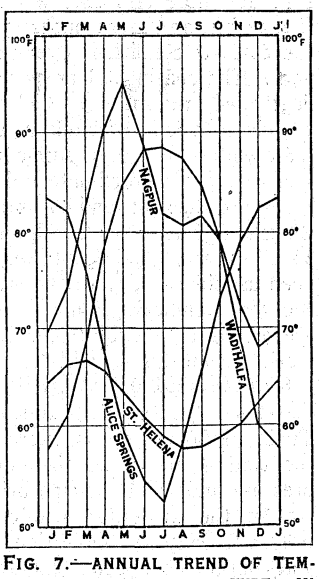


FIG. 7.—ANNUAL TREND OF TEMPERATURE; TROPICAL TYPE IN NORTHERN AND SOUTHERN HEMISPHERES

In the Australian monsoon region, which reaches across New Guinea and the Sunda islands, and west of Australia, in the Indian ocean, over latitudes 0°–10° S., the monsoon rains come with north-west winds between November and March or April. The general rule that eastern coasts between the Tropics are the rainiest finds exceptions in the case of the rainy western coasts in India and other districts with similar monsoon rains. On the coast of the Gulf of Guinea, for example, there is a small rainy monsoon area during the summer; heavy rains fall on the seaward slopes of the Cameroon Mountains where Debundscha averages 369 inches. Gorée, lat. 15° N., on the coast of Senegambia, gives a fine example of a rainy (summer) and a dry (winter) monsoon. In island groups such as the Malay Archipelago where trade winds alternate with monsoons the annual variation of rainfall becomes very complex.

Mountain Climate.—In the torrid zone altitude is chiefly important because of its effect in tempering the heat of the lowlands, especially at night. If mountains are high enough, they carry snow all the year round, even on the Equator. The highlands and mountains within the Tropics are thus often sharply contrasted with the lowlands, and offer more agreeable conditions in Africa and South America. In India, the hill stations are crowded during the hot months by Europeans. The climate of many tropical plateaus and mountains has the reputation of being a "perpetual spring." The rainfall between the Tropics on mountains and highlands often differs considerably in amount from that on the lowlands, and other features common to mountain climates the world over are also noted.

TEMPERATE ZONES

The designation "temperate" is appropriate for the middle latitudes of the southern hemisphere and of the oceans and western coasts in the northern hemisphere, but not for the continental interiors and eastern coasts of Asia and North America, for which Köppen's term "boreal" is better. The temperate zones as a whole are however characterized by the extreme changeableness of their weather, resulting from the frequent passage of barometric depressions.

Temperature.—The annual range of temperature exceeds the diurnal range in all parts of the temperate zone, but the former varies greatly from one part to another. It is smallest on windward islands and coasts and greatest in the interior of the continents, but nearer the east coasts than the west. Thus at Lerwick the range is 15° F from 38° F in February to 53° F in August, while at Iakutsk in Siberia it is 112° F from −46° F in January to 66° F in July, and the average difference between two consecutive months at Iakutsk is greater than the change in six months at Lerwick. Even at Vladivostok on the Pacific coast of Siberia the mean annual range is 61°. The southern part of the temperate zone in central Asia has very hot summers; thus Luktchun in 43° N. has a mean July temperature of 90° and a mean daily maximum in that month of 109°. Over much of the oceans of the temperate zones the annual range is less than 10°. In the south temperate zone there are no extreme ranges, the maxima, slightly over 30°, being near the margin of the zone in the interior of South America, Africa and Australia.

The north-east Atlantic and north-western Europe are about 35° too warm for their latitude in January, while north-eastern Siberia is 30° too cold. The lands north of Hudson bay are 25° too cold, and the waters of the Alaskan bay 20° too warm. In July, and in the southern hemisphere, anomalies are small. The diurnal variability of temperature is greater in the north temperate zone than elsewhere and the same month may differ greatly in its character in different years. The annual temperature curve has one maximum and one minimum. In the continental type the times of maximum and minimum are about one month behind the solstices. In the marine type the retardation may amount to nearly two months. Coasts and islands have a tendency to a cool spring and warm autumn; continents, to similar temperatures in both spring and autumn.

Pressure and Winds.—Over the oceans pressure decreases steadily from the sub-tropical anticyclones to the semi-permanent low pressure areas in about lat. 60°. Hence the prevailing winds are westerly but they are frequently disturbed by the passage of barometric depressions, and the wind may blow from any direction. In the northern hemisphere pressure is higher over the continents than over the oceans in winter, but higher over the oceans than the continents in summer. Hence winter is the stormiest season over the oceans and the prevailing winds become south-westerly on the western coasts of the continents and northerly on the eastern coasts, while in summer they are north-westerly on the western and south-easterly on the eastern coasts. These seasonal changes are best developed on the eastern coast of Asia, where they have the regularity of true monsoons. The winter anticyclone of central Asia has produced the highest known readings of pressure. In the southern hemisphere the seasonal changes are less marked, owing to the preponderance of water, and between lat. 40° and 50° S. the winds blow from some westerly point with considerable regularity and force. These are the "roaring forties" or "brave west winds." Between 50° and 60° S. the winds, while still mainly westerly, are more irregular in direction owing to the frequent passage of storm-centres. Winter in these latitudes is stormier than summer, but seasonal difference is less than north of the Equator.

Rainfall.—Rainfall is fairly abundant over the oceans and also over a considerable part of the lands (30–80in. and more). It comes chiefly in connection with the usual cyclonic storms, or in thunderstorms. The variations, geographic and periodic, in rainfall produced by differences in temperature, topography, cyclonic conditions, etc., are very complex. The equatorial margin of the temperate zone rains is clearly defined on the west coasts, at points where coast deserts are replaced by belts of light or moderate rainfall. Bold west coasts, on the polar side of lat. 40°, are very rainy (100in. to 200in. a year in special situations). The hearts of the continents, far from the sea, especially when well enclosed by mountains, or when blown over by cool ocean winds which warm while crossing the land, have light rainfall (less than 20in.). East coasts are wetter than interiors but drier than west coasts. Autumn and winter are the seasons of maximum rainfall over oceans, islands and west coasts, for the westerlies are then most active, cyclonic storms are most numerous and best developed, and the relatively cold lands chill inflowing damp air. In winter, however, low temperatures, high pressures, and tendency to outflowing winds over continents are unfavourable to rainfall, and the interior land areas as a rule then have their minimum. The warmer months bring the maximum rainfall over the continents. Conditions are then favourable for inflowing damp winds from the adjacent oceans; there is the best opportunity for convection; thunder-showers readily develop on the hot afternoons; the capacity of the air for water vapour is greatest. The marine type of rainfall, with a winter maximum, extends in over the western borders of the continents, and is also found in the winter rainfall of the sub-tropical belts. Rainfalls are heaviest along the tracks of most frequent cyclonic storms. For continental stations the typical daily march of rainfall shows a chief maximum in the afternoon, and a secondary maximum in the night or early morning. The chief minimum comes between 10 A.M. and 2 P.M. Coast stations generally have a night maximum and a minimum between 10 A.M. and 4 P.M.

Humidity and Cloudiness.—Relative humidity is high (80–90%) over the oceans and western coasts and islands. On the eastern coasts and the neighbouring parts of the continents which come under the influence of the inblowing summer winds relative humidity is high in summer but low in winter. In the dry interior of the continents relative humidity is low (20–40%) in summer, though owing to the great heat the absolute humidity may be surprisingly high. In winter in the cold interiors the reverse holds; the absolute humidity is very low but the relative humidity comparatively high. Owing to difficulties of measurement at low temperatures, however, the data available are of doubtful accuracy.

The distribution of cloudiness resembles that of humidity, ranging from one-tenth in the interior deserts to nine-tenths in the oceanic storm areas. The averages for different latitudes are as follows:

Latitude	60°–50° N.	50°–40° N.	40°–30° N.	30°–40° S.	40°–50° S.	50°–60° S.
Land .	6·0	5·0	4·0	4·8	5·8	7·0
Sea . .	6·7	6·6	5·2	5·7	6·7	7·2
Mean .	6·2	5·6	4·5	5·4	6·6	7·2

Seasons in the temperate zones are classified according to temperature, not, as in the Tropics, by rainfall. The four seasons are important characteristics, especially of the middle latitudes of the north temperate zone. Towards the equatorial margins of the zones the difference in temperature between summer and winter becomes smaller, and the transition seasons weaken and even disappear. At the polar margins the change from winter to summer, and vice versa, is so sudden that there also the transition seasons disappear. These seasonal changes are of the greatest importance in the life of man. The monotonous heat of the Tropics and the continued cold of the polar zones are both depressing. The seasonal changes of the temperate zones stimulate man to activity and encourage higher civilization.

Climatic Subdivisions.—There are fundamental differences between north and south temperate zones. Marginal sub-tropical belts must also be considered as a separate group by themselves. The north temperate zone includes large and diverse areas of land, stretching over many degrees of latitude, as well as of water, and has a remarkable diversity of climates. Thus there are the ocean areas and the land areas. The latter are then subdivided into western (windward) and eastern (leeward) coasts and interiors. Mountain climates remain as a separate group.

South Temperate Zone.—Because of the large ocean surface, the régime in the south temperate zone is more uniform than in the northern. The south temperate zone may properly be called "temperate." Temperature changes are small, prevailing winds are stronger and steadier than in the northern hemisphere; seasons are more uniform; weather is prevailingly stormier, more changeable, and more under cyclonic control. The uniformity of the climatic conditions over the far southern oceans is monotonous. The continental areas are small, and develop to a limited degree only the more marked seasonal and diurnal changes which are characteristic of lands in general. Summers are less stormy than winters, but even summer temperatures are not high. New Zealand, with mild climate and fairly regular rains, is really at the margin of the zone, and has much more favourable conditions than the islands farther south, which have dull, cheerless climates. The zone enjoys a good reputation for healthfulness, which fact has been ascribed chiefly to the strong and active air movement and the cool summers. It must be remembered, also, that the lands are mostly in the sub-tropical belt, which possesses peculiar climatic advantages, as will be seen.

Sub-tropical Belts: *Mediterranean Climates.*—At the tropical margins of the temperate zones are the so-called sub-tropical belts. Their rainfall régime is alternately that of the westerlies and of the trades. In winter the equatorward migration of the great pressure and wind systems brings these latitudes under the control of the westerlies, whose frequent irregular storms give a moderate winter precipitation. These winter rains are not steady and continuous, but are separated by spells of fine sunny weather. The amounts vary greatly; much of the area has less than 20in., but Crkvice, on the Gulf of Cattaro, has 183 in. In summer, when the trades are extended polewards by the out-flowing equatorward winds on the eastern side of the ocean anticyclones, mild, dry and nearly continuous fair weather prevails, with northerly winds blowing towards the tropic.

Sub-tropical belts of winter rains and dry summers are mainly limited to western coasts of continents, and to the islands off these coasts in latitudes between about 28° and 40°. The sub-tropical belt is exceptionally wide in the Old World, and reaches far inland there, embracing countries bordering on the Mediterranean in southern Europe and northern Africa, and then extend-

ing eastward across the Dalmatian coast and the southern part of the Balkan peninsula into Syria, Mesopotamia, Arabia, north of the tropic, Persia and adjacent lands. This distribution has led to the use of the name "Mediterranean climate." Owing to great irregularity of topography and outline, the Mediterranean province embraces many varieties of climate, but the dominant characteristics are the mild temperatures, except on the heights, and the winter rains.

On the western coasts of the two Americas the sub-tropical belt of winter rains is clearly seen in California and in north Chile, on the west of the coast mountains. Between the region which has rain throughout the year from the stormy westerlies, and the districts which are permanently arid under the trades, there is an indefinite belt over which rains fall in winter. In south Africa, which is controlled by high pressure areas of the south Atlantic and south Indian oceans, the south-western coastal belt has winter rains, decreasing to the north while the east coast and adjoining interior have summer rains, from the south-east trade. Southern Australia is climatically similar to south Africa. In summer the trades give rainfall on the eastern coast decreasing inland. In winter the westerlies give moderate rains, chiefly on the south-western coast. Sub-tropical climates follow the tropical high pressure belts across the oceans, but do not retain their distinctive character far inland from the west coasts of the continents (except in the Mediterranean), nor on the east coasts. On the latter, summer monsoons and the occurrence of general summer rains interfere, as in east Asia and in Florida.

Strictly, winter rains are typical of the coasts and islands of this belt. The more continental areas have a tendency to spring and autumn rains. The rainy and dry seasons are most marked at the equatorward margins of the belt. With increasing latitude, the rain is more evenly distributed through the year, the summer becoming more and more rainy until, in the continental interiors of the higher latitudes, summer becomes the season of maximum rainfall. The monthly distribution of rainfall in two sub-tropical regions is shown in the accompanying curves for Malta and for Perth (Western Australia) (fig. 8). In Alexandria the dry season lasts nearly eight months; in Palestine from six to seven months; in Greece about four months. The winter rains which migrate equatorward are separated by the Sahara from the equatorial rains which migrate poleward. Large variations in annual rainfall may be expected towards the equatorial margins of sub-tropical belts.

The main features of the sub-tropical rains east of the Atlantic are repeated on the Pacific coasts of the two Americas. In North America the rainfall decreases from Alaska, Washington and northern Oregon southwards to lower California, and the length of the summer dry season increases. At San Diego, six months (May–October) have each less than 5% of the annual precipitation, and four of these have 1%. The southern extremity of Chile, from about latitude 38° S. southward, has heavy rainfall throughout the year from the westerlies, with a winter maximum. Northern Chile is persistently dry. Between these two there are winter rains and dry summers. Neither Africa nor Australia extends far enough south to show the different members of this system well. New Zealand is almost wholly in the prevailing westerly belt. Northern India is unique in having summer monsoon rains and also winter rains, the latter from weak cyclonic storms which correspond with sub-tropical winter rains.

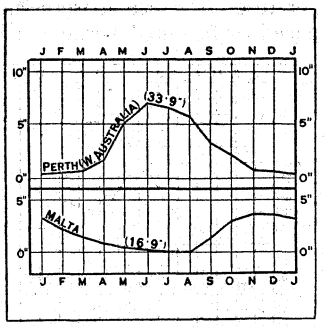


FIG. 8.—ANNUAL TREND OF RAINFALL, SUBTROPICAL TYPE, AT PERTH (W. AUSTRALIA) AND MALTA

From the position of the sub-tropical belts to leeward of the oceans, and at the equatorial margins of the temperate zones, it follows that their temperatures are not extreme. Further, the protection afforded by mountain ranges, as by the Alps in Europe and the Sierra Nevada in the United States, is an important factor in keeping out extremes of winter cold. The annual march and ranges of temperature depend upon position with reference to continental or marine influences (fig. 9). The Mediterranean basin is particularly favoured in winter, not only in the protection against cold afforded by the mountains, but also in the high temperature of the sea itself. The southern Alpine valleys and the Riviera are well situated, having good protection and a southern exposure. The coldest month usually has a mean temperature well above 32°. Mean minimum temperatures of about, and somewhat below, freezing occur in the northern portion of the district, and in the more continental localities such as northern Spain and the Balkans minima a good deal lower have been observed. Somewhat similar conditions obtain in the sub-tropical district of North America. Under the control of passing cyclonic storm areas, hot or cold winds, which often owe some of their special characteristics to the topography, bring into the sub-tropical belts, from higher or lower latitudes, unseasonably high or low temperatures. These winds have been given special names (mistral, sírocco, bora, etc.). Cloudiness is moderate in winter but very small in summer. The winter rains do not bring continuously overcast skies, and a summer month with a mean cloudiness of one tenth is not exceptional in the drier parts of the sub-tropics. With prevailing fair skies, even temperatures and moderate rainfall, the sub-tropical belts possess many climatic advantages which fit them for health resorts. The long list of well-known resorts on the Mediterranean coast, and the shorter list for California, bear witness to this fact.

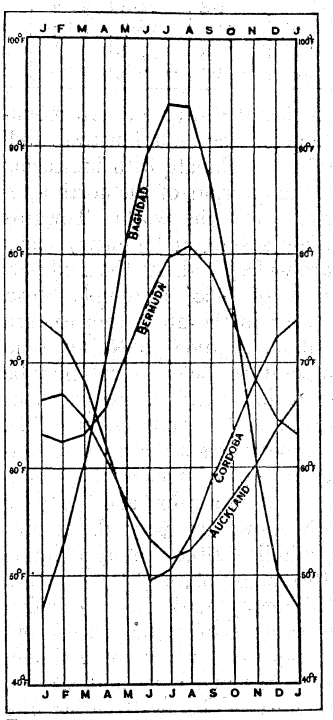


FIG. 9.—ANNUAL TREND OF TEMPERATURE FOR SELECTED SUBTROPICAL STATIONS

North Temperate Zone: *West Coasts:*—Marine climatic types are carried by the prevailing westerlies on to the western coasts of the continents, giving them mild winters and cool summers, abundant rainfall, and a high degree of cloudiness and relative humidity. North-western Europe is particularly favoured because of the remarkably high temperatures of the north Atlantic Ocean. January means of 40° to 50°F in the British Isles and on the northern French coast occur in the same latitudes as those of below 0° in the far interior of Asia. In July means of 60° to 70° in the former contrast with 70° to 80°F in the latter districts. The conditions are somewhat similar in North America. Along the western coasts of North America and of Europe the mean annual ranges are under 25°—actually no greater than some of those between the tropics. Irregular cyclonic temperature changes, are, however, marked in the temperate zone, while absent between the Tropics. The figures for the Scilly isles and for Thorshavn, Faröe islands, illustrate the insular type of temperature on the west coasts. The annual march of rainfall, with the slight maximum in the autumn and winter characteristic of the marine régime, is illustrated in the curve for north-western Europe (fig. 10). On the northern Pacific coast of North America the distribution is similar, and in the southern hemisphere the western coasts of southern America, Tasmania and New Zealand show the same type. The cloudiness and relative humidity average high on western coasts, with the maximum in the colder season.

Continental Interiors.—The equable climate of western coasts changes, gradually or suddenly, into the more extreme climates of the interiors. In Europe, where no high mountain ranges intervene, the transition is gradual, and broad stretches benefit by the tempering influences of the Atlantic. In North America the

MEAN TEMPERATURE

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Scilly Isles	45·7	45·3	46·0	48·6	52·5	57·2	60·5	60·8	58·6	53·8	49·8	47·4	52·2
Prague	29·7	33·1	39·0	47·4	57·0	63·5	66·2	65·1	58·5	49·0	37·9	31·5	48·2
Kharkov	18·0	21·6	29·5	44·6	58·1	64·0	68·0	65·7	55·9	44·8	32·7	23·0	43·7
Omsk	− 3·1	0·1	10·9	32·4	51·8	62·1	66·9	61·3	51·1	34·3	16·0	2·5	32·2
Irkutsk	− 5·8	0·1	15·4	34·0	46·7	58·3	63·9	59·5	47·5	32·9	12·7	−0·6	30·4
Blagoveshchensk	−13·0	− 1·8	14·9	35·2	49·6	63·1	70·0	65·5	53·6	34·3	10·8	−8·0	31·2
Petropavlovsk (Kamchatka)	12·4	12·2	18·7	28·4	36·0	44·2	51·1	53·2	48·4	38·5	27·3	18·1	32·4
Thorshavn	37·6	37·4	37·2	41·0	44·2	48·7	51·3	51·1	48·4	43·9	40·3	38·1	43·3
Yakutsk	−46·1	−34·1	− 9·8	15·6	40·6	58·8	65·5	59·2	42·3	16·5	−19·8	−40·9	−12·4

change is abrupt and comes on crossing the lofty western mountain barrier. The figures in the accompanying table illustrate well the gradually increasing continentality of climate with increasing distance inland in Eurasia. Continental interiors of the north temperate zone have the greatest extremes in the world. Towards the arctic circle winters are extremely severe, and January mean temperatures of −10° and −20° are widespread. At the cold pole of north-east Siberia a January mean of −60° is found. Mean minimum temperatures of −40° occur in the area from eastern Russia, over Siberia and down to about latitude 50°N. Over no small part of Siberia minimum temperatures below −70° may be looked for every winter. Thorshavn and Yakutsk are excellent examples of temperature differences along the same latitude line. Fortunately in Siberia the lowest temperatures are always accompanied by calm weather. A temperature of 0° accompanied by a strong wind is harder to bear than −50° in a calm, and the gales (*buran, purga*), which carry loose snow, are very dangerous. North American winter weather in middle latitudes is often interrupted by cyclones, which, under the steep poleward temperature gradient then prevailing, cause frequent, marked and sudden changes in wind direction and temperature over the central and eastern United States. Cold waves and warm waves are common, and blizzards resemble the buran or purga of Russia and Siberia. With cold northerly winds, temperatures below freezing are carried far south towards the tropic.

The January mean temperatures in the southern portions of the continental interiors average about 50°. In summer the northern continental interiors are warm, with July means of 60° and thereabouts. These temperatures are not much higher than those on the west coasts, but as the northern interior winters are much colder than those on the coasts, the interior ranges are very large. Mean maximum temperatures of 86° occur beyond the Arctic circle in north-eastern Siberia, and beyond latitude 60° in North America. In spite of the extreme winter cold, agriculture extends remarkably far north in these regions, because of warm, though short summers, with favourable rainfall distribution. Summer heat is sufficient to thaw the upper surface of the frozen ground, and vegetation prospers for its short season; great stretches of flat surface become swamps. The southern interiors have torrid heat in summer, temperatures of over 90° being recorded in the south-western United States and in southern Asia. The diurnal ranges of temperature are very large, often exceeding 40°, and mean maxima exceed 110°.

The winter maximum of rainfall and cloud on the west coasts becomes a summer maximum in the interiors. The change is gradual in Europe, as is the change in temperature, but more sudden in North America. The rainfall curves for central Europe and for northern Asia illustrate these continental summer rains (*see* fig.10). The summer maximum becomes more marked with increasing continental character of the climate. There is also a well-marked decrease in the amount of rainfall inland. In western Europe rainfall averages 20in. to 30in., with much larger amounts (reaching 120in. and even more) on bold west coasts, as in the British Isles and Scandinavia, where moist Atlantic winds are deflected upwards, and also locally on mountain ranges, as on the Alps. There are small rainfalls (below 20in.) in eastern Scandinavia and on the Iberian peninsula. Eastern Europe has generally less than 20in., western Siberia about 15in., and eastern Siberia about 10in. In the southern part of the great overgrown continent of Asia an extended region of steppes and deserts, too far from the sea to receive sufficient precipitation, shut in, furthermore, by mountains, controlled in summer by drying northerly winds, receives less than 10in. a year, and in places less than 5in.

The North American interior because of its small area has more favourable rainfall conditions than Asia. The heavy rainfalls on the western slopes of the Pacific coast mountains correspond, in a general way, with those on the western coast of Europe. The coast mountains cause a much more rapid decrease of rainfall inland than in Europe and a considerable south-western interior region has deficient rainfall (less than 10in.). The eastern part of the continent is freely open to the Atlantic and the Gulf of Mexico, so moist cyclonic winds have access, and rainfalls of over 20in. are found everywhere east of the 100th meridian. These conditions are much more favourable than those in eastern Asia. The greater part of the interior of North America has the usual warm-season rains. In the interior basin, between the Rocky and Sierra Nevada mountains, the higher plateaux and mountains receive much more rain (largely from thunderstorms) than the desert lowlands. Forests grow on the higher elevations, while irrigation is necessary for agriculture below. In southern South America the narrow Pacific slope has heavy rainfall (over 80in.); east of the Andes the plains are dry (mostly less than 10in.). The southern part of the continent is very narrow, and is open to the east as well as more open to the west owing to decreasing height of the mountains. Hence the rainfall increases somewhat to the south with passing cyclones. Tasmania and New Zealand have most rain on their western slopes.

East Coasts.—Prevailing winds carry the interior continental climates off over the eastern coasts of the temperate zone lands and even on to the adjacent oceans. The east coasts therefore have continental climates, with modifications resulting from the presence of the oceans to leeward, and have little in common with the west coasts. On west coasts of north temperate lands isotherms are far apart. On east coasts they crowd together. The east coasts share with the interiors large annual and cyclonic ranges of temperature. A glance at isothermal maps of the world will show at once how favoured, because of its position to leeward of the warm North Atlantic waters, is western Europe as compared with eastern North America. A similar contrast, less marked, is seen in eastern Asia and western North America. In eastern Asia coast mountains give some shelter from extreme cold of the interior, but in North America, with no such barrier, severe cold winds sweep across the Atlantic coast States, even far to the south. Owing to prevailing offshore winds, oceans to leeward have relatively little effect.

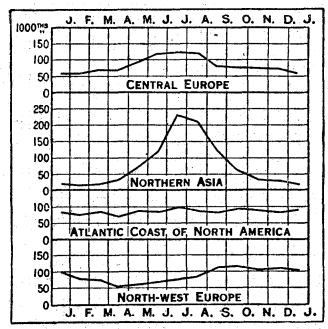


FIG. 10.—ANNUAL TREND OF RAINFALL IN NORTH TEMPERATE ZONE, IN THOUSANDTHS OF ANNUAL TOTALS

The rainfall increases from the interiors towards the east coasts. In North America the distribution through the year is very uniform, with some tendency to a summer maximum, as in the interior (N. A. fig.10). In eastern Asia winters are relatively dry and clear, under the influence of the cold offshore monsoon, and summers are warm and rainy. Rainfalls of 40in. are found on the east coasts of Korea, Kamchatka and Japan, while in North America, which is more open, they reach farther inland. Japan, although occupying an insular position, has a modified continental

rather than a marine climate. The winter monsoon after crossing the water, gives abundant rain and snow on the western coast, while the winter is relatively dry in the lee of the mountains, on the east. Japan has smaller temperature ranges than the mainland.

Mountain Climates.—If the altitude is sufficient, decreased temperature gives mountains a polar climate, with the difference that summers are relatively cool while winters are mild owing to inversions of temperature in anticyclonic weather. Hence annual ranges are smaller than over lowlands. At such times of inversion mountain-tops often appear as local areas of higher temperature in a general region of colder air over valleys and lowlands. Increased intensity of insolation aloft is important for certain mountain resorts in winter (*e.g.*, Davos and Meran). Of Meran it has been well said that from December to March the nights are winter, but the days are mild spring. The diurnal ascending air currents of summer usually give mountains their maximum cloudiness and highest relative humidity in the warmer months, while winter is the drier and clearer season.

CHARACTERISTICS OF THE POLAR ZONES

The temperate zones merge into the polar zones at the Arctic and Antarctic circles, or, if temperature be used as the basis of classification, at the isotherms of 50°F for the warmest month, as suggested by Supan. The longer or shorter absence of the sun gives the climate a peculiar character. Beyond the isotherm of 50°F for the warmest month forest trees and cereals do not grow. In the northern hemisphere this line is well north of the Arctic circle, in the continental climate of Asia, and north of it also in north-western North America and in northern Scandinavia, but falls well south in eastern British America, Labrador and Greenland, and also in the north Pacific Ocean. In the southern hemisphere this isotherm crosses the southern extremity of South America, and runs fairly east and west around the globe. There is a minimum of life, but more in the north polar than the south polar zone. Plants and land animals are few. Farming and cattle raising cease. Population is small and scattered. Man seeks his food chiefly in the sea and lives near the sea-coast. There are no permanent settlements at all within the Antarctic circle. Interior lands are deserted. Arctic vegetation must make rapid growth in the short, cool summer. In the highest latitudes summer temperatures are not high enough to melt snow on a level. Arctic plants grow and blossom rapidly and luxuriantly where the exposure is favourable, and the water from melting snow can run off; the soil then dries quickly and can be effectively warmed. Protection against cold winds is another important factor. Over great stretches of the northern plains the surface only is thawed out in the warmer months, and swamps, mosses and lichens are found over perpetually frozen ground.

Temperature.—At the solstices the two poles receive the largest amounts of insolation which any part of the earth's surface ever receives. Temperatures do not follow insolation in this case because much of the latter never reaches the earth's surface and because much energy which does reach the surface is expended in melting snow and ice of the polar areas. In the winter months there are three cold poles, in Siberia, in Greenland and at the pole itself. In January the mean temperatures at these three cold poles are −49°, −40° and −40° F respectively. The Siberian cold pole becomes a maximum of temperature during the summer, but the Greenland and polar minima remain throughout the year. In July the temperature distribution shows considerable uniformity; the gradients are relatively weak. A large area in the interior of Greenland, and one of about equal extent around the pole, are within the isotherm of 32°. For the year a large area around the pole is enclosed by the isotherm of −4°, with an isotherm of the same value in the interior of Greenland. The annual range of temperature is about 120° in Siberia, 80° in North America, 76° at the North Pole and 72° in Greenland. The North Pole obviously has a continental climate.

For the Antarctic our knowledge is still very fragmentary, and relates chiefly to summer months. Meinardus has determined mean temperatures of higher southern latitudes as follows:—

Mean Temperatures of High Southern Latitudes

S. Lat.	50°	60°	70°	80°
Mean Annual	41·9F	24·6F	8·1F	−12·5F
January	46·9	34·2	29·7	18·7
July	37·4	13·5	−11·0	−33·3

The whole southern hemisphere is colder than the northern. Antarctic summers are decidedly cold. Mean annual temperatures are about 10°, and minima of an ordinary Antarctic winter go to −40° and below, but so far no minima of the severest Siberian intensity have been noted. Maxima have varied between 35° and 50°. Temperatures at the South Pole itself suggest interesting speculations. It is likely that near the South Pole will prove to be the coldest point on the earth's surface for the year, as the distribution of insolation implies and as the conditions of land, ice and snow there suggest. The lowest winter and summer temperatures in the southern hemisphere will probably be found near the pole. Isotherms in the antarctic region bend polewards and equatorwards at different meridians, although much less so than in the Arctic.

The annual march of temperature in the north polar zone, for which we have the best comparable data, is peculiar in having a much retarded minimum in February or even in March—the result of the long cold winter. Temperature rises rapidly towards summer, reaching a maximum in July. Autumn is warmer than spring. The continents do not penetrate far enough into the Arctic zone to develop a pure continental climate in the highest latitudes. Verkhoyansk, latitude 67° 6′N., has an exaggerated continental type for the margin of the zone, with an annual range of 120°. One-third as large a range is found on Novaya Zemlya. Polar climate as a whole has large annual and small diurnal ranges, but sudden changes of wind may cause marked irregular temperature changes especially in winter. The smaller ranges are associated with greater cloudiness, and vice versa.

Pressure and Winds.—Pressure and winds follow a simpler scheme in the southern than in the northern hemisphere, because of the large extent of ocean. The southward decrease of pressure in temperate latitudes, previously described, ceases in about 60°S., where a trough of low pressure encircles the globe, widening somewhat over the Ross and Weddell Seas, while still farther south pressure rises again. On the northern side of this trough westerly winds prevail, on the southern side easterly winds. Over the Antarctic continent itself periods of calm, and, in winter, intense cold alternate with periods of high winds, which often develop into blizzards. Blizzards are not equally developed on all parts of the Antarctic coast, their frequency depending on the local topography and distribution of pressure; they are especially numerous in Adelie Land. Winds of any force sweep away the surface layer of cold air and cause a marked rise of temperature. They whirl up the loose surface snow but are also accompanied by fresh snow, and visibility is limited to a few yards.

In the Arctic area wind systems are less clearly defined and pressure distribution is much less regular, on account of irregular distribution of land and water. The North Atlantic low-pressure area is more or less well developed in all months. Except in June, when it lies over Southern Greenland, this tongue-shaped trough of low pressure lies in Davis strait, to the south-west or west of Iceland, and over the Norwegian sea. In winter it greatly extends its limits farther east into the inner Arctic ocean, to the north of Russia and Siberia. The Pacific minimum of pressure is found south of Bering strait and in Alaska. Between these two regions a ridge of higher pressure extends from North America to eastern Siberia. This has been called by Supan the *"Arktische Windscheide."* Pressure gradients are steepest in winter. The prevailing westerlies which in the high southern latitudes are so symmetrically developed, are interfered with by the varying pressures over the northern continents and oceans in summer and winter. Isobaric and wind charts show that on the whole winds blow out from the inner polar basin, especially in winter and spring.

Rain and Snow.—The amount of precipitation is comparatively slight in the polar zones, chiefly because of the small capacity of the air for water vapour at the low temperatures there prevailing; partly also because of the rarity of local convectional

storms and thunder-showers. Even cyclonic storms cannot yield much precipitation. Extended snow and ice fields tend to give an exaggerated idea of the actual amount of precipitation. It must be remembered, however, that evaporation is slow at low temperatures, and melting is not excessive. Hence the polar store of fallen snow is well preserved; interior snowfields, ice sheets and glaciers are produced. The commonest form of precipitation is naturally snow, the summer limit of which, in the northern hemisphere, is near the Arctic circle, with the exception of Norway. So far as exploration has yet gone into the highest northern latitudes, rain falls in summer, but probably over most of the Antarctic continent rain never falls. The snow of the polar regions is characteristically fine and dry. At low polar temperatures flakes of snow are not found, but precipitation is in the form of ice spicules. The finest glittering ice needles often fill the air even on clear days, and in calm weather, and, gradually descending to the surface, slowly add to the depth of snow on the ground. Dry snow is also blown from the snowfields on windy days, interfering with the transparency of the air.

Humidity, Cloudiness and Fog.—Absolute humidity is low in polar latitudes, especially in winter, on account of low temperatures. Relative humidity varies greatly, and very low readings have often been recorded. Cloudiness seems to decrease somewhat towards the inner polar areas, after passing the belt of high cloudiness in the higher latitudes of the temperate zones. In marine climates of high latitudes summer has the maximum cloudiness; winter is clearer. The summer maximum is associated with fogs, produced where warm, damp air is chilled by contact with ice. They are also formed over open waters, as among the Faroe islands, for example, and open water spaces, in the midst of an ice-covered sea, are commonly detected at a distance by means of "steam fog." Fogs are less common in winter, when they occur as radiation fogs, of no great thickness. The small winter cloudiness, reported also from the Antarctic zone, corresponds with low absolute humidity and small precipitation. Coasts and islands bathed by warm water of the Gulf Stream drift are usually more cloudy in winter than in summer. The place of fog is in winter taken by fine snow crystals, which often darken the air like fog when strong winds raise the dry snow from the surfaces on which it is lying. Cumulus cloud forms are rare, even in summer. Stratus is probably the commonest cloud of high latitudes, often covering the sky for days without a break.

Physiological Effects.—The north polar summer, in spite of its lack of warmth, is in some respects pleasant and healthful, but the polar night is monotonous, depressing and repelling. Sir W. E. Parry said that it would be difficult to conceive of two things which are more alike than two polar winters. An everlasting uniform snow covering, rigidity, lifelessness and silence—except for the howl of the gale or the cracking of the ice. Small wonder that the polar night has sometimes unbalanced men's minds. The first effects are often a strong desire for sleep and indifference. Later effects have been sleeplessness and nervousness, tending in extreme cases to insanity, anaemia and digestive troubles. Extraordinarily low winter temperatures are easily borne if the air be dry and still. Zero weather seems pleasantly refreshing if clear and calm. But high relative humidity and wind —even a light breeze—give the same degree of cold a penetrating feeling of chill which may be unbearable. Large temperature ranges are endured without danger in the polar winter when the air is dry. Under direct insolation skin burns and blisters; lips swell and crack. Thirst has been much complained of by polar explorers, and is due to the active evaporation from the warm body into the dry, relatively cold air. Polar air is singularly free from micro-organisms owing to lack of communication with other parts; hence many diseases common in temperate zones, "colds" among them, are rare.

Changes of Climate.—The climatic divisions of the world appear to be constant in their broad outlines, but are subject to minor fluctuations which have a duration from a few years up to many centuries. Some known fluctuations of climate have been irregular, but others recur with some regularity. The best known of these meteorological periodicities are the 11-year sunspot cycle, best shown in the tropics, and the Brückner cycle, of about 35 years, in temperate regions. In the geological past there have been far more extensive changes (see *e.g.*, CLIMATIC HISTORY).

BIBLIOGRAPHY.—Scientific climatology is based upon numerical results, obtained by systematic, long continued, accurate meteorological observations. The essential part of its literature is therefore found in the collection of data published by the various meteorological services. The only comprehensive text-book of climatology is the *Handbuch der Klimatologie* of the late J. von Hann (Stuttgart, 1908–11). The first volume deals with general climatology, and has been translated into English (London and New York, 1903). Reference should be made to this book for further details than are here given. The second and third volumes are devoted to the climates of the different countries of the world. Köppen's *Die Klimate der Erde* and Kendrew's *Climates of the Continents* are valuable reference books. The standard meteorological journal of the world, the *Meteorologische Zeitschrift* (Braunschweig, monthly), is indispensable. The *Quarterly Journal of the Royal Meteorological Society* (London), the *Meteorological Magazine* (London), and the *Monthly Weather Review* (Washington, D. C.) are also valuable. The best collection of charts is that in the *Atlas of Meteorology* (London, 1899) which gives an excellent working bibliography. *See* also the bibliography issued by the Royal Meteorological Society.

CLIMATE IN THE TREATMENT OF DISEASE.

Broadly speaking, purity of air (*i.e.*, freedom from solid particles and irritating gases), average temperature, range of temperature, amounts of sunshine and of humidity are the most important considerations in the climatic treatment of disease. Social and economic conditions in any given locality are important but are not discussed here. Individuals react both to heat and cold very differently. At health resorts, where the temperature varies between 55° and 70° F., strong individuals gradually lose strength, whereas a delicate person gains vigour of mind and body and puts on weight. And a corresponding intensity of cold acts in the reverse manner in each case. Thus a moderately warm health resort suits delicate, convalescent or elderly people. Cold, however, when combined with wind and damp, must be avoided by the aged, the delicate, and those prone to gouty and rheumatic affections. The moisture of the atmosphere controls the distribution of warmth on the earth, and is closely bound up with the prevailing winds, temperature, light and pressure. In dry air the evaporation from skin and lungs is increased, especially if the sunshine be plentiful and the altitude high. In warm moist air strength is lost and digestive troubles are common. In moist cold air perspiration is checked, and rheumatic and joint affections are common. The main differences between mountain air and that of the plains depend on the former being more rarefied, colder, of a lower absolute humidity, and offering less resistance to the sun's rays. As the altitude is raised, circulation and respiration are quickened, probably as an effort on the part of the organism to compensate for the diminished supply of oxygen, and somewhat more gradually body weight and the number of red blood corpuscles increase, this increase persisting after a return to lower ground. Thus children and young people are especially likely to benefit by the impetus given to growth and the blood-forming organs. For older people, however, the benefit depends on whether their organs of circulation and respiration can respond to the increased demands on them. For anaemia, pulmonary tuberculosis, deficient expansion of the lungs, neurasthenia, and the debility following fevers and malaria, mountain air is invaluable. But where there is valvular disease of the heart, or rapidly advancing disease of the lungs, it is to be avoided. Light, especially direct sunlight, is of primary importance, the lack of it tending to depression and dyspeptic troubles. Indeed, the modern view is that the value of a climate is determined chiefly by the average intensity of ultra-violet light. Probably its germicidal power accounts in part for the aseptic character of the air of the Alps, the desert and other places.

A "good" climate is that in which all the organs and tissues of the body are kept evenly at work in alternation with rest. Thus a climate with constant moderate variations in its principal factors is the best for the maintenance of health. But the best climate for an invalid depends on the particular weakness from which he suffers. Thus in pulmonary tuberculosis a cool sunny climate is greatly superior to a tropical one. Exposure to strong winds is harmful, since it increases cough. A high altitude, from the sunshine, the purity and stimulating properties of the air, is of value

to many mild or very early cases, but where the disease is extensive or the heart is irritable, or there is insomnia, high altitudes are contra-indicated. Where the disease is of long standing, with much expectoration, or accompanied by albuminuria, the patient appears to do best in a humid atmosphere but little above the sea level. The climate of Egypt is suitable for cases complicated with bronchitis or bronchiectasis, but is contra-indicated where there is attendant diarrhoea. Madeira and the Canaries are useful when emphysema is present. Bronchitis in young people is best treated by high altitudes, but in older patients by a moist mild climate, except where much expectoration is present.

Delicate children benefit by residence at the seaside and if very delicate, with small power of reaction, the winter should be passed at some mild coast resort. Gouty and rheumatic affections require a dry soil and warm dry climate, cold and moist winds being especially injurious.

For heart affections high altitudes are to be avoided, though some physicians make an exception of mitral cases where the compensation is good. Moderate elevations of 500 to 1,500ft. are preferable to the sea level.

In diseases of the kidneys, a warm dry climate, by stimulating the action of the skin, lessens the work to be done by these organs, and thus is the most beneficial. Extremes of heat and cold and elevated regions are all to be avoided. (*See* HELIOTHERAPY.)

CLIMATIC HISTORY. The geological history of the earth is divided into five main divisions, Archaean or Pre-Cambrian, Palaeozoic, Mesozoic, Tertiary and Quaternary periods (*see* GEOLOGY). These different periods contain evidence of many great changes of climate, but this article is limited to those which have occurred since the appearance of man. The earliest forms of man-like creatures probably appeared towards the close of the Tertiary period, and their development has been greatly influenced by a series of climatic changes which occurred during the Quaternary. The Tertiary is divided into Eocene, Oligocene, Miocene and Pliocene; a fifth stage, the Pleistocene, is now generally included with the Quaternary. The Eocene began 60 million years ago, the Pliocene ended probably 600,000 to a million years ago. At the beginning of the Eocene the climate of middle latitudes was somewhat warmer than it is at present, and in the later Eocene and Oligocene it became very much warmer. Beds of fossil plants of warm temperate aspect dating from these periods have been found north of the Arctic Circle in many regions. In the Miocene the climate was somewhat cooler than in the Oligocene, though probably warmer than the present. At the beginning of Pliocene times, ten to 15 million years ago, the climate of the north temperate regions again became warmer, but this was temporary, and towards the close of this period there was a rapid cooling. This change is well shown in East Anglia, where the earlier Pliocene beds contain mainly southern mollusca, while in the upper part of the Red Crag northern species become increasingly frequent. The later Pliocene beds of East Anglia, the Chillesford beds and Weybourne Crag, contain large numbers of arctic species, and are probably contemporaneous with the first glaciations of Scandinavia and the Alps. The latest bed in this country which was formerly attributed to the Pliocene, the Cromer Forest bed, indicates a return of somewhat warmer conditions; it is succeeded by boulder clays and other deposits of land ice, indicating the oncoming of glacial conditions in England itself. The discovery of Palaeolithic implements in this bed indicates, however, that the forest bed and the underlying Weybourne crag should be removed to the Pleistocene. The "Quaternary" Ice age began on the continent of Europe and in North America in the Pliocene, but it is convenient to ignore this somewhat arbitrary division and to consider the Ice Age as a whole.

The Quaternary Ice Age.—The Quaternary or Pleistocene Ice Age was characterized by the advance of great glaciers or ice-sheets from a number of centres, of which the most important were Scandinavia and the Alps in Europe, the Cordilleras and various other centres in North America. Minor centres of glaciation were located in Spitsbergen, Iceland, Ireland, Scotland and northern England, the Pyrenees, the Caucasus Range, the Himalayas, the mountain ranges of central Asia, Alaska and the whole chain of the Rockies and Andes, the highest mountains of equatorial Africa, south-eastern Australia and New Zealand. The ice-sheets of Greenland and Antarctica are remnants of the Quaternary glaciation, and illustrate the character of the great inland ice-sheets of northern Europe and North America.

Glaciation of the Alps.—The classical work of A. Penck and E. Brückner in the Alpine region has shown that there were four main advances of the glaciers in Central Europe, which they designated Gunz, Mindel, Riss and Wurm. The intervening periods during which the ice retreated (interglacial periods) are termed Gunz-Mindel, Mindel-Riss and Riss-Wurm. In the Gunz glaciation the snow-line probably lay 3,900ft. lower than now, but the remains of this glaciation have been almost entirely obliterated by the later advances. Of the Gunz-Mindel interglacial nothing is known with certainty, but from the amount of erosion performed by the rivers its duration is estimated as 60,000 years. The Mindel glaciation was regarded by Penck and Brückner as the greatest advance of the ice over the eastern half of the Alpine region. The snow-line lay about 4,250ft. below the present. The Mindel-Riss interglacial was very long (about 240,000 years), and for part of the time warmer than the present. The Riss was regarded as the greatest glaciation in the south-west and west, with a snow-line about 4,250ft. below the present. The Riss-Wurm interglacial was relatively short (about 60,000 years), but probably for a time warmer than the present. The Wurm glaciation was considered by Penck and Brückner to have been smaller in extent than the Riss (depression of snow-line 3,900ft.), but the latest worker, W. Soergel, regards it as the greatest glaciation of the Alps. The Wurm was double, the two maxima being separated by a slight retreat. The final retreat of the ice was interrupted by three re-advances, the Bühl, Gschnitz and Daun stages. The interval between the second maximum of the Wurm (Wurm II.) and the Bühl, which is important archaeologically, is termed the Achen oscillation. Penck and Brückner estimated the length of the post-Wurm period as 20,000 years.

Changes of Sea Level.—The changes of sea level during the Quaternary are best known from the work of E. Dépéret in the Mediterranean. He recognizes four shore-lines or raised beaches, representing periods when the sea was considerably above its present level. These were separated by periods of land elevation when the sea was below its present level and the Mediterranean was divided into two separate basins.

TABLE I. *The Divisions of the Quaternary Ice Age (the latest are at the top).*

Changes of level.		Glacial stages.	Human Industries.
Monastirian	Upper: Elevation Lower: Submergence to 60ft.	Bühl Re-advance Achen Retreat Wurm Glaciation Riss-Wurm	Magdalenian Solutrean Aurignacian Mousterian Acheulean Evolved Chellean
Tyrrhenian	Upper: Elevation Lower: Submergence to 100ft.	Riss Glaciation Mindel-Riss	Chellean
Milazzian	Upper: Elevation Lower: Submergence to 190ft.	Mindel Glaciation Gunz-Mindel	Pre-Chellean
Sicilian	Upper: Elevation Lower: Submergence to 330ft.	Gunz Glaciation	

Glaciation in Northern Europe.—The history of the Scandinavian ice-sheet is not known so fully as that of the Alps. The ice probably formed first on the Norwegian mountains, but the centre soon shifted to Sweden and the Gulf of Bothnia. The ice-sheet extended into Russia, Germany, Denmark and Holland, and at its maximum filled the North Sea and encroached on the east coast of England, especially over East Anglia, where for a time it united with the ice from northern England. The edge of the

ice-sheet over Europe underwent great fluctuations; it is not known with certainty whether it ever completely melted during the whole course of the Quaternary glaciation, but it is highly probable that this happened during at least the Mindel-Riss interglacial. In East Anglia the Scandinavian ice was followed by English ice bearing great quantities of chalk, which formed the Great Chalky Boulder Clay, but the time relations of the various glacial deposits are not yet settled. Gerard de Geer's study of the deposits left by the retreating ice in Sweden has shown that the last ice-sheet began its final retreat about 20,000 years ago. As in the Alps, the retreat of the ice was interrupted by several re-advances, indicated by great terminal moraines (*see* below).

North America.—In North America great ice-sheets reached lower latitudes than anywhere else on the earth. The ice spread out from three main centres, the Cordilleras in the west, the Keewatin west of Hudson's Bay, and Labrador in the east. The deposits of these various centres are complex, but a succession of five glacial and four interglacial stages has been made out in the Mississippi Valley. The latest glaciation, termed the Wisconsin, was double, like the Wurm, and de Geer has succeeded in correlating the stages of its final retreat with those of the last Scandinavian ice-sheet, but the relations of the earlier glacial stages with those in Europe are uncertain. Interglacial beds in Toronto indicate a long period of retreat and perhaps of complete disappearance of the ice, but their position in the Mississippi sequence is uncertain. In most other parts of the world the glaciation has been shown to include three or four advances of the ice, indicating a general similarity with the sequence in the Alps, but direct correlation is not yet possible.

Stages of Human Culture.—The Quaternary Ice Age roughly coincides with the Palaeolithic (*see* ARCHAEOLOGY: *Stone Age*) stage of human culture. The industries into which the Palaeolithic of western Europe is divided are shown in table 1 with their probable positions in the glacial sequence, but there is still doubt as to the early Palaeolithic. The Magdalenian falls in the period of arctic climate about the Bühl re-advance, while the Solutrean and Aurignacian occupy the Achen oscillation, a period of dry steppe-like climate which followed Wurm II. The whole Wurm glaciation (Upper Monastirian) is occupied by the Mousterian, which extends back into the Riss-Wurm interglacial (Lower Monastirian), but how far is not quite settled. The controversy has been concerned chiefly with the position of the Chellean industry, which some assign to the Riss-Wurm, others to the Mindel-Riss interglacial. The correlation in table 1 is a compromise, due to Prof. W. J. Sollas, who places the Chellean proper in the Mindel-Riss (Lower Tyrrhenian) and a later development of it, the "evolved Chellean," in the early part of the Riss-Wurm, while the Acheulean occupies the central and latter parts of that interglacial and the Lower Mousterian its closing stages. The fore-runners of the Chellean types (Pre-Chellean) apparently belong to the Gunz-Mindel interglacial (Lower Milazzian).

Late-Glacial and Post-Glacial Periods.—The climatic history of the concluding stages of the Ice Age is best known from Scandinavia, and thanks to the researches of G. de Geer the various stages have been dated. About 20,000 B.C. the ice-edge lay for a time across Denmark and the Baltic coast of Germany and formed the *Daniglacial* moraine. After a period of retreat, the ice-edge halted again near the coast of the Scandinavian peninsula, where it formed the *Gotiglacial* moraine. The ice then vacated Scania, but there was another long halt about 9000 B.C., forming the great *Fennoscandian* moraines. Up to this time the recession had been comparatively slow, and the edge of the ice had changed but little on the coast of Norway and in northern Finland, while it had everywhere been bordered by a belt of Arctic plants, showing that the temperature was still very low. After the formation of the Fennoscandian moraines, however, there followed a period of very rapid retreat, termed *Finiglacial* time, during which temperate plants occupied almost immediately the ground vacated by the ice, indicating a comparatively high temperature. By about 7000 B.C. the remnants of the ice-sheet had shrunk to a long narrow strip along the centre of Scandinavia. After a short halt termed the *Ragunda* Pause, the ice-sheet split into two separate portions about 6500 B.C., and this date is regarded by Scandinavian geologists as the "official" end of the Ice Age. The correlation between the stages of retreat in Scandinavia and the Alps is not yet known, but it is not unlikely that the great Fennoscandian moraines represent the Bühl stage.

In Britain various Arctic plant beds are known which were presumably formed during the halts represented by the Gotiglacial and Fennoscandian moraines, and there were local re-advances of mountain glaciers in Scotland at the same times. The retreat stages of other centres of glaciation are not yet known in detail, but de Geer and Ernst Antevs have been able to date parts of the retreat stages of the ice-sheets in Canada and southern Argentina by comparing the relative thicknesses of successive annual clay deposits with those in Sweden.

Changes in Land and Sea Distribution.—As the Scandinavian ice-sheet began to vacate the Baltic basin, the latter was occupied by a fresh-water lake, bounded on the north by the ice. After the formation of the Fennoscandian moraines a subsidence of the land allowed the ingress of the sea, both from the Atlantic across Scania and from the White sea across Finland. The site of the Baltic was now occupied by the Arctic sea, called the *Yoldia sea* from the presence of the high northern mollusc *Yoldia arctica*. About the time of the Ragunda Pause the land rose again and both outlets to the ocean were closed. The Baltic now became a fresh-water lake, which from its characteristic mollusc is termed the *Ancylus* lake. The greater part of the Ancylus lake stage falls in post-glacial time, during which the last remnants of the ice-sheet disappeared. About 4000 B.C. a new period of submergence began in the south-west Baltic, again admitting the waters of the Atlantic and forming the *Littorina sea*. This sea was warmer and more saline than the present Baltic, because the inlet from the Atlantic was wider and deeper. The maximum subsidence probably occurred about 3000 B.C., after which the land gradually rose again and conditions approached those of the present.

A raised beach at a height of about ten ft. above the present beach is found almost all over the world, and in many parts is accompanied by a kind of fauna now known only from lower latitudes. Such a widespread change of level indicates a rise of the sea, due to a greater volume of water in the oceans. The additional water can only have come from a melting back of the still existing ice-sheets, especially of Greenland and Antarctica, beyond their present limits; there is also independent evidence that this occurred. This general warm period is termed the *Climatic Optimum*; it falls somewhere within the time of the Littorina sea and probably between 2000 and 1000 B.C.

Vegetation.—Much information as to late-glacial and post-glacial climates is provided by the vegetation, especially of peat-bogs. In central Europe the Wurm glaciation was accompanied and followed by tundra, which gave place during the latter half of the Achen oscillation to dry cold steppe conditions during which Solutrean man, who hunted the horse, penetrated Europe from the east. In the Lower Magdalenian, the culture of which is based on the reindeer, conditions again became moister and colder, and the tundra returned for a short time, to be rapidly replaced by pine forest spreading up from the south-east. In the Upper Magdalenian the pine began to be replaced by dense forests of oak and the reindeer gave way to the red deer. Dense forests were almost impenetrable to primitive man, and in central Europe there is almost a gap—the "hiatus"—between Palaeolithic and neolithic industries.

In Scandinavia the retreating ice-sheet was bordered by a broad zone of Arctic vegetation until the close of the Fennoscandian halt. The aspen appeared in the much warmer Finiglacial, the fir in the Ancylus period. The very favourable conditions of Littorina time were marked by a wealth of new trees, including oak, hazel and beech; at one time the hazel greatly exceeded its present limits both of latitude and height.

Wet and Dry Periods.—The post-glacial period has had marked alternations of wet and dry climates, which were first set out by the Norwegian Axel Blytt. The time of the Ancylus lake was generally dry, with warm summers but cold winters; Blytt termed this the *Boreal* stage. The early part of Littorina time

was moist, with very mild winters and summers probably as warm as at present, forming the *Atlantic* stage, which was marked by a great growth of peat in northern and western Europe. About 3000 B.C. the warm moist conditions gave way to a dry climate, with very warm summers and winters no colder than the present. The surfaces of the peat-bogs dried up, and in Scandinavia, Scotland and Ireland they were occupied by oak forests; in Germany there is instead a layer of dry heath peat. Blytt terms this the *Sub-Boreal* period. About 850 B.C. there was a marked deterioration of climate, which became moist and cold, forming the *Sub-Atlantic* period, when the forests on the peat-bogs died and were replaced by a new and very rapid growth of peat. The change from the very favourable climate of the Sub-Boreal to the unfavourable climate of the Sub-Atlantic was very marked in the Alps; during the Bronze Age and the beginning of the Early Iron Age the climate was highly favourable and there was free communication across the passes; but early in the Iron Age the passes were closed and human occupation was banished to the lowest and warmest valleys, while at the same time many of the lake-dwellings were submerged. It seems probable that the Daun re-advance of the Alpine glaciers should be attributed to this stage; Penck and Brückner dated the Daun re-advance as older than the Bronze Age, but on very scanty evidence.

The Boreal period is not well shown in the British Isles, but the succession of Atlantic peat, Sub-Boreal forest and Sub-Atlantic peat is well seen in Ireland, most of Scotland and western England but not well developed in eastern England.

Summary.—The various late-glacial and post-glacial stages in Scandinavia may be summarized as follows:

TABLE 2. *Late-glacial and Post-glacial Stages.*

Date B.C.	Scandinavian Ice Sheet.	Land and Sea.	Trees.	Wet and dry periods.
0	Post-glacial	Littorina Sea	Oak Beech Hazel	Sub-Atlantic
1000				
2000				Sub-Boreal
3000				
4000				Atlantic
5000		Ancylus Lake	Fir	
6000				Boreal
7000	Ragunda Pause		Aspen	
8000	Finiglacial Retreat	Yoldia Sea	Arctic Plants	Sub-Arctic and Arctic
9000	Fennoscandian Halt	Ice-Lakes		
10000				

THE HISTORICAL PERIOD

There is no clear boundary between the geological and historical periods, for in Egypt and south-west Asia the beginnings of history are almost contemporary with the end of the Ice Age in Scandinavia. In the arid regions of Arabia, Mesopotamia and central Asia variations of rainfall are of much greater importance than small variations of temperature, and this discussion is accordingly limited to the alternations of wet and dry periods.

Persia.—The semi-arid settlement of Anau on the northern margin of Persia is important. This site was occupied from time to time and abandoned during the intervening periods, and since there is no evidence of conquest, while the periods of abandonment are represented by desert formations, it is highly probable that the interruptions were due to drought. These settlements were investigated by Mr. Raphael Pumpelly, who dated them by means of the relative thickness of deposits. According to Pumpelly's estimates the first settlement began about 9000 B.C., the second, which immediately succeeded it, about 6000 B.C. The last part of the first settlement and the whole of the second show evidence of gradually increasing drought, and the site was abandoned soon after 6000 B.C. It was reoccupied, after an interval of desert conditions, about 5200 B.C. The third settlement continued until about 2200 B.C., with a short interruption, probably due to drought, about 3000 B.C. These estimates of the age of Anau appear to be far too great, and H. Peake and H. J. Fleure suggest that the first settlement did not begin till about 3900 B.C., while the third settlement lasted from about 2500 to 1600 B.C. At the close of the third period there began a period of intense drought, and Anau was not reoccupied until the Iron Age, probably about 750 B.C.

It is highly probable that in semi-arid regions the amount of unrest and migration increases during periods of drought, so that we can infer the variations of dryness from the frequencies of migrations. A period of extensive migration began about 2650 B.C. and culminated between 2300 and 2050. Another maximum occurred about 1350 to 1300, after which the desert peoples began to settle down, and remained quiet until the Arabian dispersal of the seventh century A.D. (which began before the birth of Mohammed).

Caspian Sea.—During the Christian era our information is mainly derived from the variations of level of the Caspian Sea, amplified and supported by records of other lakes in Asia, and by Chinese archives. There is some doubtful evidence that the level of the Caspian was high about A.D. 0, but this is not confirmed by other sources. In the 5th century A.D. the Caspian was very low. Then follows a period of rapid fluctuations; high level about 920, low about 1125, very high from 1306 to 1325 and again early in the 15th century and about 1560 to 1640.

Africa.—The evidence from northern Africa is mainly provided by the levels of the Nile floods, the history of Kharga Oasis, and the variations in the level of civilization in the Sahara. These point to a rainfall much higher than the present about 500 B.C., a minimum about A.D. 200, a slight improvement about 400, a very dry season from 700 to 1000, and a great improvement from about 1225 to 1300, followed by a decline to present conditions. It is interesting that E. J. Wayland has recently shown the existence of a marked dry period in central Africa in Neolithic times, probably representing the Sub-Boreal period.

America.—In North America the evidence is derived mainly from the width of the annual rings of growth of the "Big Trees" of California; the curve of tree growth can be checked and adjusted by the variations in the levels of the salt lakes of western America, and by archaeological evidence. The result shows that a long dry period ended about 1000 to 800 B.C., followed by a period of high rainfall from 700 B.C. to A.D. 200, reaching a strongly marked maximum at 400 B.C. A long dry period began about A.D. 400 and continued until about 1250, with one break at about 1000, and there was a further dry spell in the 15th century.

In Yucatan and central America the Mayan civilization reached its highest level apparently from 100 B.C. to A.D. 350. After about 350 came the Mayan "Dark Ages," when southern Yucatan relapsed into barbarism. A revival occurred about A.D. 1000, but did not reach the level of the earlier period and probably lasted little more than two centuries. The ruins are now overgrown by dense forests, and Ellsworth Huntington makes the plausible assumption that the periods of high culture represent dry periods. If so, these are contemporaneous with the wet periods of Arizona, and represent a southward swing of all the climatic belts.

Recent excavations in southern Greenland have shown that its climate was far more favourable in the tenth century than it is to-day, and Baffin Bay seems to have been almost free of ice. There was a deterioration about A.D. 1000, followed by a slight improvement during the 11th and 12th centuries, after which the climate rapidly became very bad. The ground, which at first thawed to a considerable depth every summer, became permanently frozen about A.D. 1400.

BIBLIOGRAPHY.—C. E. P. Brooks, *The Evolution of Climate* (2nd ed. 1925) (Glacial and late glacial periods) and *Climate through the Ages* (1926); A. P. Coleman, *Ice Ages* (1926); H. Peake and H. J. Fleure, *Corridors of Time*, 1. *Apes and Men*, 2. *Hunters and Artists*, 3. *Peasants and Potters* (1927); A. Penck and E. Brückner, *Die Alpen im Eiszeitalter* (Leipzig, 1902–09); W. J. Sollas, *Ancient Hunters* (3rd ed. 1924). (C. E. P. B.)

CLIMAX, JOHN (*c.* 525–600 A.D.), ascetic and mystic, also called Scholasticus and Sinaïtes. After 40 years in a cave at the foot of mount Sinai, he became abbot of the monastery. His life has been written by Daniel, a monk of the monastery of Raithu, on the Red Sea. He derives his name Climax (or Climacus) from his work of the same name (Κλῖμαξ τοῦ Παραδείσου, ladder to Paradise), in 30 sections, corresponding to the 30 years of life of Christ. It is written in a simple and popular style, and treats of the vices that hinder the attainment of holiness and the Christian virtues.

BIBLIOGRAPHY.—Migne, *Patr. graeca,* lxxxviii. (including the biography by Daniel); *see* also C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897); Herzog-Hauck, *Realencyklopädie.* The *Ladder* has been translated into several languages—into English by Father Robert, Mount St. Bernard's Abbey, Leicestershire (1856).

CLIMB INDICATOR: *see* ALTIMETER.

CLIMBING BITTERSWEET (*Celastrus scandens*), a North American climbing shrub of the staff-tree family (Celastraceae), called also false bittersweet and waxwork. It grows, mostly in rich soil, from Quebec to Manitoba and southward to North Carolina and New Mexico, usually trailing on banks or small shrubs but sometimes climbing to a height of 25 ft. on trees. It has smooth, pointed leaves and small greenish flowers and matures in autumn showy clusters of orange-yellow, berry-like capsules which split open after frost, disclosing the crimson coverings (arils) enclosing the seeds. The handsome, persistent fruit is used in winter for indoor decoration. (*See* BITTERSWEET.)

CLIMBING FERN, the botanical genus *Lygodium,* with 40 species, chiefly in the warmer parts of the Old World. The plants have a creeping stem, on the upper face of which is borne a row of leaves. Each leaf has a slender, stem-like axis, which twines round a support and bears leaflets at intervals; it goes on growing indefinitely. Several species are favourite greenhouse plants. The American climbing fern (*L. palmatum*), called also Hartford fern and Windsor fern, one of the most beautiful ferns native to the United States, grows in open woods from New Hampshire to Pennsylvania and Ohio south to Florida and Tennessee.

CLIM or **CLYM OF THE CLOUGH,** a legendary English archer, a supposed companion of the Robin Hood band. He is commemorated in the ballad *Adam Bell, Clym of the Cloughe and Wyllyam of Cloudeslee.* The three were outlaws who had many adventures of the Robin Hood type. The oldest printed copy of this ballad is dated 1550.

CLINCHANT, JUSTIN (1820–1881), French soldier, was born at Thiaucourt (Meurthe) on Dec. 24, 1820, and died in Paris on March 20, 1881. He entered the army from St. Cyr in 1841. He served in Algeria (1847–52), in the Crimea (1854–55), and in Mexico. He held a brigade command in 1870, was captured at Metz, but escaped, and was placed in command of the 20th Corps of the Army of the East. He was under Bourbaki during the campaign of the Jura, and when Bourbaki attempted to commit suicide he succeeded to the command (Jan. 23, 1871), only to be driven with 84,000 men over the Swiss frontier at Pontarlier. In 1871 Clinchant commanded the 5th Corps operating against the Commune. He was military governor of Paris when he died.

CLINIC, an institution that offers diagnostic, therapeutic or preventive treatment to ambulatory patients. Considered from the standpoint of organization, range of diseases treated, general purpose and function, the term may be used to include outpatient departments of hospitals, unattached units, teaching clinics—either separate or attached—health centres, preventive, curative, public or proprietary institutions. It may also be used to define a particular lecture, classroom or bedside examination where several medical men express their views.

The first dispensary or clinic in the English-speaking world was founded in London in 1696 by philanthropic physicians as a means of providing medicines to accompany the services they made without payment toward the relief of the sick poor. The Philadelphia, New York and Boston Dispensaries, founded in 1786, 1791 and 1796, respectively, had the same object in view. The modern attitude, however, substitutes medical service for medicine and a small payment for actual charity. Johns Hopkins and Massachusetts General Hospital, by establishing outpatient departments in which their medical students could be taught methods of diagnosis and treatment by personal contact, are believed to be the American pioneers in this form of medical education. As for the public health aspect—the first great movement of this kind resulted in the founding of the National Organization for the Study and Prevention of Tuberculosis in 1905, with the consequent establishment of 500 tuberculosis clinics during the first ten years of its existence. Meanwhile interest in the public welfare has added further clinics, as evidenced by the following figures, available in 1927: In a survey conducted in 83 large cities of the United States it was discovered that 81 had well-baby clinics; 81 had venereal disease clinics; 77 tuberculosis; 68 prenatal and 31 mental clinics—maintained in large part by city health appropriations.

Social service agencies, realizing the important part that illness plays in social maladjustment, have contributed their share in increasing clinic attendance, which jumped from 4,000,000 in 1917 to 10,000,000, in 1927. This increase is largely due to greater efforts for the prevention of disease. Many diseases that in the past were not attended to until they had reached a bed-confining stage can now be diagnosed and cared for in the early stages at clinics, while specialized treatment for various diseases of the skin, eye, nose and throat, and mental, nutritional and postural defects that either were not previously recognized or have come into being as a result of present living and industrial conditions, can be cared for under conditions obtaining at the clinics. In 1925 it was estimated that the number of clinics existing in the United States totalled 5,000, as contrasted with 150 in 1900. In Great Britain the activities outlined above are in the main grouped around the great general hospitals but a few independent dispensaries still exist and have expanded their usefulness.

CLINKER, in industry, the common name for coal residues which are formed in lumps, partly fused, in grates or furnaces. Such clinker is used for many purposes as a raw material, and is a useful matrix for inferior Portland cement concrete. The name is also applied to the fused masses of brick which occur in brick ovens.

What is really a different word, but with the same spelling, is derived from *clinch,* or *clench,* a common Teutonic word, meaning to "fasten together." This word appears in the form "clinker-built" as distinguished from "carvel-built" for a boat whose strakes overlap and are not fastened "flush."

CLINOCLASITE, a rare mineral consisting of the basic copper arsenate $(CuOH)_3AsO_4$. It is deep blue in colour and crystallizes in the monoclinic system with a perfect cleavage parallel to the basal plane; hardness $2\frac{1}{2}$-3; specific gravity 4·36. The mineral was formerly found with other copper arsenates in the mines of the St. Day district of Cornwall and near Tavistock in Devonshire, near Sayda (or Saida) in Saxony, and in the Tintic district of Utah. It is a mineral of secondary origin, having resulted by the decomposition of copper ores and mispickel in the upper part of mineral veins.

CLINOGRAPH, a set-square the acute angles of which are made adjustable by connecting the side opposite the right-angle to one of the other sides by a hinge; it is frequently employed in mechanical drawing (*see* DRAWING, ENGINEERING).

CLINTON, DE WITT (1769–1828), American political leader, was born on March 2, 1769, at Little Britain, N.Y. His father, James Clinton (1736–1812), served as a captain of provincial troops in the French and Indian War, and as a brigadier-general in the American army in the Revolutionary War. De Witt Clinton graduated at Columbia college in 1786, and in 1790 was admitted to the bar. From 1790 to 1795 he was the private secretary of his uncle, George Clinton, governor of New York and a leader of the Republican Party. He entered the State senate in 1798, serving until 1802. He at once became a dominant factor in New York politics, and for the next quarter of a century he played a leading rôle in the history of the commonwealth. From 1801 to 1802 and from 1806 to 1807 he was a member of the council of appointment; and realizing the power this body possessed through its influence over the selection of a vast number of State, county and municipal officers, he secured in 1801, while

his uncle was governor, the removal of a number of Federalist office-holders, in order to strengthen the Republican organization by new appointments. On this account Clinton has generally been regarded as the originator of the "spoils system" in New York; but he was really opposed to the wholesale proscription of opponents that became such a feature of American politics in later years. It was his plan to fill the more important offices with Republicans, as they had been excluded from appointive office during the Federalist ascendancy, and to divide the smaller places between the parties somewhat in accordance with their relative strength. In counties where the Federalists had a majority very few removals were made.

In 1802 Clinton became a member of the U.S. Senate, but resigned in the following year to become mayor of New York city, an office which he held for 10 years in the period 1803–15. During his mayoralty he also held other offices, being a member of the State senate in 1806–11 and lieutenant-governor in 1811–13. In 1812, after a congressional caucus at Washington had nominated Madison for a second term, the Republicans of New York, desiring to break up the so-called Virginia dynasty as well as the system of congressional nominations, nominated Clinton for the presidency by a legislative caucus. Opponents of a second war with Great Britain had revived the Federalist organization, and Federalists from 11 States met in New York and agreed to support Clinton, not on account of his war views, which were not in accord with their own, but as a protest against the policy of Madison. In the election Clinton received 89 electoral votes and Madison 128.

As a member of the legislature Clinton was active in securing the abolition of slavery and of imprisonment for debt, and in perfecting a system of free public schools. In 1810 he was a member of a commission to explore a route for a canal between Lake Erie and the Hudson river, and in 1811 he and Gouverneur Morris were sent to Washington to secure Federal aid for the undertaking, but were unsuccessful. The second war with Great Britain prevented any immediate action by the State; but in 1816 Clinton was active in reviving the project, and a new commission was appointed, of which he became president. His connection with this work so enhanced his popularity that he was chosen governor by an overwhelming majority and served for two triennial terms (1817–23). As governor he devoted his energies to the construction of the canal, but the opposition to his administration, led by Martin Van Buren and Tammany Hall, became so formidable by 1822 that he declined to seek a third term. His successful opponents, however, overreached themselves when in 1824 they removed him from the office of canal commissioner. This partisan action aroused such indignation that at the next election he was again chosen governor, by a large majority, and served from 1825 until his death. As governor he took part in the formal ceremony of admitting the waters of Lake Erie into the canal in Oct. 1825, and thus witnessed the completion of a work which owed more to him than to any other man. Clinton died at Albany, N.Y., on Feb. 11, 1828. In addition to his interest in politics and public improvements, he devoted much study to the natural sciences; among his published works are a *Memoir on the Antiquities of Western New York* (1818) and *Letters on the Natural History and Internal Resources of New York* (1822).

See J. Renwick's *Life of De Witt Clinton* (1845); D. Hosack's *Memoir of De Witt Clinton* (1829); W. W. Campbell's *Life and Writings of De Witt Clinton* (1849); H. L. McBain's *De Witt Clinton and the Origin of the Spoils System in New York* (1907); T. E. Benedict, "De Witt Clinton's Birthplace," *Olde Ulster*, vol. vii., pp. 65–69 (1911); and E. A. Fitzpatrick, "The Educational Views and Influence of De Witt Clinton," *Teachers College, Columbia University Contributions to Education*, No. 44 (1911).

CLINTON, GEORGE (1739–1812), American soldier and political leader, was born at Little Britain, Ulster (now Orange) county (N.Y.), on July 26, 1739, the son of Charles Clinton (1690–1773), who had emigrated to America in 1729, and commanded a regiment of provincial troops in the French and Indian War. The son went to sea at the age of 16, but, finding the sailor's life distasteful, joined his father's regiment and accompanied him as lieutenant in the expedition against Fort Frontenac in 1758. After the war he practised law and held a number of minor civil offices in Ulster county. From 1768 to 1775 he sat in the New York provincial assembly, and in the controversies with Great Britain zealously championed the colonial cause. In 1774 he was a member of the New York committee of correspondence, and in 1775 was a member of the second Continental Congress. In December of this year he was appointed a brigadier-general of militia by the New York provincial congress. In the following summer, being ordered by Washington to assist in the defence of New York, he left Philadelphia, after voting for the Declaration of Independence, and before he could sign it.

General Clinton took part in the battle of White Plains (Oct. 28, 1776), and was charged with the defence of the highlands of the Hudson, where, with De Witt Clinton, in Oct. 1777, he offered a firm but unsuccessful resistance to the advance of Sir Henry Clinton. In March of this year he had been appointed by Congress a brigadier-general in the continental army, and he thus held two commissions, as the State convention refused to accept his resignation as brigadier-general of militia. So great was Clinton's popularity at this time that at the first election under the new State constitution he was chosen both governor and lieutenant-governor. He declined the latter office, and on July 30, 1777, entered upon his duties as governor, which were at first largely of a military nature. In 1780 he took the field and checked the advance of Sir John Johnson and the Indians in the Mohawk valley. In his administration Clinton was energetic and patriotic, and though not so intellectual as some of his New York contemporaries, he was more popular than any of them. He served as governor for 18 successive years (1777–95), and for another triennial term from 1801 to 1804. In the elections of 1780, 1783, and 1786 he had no opponent. In 1800–01 he was a member of the assembly.

In the struggle in New York over the adoption of the Federal constitution he was one of the leaders of the opposition, but in the State convention of 1788, over which he presided, his party was defeated and the constitution was ratified. In national politics he was a follower of Thomas Jefferson, and in State politics he led the long dominant faction known as "Clintonians." In 1789, 1792, and 1796 Clinton received a number of votes in the electoral college but not enough to secure him the vice-presidency, which was then awarded to the recipient of the second highest number of votes. In 1804, however, after the method of voting had been changed, he was nominated for the vice-presidency by a congressional caucus, and was duly elected. In 1808 he sought nomination for the presidency and was greatly disappointed when this went to Madison. He was again chosen as vice-president, however, and died in Washington before the expiration of his term, on April 20, 1812. He was buried in the congressional cemetery, from which in May, 1908, his remains were transferred to Kingston (N.Y.). His casting vote in the Senate in 1811 defeated the bill for the renewal of the charter of the Bank of the United States.

The *Public Papers of George Clinton*, 6 vols. (1899–1902) have been published by the State of New York. *See* also St. S. Spaulding, *George Clinton and the New York Democracy* (Harvard University, 1926).

CLINTON, SIR HENRY (*c.* 1738–1795), British general, was the son of Admiral George Clinton (governor of Newfoundland and subsequently of New York), and grandson of the 6th earl of Lincoln. After serving in the New York militia, he came to England and joined the Coldstream Guards. In 1758 he became captain and lieutenant-colonel in the Grenadier Guards, and in 1760–62 served as aide-de-camp to Ferdinand of Brunswick in the Seven Years' War. He became major-general in 1772. From 1772 to 1784, thanks to the influence of his cousin, the 2nd duke of Newcastle, he had a seat in parliament, first for Boroughbridge and subsequently for Newark, but for the greater part of this time he was on active service in America in the War of Independence. He took part in the battles of Bunker Hill and Long Island, subsequently taking possession of New York. For his share in the battle of Long Island he was made a lieutenant-general and K.B. After Saratoga he succeeded Sir William Howe as commander-in-chief in North America. He had already been made a

local general. He at once concentrated the British forces at New York, pursuing a policy of foraying expeditions in place of regular campaigns. In 1779 he invaded South Carolina, and in 1780 in conjunction with Admiral M. Arbuthnot captured Charleston. There was constant friction between him and Lord Cornwallis, his second in command, and in 1782, after the capitulation of Cornwallis at Yorktown, he was superseded by Sir Guy Carleton. Returning to England, he published in 1783 his *Narrative of the Campaign of 1781 in North America,* which provoked an acrimonious reply from Lord Cornwallis. He was elected M.P. for Launceston in 1790, and in 1794 was made governor of Gibraltar, where he died on Dec. 23, 1795.

His younger son, SIR HENRY CLINTON (1771–1829), entered the army in 1787 and saw some service with the Prussians in Holland in 1789. He was almost continuously in active service; in the Corunna campaign of 1808–9, he was adjutant general to his close friend, Sir John Moore. Promoted major general in 1810, he returned to the peninsula to fill a divisional command under Wellington in 1811. His division played a notable part in the capture of the forts at Salamanca and in the battle of Salamanca (1812), and he was given the local rank of lieutenant general early in 1813. For his conduct at Vittoria he was made a K.B., and he took his part in the subsequent victories of the Nive, Orthes and Toulouse. At the end of the war he was made a lieutenant general and inspector general of infantry. Clinton commanded a division with distinction at Waterloo. He died on Dec. 11, 1829.

CLINTON, HENRY FYNES (1781–1852), British classical scholar and chronologist, was born at Gamston in Nottinghamshire. He was educated at Westminster and Oxford, and from 1806 to 1826 was M.P. for Aldborough. The value of his *Fasti,* which set classical chronology on a scientific basis, can scarcely be overestimated, even though subsequent research has corrected some of his conclusions.

His chief works are: *Fasti Hellenici, the Civil and Literary Chronology of Greece from the 55th to the 124th Olympiad* (1824–51), including dissertations on points of Greek history and scriptural chronology; and *Fasti Romani, the Civil and Literary Chronology of Rome and Constantinople from the Death of Augustus to the Death of Heraclius* (1845–50). In 1851 and 1853 respectively he published epitomes of the above. *The Literary Remains of H. F. Clinton* (the first part of which contains an autobiography written in 1818) were edited by C. J. F. Clinton in 1854.

CLINTON, a city of Illinois, U.S.A., on federal highway 51 and the Illinois Central railroad, 22 mi. S. of Bloomington; the county seat of De Witt county. The population in 1940 was 6,331. It is in the heart of the corn belt; and has railroad shops and clothing factories. It was settled about 1836, and was incorporated as a city in 1855.

CLINTON, a city of Vermilion county, Indiana, U.S.A., on the Wabash river, 15 mi. N. of Terre Haute and 8 mi. E. of the Illinois state line. It is 1 mi. from federal highway 41, and is served by the Chicago and Eastern Illinois railway. In 1900 the population was 2,918; in 1930, 7,936; in 1940 it was 7,092 by federal census.

Clinton is in a farming and coal mining region, and has varied manufactures, including mining and agricultural machinery, meat and dairy products, sauces and relishes, vaults and other articles of cement, flour, overalls, furniture and blasting powder. The county hospital is located there. Clinton was incorporated as a city in 1893.

CLINTON, a city in the extreme eastern part of Iowa, U.S.A., on the Mississippi river where the Lincoln highway crosses it; the county seat of Clinton county. It is on the Burlington; the Chicago and North Western; the Chicago, Milwaukee, St. Paul and Pacific; and the Rock Island, and is served by several bus lines. The pop. (1920) was 24,151, of whom 3,739 were foreign-born white (1,573 Germans); and in 1940 federal census, 26,270. The city lies about 600 ft. above sea level, and has a background of rolling farm land to the west and rocky bluffs to the north. It has a large system of public parks, mostly along the Mississippi, and beautiful homes shaded by elms which the early settlers planted. Clinton was formerly a great sawmill centre, but when the supply of lumber gave out in the north, the city turned to other industries, such as corn products, mill work, builders' hardware, stock feeds, cellophane, structural steel, and steel and wire specialties. The annual factory output is valued at $30,000,000, and bank deposits amount to more than $10,000,000. There is a 1,000-bed army general hospital in the city.

The first settlers arrived in 1835. The town was replatted in 1855 and named after De Witt Clinton, former governor of New York. It was incorporated in 1859 and reincorporated in 1881.

CLINTON, a town of Worcester county, Massachusetts, U.S.A., on the Nashua river, 15 mi. N.N.E. of Worcester. It is served by the Boston and Maine and the New York, New Haven and Hartford railways. The population in 1920 was 12,979 (32% foreign-born white); 12,817 in 1930; and 12,440 in 1940 by federal census. The town contains varied and picturesque hilly country, with charming scenery along the river. In its southwest corner, on the southern branch of the Nashua river, is part of the Wachusett dam and reservoir of the water-supply system of the Boston metropolitan area. There are extensive manufactures, with an output in 1937 valued at $9,955,943. In 1813 cotton cloth was produced there under the factory system, but the first modern textile mill was established in 1838, for making coach-lace. The industrial importance of the town is due largely to Erastus Brigham Bigelow (1814–79), inventor of power looms which revolutionized the manufacture of figured fabrics, and of a loom for weaving wire cloth. In 1843, with his brother Horatio M. Bigelow, he established in Clinton the Lancaster mills for the manufacture of ginghams, and about ten years later, the Bigelow carpet mills. The Roubaix mills (making fine velours) are also there.

Clinton was settled in 1645, and was separated from Lancaster as an independent town in 1850.

CLINTON, a city of Missouri, U.S.A., 78 mi. S.E. of Kansas City; county seat of Henry county. It is served by the Frisco and the Missouri-Kansas-Texas railways. Population (1940) 6,041. The city lies at the edge of a rolling prairie, 770 ft. above sea level. It is the trade centre for an agricultural and stock raising district and has large flour mills. Considerable coal is mined in the county. It produces over 20,000,000 chicks annually. Clinton was laid out in 1836 and incorporated in 1865.

CLINTON, a village of Oneida county, N.Y., U.S.A., 9 mi. S.W. of Utica, on Oriskany creek and the New York, Ontario and Western railway. The population in 1940 federal census was 1,478. There are mineral springs and iron mines in the vicinity, and the village has knitting and paint mills and vegetable canneries. Many business and professional men of Utica make it their home. It is the seat of Hamilton college for men (opened as an academy for Indian boys in 1798 and chartered as a college in 1812), which was founded by Samuel Kirkland (1741–1808), a missionary among the Oneida Indians, and named after Alexander Hamilton. Its cornerstone was laid by Baron von Steuben; and its shade trees were presented by Thomas Jefferson. The village was widely known as an educational centre between 1798 and 1907, more than 40 private schools for both boys and girls having been established there during that period. The village, settled about 1786 by pioneers from New England, was named after George Clinton, and was incorporated in 1843. It was the birthplace and the summer home of Elihu Root (1846–1937).

CLINTONIA, a genus of beautiful herbs of the lily family (Liliaceae), named in honour of De Witt Clinton (1769–1828), governor of the state of New York. There are 6 species, 4 North American and 2 Asian, all stemless perennials, with a few broad leaves rising from a slender rootstock, and lilylike flowers, usually borne in clusters (umbels) at the top of the flower stalk (scape). The yellow clintonia (*C. borealis*) is found in woods from Newfoundland to Manitoba and southward to North Carolina and Wisconsin; the white clintonia (*C. umbellulata*) occurs in woods from New York and New Jersey to Tennessee and Georgia; the mountain clintonia (*C. uniflora*), with a single white flower, grows from Montana and California northward to Alaska; the western clintonia (*C. andrewsiana*) is found near the Pacific coast in central California.

CLINTONITE: *see* OTTRELITE.

CLIPPER SHIPS, a class of sailing vessel developed principally by American ship-builders during the first half of the 19th century. The origin of the word clipper is not definitely known. Some authors think that the expression "going at a clip" might have been responsible for it, while others have traced the word to the poets Shelley and Burns. The first large ship of the kind was the "Ann McKim" (494 tons), built in Baltimore in 1833; but smaller vessels of similar construction were already well known as "Baltimore clippers." The gold rush in California, which gave such impetus to the building of these ships, was responsible for the launching of 160 clipper ships within 4 years, during the first of which 90,000 passengers were carried, while the discovery of gold in Australia soon after caused 400,000 people to be transported to that country in British-owned clippers. The Bell, Hall, Steers, Webb, Collier, McKay and Magoun are some of the American families who built clipper ships, and the Osgood, Marshall, Trask, Woodhouse, Delano, DePuyster and Russell families had among their members many captains of these vessels. The type was abandoned by American builders after 1854, when freight rates dropped, and since the American clippers were built of oak or other expensive hardwoods, it was no longer profitable to construct them. Subsequently, for more than a decade, a modified ship known as the "medium clipper" was developed. Its speed, however, never equalled that of the original, or "extreme clipper," which might make as much as 18 knots. Typically, the extreme clipper was a long, slender vessel, with a sharp, long bow and with the three masts slanting backwards and carrying rectangular sails. In small vessels, these characteristics of narrow beam and great sail-carrying capacity had been developed by American builders before 1812. The invention of the type, however, was not American; it was an adaptation of principles that had been carefully studied by French scientists during the 18th century and accepted by the builders of French war vessels, which were then the fastest afloat. The majority of the clippers were built in New England yards, and their usual run was between ports of the eastern American seaboard and China, Australia or San Francisco. But the career of the famous "Nightingale," from the time of its launching in 1851 until its loss in 1893, shows a variety of voyages to every part of the world. The equally well known "Witch of the Wave" had a similar record, although shorter by some 20 years.

Besides the Californian and Australian gold rushes and the opium and slave trades, which gave such impetus to the building of clipper ships, one of the most potent motives for speed by water in the early nineteenth century was furnished by the Chinese tea trade. Inasmuch as this commodity quickly loses its flavour in the hold of a ship, annual prizes were offered by London merchants for the delivery at the earliest possible moment of the first crop of the season. Public excitement ran high, and rivalry among the various ships in the annual race from China was keen. One of these, the "Cutty Sark," built in 1869 and still afloat in 1928, covered 363m. in a day's travel, the record for tea clippers. By 1872, due to the opening of the Suez Canal in 1870 which shortened the route to the East, aided further by the greater improvement in and more extended use of steam-propelled boats, these romantically interesting tea races had virtually passed out of existence. With her hull picturesquely painted in bands of white and black, and dummy portholes in black, with her great number of sails and long, sharp bow the clipper ship of the nineteenth century was "the ideal of applied art and a sheer delight to the eye"—the possessor of "that peculiarly satisfying beauty which always belongs to the thing absolutely fitted for the purpose it is designed to fill." An excellent account has been compiled by Octavius T. Howe and Frederick C. Matthews, *American Clipper Ships 1833–58* (1926–27) published by the Marine Research Society at Salem.

CLISSON, OLIVIER DE (1336–1407), French soldier, was the son of Olivier de Clisson who was put to death in 1343 on the suspicion of having wished to give up Nantes to the English. He was brought up in England, where his mother, Jeanne de Belleville, had married her second husband. On his return to Brittany he took arms on the side of de Montfort, distinguishing himself at the battle of Auray (1364), but in consequence of differences with Duke John IV. went over to the side of Blois. In 1370 he joined Bertrand du Guesclin, who had lately become constable of France, and followed him in all his campaigns against the English. On the death of du Guesclin Clisson received the constable's sword (1380). He fought with the citizens of Ghent, defeating them at Roosebeke (1382), later on commanded the army in Poitou and Flanders (1389), and made an unsuccessful attempt to invade England. On his return to Paris, in 1392, an attempt was made to assassinate him by Pierre de Craon, at the instigation of John IV. of Brittany. In order to punish the latter Charles VI., accompanied by the constable, marched on Brittany, but it was on this expedition that the king was seized with madness. The uncles of Charles VI. took proceedings against Clisson, so that he had to take refuge in Brittany. He was reconciled with John IV., and after the duke's death, in 1399, he became protector of the duchy, and guardian of the young princes. He had gathered vast wealth before his death on April 23, 1407.

CLISSON, a town of western France, in the department of Loire-Inférieure, 17 m. S.E. of Nantes, at the confluence of the Sèvre and the Moine, both of which are crossed by old bridges. Pop. (1936) 2,557. The town gave its name to the celebrated family of Clisson, of which the most famous member was Olivier de Clisson. It has the imposing ruins of their stronghold, parts of which date from the 13th century. The town and castle were destroyed in 1792 and 1793 during the Vendean wars, but the town was rebuilt shortly afterwards.

CLITHEROE, municipal borough, northeast Lancashire, England, 35 mi. N.W. from Manchester, on the L.M.S.R. Pop. (est. 1938) 11,260. Area 3.7 sq.mi. It is finely situated in the valley of the Ribble, at the foot of Pendle Hill, a steep plateau-like mass rising to 1,831 feet.

The Honour of Clitheroe (Clyderhow or Cletherwoode) was first held by Roger de Poictou, almost certainly the builder of the castle. He granted it to Robert de Lacy, and it passed by marriage to Thomas, earl of Lancaster, in 1310. It was part of the duchy of Lancaster till Charles II. bestowed it on General Monk, from whose family it descended through the house of Montague to that of Buccleuch. The first charter was granted about 1283 to the burgesses by Henry de Lacy, confirming the liberties granted by the first Henry de Lacy. The 1283 charter was confirmed by Edward III., Henry V., Henry VIII. and James I. Fairs, on Dec. 7 to 9 and March 24 to 26 are held under a charter of Henry IV. A weekly market has been held on Saturday since William I.'s days. The church of St. Mary Magdalene, though occupying an ancient site, is modern. The town has a grammar school, founded in 1554, and a technical school. On a height commanding the valley stands the keep and other fragments of the Norman castle but part of the site is occupied by a modern mansion. A large percentage of the population is engaged in the textile industry. In 1558 the borough was granted two members of parliament, and continued to return them till 1832, when the number was reduced to one. In 1885 the borough was disfranchised and is now represented in the Clitheroe Division of Lancashire.

Stonyhurst College, 5 m. S.W. of Clitheroe, is a college for Roman Catholic students. The nucleus of the buildings is a mansion (17th century) given by Thomas Weld in 1795 to refugee Jesuits from the continent. An observatory is attached to the college.

CLITUMNUS, a river in Umbria, Italy, rising from an abundant spring by the road between the ancient Spoletium and Trebia, 8m. from the former, 4m. from the latter. After a short course through the territory of Trebia it joins the Tinia, a tributary of the Tiber. Pliny described and Caligula and Honorius visited the lake, which is still a clear pool surrounded by poplars and weeping willows. The stream was personified as a god, whose ancient temple lay near the spring; close by were other smaller shrines and it occurs under the name *Sacraria* (the shrines) as a Roman post station. The building, generally known as the Tempio di Clitunno, close to the spring, is an ancient Christian chapel, its decorative sculptures being contemporary with those of S. Salvatore at Spoleto (4th century).

CLIVE, ROBERT CLIVE, BARON (1725–1774), the statesman and general who founded the empire of British India, was born on Sept. 29, 1725, at Styche, the family estate, in the parish of Moreton Say, Market Drayton, Shropshire. The Clives, or Clyves, were one of the oldest families in the county of Shropshire, having held the manor of that name in the reign of Henry II. One Clive was Irish chancellor of the exchequer under Henry VIII.; another was a member of the Long Parliament; Robert's father for many years represented Montgomeryshire in parliament.

Young Clive was the despair of his teachers. Sent from school to school, and for only a short time at the Merchant Taylors' school, he neglected his books for perilous adventures. But he could read Horace in after life; and he must have laid in his youth the foundation of that clear and vigorous English style which marked all his despatches, and made Lord Chatham declare of one of his speeches in the House of Commons that it was the most eloquent he had ever heard. At 18 he was sent out to Madras as a "factor" or "writer" in the civil service of the East India Company. For the first two years of his residence he felt keenly the separation from home; he was always breaking through the restraints imposed on young "writers"; and he was rarely out of trouble with his fellows, with one of whom he fought a duel. His one solace was found in the governor's library, where he sought to make up for past carelessness by a systematic course of study. He was just of age, when in 1746 Madras was forced to capitulate to Labourdonnais during the War of the Austrian Succession. The breach of that capitulation by Dupleix, then at the head of the French settlements in India, led Clive, with others, to escape from the town to the subordinate Fort St. David, some 20m. to the south. There Clive obtained an ensign's commission.

At this time India was ready to become the prize of the first conqueror who combined administrative with military skill. For the 40 years since the death of the emperor Aurangzeb, the power of the Great Mogul had gradually fallen into the hands of his provincial viceroys or *subadhars*. The three greatest of these were the nawab of the Deccan, or south and central India, who ruled from Hyderabad, the nawab of Bengal, whose capital was Murshidabad, and the nawab or wazir of Oudh. The prize lay between Dupleix, who had the genius of an administrator, or rather intriguer, but was no soldier, and Clive, the first of a century's brilliant succession of those "soldier-politicals" to whom Great Britain owed the conquest and consolidation of India. Clive successively established British ascendancy against French influence in the three great provinces under these nawabs. But his merit lies especially in the ability and foresight with which he secured the richest of the three, Bengal. But Clive had hardly been able to commend himself to Maj. Stringer Lawrence, the commander of the British troops in Madras and the Deccan, by his courage and skill in several small engagements, when the peace of Aix-la-Chapelle (1748) forced him to return to his civil duties for a short time. An attack of fever which severely affected his spirits led him to visit Bengal. On his return he found a contest going on between two sets of rival claimants for the position of viceroy of the Deccan, and for that of nawab of the Carnatic, the greatest of the subordinate States under the Deccan. Dupleix, who took the part of the pretenders to power in both places, was carrying all before him. The British had been weakened by the withdrawal of a large force under Admiral Boscawen, and by the return home, on leave, of Maj. Lawrence. But that officer had appointed Clive commissary for the supply of the troops with provisions, with the rank of captain. More than one disaster had taken place on a small scale, when Clive drew up a plan for dividing the enemy's forces, and offered to carry it out himself. The pretender, Chandar Sahib, had been made Nawab of the Carnatic with Dupleix's assistance, while the British had taken up the cause of the more legitimate successor, Mohammed Ali. Chandar Sahib had left Arcot, the capital of the Carnatic, to reduce Trichinopoly, then held by a weak English battalion. Clive offered to attack Arcot in order to force Chandar Sahib to raise the siege of Trichinopoly. But Madras and Fort St. David could supply him with only 200 Europeans and 300 sepoys. Of the eight officers who led them, four were civilians like Clive himself, and six had never been in action. His force had but three field-pieces. The circumstance that Clive, at the head of this handful, had been seen marching during a storm of thunder and lightning, frightened the enemy into evacuating the fort, which the British at once began to strengthen against a siege. Clive treated the great population of the city with so much consideration that they helped him to make successful sallies against the enemy. As the days passed on, Chandar Sahib sent a large army under his son and his French supporters, who entered Arcot and closely besieged Clive in the citadel. The story of the gallant defence of the citadel and of the repulse of the enemy is told in Macaulay's famous essay on Clive.

In India there is no parallel to the defence of the citadel of Arcot in 1751 till we come to the siege of Lucknow in 1857. Clive, now reinforced, followed up his advantage, and Maj. Lawrence returned in time to carry the war to a successful issue. In 1754 the first of the Carnatic treaties was made provisionally, between T. Saunders, the company's resident at Madras, and M. Godeheu, the French commander, in which the British protégé, Mohammed Ali, was virtually recognized as nawab, and both nations agreed to equalize their possessions. When war again broke out in 1756, and the French, during Clive's absence in Bengal, obtained successes in the northern districts, his efforts helped to drive them from their settlements. The Treaty of Paris in 1763 formally confirmed Mohammed Ali in the position which Clive had won for him. Two years after, the Madras work of Clive was completed by a firman from the emperor of Delhi, recognizing the British possessions in southern India.

The siege of Arcot at once gave Clive a European reputation. Pitt pronounced the youth of 27 who had done such deeds a "heaven-born general." When the court of directors voted him a sword worth £700, he refused to receive it unless Lawrence was similarly honoured. He left Madras for home, after ten years' absence, early in 1753. Before leaving India he married Margaret Maskelyne. The marriage was a happy one, and the scandalous stories of his private life spread later by his enemies are devoid of foundation. After he had been two years at home the state of affairs in India made the directors anxious for his return. He was sent out, in 1756, as governor of Fort St. David, with the reversion of the Government of Madras, and with the commission of Lieutenant-colonel in the king's army. He took Bombay on his way, and there commanded the land force which captured Gheria, the stronghold of the Mahratta pirate, Angria. He took his seat as governor of Fort St. David on the day on which the nawab of Bengal captured Calcutta, and thither the Madras Government at once sent him, with Admiral Watson. He entered on the second period of his career.

Since, in Aug. 1690, Job Charnock had landed at the village of Sutanati with a guard of one officer and 30 men, the infant capital of Calcutta had become a rich centre of trade. The successive nawabs or viceroys of Bengal had been friendly to it, till, in 1756, Suraj-ud-Dowlah succeeded his uncle at Murshidabad. His predecessor's financial minister had fled to Calcutta to escape the extortion of the new nawab, and the English governor refused to deliver up the refugee. Enraged at this, Suraj-ud-Dowlah captured the old fort of Calcutta on June 20, and plundered it. Many of the English fled to ships and dropped down the river. The 146 who remained were forced into "the Black Hole" in the stifling heat of the sultriest period of the year. Only 23 came out alive. The fleet was as strong, for those days, as the land force was weak. Disembarking his troops some miles below the city, Clive marched through the jungles, where he lost his way owing to the treachery of his guides, but soon invested Fort William, while the fire of the ships reduced it, on Jan. 2, 1757. On Feb. 4, he defeated the whole army of the nawab, which had taken up a strong position just beyond what is now the most northerly suburb of Calcutta. The nawab hastened to conclude a treaty, under which favourable terms were conceded to the company's trade, the factories and plundered property were restored, and an English mint was established. In the accompanying agreement, offensive and defensive, Clive appears under the name by which he was always known

to the natives of India, Sabut Jung, or "the daring in war." With 600 British soldiers, 800 sepoys, seven field-pieces and 500 sailors to draw them, he had routed a force of 34,000 men with 40 pieces of heavy cannon and 50 elephants, and had seized a camp four miles in length.

In spite of his double defeat and the treaty which followed it, the madness of the nawab burst forth again. As England and France were once more at war, Clive sent the fleet up the river against Chandernagore, while he besieged it by land. After consenting to the siege, the nawab sought to assist the French, but in vain. The capture of their principal settlement in India, next to Pondicherry, which had fallen in the previous war, gave the combined forces prize to the value of £130,000. The rule of Suraj-ud-Dowlah became as intolerable to his own people as to the British. They formed a confederacy to depose him, at the head of which was Jafar Ali Khan, his commander-in-chief. Associating with himself Admiral Watson, Governor Drake and Mr. Watts, Clive made a treaty in which it was agreed to give the office of viceroy of Bengal, Behar and Orissa to Jafar, who was to pay a million sterling to the company for its losses in Calcutta and the cost of its troops, half a million to the British inhabitants of Calcutta, £200,000 to the native inhabitants, and £70,000 to its Armenian merchants. Up to this point all is clear. Suraj-ud-Dowlah was hopeless as a ruler. His relations alike to his master, the merely titular emperor of Delhi, and to the people left the province open to the strongest. After "the Black Hole," the battle of Calcutta, and the treachery at Chandernagore, in spite of the treaty which followed that battle, the East India Company could treat the nawab only as an enemy. Clive, it is true, might have disregarded all native intrigue, marched on Murshidabad, and at once held the delta of the Ganges in the company's name. But the time was not ripe for this, and the consequences, with so small a force, might have been fatal. The idea of acting directly as rulers, or save under native charters and names, was not developed by events for half a century. The political morality of the time in Europe, as well as the comparative weakness of the company in India, led Clive not only to meet the dishonesty of his native associate by equal dishonesty, but to justify his conduct by the declaration, years after, in parliament, that he would do the same again. It became necessary to employ the richest Bengali trader, Omichund, as an agent between Jafar Ali and the British officials. Master of the secret of the confederacy against Suraj-ud-Dowlah, the Bengali threatened to betray it unless he was guaranteed, in the treaty itself, £300,000. To dupe the villain, who was really paid by both sides, a second, or fictitious treaty, was shown him with a clause to this effect. This Admiral Watson refused to sign; "but," Clive deposed to the House of Commons, "to the best of his remembrance, he gave the gentleman who carried it leave to sign his name upon it; his lordship never made any secret of it; he thinks it warrantable in such a case, and would do it again a hundred times; he had no interested motive in doing it, and did it with a design of disappointing the expectations of a rapacious man." Such is Clive's own defence of the one act which, in a long career of abounding temptations, was of questionable honesty.

The whole hot season of 1757 was spent in these negotiations, till the middle of June, when Clive began his march from Chandernagore, the British in boats, and the sepoys along the right bank of the Hugli. That river above Calcutta is, during the rainy season, fed by the overflow of the Ganges to the north through three streams, which in the hot months are nearly dry. On the left bank of the Bhagirathi, the most westerly of these, 100m. above Chandernagore, stands Murshidabad, the capital of the Mogul viceroys of Bengal, and then so vast that Clive compared it to the London of his day. Some miles farther down is the field of Plassey, then an extensive grove of mango trees. On June 21, Clive arrived on the bank opposite Plassey, in the midst of that outburst of rain which ushers in the south-west monsoon of India. His whole army amounted to 1,100 Europeans and 2,100 native troops, with nine field-pieces. The nawab had drawn up 18,000 horse, 50,000 foot and 53 pieces of heavy ordnance, served by French artillerymen. For once in his career Clive hesitated, and called a council of 16 officers to decide, as he put it, "whether in our present situation, without assistance, and on our own bottom, it would be prudent to attack the nawab, or whether we should wait till joined by some country power?" Clive himself headed the nine who voted for delay; Major (afterwards Sir) Eyre Coote led the seven who counselled immediate attack. But, either because his daring asserted itself, or because also, of a letter that he received from Jafar Ali, as has been said, Clive was the first to change his mind and to communicate with Major Eyre Coote. One tradition, followed by Macaulay, represents him as spending an hour in thought under the shade of some trees, while he resolved the issues of what was to prove one of the decisive battles of the world. Another, turned into verse by Sir Alfred Lyall, pictures his resolution as the result of a dream. However, that may be, he did well as a soldier to trust to the dash and even rashness that had gained Arcot and triumphed at Calcutta, and as a statesman, since retreat, or even delay, would have put back the conquest of India for years. When, after the heavy rain, the sun rose brightly on the 22nd, the 3,200 men and the nine guns crossed the river and took possession of the grove and its tanks of water, while Clive established his headquarters in a hunting lodge. On the 23rd the engagement took place and lasted the whole day. Except the 40 Frenchmen and the guns which they worked, the enemy did little to reply to the British cannonade which, with the 39th Regiment, scattered the host, inflicting on it a loss of 500 men. Clive restrained the ardour of Maj. Kilpatrick, for he trusted to Jafar Ali's abstinence, if not desertion to his ranks, and knew the importance of sparing his own small force. He lost hardly a white soldier; in all 22 sepoys were killed and 50 wounded. Suraj-ud-Dowlah fled from the field on a camel, secured what wealth he could, and came to an untimely end. Clive entered Murshidabad, and established Jafar Ali in the position which his descendants have since enjoyed, as pensioners, but have not infrequently abused. When taken through the treasury, amid a million and a half sterling's worth of rupees, gold and silver plate, jewels and rich goods, and besought to ask what he would, Clive was content with £160,000, while half a million was distributed among the army and navy, both in addition to gifts of £24,000 to each member of the company's committee, and besides the public compensation stipulated for in the treaty. It was to this occasion that he referred in his defence before the House of Commons, when he declared that he marvelled at his moderation. He followed a usage fully recognized by the company, although the fruitful source of future evils which he himself was again sent out to correct. The company itself acquired a revenue of £100,000 a year, and a contribution towards its losses and military expenditure of a million and a half sterling. Jafar Ali afterwards presented Clive with the quit-rent of the company's lands in and around Calcutta, amounting to an annuity of £27,000 for life, and left him by will the sum of £70,000 which Clive devoted to the army.

While busy with the civil administration, the conqueror of Plassey followed up his military success. He sent Maj. Coote in pursuit of the French almost as far as Benares. He despatched Col. Forde to Vizagapatam and the northern districts of Madras, where that officer gained the battle of Condore. He came into direct contact, for the first time, with the Great Mogul himself, an event which resulted in the most important consequences during the third period of his career. Shah Alam, when *shahzada,* or heir-apparent, quarrelled with his father, Alam Gir II., the emperor, and united with the viceroys of Oudh and Allahabad for the conquest of Bengal. He advanced as far as Patna, which he besieged with 40,000 men. Jafar Ali, in terror, sent his son to its relief, and implored the aid of Clive. Major Caillaud defeated the prince's army and dispersed it. Finally, at this period, Clive repelled the aggression of the Dutch, and avenged the massacre of Amboyna, on that occasion when he wrote his famous letter, "Dear Forde, fight them immediately; I will send you the order of council tomorrow." Meanwhile he never ceased to improve the organization and drill of the sepoy army, after a European model, and enlisted into it many Mohammedans of fine physique from upper India. He refortified Calcutta. In 1760, after four years of inces-

sant labour his health gave way and he returned to England. "It appeared," wrote a contemporary on the spot, "as if the soul was departing from the Government of Bengal." He had been formally made governor of Bengal by the court of directors at a time when his nominal superiors in Madras sought to recall him to their help there. But he had discerned the importance of the province even during his first visit to its rich delta, mighty rivers and teeming population. It should be noticed, also, that he had the kingly gift of selecting the ablest subordinates, for even thus early he had discovered the ability of young Warren Hastings, destined to be his great successor, and, a year after Plassey, made him resident at the nawab's court.

In 1760, at 35 years of age, Clive returned to England with a fortune of at least £300,000 and the quit-rent of £27,000 a year, after caring for the comfort of his parents and sisters, and giving Maj. Lawrence, his old commanding officer, £500 a year. The money had been honourably and publicly acquired, with the approval of the company. The amount might have been four times what it was had Clive been either greedy after wealth or ungenerous to the colleagues and the troops whom he led to victory. He was well received at court, was made Baron Clive of Plassey, in the peerage of Ireland, bought estates, and got not only himself, but his friends returned to the House of Commons after the fashion of the time. He then set himself to reform the home system of the East India Company, and began a bitter warfare with Sulivan, chairman of the court of directors, whom in the end he defeated. In this he was aided by the news of reverses in Bengal. Vansittart, his successor, having no great influence over Jafar Ali Khan, had put Kasim Ali Khan, the son-in-law, in his place in consideration of certain payments to the English officials. After a brief tenure Kasim Ali had fled, had ordered Walter Reinhardt (known to the Mohammedans as Sumru), a Swiss mercenary of his, to butcher the garrison of 150 English at Patna, and had disappeared under the protection of his brother viceroy of Oudh. The whole company's service, civil and military, had become demoralized by gifts, and by the monopoly of the inland as well as export trade, to such an extent that the natives were pauperized, and the company was plundered of the revenues which Clive had acquired for them. The court of proprietors, accordingly, who elected the directors, forced them, in spite of Sulivan, to hurry out Lord Clive to Bengal with the double powers of governor and commander-in-chief.

What he had done for Madras, what he had accomplished for Bengal proper, and what he had effected in reforming the company itself, he was now to complete in less than two years, in this the third period of his career, by putting his country politically in the place of the emperor of Delhi, and preventing for ever the possibility of the corruption to which the British in India had been driven by an evil system. On May 3, 1765, he landed at Calcutta to learn that Jafar Ali Khan had died, leaving him personally £70,000, and had been succeeded by his son, though not before the Government had been further demoralized by taking £100,000 as a gift from the new nawab; while Kasim Ali had induced not only the viceroy of Oudh, but the emperor of Delhi himself, to invade Behar. After the first mutiny in the Bengal army, which was suppressed by blowing the sepoy ringleader from a gun, Major Munro, "the Napier of those times," scattered the united armies on the hard-fought field of Buxar. The emperor, Shah Alam, detached himself from the league, while the Oudh viceroy threw himself on the mercy of the British. Clive had now an opportunity of repeating in Hindustan, or Upper India, what he had accomplished in Bengal. He might have secured what are now called the United Provinces, and have rendered unnecessary the campaigns of Wellesley and Lake. But he had other work in the consolidation of rich Bengal itself, making it a base for the development of the mighty fabric of British India. Hence he returned to the Oudh viceroy all his territory save the provinces of Allahabad and Kora, which he made over to the weak emperor. But from that emperor he secured the most important document in the whole of British history in India up to that time, which appears in the records as "firmaund from the King Shah Aalum, granting the dewany of Bengal, Behar and Orissa to the company, 1765." The date was Aug. 12, the place, Benares, the throne an English dining-table covered with embroidered cloth and surmounted by a chair in Clive's tent. It is all pictured by a Mohammedan contemporary, who indignantly exclaims that so great a "transaction was done and finished in less time than would have been taken up in the sale of a jackass." By this deed the company became the real sovereign rulers of thirty millions of people, yielding a revenue of four millions sterling. On the same date Clive obtained not only an imperial charter for the company's possession in the Carnatic also, thus completing the work he began at Arcot, but a third firman for the highest of all the lieutenancies of the empire, that of the Deccan itself. This fact is mentioned in a letter from the secret committee of the court of directors to the Madras government, dated April 27, 1768.

Having thus founded the empire of British India, Clive sought to reform the administration. The civil service was de-orientalized by raising the miserable salaries which had tempted its members to be corrupt, by forbidding the acceptance of gifts from natives, and by exacting covenants under which participation in the inland trade was stopped. Not less important were his military reforms. He put down a mutiny of the English officers, who chose to resent the veto against receiving presents and the reduction of batta at a time when two Mahratta armies were marching on Bengal. He reorganized the army, dividing the whole into three brigades, so as to make each a complete force, in itself equal to any single native army that could be brought against it. He had not enough British artillerymen, however, and would not make the mistake of his successors, who trained natives to work the guns, which were turned against the British with such effect in 1857.

Clive's final return to England, a poorer man than he went out, in spite of still more tremendous temptations, was the signal for an outburst of his personal enemies. Every civilian whose illicit gains he had cut off, every officer whose conspiracy he had foiled, every proprietor or director, like Sulivan, whose selfish schemes he had thwarted, now sought his opportunity. Clive had, with consistent generosity, at once made over the legacy of £70,000 from the grateful Jafar Ali, as the capital of what has since been known as "the Clive Fund," for the support of invalided European soldiers, as well as officers, and their widows, and the company had allowed 8% on the sum for an object which it was otherwise bound to meet. Gen. John Burgoyne, of Saratoga memory, did his best to induce the House of Commons, in which Lord Clive was now member for Shrewsbury, to impeach the man who gave his country an empire, and the people of that empire peace and justice. The result, after the brilliant and honourable defences of his career which will be found in Almon's *Debates* for 1773, was a compromise. On a division the House, by 155 to 95, carried the motion that Lord Clive "did obtain and possess himself" of £234,000 during his first administration of Bengal; but, refusing to express an opinion on the fact, it passed unanimously the second motion, at five in the morning, "that Robert, Lord Clive, did at the same time render great and meritorious services to his country." The one questionable transaction in all that brilliant and tempted life—the Omichund treaty—was not touched.

Only one who can personally understand what Clive's power and services had been will rightly realize the effect on him, though in the prime of life, of the discussions through which he had been dragged. In the greatest of his speeches, in reply to Lord North, he said—"My situation, sir, has not been an easy one for these 12 months past, and though my conscience could never accuse me, yet I felt for my friends who were involved in the same censure as myself . . . I have been examined by the select committee more like a sheep-stealer than a member of this House." Fully accepting that statement, and believing him to have been purer than his accusers in spite of temptations unknown to them, we see in Clive's end the result merely of physical suffering, of chronic disease which opium failed to abate, while the worry and chagrin caused by his enemies gave it full scope. This great man, who did more for his country than any soldier till Wellington, and more for the people and princes of India than any statesman in history, died by his own hand on Nov. 22, 1774, in his 50th year.

His son Edward (1754–1839) became Earl of Powis in 1804.

See C. Caraccioli, *Life of Lord Clive* (1775); G. B. Malleson, *Lord Clive* ("Rulers of India" series) (1890); Sir C. Wilson, *Lord Clive* ("English Men of Action" series) (1890); F. M. Holmes, *Four Heroes of India* (1892); Sir A. J. Arbuthnot, *Lord Clive* ("Builders of Great Britain" series) (1899).

CLIVE, CAROLINE (1801–1873), English authoress, was born in London, June 24, 1801, died at Whitfield, Herefordshire, on July 13 1873. She was the daughter of Mr. Meysey-Wigley, M.P. for Worcester, and married, in 1840, the Rev. Archer Clive. She is best known as the author of *Paul Ferroll* (1855), a sensational novel, and *Why Paul Ferroll killed his Wife* (1860).

CLIVE, CATHERINE (KITTY) (1711–1785), British actress, was born, probably in London, in 1711. Her father, William Raftor, an Irishman of good family but small means, had held a captain's commission in the French army under Louis XIV. About 1728 she began to play at Drury Lane, of which Colley Cibber was then manager. She married George Clive, a barrister and a relative of the 1st Lord Clive, but husband and wife soon separated by mutual consent. In 1731 she definitely established her reputation as a comic actress and singer in Charles Coffey's farce-opera adaptation, *The Devil to Pay,* and from this time she was always a popular favourite. She acted little outside Drury Lane, where in 1747 she became one of the original members of Garrick's company. She took part, however, in some of the oratorios of Handel, whose friend she was. In 1769, having been a member of Garrick's company for 22 years, she quitted the stage, and lived for 16 years in retirement at a villa at Twickenham, which had been given her some time previously by her friend Horace Walpole. Mrs. Clive had small claim to good looks, but as an actress of broad comedy she was unreservedly praised by Goldsmith, Johnson and Garrick. She had a quick temper, which on various occasions involved her in quarrels, and at times sorely tried the patience of Garrick, but her private life remained above suspicion, and she regularly supported her father and his family. She died at Twickenham on Dec. 6, 1785. Horace Walpole placed in his garden an urn to her memory, bearing an inscription, of which the last two lines run:—

> The comic muse with her retired
> And shed a tear when she expired.

See Percy Fitzgerald, *Life of Mrs. Catherine Clive* (1888); W. R. Chetwood, *General History of the Stage* (1749); Thomas Davies, *Memoirs of the Life of David Garrick* (1784).

CLOACA, the Latin term for a drain or sewer. The most famous is the Cloaca Maxima at Rome, built to drain the marsh where the Forum Romanum was situated. Constructed originally in about the 6th century B.C. as an open stone-lined channel, it was vaulted *c.* 4th or 5th century B.C., with a stone barrel vault.

CLOACA is also the name given to the joint opening of the urino-genital and alimentary systems characteristic of all the vertebrates except the mammals, among which it is only retained in the monotremata (*q.v.*).

CLOCKS. A clock consists of a train of wheels, actuated by a spring or weight or other means, and provided with an oscillating governing device which so regulates the speed as to render it uniform. Generally it has a mechanism by which it strikes the hours on a bell or gong (Fr. *cloche;* Ger. *Glocke,* a bell) whereas a timepiece simply shows the time.

History of Clocks.—The earliest clocks seem to have come into use in Europe during the 13th century, although there is evidence that they may have been invented some centuries sooner. The invention of the first clock is ascribed to Pope Silvester II. in A.D. 996. A clock was put up in a former clock-tower at Westminster in 1288, one in Canterbury cathedral in 1292, and another at St. Albans in 1326 which showed various astronomical phenomena. One placed in Dover Castle in 1348 was exhibited, going, in the Scientific Exhibition of 1876.

All these old clocks had the duty of keeping time. They were corrected occasionally by sundials or by crude astronomical observations. But sundials were of little use on dull days, and observatories were very few and maintained mainly for astrology. But now the world is well supplied with observatories at which the correct time can be most accurately determined and communicated electrically to any point. The problem thus is to devise some simple mechanism that will have a steady rate for short intervals that can be accurately observed. It is the rate of going that is important. If we know the rate of error of a clock we can allow for it in an observatory or neglect it in common life. Our real timekeeper is the stars. The time is set all over the world by the consensus of a host of observatories.

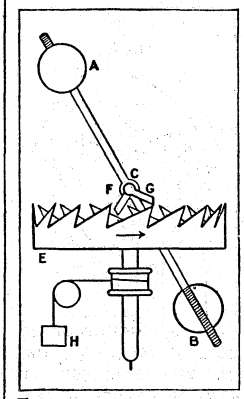


FIG. 1.—VERGE ESCAPEMENT, SHOWING THE METHOD OF USING AN OSCILLATING MASS TO KEEP TIME

Clock Motion.—The oscillating body, which regulates the rate of going, must have mass and movement, and must be kept going by the expenditure of force. Two weights of equal mass, one at each end of a rod, might be swung in a circular path, and a spring of some sort might be fixed to them so as to gradually retard their motion. This was the first idea of the 14th century clock-makers, and on it the Glastonbury clock was designed. The method of attaching the spring was very clumsy, and quite destructive of accuracy. It is shown in fig. 1 and is called the verge escapement. A rod or verge has weights attached to each end *AB;* it is then fixed at right angles to a horizontal axis *C* which is mounted on pivots in proximity to a horizontal crown wheel *E.* The "pallets" *FG* are mounted on the horizontal axis so as alternately to engage the opposite teeth of the crown wheel. The crown wheel is caused to rotate by a cord and weight *H.* As it goes round, one of the pallets engages with a tooth, the swing of the verge is stopped, and the verge is given a swing in the opposite direction. The process is then repeated—the other pallet engaging a tooth on the other side of the crown wheel. Very heavy balls are needed to keep the period of oscillation approximately uniform. The friction on the axis, caused by the weight of the balls, is largely destructive of accuracy.

The Pendulum.—The verge escapement led to the idea of one ball at the lower end of a rod suspended by a flexible metal band. Such a ball was found to swing in periods which were very nearly uniform when the swings were not very unequal in amplitude. The time of swing varies with the square root of the length of the pendulum, and changes very little when the arc is slightly changed. When the length of the pendulum rod was 39·14 in., a difference of $\frac{1}{1000}$ in. of length was found to make the clock go slower by about a second a day; and when the arc of vibration of 3 in. was increased by $\frac{1}{10}$ in., the clock was again found to go slower by about a second a day. It is possible to express the time of going of a clock by a formula. Thus, let L be the length of the pendulum (39·14 in.), G twice the distance that a weight will fall to the earth in one second (32 ft.), π the ratio of the circumference of a circle to its diameter (3·1415), and M the arc of swing in inches. Then the time of a single swing in seconds $=\pi\sqrt{\left[\frac{L}{G}\left(1+\frac{M^2}{8L^2}\right)\right]}$ very nearly.

Compensation of Pendulums.—The equation given above, as well as practice, indicates that the time of swing of a pendulum is altered by temperature. The expansion of steel is about ·0001 in. for each increase of 4° of temperature. The effect of temperature on the length and time of a particular pendulum can be computed. If a vessel of mercury about 7 in. in height is placed so as to rest on the bottom of an iron pendulum rod, it will expand so that the distance of its centre from the point of suspension is practically constant with varying temperatures. The use of the steel alloy (*invar*), which expands by heat only about one-tenth of the amount of ordinary steel, has greatly simplified the construction of accurate pendulums. There are several other factors which affect the real length of the pendulum, but, for reasons that have been explained, it is daily becoming less important to have extraordinary means of effecting compensation even in astronomical clocks. The true method of correction is by means

of stellar observation. The heat compensator is a needful adjunct to every clock that aspires to be more than a mere old "grandfather," but fine mechanical regulation is less necessary than in former years.

Escapements.—The term escapement is applied to any arrangement by which, as the wheels rotate, periodic impulses are given to the pendulum, while at the same time the motion of the wheels is arrested until the vibration of the pendulum has been completed. The escapement thus serves as a mechanism for both counting and impelling the pendulum and adapting the length of its swing to the impulse it has received. The best escapement is one which gives an impulse to the pendulum for a short period at the lowest point of its path, and then leaves it free until the time comes for the next impulse. It is also desirable that the impulses given to it shall be equal. The driving force of the escapement varies with the amount of energy absorbed by friction and with the thickness of the oil. It is therefore desirable to secure uniformity of impulse; *e.g.*, by causing the train of wheels to lift a weight and let its drop act on the pendulum at regular intervals.

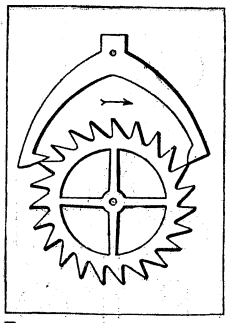


FIG. 2.—ANCHOR OR RECOIL ESCAPEMENT, ONE OF THE EARLIEST ATTEMPTS TO USE A PENDULUM

The two requirements above stated have given rise respectively to what are known as detached escapements and remontoires, which will be described presently. In the first place, however, it is desirable to describe the principal forms of escapement in ordinary use. The balance escapement was in use before the days of pendulums. It was to a balance escapement that Huygens applied the pendulum, by removing the weight from one arm and increasing the length of the other arm. Very shortly afterwards R. Hooke invented the anchor or recoil escapement. This is represented in fig. 2, where a tooth of the escape-wheel is just escaping from the right pallet, and another tooth at the same time falls upon the left-hand pallet at some distance from its point. As the pendulum moves on in the same direction, the tooth slides farther up the pallet thus producing a recoil, as in the crown-wheel or verge escapement. To get rid of this defect the dead escapement, or, as the French call it, *l'échappement à repos,* was invented by G. Graham. It is represented in fig. 3. The teeth of the scape-wheel have their points set the opposite way to those of the recoil escapement. The tooth *B* is here represented in the act of dropping on to the right-hand pallet as the tooth *A* escapes from the left pallet. But instead of the pallet having a continuous face as in the recoil escapement, it is divided into two, of which *BE* on the right pallet, and *FA* on the left, are called the impulse faces, and *BD, FG* the dead faces. The dead faces are portions of circles (not necessarily of the same circle), having the axis of the pallets *C* for their centre; and the consequence evidently is that, as the pendulum goes on, carrying the pallet still nearer to the wheel than the position in which a tooth falls on to the corner *A* or *B* of the impulse and the dead faces, the tooth still rests on the dead faces without any recoil, until the pendulum returns and lets the tooth slide down the impulse face, giving the impulse to the pendulum as it goes. In order to diminish the friction and the necessity for using oil as far as possible, the best clocks are made with jewels (sapphires are the best) let into the pallets.

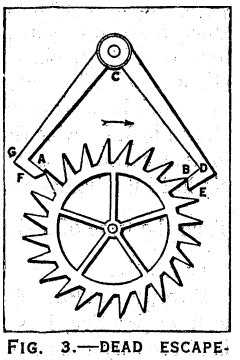


FIG. 3.—DEAD ESCAPEMENT, A REFINEMENT OF THE ANCHOR ESCAPEMENT

The pallets are generally made to embrace about $\frac{1}{3}$ of the circumference of the wheel, and it is not at all desirable that they should embrace more; for the longer they are, the longer is the run of the teeth upon them, and the greater the friction. A not uncommon proportion is that out of a total arc of swing of 3°, 2° or about 1° on each side of the vertical, are occupied in receiving the impulse. In other words, the points *F* and *A* should subtend an angle of 2° at the centre *C*. It is not to be forgotten that the scape-wheel tooth does not overtake the face of the pallet immediately, on account of the moment of inertia of the wheel.

One of the great obstacles to accurate timekeeping was that the train of wheels which drives the escapement is liable to variation of force. This is chiefly caused by cold, which thickens the oil, by wear of the parts, and by grit which gets into them. To obviate this an old suggestion was that the scape-wheel teeth should not be made to act directly on the pallets, but that each of them as it revolved should lift a weight which then fell on the pallets with a force which was nearly invariable. The scheme, however, was difficult to work out practically until Bloxam, a barrister, invented what is called the three-legged gravity escapement (fig. 4). As the pendulum swings out it lifts alternately the arms pivoted round centres *C*. This draws away the detents *E* and *F*, and allows the escape-wheel to rotate. But instead of the pendulum receiving its impulses from the pins on the escape-wheel, it receives them from the arms which are actuated by gravity, and all the escape-wheel does is to lift those arms and then release them. Lord Grimthorpe improved this escapement by adding a fly-vane to give a gentle movement to the escape-wheel and prevent banging. Big Ben at Westminster, London, was made with this gravity escapement and has gone excellently for over half a century.

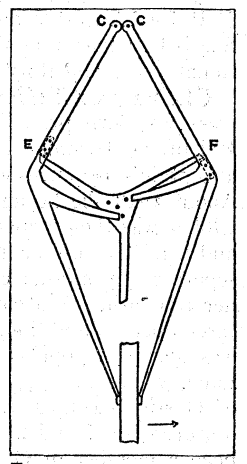


FIG. 4.—THREE-LEGGED ESCAPEMENT ADOPTED TO UTILIZE GRAVITY TO GIVE UNIFORM IMPULSES TO A PENDULUM

One of the great difficulties in all these old escapements was that the driving force which impelled the pendulum on the one side and received its return impulses on the other was connected through all its motion with the pendulum rod. Now one of the necessities for true harmonic motion is to kick a mass into space, and let it swing freely till it came to rest and then swing back freely. Hence it was desirable as soon as the scape-wheel had delivered its impulse, to detach it from the pendulum, and then only let the pendulum come in contact with it again on its journey—in other words, to cause the action between the scape-wheel and pendulum to take place only at the centre of the swing. This gave rise to the chronometer spring escapement. All that need be done is to fix on to the pendulum a small ratchet or flipper arranged so as to push as it goes one way and miss as it returns (fig. 5). This flipper acts on a detent. When it pushes the detent one way, the detent releases an arm which gives the flying pendulum a push. But as the pendulum returns, the flipper passes the detent and allows the pendulum to swing free. Thus the pendulum receives an impulse on every alternate swing. A great many escapements have been designed on this plan for chronometers. One was invented by Robert Houdin, the conjurer, about 1830, and another by that great genius Sir George Airy (*q.v.*). A simple form (fig. 6) was designed by Sir Henry Cunynghame and has been keeping good time for the last 30 years. Its chief merit is that it does not depend for accuracy on expensive making. Let *A* be a block of metal fixed to the lower end of the pendulum rod; on this block let a small pall be fastened free to move round a centre *C* and resting against a stop *D*. Let *E* be a four-leaved scape-wheel, the teeth of which as they come round rest against the bent pall *GFL* at *G*. The pall is prevented from flying too far back by a pin *H*, and kept up to position by a very delicate spring *K*. As soon as the pendulum rod, moving from right to left, has arrived at the position shown in the figure, the pall *B* will engage the arm *FL*, force it forwards, and liberate the scape-wheel, a tooth of which, *M*, will thus close upon the heel of the block *A*,

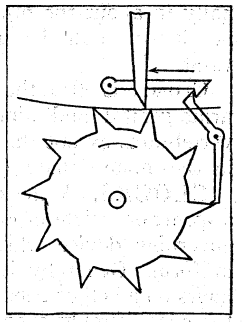


FIG. 5.—FREE ESCAPEMENT (OLD FORM), AN ADAPTATION OF THE CHRONOMETER ESCAPEMENT TO CLOCKS

and urge it forward. As soon, however, as M has arrived at G the tooth M will slip off the block A and rest on the pall G, and the impulse will cease. The pendulum is now perfectly free or "detached" and can swing unimpeded as far as it chooses. On its return from left to right, the pall B slips over pall L without disturbing it, and the pendulum is still free to make an excursion towards the left. On its return journey the process is again repeated. Such an escapement operates once every two seconds, and consideration will show that it is only the application of the detached chronometer escapement to a clock. It will be found very easy to make by an amateur. The escapement has a large arc to act upon, being on the lower part of the pendulum.

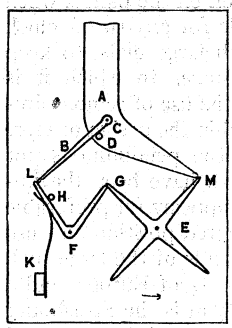


FIG. 6.—DETACHED ESCAPEMENT, AN ENDEAVOUR TO APPLY THE CHRONOMETER MOVEMENT TO CLOCKS

A few attempts to combine the escapement with the detached escapement have been made. One is shown in fig. 7. It is only a modification of the detached escapement shown in fig. 6. It has worked very well for about 30 years, and seems to combine efficiency with simplicity. The lower part of the pendulum A carries a flipper C which, as the pendulum passes from right to left, engages the end of the detent D, which, moving towards the left, releases E, a tooth attached to the gravity arm F, thus allowing its end G to fall on the incline H, which is attached to the end of the pendulum. As soon as the pendulum has gone, F falls on an electric contact K, whereupon an electro-magnet hoists it up again so that it falls on end E of the detent, and disjoins the electric contact at K, whereupon the electro-armature L resumes its position. On the return from left to right, the flipper C glides over the end of the detent D. The arrangement of the armature L is similar to one arranged by F. Hope Jones for electric clock-winders. The object of making H double sided is that if the electricity ceases while the pendulum is swinging back from left to right, the part H shall not come into contact with G and be smashed, but simply slide over G. The escapement part of the clock is fixed on a frame attached to the suspension bracket of the pendulum by two steel rods of the same metal as the pendulum rod, so as to keep them in relative position in spite of temperature changes. The impulse given depends on the weight of the impulse arm. The work done in unlocking the detent is invariable, as it is independent of the electric drive. The duration of the impulse is very short, only about one-tenth of the arc of the swing. It is given exactly at the centre of the swing, and when not under impulse the pendulum is detached.

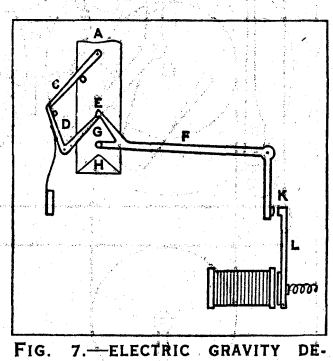


FIG. 7.—ELECTRIC GRAVITY DETACHED ESCAPEMENT, COMBINING GRAVITY WITH THE DETACHED CHRONOMETER MOVEMENT AND UTILIZING ELECTRICITY TO DRIVE THE CLOCK

Clock Wheels.—To keep the force which acts on the pendulum uniform is the object of the best escapement. Inasmuch as the impulse on the pendulum, derived from the work done by a falling weight or an unwinding spring, is transmitted through a train of wheels, it is desirable that transmission should be as free from friction and as regular as possible. This involves care in the shaping of the teeth. The object to be aimed at is that as the wheel turns around, the ratio of the power of the driver to that of the driven wheel ("runner" or "follower") should never vary. The teeth of the wheels are given an epicycloidal form.

Going Barrels.—A clock must have some contrivance to keep it going while it is being wound up. In the old-fashioned house clocks this was done by what is called the endless chain of Huygens. This kind of going barrel, however, is evidently not suited to an astronomical clock, and Harrison's going barrel is now universally adopted. Fig. 8 shows its construction. The click of the barrel-ratchet R is set upon another larger ratchet-wheel with its teeth pointing the opposite way, and its click rT is set in the clock frame. That ratchet is connected with the great wheel by a spring $s's$ pressing against the two pins s in the ratchet and s in the wheel. When the weight is wound up (which is equivalent to taking it off), the click Tr prevents that ratchet from turning back or to the right; and as the spring $s's$ is kept by the weight in a state of tension equivalent to the weight itself, it will drive the wheel to the left for a short distance, when its end s is held fast, with the same force as if that end was pulled forward by the weight; and as the great wheel has to move very little during the short time the clock is winding, the spring will keep the clock going long enough.

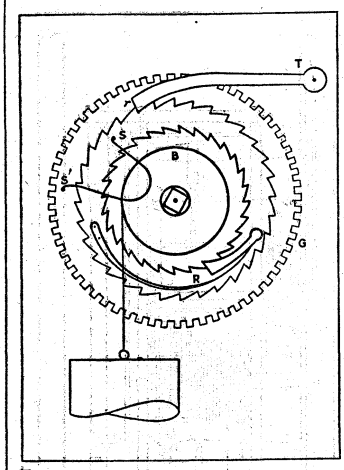


FIG. 8.—HARRISON'S GOING BARREL, WHICH KEEPS THE MODERN CLOCK GOING WHILE IT IS BEING WOUND UP

Remontoire.—To abolish errors arising from the changes in the force driving the escapement, what is known as the "remontoire" system was adopted. It first came into use for watches. The idea of remontoire is to disconnect the escapement from the clock-train, and to give the escapement a driving power of its own, acting as directly as possible on the pallets without the intervention of a clock-train. The escapement is thus made into a separate clock, which of course needs repeated winding, and this winding is effected by the clock-train. From this it results that variations in the force transmitted by the clock-train merely affect the speed at which the "rewinding" of the escapement is effected, but do not affect the force exerted by the driving power of the escapement.

There are several modes of carrying out this plan. The first of them is simply to provide the scape-wheel with a weight or spring of its own, which spring is wound up by the clock-train as often as it runs down. Contrivances of this kind are called train remontoires. In arranging such a remontoire it is obvious that the clock-train must be provided with a stop to prevent it from overwinding the scape-wheel weight or spring, and further, that there must be on the scape-wheel a stud or other contrivance to release the clock-train as soon as the scape-wheel weight or spring has run down and needs rewinding. The first maker of a large clock with a train remontoire was probably Thomas Reid, of Edinburgh, who described his apparatus in his book on *Horology* (1819). A clock at the Royal Exchange, London, was made in 1844 on this principle.

In these gravity remontoires, however, only the friction of the heavy parts of the train and the dial-work is got rid of, and the scape-wheel is still subject to the friction of the remontoire wheels, which though much less than the other, is still considerable. Accordingly, attempts have frequently been made to drive the scape-wheel by a spiral spring, like the mainspring of a watch. Sir G. Airy invented one, of which one specimen is still going well.

General View of a Common Clock.—The general construction of the going part of all clocks, large or turret clocks, is substantially the same, and fig. 9 is a section of any ordinary house clock. B is the barrel with the cord coiled round it. The barrel is fixed to its arbor K, which is prolonged into the winding square coming up to the face or dial of the clock. The great wheel G rides on the arbor, and is connected with the barrel by the ratchet R, the action of which is shown more fully in fig. 10. The great wheel drives the pinion c, which is called the centre pinion, on the arbor of the centre wheel C, which goes through to the dial, and carries the long, or minute hand. The centre wheel drives the second wheel D by its pinion d, and that again drives the scape-wheel E by its pinion e. If the pinions d and e have each eight teeth or leaves, C will have 64 teeth and D 60, in a clock of which the scape-wheel turns in a minute, so that the second hand may be

set on its arbor prolonged to the dial. *A* represents the pallets of the escapements and their arbor *a* goes through a large hole in the back plate near *F*, and its back pivot turns in a cock *OFQ* screwed on to the back plate. From the pallet arbor at *F* descends the crutch *Ff*, ending in the fork *f*, which embraces the pendulum *P*, so that as the pendulum vibrates, the crutch and the pallets necessarily vibrate with it. The pendulum is hung by a thin spring *S* from the cock *Q*, so that the bending point of the spring may be just opposite the end of the pallet arbor, and the edge of the spring as close to the end of that arbor as possible.

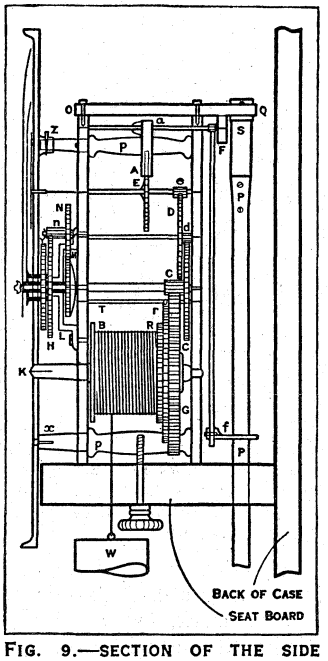


FIG. 9.—SECTION OF THE SIDE VIEW OF A COMMON HOUSE CLOCK WITHOUT STRIKING MOVEMENT

The minute hand fits on to a squared end of a brass socket, which is fixed to the wheel *M*, and fits close, but not tight, on the prolonged arbor of the centre wheel. Behind this wheel is a bent spring which is set on the same arbor with a square hole in the middle, so that it must turn with the arbor; the wheel is pressed up against this spring, and kept there by a cap and a small pin through the end of the arbor. The consequence is that there is friction enough between the spring and the wheel to carry the hand round, but not enough to resist a moderate push with the finger for the purpose of altering the time indicated. This wheel *M* drives another wheel *N*, of the same number of teeth, which has a pinion attached to it; and that pinion drives the 12 hour wheel *H*, which is also attached to a large socket or pipe carrying the hour hand, and riding on the former socket. The weight *W*, which drives the train and gives the impulse to the pendulum through the escapement, is generally hung by a catgut line passing through a pulley attached to the weight, the other end of the cord being tied to some convenient place in the clock frame or seat-board, to which it is fixed by screws through the lower pillars.

Striking Mechanism.—Fig. 10 is a front view with the face taken off, showing the repeating or rack-striking movement. *M* is the hour-wheel, on the pipe of which the minute-hand is set; *N* the reversed hour-wheel, and *n* its pinion, driving the 12-hour wheel *H*, on whose socket is fixed what is called the snail *Y*, which belongs to the striking work exclusively. The hammer is raised by the eight pins in the rim of the second wheel in the striking train. The hammer does not quite touch the bell, as it would jar in striking and muffle the full sound. The form of the hammer-shank at the arbor where the spring *S* acts upon it is such that the spring both drives the hammer against the bell when the tail *T* is raised, and also checks it just before it reaches the bell, the blow on the bell thus being given by the bending of the hammer shank. Sometimes two springs are used, one for impelling the hammer and the other for checking it. But nothing will check the chattering of a heavy hammer, except making it lean forward so as to act, partially at least, by its weight. The pinion of the striking-wheel generally has eight leaves, the same number as the pins; and as a clock strikes 78 blows in 12 hours, the great wheel will turn in that time if it has 78 teeth instead of 96, which the great wheel of the going part has for a centre pinion of eight. The striking-wheel drives the wheel above it once round for each blow; that wheel drives a fourth (in which there is a single pin *P*), six or any other integral number of turns for one turn of its own. A fan-fly moderates the velocity of the train by the resistance offered by the air.

Church and Turret Clocks.—A clock is a machine in which the only work to be done is the overcoming of its own friction and the resistance of the air. It is evident that when the friction and resistance are much increased it may become necessary to neutralize their effects. In a turret clock the friction is enormously increased by the great weight of all the parts and the resistance of the wind, and sometimes snow, to the motion of the hands. Besides that, there is the exposure of the clock to dirt and dust, and of the oil to a temperature which nearly or quite freezes it. This last circumstance alone will generally make the arc of the pendulum at least half a degree more in summer than in winter.

Inasmuch as the time is materially affected by the force which arrives at the pendulum, as well as the friction on the pallets when it does arrive there, it is evidently impossible for any turret clock of the ordinary construction, especially with large dials, to keep any constant rate through the various changes to which it is exposed. Hence special precautions, such as the use of remontoires and gravity escapements, have to be observed in the design of large clocks in order to ensure that the arc of the pendulum is not affected by external circumstances. But such have been the improvements effected in electric clocks, that it appears far preferable to keep an accurate timepiece in some sheltered position and use it with a source of electricity to drive the hands of the large dial.

There are many turret clocks in various parts of Europe, and a limited number in England. The largest of them is the Strasbourg clock of 1547. It aims at showing the movements of the earth and stars as well as the time, also the seasons, epochs of the year,

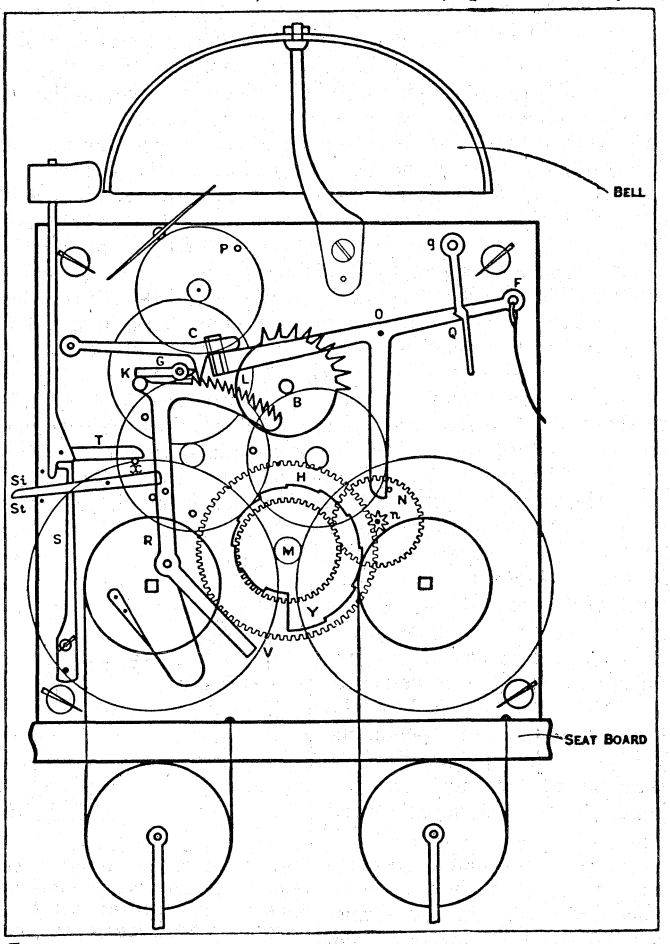


FIG. 10.—DIAGRAM OF A FRONT VIEW OF COMMON ENGLISH HOUSE CLOCK WITH STRIKING MOVEMENT

moral emblems and the life of man; it was restored in 1842. Some of these clocks contain large figures which strike the hours.

The Portable Clock.—Simultaneously with the development of the case clock, the watch was evolved. The need for it arose from the impossibility of moving the pendulum clock from place to place. The first use of a mainspring was probably in the 16th century. It was used for watches, then called Nuremberg eggs. The escapement was usually of the verge form with a crown wheel. A table clock, early 17th century, is shown in the plate. The escapement is furnished with a balance wheel governed by a hair spring.

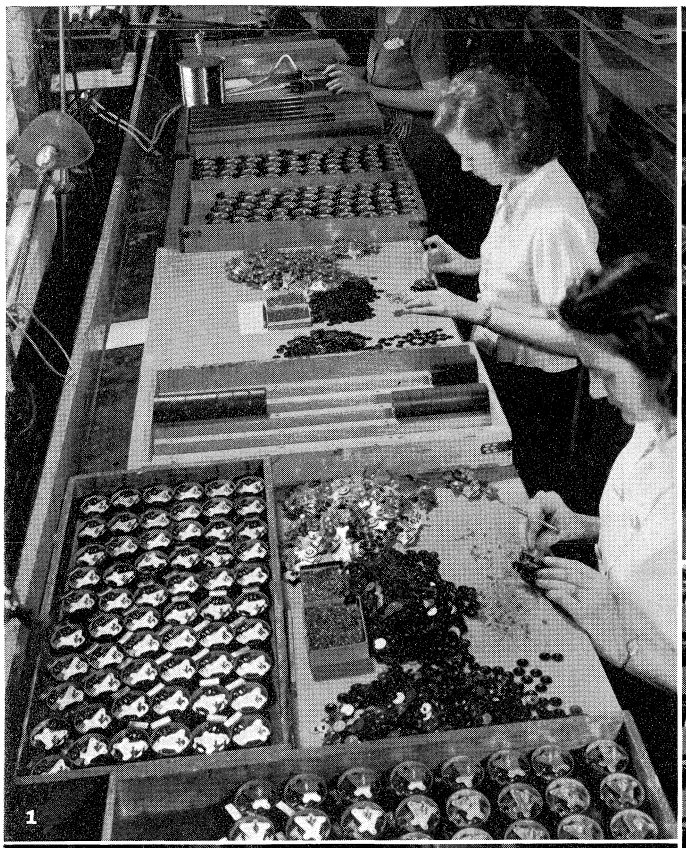


BY COURTESY OF (1) THE KEEPER OF THE WALLACE COLLECTION, (2) LIBERTY AND COMPANY, LTD., (4, 6, 9) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM, (5, 7, 8, 10, 11) THE TRUSTEES OF THE BRITISH MUSEUM, (12) THE WEST END CLOCK COMPANY; PHOTOGRAPH, (3) ALINARI, BY COURTESY OF THE ITALIAN TRAVEL BUREAU, LONDON

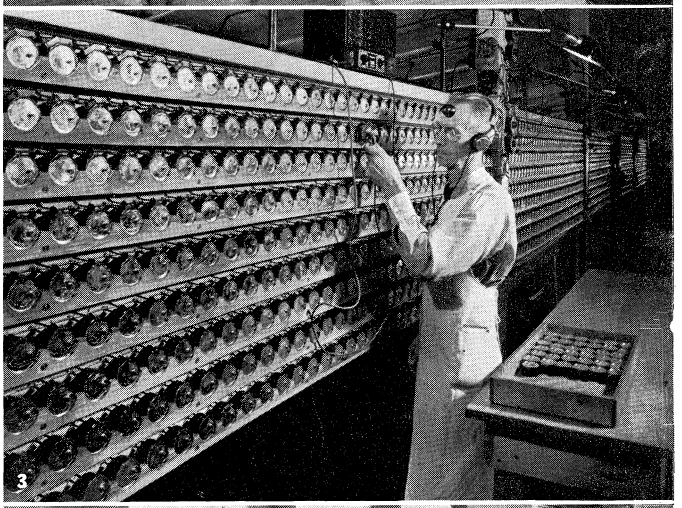
CURIOUS DECORATIVE AND MECHANICAL CLOCKS

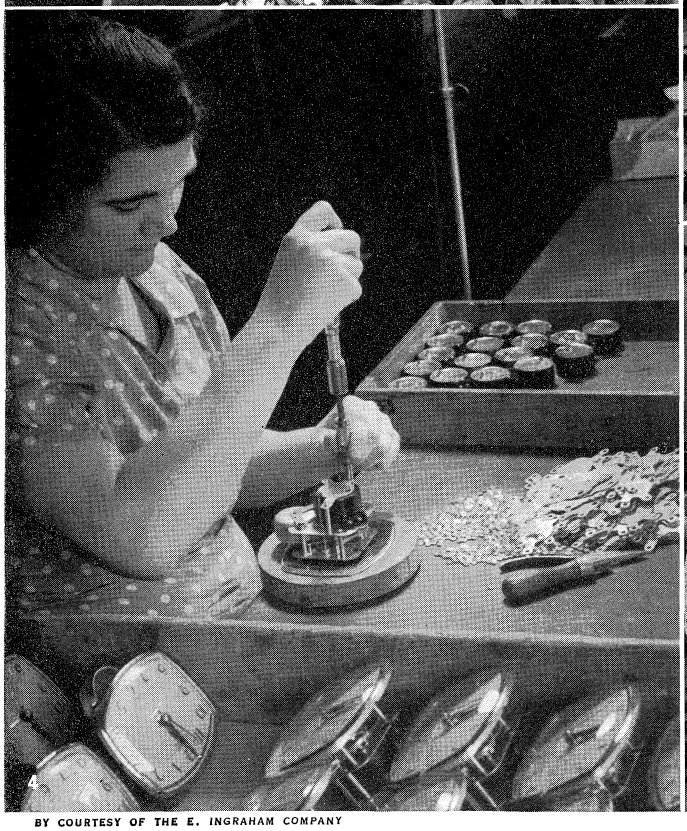
1. Clock with case of Boulle-work. 2. Clock outside the shop of Messrs. Liberty & Co., London. 3. Mechanical clock, Venice. Hours struck by figures at top of tower. 4. Grandfather clock in case decorated with floral marquetry. 5. Globe or falling-ball clock, *c.* 1650. Suspended, it goes by its own weight. 6. Astronomical clock in form of celestial globe; German, *c.* 1584. 7. French astronomical clock with astrolabe; dated about 1560. 8. German horizontal clock with hunting scenes in relief; *c.* 1600. 9. Louis XVI. clock made of Oriental alabaster. 10. Standing clock (still going) by Isaac Hobrecht, Strasbourg, 1589. 11. Clock in form of a ship with dial at base of middle mast; the small figures are set in motion by mechanism of clock. By Schlott, 1580. 12. Modern 400-day clock. Fly-wheel suspended on strip of elastic steel

CLOCKS











BY COURTESY OF THE E. INGRAHAM COMPANY

PROGRESSIVE STEPS IN THE MANUFACTURE OF ELECTRIC CLOCKS

1. Assembling self-starting synchronous motors for clocks
2. Sealing the motor housing so that it will retain the bath of lubricating oil
3. Testing a bank of motors running on racks
4. Attaching motor to movement of clock
5. After the clocks are cased and plugs are attached, the finished product is given a final testing

The most usual pattern of portable clock in England has a pendulum of about 10 in. in length beating half seconds, a striking mechanism, shows the days of the month and dates from about the middle of the 18th century. After this period, the tendency was for portable clocks to become smaller.

A characteristic table clock has a flat shape mounted in a gilt stand, suitable for travelling.

A great number of ornamental cases for portable clocks were made in the 18th and 19th centuries. A rather handsome one is of enamelled copper, mounted in gilt frames. It has on the reverse side five dials showing the positions of the moon and planets. It has also a repeater, which, by pulling a string, causes the hour to sound whenever wanted.

This is an old plan much used before the invention of lucifer matches.

Two hands for clocks came in about the commencement of the 18th century.

Old and Modern Clocks Compared.—Of old makers the most distinguished was Thomas Tompion, at whose works a vast quantity of beautiful clocks and watches were made during the latter part of the 17th century. He is called the father of English watchmaking. The name next to Tompion is that of his pupil, George Graham, who flourished during the early part of the 17th century, and who invented the mercurial pendulum and the dead-beat escapement. Quare is another maker whose clocks are valuable. A collection of stand clocks is to be seen at the South Kensington museum.

Robert Hooke (*q.v.*) was the first who drew attention to the fact that springs when stretched resist with a force proportional to their extension, and thus helped to lay the foundation of the laws of harmonic motion as applied to clockwork. He also invented a wheel-cutting device and the anchor escapement.

Huygens was one of the originators of the application of the pendulum to the clock and the inventor of the going barrel. Harrison invented the "grid-iron" pendulum, and also enormously improved the chronometer, by means of which he proved that the Board of Admiralty was a whole day's sail out of the proper reckoning of the island of Madeira. This chronometer in one experiment kept time to within 65 minutes in about five months, which was a wonderful performance in those days, for it was then thought quite a feat to determine the position of a ship at sea by means of a chronometer to 40 miles.

Modern household clocks are now made with short 10 in. pendulums, and frequently are wound up by electricity at short intervals. Companies provide master-clock control for hotels and public buildings. These clocks do not aim at the accuracy of astronomical clocks, but they are admirably adapted for the uses of ordinary life.

Electrical Clocks.—Electrical timepieces only differ from timepieces driven by weights or springs in that some arrangement is made to use electricity to wind up those weights or springs mechanically, either at every beat of the pendulum or at intervals. With dry batteries small clocks can be made to run for a long time without attention. For bigger clocks it is possible to use the electric lighting supply. This is not difficult where the current is continuous, but where it is alternating, a transformer or a special synchronous design known as the telechron (*q.v.*) is used. An ingenious form is the well-known Hipp's clock at the observatory of Neuchâtel in which, as the pendulum passes its lowest point, a vertical flipper is made to close an electrical circuit. Its average variation from its daily rate is about one-thirtieth of a second.

The bibliography of horology is very extensive. Among modern works Lord Grimthorpe's *Rudimentary Treatise on Clocks, Watches and Bells* (8th ed., 1903) is perhaps the most convenient. Many references to older literature will be found in Thomas Reid's *Treatise on Clocks and Watchmaking* (1849). (H. H. C.)

THE CLOCK IN DECORATION

In art the clock occupies a position of considerable distinction, and antique examples are prized and collected as much for the decorative qualities of their cases as for the excellence of their timekeeping. French and English cabinetmakers have especially excelled, although in entirely different ways, in the making of clock cases. The one aimed at comely utility, often made actually beautiful by fit proportion and the employment of finely grained woods; the other sought a bold and dazzling splendour in which ornament over-lay material. It was not in either country until the latter part of the 17th century that the cabinet-maker's opportunity came. The bracket or chamber clock gave comparatively little scope to the worker in wood—in its earlier period, indeed, it was almost invariably encased in brass or other metal; and it was not until the introduction of the long pendulum swinging in a small space that it became customary to encase clocks in decorative woodwork. What is, perhaps, the earliest surviving English specimen of "grandfather" clock is inscribed with the date 1681. Originally it was a development of the dome-shaped bracket clock, and in the older examples the characteristic dome or canopy is preserved. The first timekeepers of this type had oaken cases but when walnut began to come into favour that beautifully marked wood was almost invariably used for the choicest and most costly specimens. Thus in 1698 the dean and chapter of St. Paul's cathedral paid the then very substantial price of £14 for an inlaid walnut long-cased eight-day clock to stand in one of the vestries. Throughout the 18th century they were made in myriads all over England, and since they were a prized possession it is not surprising that innumerable examples have survived. Vary as they may in height and girth, in wood and dial, they are all essentially alike. In their earlier years their faces were usually of brass engraved with cherubs' heads or conventional designs, but eventually the less rich white face grew common. There are two varieties—the eight-day and the 30-hour. The favourite walnut case of the late 17th and early 18th centuries gave place in the course of a generation to mahogany, which retained its primacy until the introduction of cheaper clocks brought about the supersession of the long-cased variety. Many of these cases were made in lacquer when that material was in vogue; satinwood and other costly foreign timbers were also used for bandings and inlay. The most elegant of the "grandfather" cases are, however, the narrow-waisted forms of the William and Mary period in walnut inlay, the head framed in twisted pilasters. During the later period of their popularity the heads of long clocks were often filled in with painted discs representing the moon, by which its course could be followed. Such conceits as ships moving on waves or time with wings were also in favour. The northern parts of France likewise produced tall clocks, usually in oaken cases; those with Louis XV. shaped panels are often very decorative. French love of applied ornament was, however, generally inimical to the rather uncompromising squareness of the English case, and the great Louis XV. and Louis XVI. cabinet-makers made some magnificent and monumental clocks, many of which were "long" only as regards the case, the pendulum being comparatively short, while sometimes the case acted merely as a pedestal for a bracket-clock fixed on the top. These pieces were usually mounted very elaborately in gilt bronze, cast and chased, and French bracket and chamber clocks were usually of gilded metal or marble, or a combination of the two; this essentially late 18th-century type still persists. English bracket clocks contemporary with them were most frequently of simple square or arched form in mahogany. The "grandfather" case was also made in the Low Countries, of generous height, very swelling and bulbous.

See Mathieu Planchon, *L'Horloge, son histoire retrospective, pittoresque et artistique* (1899); F. J. Britten, *Old Clocks and Watches and their Makers* (2nd ed., 1904). (J. P.-B.)

THE CLOCK TRADE IN GREAT BRITAIN

The consumption of clocks in Great Britain is enormous and it is very largely met by importation from abroad. In the 17th and 18th centuries clock-making was mainly centred in England and France, but the modern output of low-priced clocks has become mainly the produce of German and American factories. At one time before the World War, a German kitchen clock was freely sold retail in England for a few shillings. The manufacture in England of the better sort of clock is still carried on at London, Coventry, Croydon, Derby and other places on a fairly large scale; in several instances munition factories have been

turned to clock-making.

There is also an English industry engaged in placing imported movements in British-made cases. The extent of this may be gathered from the fact that under the heading "parts of clocks" the imports into the United Kingdom in 1925 were valued at £1,239,000 and in 1926 at £463,000. A number of British manufacturers are producing clocks on mass-production lines with success, and it is claimed that the protection they have obtained of a 33⅓% import duty is of great assistance to the trade. The imports of clocks into the United Kingdom fell from a value of £1,099,000 in 1925 to £376,000 in 1926. The exportation of British clocks from the United Kingdom is negligible; it amounted in 1926 to a value of £12,690. (X.)

CLOCK INDUSTRY IN AMERICA

The clock industry showed an entirely different development in America from that in Europe. In Europe, clocks were made by jewellers, locksmiths, blacksmiths, astronomers and priests. The new world recruited its first clock-makers from the ranks of the carpenters, and consequently the oldest American clocks were constructed of wood. In New England, which is still the greatest manufacturer of watches and clocks in the world, the new industry was born, and Eli Terry of Connecticut was one of the first and best-known clock-makers. It is well-known that he and his helpers made a few dozen clocks by hand, and Eli mounted his horse, with clocks hanging from the saddle, and sold them to the farmers in the surrounding countries. Terry was the first clock-maker to use machinery, when his orders began to increase, and thus became a clock manufacturer in the true sense of the word. Another old time clock mechanic, who developed into a clock manufacturer, was one of Eli Terry's helpers, Seth Thomas. His honest and clever workmanship built up a business that is still one of the largest and best-known in America. It is carried on in a large clock factory whose product still carries his name. It was Chauncey Jerome, another New Englander, who saw the great advantages of using brass instead of wood in clock movements. Through this change in material, clock movements became less cumbersome and easier to transport, and most important of all, cheaper. Eli Terry's hand-made clocks sold for about $40 apiece. Jerome's clocks could be bought for from $5 to $6 each. In America, in contrast to European conditions, the individual clock-makers were absorbed by larger corporations, as the following description shows. Chauncey Jerome leased together with E. D. Bryant a building from the American Brass and Copper Company, located in Ansonia in the Naugatuck valley, the centre of the present clock manufacturing district, for the manufacture of clock cases and clock movements. Subsequently, both makes of cases and movements passed into the hands of the Ansonia Brass and Copper Company. The business of the Ansonia Brass and Copper Company assumed such magnitude that in 1877 a reorganization became desirable, and a new corporation was formed under the name of the Ansonia Clock Company.

The American manufacturers concentrated from the start in the elimination of costly handwork. The old way of making a clock was to have a master-mechanic build a model clock, which after it had passed inspection and test runs would be taken apart, the parts distributed to different workmen, who had to copy these parts as closely as possible; these parts then were returned to the clock-maker, who assembled and adjusted them again. Although all of these clocks were expected to be alike, no part of one of them could be interchanged with the same part of another clock. It was, therefore, the aim of the early Yankee clock-makers to produce a clock with interchangeable parts, which was accurate in telling time, and cheap enough to bring it within the reach of everyone. Even though all theoretical work had been finished in the European clock-making countries, there remained still the work of mass production. Fortunately the period coincided with the period of great American inventiveness. In this period, the old method of producing all work by hand was rapidly superseded by new methods, where new machinery was invented and used in all branches of manufacture. When the means for more rapid producing of parts had been obtained other factors had to be considered, not only the design of the clock as timekeeper had to be correct, parts to be absolutely interchangeable, and the ease of assembly had to be taken into consideration, but also much thought had to be given to making the work of the clock-repairer easy, in order that the price of any eventual repairing would not be prohibitive.

In 1850 a firm that could boast seven timepieces a day, was doing well. In 1928 clock companies could produce from 10,000 to 30,000 timepieces each, per day. As a result prices tumbled so that a watch or an alarm clock which will give good service can be bought for as low as $1.00. The number of pieces in a watch or clock have not materially changed since clocks were first made. It is only through the replacement of handwork by machinery, that modern production and low prices become possible. Almost all new inventions in the clock field are not so much concerned with different designs or reduction of parts as with easier and cheaper manufacturing. With the advent of the radio, and the broadcasting of the exact time, the public has become more exacting as regards the time-keeping qualities of clocks and watches. The owner checks his timepiece with the observatory time signals, and is dissatisfied if there is any variation. (W. H. Ba.)

CLODIA, VIA, an ancient high-road of Italy. Its course, for the first 11 m., was the same as that of the *Via Cassia;* it then diverged to the north-north-west and ran on the west side of the *Lacus Sabatinus,* past Forum Clodii and Blera (mod. Bieda) to Tuscania, after which its course is uncertain. According to Millee (*Itineraria Romana*) it went on by Maternum (Valentano) Acquapendente, Radicofani, Buonconvento Siena, and Luca past another Forum Clodii to Luna: but this is doubtful. In parts it follows older Etruscan roads, and may date from the end of the 4th century B.C. *See* also Cassia, Via.

See D. Anziani in *Mélanges de l'École Française de Rome,* 1913, 169 *sqq.*

CLODIUS, PUBLIUS (*c.* 93–52 B.C.), surnamed Pulcher, Roman politician. He took part in the third Mithridatic War under his brother-in-law Lucius Licinius Lucullus, but considering himself treated with insufficient respect he stirred up a revolt; another brother-in-law, Q. Marcius Rex, governor of Cilicia, gave him the command of his fleet, but he was captured by pirates. On his release he repaired to Syria, where he nearly lost his life during a mutiny instigated by himself. Returning to Rome in 65, he prosecuted Catiline for extortion, but was bribed by him to procure acquittal. There seems no reason to believe that Clodius was implicated in the Catilinarian conspiracy; according to Plutarch he supported Cicero. But Cicero attacked him when he was on trial for profaning the mysteries of the Bona Dea (61), and this made Clodius his enemy for life and he became the tool of Caesar. On his return from Sicily (where he had been quaestor in 61) he was adopted by a plebeian and elected tribune of the people (59). His first act was to bring forward certain laws calculated to secure him the popular favour. Corn was to be distributed gratuitously once a month; the magistrates' right of preventing the assembly of the comitia was abolished; the old guilds of workmen were re-established; the censors were forbidden to exclude any citizen from the senate or inflict any punishment upon him unless he had been publicly accused and condemned. He then contrived the exile of Cicero and the despatch of the younger Cato on a mission to Cyprus. Cicero's property was confiscated by order of Clodius. After the departure of Caesar for Gaul, Clodius became practically master of Rome by means of his armed gangs. But he fell out with Pompey and was not re-elected for 57, while one of the Tribunes, Milo, countered his force with force, so despite his opposition, in Aug. 57 Cicero was recalled. Riots between Clodius and Milo continued; in 56, when *curule aedile,* Clodius impeached Milo for public violence (*de vi*), but the matter was dropped. In 53, when Milo was a candidate for the consulship, and Clodius for the praetorship, the rivals collected armed bands and fights took place in the streets of Rome, and on Jan. 20, 52, Clodius was slain near Bovillae.

His sister, Clodia, wife of Q. Caecilius Metellus Celer, was notorious for her numerous love affairs. It is now generally admitted that she was the Lesbia of Catullus (Teuffel-Schwabe,

Hist. of Roman Lit., Eng. tr., 214, 3). For her intrigue with M. Caelius Rufus, whom she afterwards accused of attempting to poison her, *see* Cicero, *Pro Caelio*.

BIBLIOGRAPHY.—The ancient authorities are Cicero, *Letters* (ed. Tyrrell and Purser), *Pro Caelio, pro Sestio, pro Milone, pro Domo sua, de Haruspicum Responsis, in Pisonem;* Plutarch, *Lucullus, Pompey, Cicero, Caesar;* Dio Cassius xxxvi. 16, 19, xxxvii. 45, 46, 51, xxxviii. 12–14, xxxix. 6, 11, xl. 48. *See* also I. Gentile, *Clodio e Cicerone* (1876); E. S. Beesley, "Cicero and Clodius," in *Fortnightly Review*, v.; G. Lacour-Gayet, *De P. Clodio Pulchro* (1888); H. White, *Cicero, Clodius, and Milo* (1900); G. Boissier, *Cicero and his Friends* (Eng. trans., 1897).

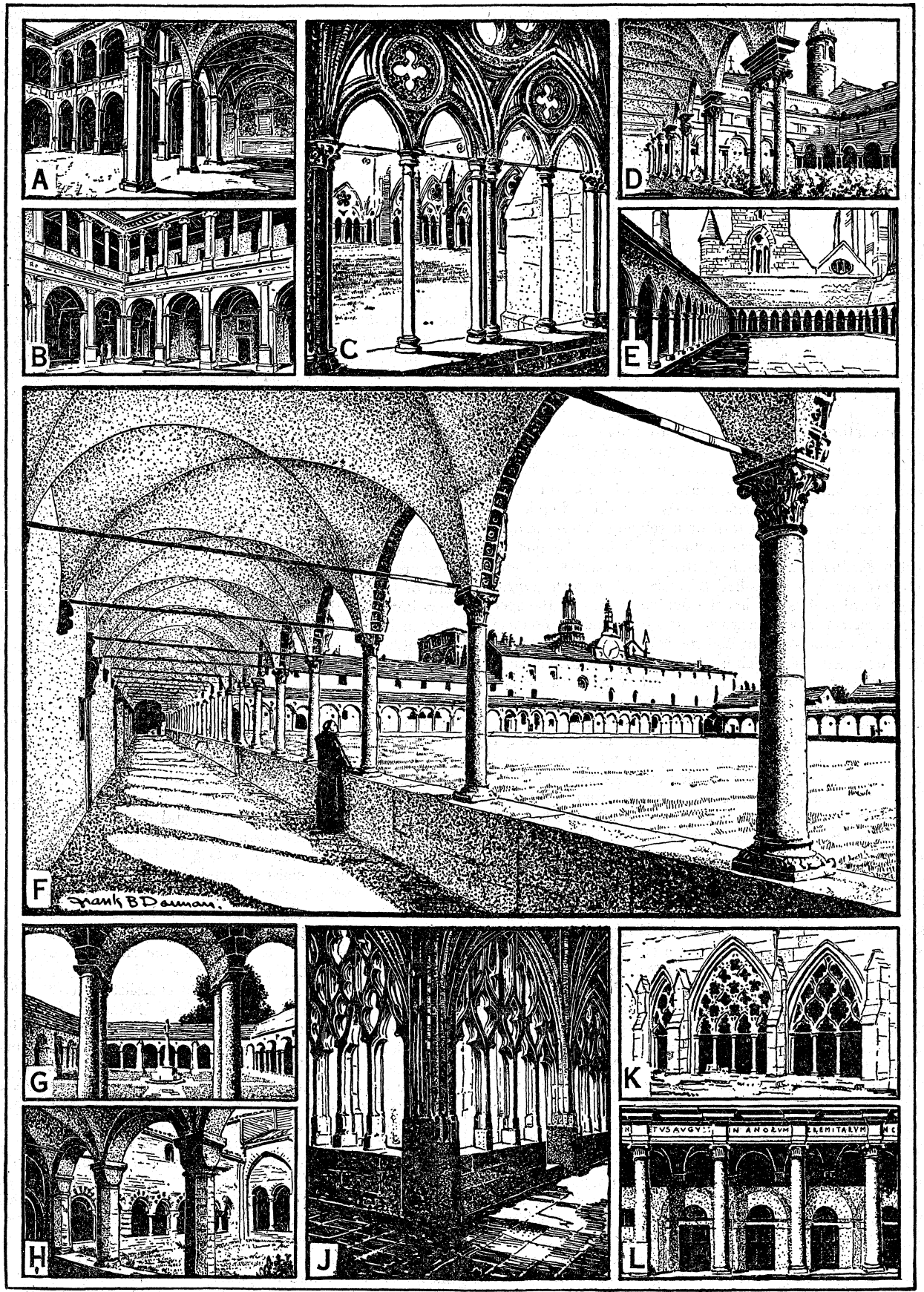
CLOGHER, a village, Co. Tyrone, Northern Ireland. Pop. (1921) 197. It gives its name to dioceses of the Church of Ireland and the Roman Catholic Church, though the seat of the bishop of the latter is at Monaghan. The dedication of the Protestant cathedral to St. Macartin is of interest, for although the building is modern, St. Macartin is associated with St. Patrick, who is said to have founded a bishopric here. The name is derived from *cloch*, a pillar stone—an object of worship in the locality, preserved in the cathedral until the 15th century.

CLOISTER originally signified an entire monastery, but is now restricted to mean the four-sided enclosure, surrounded with covered ambulatories, usually attached to conventual and cathedral churches, and sometimes to colleges, or, by a still further limitation, to the ambulatories themselves. In its older sense it is frequently used in earlier English literature and is still so employed in poetry. The Latin *claustrum*, as its derivation implies, primarily denoted the enclosing wall of a religious house, and then came to be used for the whole enclosed building. To this sense the German *Kloster* is still limited, the covered walks, or cloister in the modern sense, being called *Klostergang*, or *Kreuzgang*. In French the word *cloître* retains the double sense. In the special sense now most common, the word "cloister" denotes the quadrilateral area in a monastery or college, round which the principal buildings are ranged, and which is usually provided with a covered way or ambulatory running all round, and affording a means of communication between the various centres of the ecclesiastical life. According to the Benedictine arrangement, which from its suitability to the requirements of monastic life was generally adopted in the West, one side of the cloister was formed by the church, the refectory occupying the side opposite to it, so that the worshippers might have the least annoyance from the noise or smell of the repasts. On the eastern side the chapter-house was placed, with other apartments adjacent to it, belonging to the common life of the brethren, and, as a rule, the dormitory occupied the whole upper story. On the opposite or western side were generally the cellarer's lodgings, with the cellars and store-houses, in which the necessary provisions were housed. In Cistercian monasteries the western side was usually occupied by the *domus conversorum*, or lodgings of the lay-brethren, with their day-rooms and workshops below, and dormitory above. The cloister, with its surrounding buildings, generally stood on the south side of the church, to secure as much sunshine as possible. A very early example of this disposition is seen in the plan of the monastery of St. Gall. Local requirements caused the cloister, in some instances, to be placed to the north of the church. This is the case at Canterbury, Gloucester, Chester and Lincoln cathedrals.

Although the covered ambulatories are essential to the completeness of a monastic cloister, a chief object of which was to enable the inmates to pass under cover from one part of the monastery to another, they were sometimes wanting. The cloister at St. Albans seems to have been deficient in ambulatories till the abbacy of Robert of Gorham, 1151–66, when the eastern walk was erected. This, as was often the case with the earliest ambulatories, was of wood, covered with a sloping roof or "penthouse." We learn from Osbern's account of the conflagration of the monastery of Christ Church, Canterbury, 1067, that a cloister with covered ways existed at that time, connecting the church, the dormitory and the refectory. An early drawing of the monastery of Canterbury shows it formed by Norman arches supported on shafts, and covered by a shed roof. A fragment of such an arcaded cloister is still found on the eastern side of the infirmary cloister. This earlier form of cloister has been generally superseded in England by a range of windows, usually unglazed, but sometimes, as at Gloucester, provided with glass, lighting a vaulted ambulatory, of which the cloisters of Westminster Abbey, Salisbury and Norwich are typical examples. The older design was preserved in the south, where "the cloister is never a window, but a range of small elegant pillars, sometimes single, sometimes coupled, and supporting arches of a light and elegant design" (Fergusson, *Hist. of Arch*, i., p. 610). Examples of this type are the exquisite cloisters of St. John Lateran, and St. Paul's without the walls, at Rome, where the coupled shafts and arches are richly ornamented with ribbons of mosaic, and those of the convent of St. Scholastica at Subiaco, all of the 13th century, and the beautiful cloisters of Le Puy-en-Velay, and Arles, in southern France (both 11th century) and that at Laach, where the quadrangle occupies the place of the "atrium" of the early basilicas at the west end, as at S. Clemente at Rome, and S. Ambrogio at Milan. Spain also presents some magnificent cloisters of both types, of which that of the royal convent of Huelgas, near Burgos, of the arcaded form, is, according to Fergusson, "unrivalled for beauty both of detail and design." Also notable are those of Monreale and Cefalu in Sicily (12th century), where the arrangement is the same, of slender columns in pairs with capitals of elaborate foliage supporting pointed arches of great elegance of form.

The Campo Santo at Pisa is in reality a large and magnificent cloister. It consists of four ambulatories as wide and lofty as the nave of a church, erected in 1278 by Giovanni Pisano, round a cemetery composed of soil brought from Palestine by Archbishop Lanfranchi in the middle of the 12th century. The window-openings are semicircular, filled with elaborate tracery in the latter half of the 15th century. The inner walls are covered with frescoes, invaluable in the history of art, by Orcagna, Simone Memmi, Buffalmacco, Benozzo Gozzoli, and other early painters of the Florentine school. The ambulatories now serve as a museum of sculpture. The great monastic establishments of Italy contain numerous important cloisters; there are frequently two or three in a single monastery—one large cloister for the general use of the monks, and smaller cloisters in connection with the residence of the prior or abbot, the service portions and various other minor buildings. The cloisters at the Certosa at Pavia (15th century) are notable for their size and quaint, early Renaissance ornament. In the Certosa at Rome, now part of the Museo delle Terme, the cloister is a large arcade of pure and simple Renaissance type. Another interesting Renaissance example is that which Bramante designed for the church of S. Maria della Pace at Rome 1504. Later Renaissance cloisters tended more and more to become duplicates of palace courtyards.

The cloister of a religious house was the scene of a large part of the life of its inmates. It was the place of education for the younger members, and of study for the elders. A canon of the Roman council of 826 enjoins the erection of a cloister as an essential portion of an ecclesiastical establishment for the better discipline and instruction of the clerks. Peter of Blois describes schools for the novices as being in the west walk, moral lectures being delivered in that next the church. At Canterbury the monks' school was in the western ambulatory, and it was there that the novices were taught at Durham (Willis, *Monastic Buildings of Canterbury*, p. 44; *Rites of Durham*, p. 71). The other alleys, especially that next the church, were devoted to the studies of the elder monks. The constitutions of Hildemar and Dunstan enact that between the church service the brethren should sit in the cloister and read theology. For this purpose small studies, known as "carrols," *i.e.*, a ring or enclosed space, were often found in the recesses of the windows. Of this arrangement there are examples at Gloucester and Chester. The use of these studies is thus described in the *Rites of Durham:* "In every wyndowe" in the north alley "were iii. pewes or carrells, where every one of the olde monkes had his carrell severally by himselfe, that when they had dyned they dyd resorte to that place of cloister, and there studyed upon their books, every one in his carrell all the afternonne unto evensong tyme. This was there exercise every daie." On the opposite wall were cupboards full of books for the



FROM: (C, K) GARDNER, "A GUIDE TO ENGLISH GOTHIC ARCHITECTURE" (CAMBRIDGE UNIVERSITY PRESS); (E) LEON, "LES MONUMENTS HISTORIQUES" (RENOUARD); (G) "ARCHITECTURAL REVIEW"; (J) ROSE, "CATHEDRALS AND CLOISTERS OF NORTHERN FRANCE" (PUTNAM)

A, UNIVERSITY, BOLOGNA (ITALIAN RENAISSANCE); B, SANTA MARIA DELLA PACE, ROME (ITAL. REN.); C, SALISBURY CATHEDRAL (ENG. GOTH.); D, MONASTERY, SAN VITALE, RAVENNA (ITAL. REN.); E, ABBEY, MONT ST. MICHEL (FR. GOTHIC); F, MONASTERY, PAVIA (ITAL. REN.); G, CLOISTERS, WINCHESTER (MOD. ENGLISH); H, MONASTERY, VEZZOLANO (ITAL. ROMANESQUE); J. ABBEY, VERDUN (FR. GOTHIC); K, WESTMINSTER ABBEY (ENG. GOTH.); L, SAN STEFANO, VENICE (ITAL. REN.)

use of the students. The cloister arrangements at Canterbury were similar. New studies were made by Prior De Estria in 1317, and Prior Selling (1472–94) glazed the south alley, and constructed "the new framed contrivances, of late styled carrols" (Willis, *Mon. Buildings,* p. 45).

The cloisters were used also for recreation. The constitutions of Archbishop Lanfranc, sec. 3, permitted the brethren to converse together there at certain hours. To maintain discipline a special officer was appointed under the title of *prior claustri.* The cloister was furnished with a stone bench running along the side. It was also provided with a lavatory, usually adjacent to the refectory, but sometimes standing in the central area termed the cloister-garth, as at Durham. The cloister-garth was used as a place of sepulture, as well as the surrounding alleys. The cloister was in some few instances of two stories, as at Old St. Paul's and St. Stephen's chapel, Westminster, and occasionally, as at Wells, Chichester and Hereford, had only three alleys, there being no ambulatory under the church wall.

The larger monastic establishments had more than one cloister; there was usually a second connected with the infirmary, of which there are examples at Westminster Abbey and at Canterbury; and sometimes one giving access to the kitchen and other domestic offices. The cloister was not an appendage of monastic houses exclusively. It was also attached to colleges of secular canons, as at the cathedrals of Lincoln, Salisbury, Wells, Hereford and Chichester, and formerly at St. Paul's and Exeter. A cloister forms an essential part of the colleges of Eton and Winchester, and of New college and Magdalen at Oxford. These were used for religious processions and lectures, and for places of exercise for the inmates generally in wet weather, as well as in some instances for sepulture.

CLONAKILTY, urban district, Co. Cork, Eire, at the head of Clonakilty bay, 33 mi. S.W. of Cork by rail. Pop. (1936) 2,961. There are megaliths in the neighbourhood. Richard Boyle, first earl of Cork, granted it a charter in 1613 and it was prosperous until 1641, when it was almost destroyed in a fight between the English and Irish. There are castles at Galley head, Dunnycove and Dunowen. The linen industry was important in the 18th century. The present trade is in brewing, agricultural produce and fishing. The harbour is obstructed, but there is a pier for large vessels at Ring 1 mi. below the town. The fisheries are of importance.

CLONES, an urban district of Co. Monaghan, Eire, 64½ mi. S.W. by W. from Belfast by the Great Northern of Ireland railway. It is at the focus of ways from Dublin, Belfast, Londonderry, Enniskillen and Cavan. Pop. (1936) 2,235. There is a rath (encampment) in the vicinity. Clones was the seat of an abbey founded in the 6th century by St. Tighernach (Tierney). Remains of the abbey include a nave and tower of the 12th century. There is a round tower 75 ft. high. The market place, called the Diamond, has an ancient cross and occupies the summit of the hillock on which the town stands. Lacemaking is now extinct, but the town has agricultural trade.

CLONMACNOISE, a famous early Christian centre on the river Shannon, Offaly Co., Eire, 9 mi. south of Athlone. An abbey founded 541 by St. Kieran became famous and several books of annals were compiled here; Alcuin came to be taught by Colcu at Clonmacnoise. The Book of the Dun Cow (written about 1100) is a copy of an older collection of romances written on the skin of a cow of St. Kieran. The ecclesiastical foundation was called the Seven Churches of Clonmacnoise and their remains still survive. The fine west doorway of the Great Church is early; the other churches are those of Fineen, Conor, St. Kieran, Kelly, Melaghlin and Dowling. There are two round towers, O'Rourke's and McCarthy's, which is attached to Fineen's church and has a doorway at ground-level, an unusual feature. There are three crosses, the Great Cross facing the door of the Great Church. Many inscribed stones of the ninth century and later are preserved in the churches. Clonmacnoise became a bishopric and there are remains of a castle and bishop's palace (14th century), it was wasted by the English in 1552, and in 1568 the diocese was merged in that of Meaths.

CLONMEL (*Cluain meala,* or vale of honey), municipal borough and county town of Co. Tipperary, 112 mi. S.W. from Dublin, Eire, a junction on the Great Southern railway (Waterford, Limerick, Thurles), on both banks of the river Suir and on Moore and Long Islands. Pop. (1936) 9,391. It is near fine scenery in the Galtee and Knockmealdown mountains. It is at the head of barge navigation on the Suir. As a walled town (remains are still visible) it was frequently mentioned in the middle ages, but it was dismantled after capture by Cromwell (1650). Bianconi (1815) made it the centre of a system of conveyance of passengers by light cars in south Ireland. The town has a fair agricultural trade, formerly made woollen goods, and is an assize town.

CLOOTS, JEAN BAPTISTE DU VAL DE GRÂCE, BARON VON (1755–1794), better known as ANACHARSIS CLOOTS, revolutionary fanatic, was born near Cleves, at the castle of Gnadenthal, of a noble Prussian family of Dutch origin. His father placed him in the military academy at Berlin, but he left it at the age of 20 and traversed Europe, preaching his revolutionary philosophy as an apostle, and spending his money as a man of pleasure. On the outbreak of the Revolution he went to Paris. On June 19, 1790, he appeared at the bar of the Assembly at the head of 36 foreigners; and, in the name of this "embassy of the human race," declared that the world adhered to the Declaration of the Rights of Man and of the Citizen. After this he was known as "the orator of the human race," by which title he called himself, dropping that of baron, and substituting for his baptismal names the pseudonym of Anacharsis, from the famous philosophical romance of the Abbé J. J. Barthélemy. In 1792 he placed 12,000 livres at the disposal of the Republic—"for the arming of 40 or 50 fighters in the sacred cause of man against tyrants." In September he was elected a member of the Convention, and he voted the king's death in the name of the human race. He was guillotined as an Hébertist on March 24, 1794.

See G. Avenel, *Anacharsis Cloots, orateur du genre humain* (1865).

CLOQUET, a city of Carlton county, Minnesota, U.S.A., on the St. Louis river, 21 mi. W. by S. of Duluth. It is served by the Chicago, Milwaukee, St. Paul and Pacific, Duluth and Northeastern, Great Northern and Northern Pacific railways. The population was 6,782 in 1930; in 1940, 7,304 by the federal census. The river supplies water-power, and the city has large lumber-mills, a pulp and paper-mill and factories making insulating materials, boxes, clothes-pins, toothpicks, broom-handles and other articles of wood. A forest experiment station of the University of Minnesota is located here. The first mill was built in 1878, and the village was named from the French word *claquet,* representing the sound made by the mill. It was chartered as a city in 1903.

CLOSE, MAXWELL HENRY (1822–1903), Irish geologist, was born in Dublin in 1822. He was educated at Weymouth and at Trinity college, Dublin, took holy orders, and held various charges in England. In 1861 he returned to Dublin and devoted himself especially to the glacial geology of Ireland. His paper, read before the Geological Society of Ireland in 1866, on the "General Glaciation of Ireland" is a masterly description of the effects of glaciation, and of the evidence in favour of the action of land-ice. Later on he discussed the origin of the elevated shell-bearing gravels near Dublin, and expressed the view that they were accumulated by floating ice when the land had undergone submergence. He died in Dublin Sept. 12, 1903.

The obituary by Prof. G. A. J. Cole in *Irish Naturalist,* vol. xii. (1903) contains a list of publications and portrait.

CLOSE, a closed place (Lat. *clausum,* shut). In English law the term is applied to land, enclosed or not, held as private property, or to any exclusive interest in land sufficient to maintain an action for trespass. In Scotland the word is used of the entry, including the common staircase, of a block of tenement houses, and in architecture of the precincts of a cathedral or abbey.

The adjective "close" (*i.e.,* closed) is found in several phrases, such as "close time" or "close season" (*see* GAME LAWS), "close prices" (*q.v.*); "close borough," one of which the rights and privileges were enjoyed by a limited class (*see* BOROUGH); "close rolls and writs," royal letters, etc., addressed to particular persons, under seal. (*See* RECORD; LETTERS PATENT.)

CLOSED SHOP. A closed shop, in America, is a shop in which trade-union members refuse to allow non-unionists to obtain permanent employment. Shops in which non-unionists are permitted are "open shops." Since 1905 trade-unionists have seriously objected to the use of the term "closed shop." Their contention is that its adoption was due to designing employers aiming to place upon unions the onus of persisting in a policy of arbitrary exclusion. Trade-unions have urged that "union shop" (the English phrase) is the proper descriptive term. Curiously enough both the term closed shop, and its opposite, open shop, have to-day meanings altogether different from their original significance. In the early period of American trade-unions a shop employing exclusively union workmen or observing trade-union rules was regarded as open, one not so restricted a closed shop. After 1889 a reversion of these definitions came into usage.

An Old Institution.—The closed shop is not a development of modern industry. Mediaeval British gilds prevented the working of non-members; so also did, when possible, the eighteenth century trade clubs. Some of the gild regulations of the 16th and 17th centuries decreed that no gild journeyman was to work with a non-member: such principles were an integral part of mediaeval society. These tactics were continued by British trade-unionism and were naturally conveyed to America. The Cordwainers' Society of the City of New York in 1804, the New York Typographical Society in 1809 and subsequently other unions adopted by-laws forbidding members to work for employers hiring men who did not belong to their organizations or who worked for wages lower than the union scale. The chief weapon used by employers until 1836 was the invoking of old laws declaring combinations of workmen and strikes criminal conspiracies. By about the year 1840 the closed-shop rule had been adopted by the majority of American trade-unions, which refused to work with non-union men. These were stigmatized after 1854 as "rats" or "scabs." With the repeal or nullification of conspiracy statutes, employers formed local associations to resist the closed-shop movement.

The Trade-Union Label.—This was a powerful influence by which the American unions gained public support for the closed shop after the year 1880. Agitating for the abolition of sweat-shops, the unions, led by the Cigar Makers' Association of the Pacific coast, succeeded in identifying in the public mind the non-union shop with unwholesome conditions productive of disease. Union propaganda along this line increasingly turned consumers against the purchase of articles not made in union establishments and not bearing the union label. Since 1900 newer laws and the modernizing of many factories have generally caused the abolition of former bad conditions of manufacture. Trade-unions, however, still regard public approval of the union label as pre-eminently essential in their campaign for the union or closed shop. This was shown at the 1926 convention of the American Federation of Labor when the union label trades department reported that by moving pictures and other means it was carrying on an educational campaign which included 36 American States, various Canadian provinces and 396 cities in the United States and Canada.

National Associations Against National Unions.—From 1870 in the United States local trade-unions gradually merged into national unions, the majority of which made the maintenance of the closed shop a vital rule. During the same period, especially in the decade before 1901, there were formed national associations of employers, one of the purposes of which was to maintain the open shop. Large factories locked out union men for demanding the closed shop; the Birmingham Rolling Mill Company did so in 1884; the Granite Manufacturers' Association of Boston in 1887; and the Carnegie Steel Company in 1892. The American Federation of Labor declared in 1890 that the working of union with non-union men was inconsistent, especially when union men displaced unionists locked out or engaged in strike. From 1850 to 1898 the major part of more than a dozen court decisions held that strikes for the closed shop were criminal or tortious. These decisions had no effect upon trade-union insistence for the closed shop.

Conflicts Over "Closed-Shop" Demands.—The struggle over the closed-shop question reached an intense stage in about the year 1901 when the unions insisted upon employers signing written agreements conceding the closed shop. Previously the granting of the closed shop had been based upon custom or oral negotiation. Declaring that they would not admit "union dictation in the management of business," the National Metal Trades Federation and other large employers' associations aggressively campaigned to destroy the closed-shop system.

The award of the anthracite coal strike commission in the great coal strike of 1902 was of most considerable moral help to manufacturers' associations; the commission granted practically every demand of the union except that for the closed shop. Encouraged by this stand, the National Association of Manufacturers in 1902 began a vigorous movement for the open shop. The Citizens' Industrial Association of America, various citizens' alliances in different cities and a number of large corporations did likewise. The American Federation of Labor reiterated that the trade-union movement stood for the strictly union shop. Union after union endorsed the closed-shop principle. The proportion of strikes for recognition of trade-unions and union rules more than trebled in succeeding years. By reducing employment, the panic of 1907 weakened the trade-unions and gave corresponding advantage to employers. The campaigns carried on by the manufacturers' associations also caused a decided shift in public sentiment in favour of the open shop. By 1910 this was established in many industries, notably those which had been consolidated into powerful corporations. The open shop prevailed generally in the South.

The Company Union.—The entry of the United States into the World War in 1917 brought about auspicious conditions for organized labour in abundant employment and high wages. The power of trade-unions seemed secure. But a formidable rival came into existence to thwart the closed-shop plan. This new factor was the formation of company unions entirely distinct from the regular trade-unions. Company unions are those limited to the workers of a particular corporation and are organized under the auspices of the corporation. Some company unions have existed for more than a quarter of a century but only as isolated, uninfluential bodies. The noteworthy impetus to their widespread creation came in 1918–19, after which they increased rapidly. The statement was made at the 1926 convention of the American Federation of Labor that the number of wage-earners working under company unions' shop management was more than 2,000,000. The National Association of Manufacturers in 1927 computed the real figure at not more than 1,800,000 and possibly as low as 1,500,000. The American Federation of Labor numbers 2,800,000; the total trade-union organization, including the Railroad Brotherhoods, the Amalgamated Clothing Workers and the Industrial Workers of the World, was in 1927 perhaps 3,700,000. *See* COMPANY UNIONS.

Much of the discussion at the American Federation of Labor's conventions in 1926 and 1927 was concerned with the matter of company unions. Resolution No. 66 in 1926 declared that the open-shop forces, under the leadership of various associated employers' associations, had organized dual and company unions. These, the resolution held, were artificial creations, and as a menace to the trade-union movement they must be overcome. Voluntary trade-union management co-operating with employers was suggested as a substitute for company unions controlled by employers. Delegates assailed the "so-called and misnamed American plan" as an un-American one by which employers deliberately sought to bring about industrial serfdom denying freedom of contract and right of choice. In its report to the 1927 convention the executive council of the American Federation of Labor defined the company union as an element which did not make standards; "it is an agency for administering the affairs of a company and is not an economic and social force."

Status of the Closed Shop.—Reports of the U.S. bureau of labour statistics show that strikes for the closed or against the open shop have been increasing in recent years; of 17,994 labour disputes from 1918 to 1925 inclusive, only 483 dealt with the closed or open shop. However, from 1927 to 1938 inclusive, of

19,649 labour disputes, 1,433 dealt with the closed or open shop.

Strikes in Which the Closed Shop Was the Major Issue, 1927–38

Compiled from the *Monthly Labor Review*, May 1937, Table 8, May 1938, Table 10, and May 1939, Table 10; also, *Strikes in the United States, 1880–1936*, Bulletin No. 651, United States Bureau of Labor Statistics, Table 28.

Year	Strikes in which the closed shop was major issue	Grand total for year
1927	43	666
1928	63	620
1929	91	924
1930	59	651
1931	52	796
1932	45	852
1933	41	1,672
1934	109	1,817
1935	151	2,003
1936	130	2,156
1937	331	4,720
1938	318	2,772
Totals	1,433	19,649

BIBLIOGRAPHY.—Sidney and Beatrice Webb, *History of Trade Unionism;* Webb, *Industrial Democracy;* J. R. Common and others, *History of American Labor;* Barnett, *The Printers, A Study in American Trade Unionism;* McNeil, *The Labor Movement in America; History of the Glass Bottle Blowers' Association;* Spedden, *The Trade Union Label;* Frank T. Stockton, *The Closed Shop in American Trade Unions;* Ernest F. Lloyd, *The Closed Shop Versus The Open Shop;* J. B. S. Hardman and others, *American Labor Dynamics* (1928); Annual Reports U.S. commissioner of labour; *Proceedings* of the annual convention of the American Federation of Labor; *Open Shop Bulletins* and other publications of the National Association of Manufacturers. (S. PE.)

CLOSE PRICES. By reason of the method in which business is conducted on the London Stock Exchange, every security—bond, stock or share—that possesses a free market, is quoted at a double price. At the higher price, the purchaser can expect to buy; at the lower, he is able to sell. Prices quoted in the Stock Exchange Official List, and those in the newspapers, are usually wider than those at which bargains can be effected by either party, buyer or seller. To take the 5 per cent. War Loan as an example, this may be quoted 100½ to 100¾ in the daily Stock Exchange Official List, a margin of 5s. between selling and buying. But the actual dealing price will show no more than 2s.6d. difference. If the market is dull, owing to sellers predominating, the price will probably be 100½ to 100⅝; the buyer pays 100⅝ in this case, the middle price of the official quotation, while the seller receives 100½. Should buyers be in the majority, the price is more likely to be 100⅝ to 100¾, when the seller would get the middle price, *i.e.*, 100⅝. In a quiet market, the price might lie midway between the outside margin of 100½ to 100¾ and be quoted 100 9/16 to 100 11/16.

The Cause of Close Prices.—The closeness of a price depends entirely upon the amount of business that is doing in a particular stock or share at a particular time. If the Stock Exchange dealer in War Stock finds himself very busy, with brokers coming to deal with him in rapid succession, some as buyers and others as sellers, he can afford to make a closer price than is possible when public business runs at a low ebb. In the first case, therefore, he may make a sixteenth price; say, for example, 100⅝ to 100 11/16, feeling reasonably confident that, in the activity shown by the public dealings, he will be able to sell at 100 11/16 the stock for which he pays 100⅝. If demand quickens, the price goes up; if stock comes in, the market gives way. Should business fall off, the price widens again. When a stock rarely changes hands, the margin between buying and selling prices may be considerable, because the Stock Exchange jobber, if he sells, may not be able to obtain the stock for some time; if he buys, he runs the risk of not being able to dispose of it. Therefore he makes a wide price by way of insurance against accident, just as he will make a close price when activity of business conditions warrants his doing so.

The Two Factors.—Competition can become so keen in some particularly popular share, or market, that dealers will make extremely close prices. The existence of a market outside London acts as a stimulus to animation and close prices. Bristol has a lively market, for example, in some of the tobacco shares; Glasgow in J. & P. Coats, chartered, etc.; Paris in Rio Tintos and certain South Africans; Brussels in Brazilian Tractions and Tanganyikas; New York in Canadian Pacifics, and so on. The degree of closeness quoted in any price will expand and contract like a concertina; it is mainly dictated, as previously observed, by the volume of public business, and by competition in the Stock Exchange market concerned.

CLOSURE, the parliamentary term for the closing of debate according to a certain rule, even when certain members are anxious to continue the debate. (*See* PARLIAMENT: *Parliamentary Procedure.*)

CLOT, ANTOINE BARTHÉLEMY (1793–1868), French physician, known as CLOT BEY, was born at Grenoble on Nov. 7, 1793, and graduated in medicine and surgery at Montpellier. After practising for a time at Marseilles he was made chief surgeon to Mohammed Ali, viceroy of Egypt. At Abuzabel, near Cairo, he founded a hospital and schools for all branches of medical instruction, as well as for the study of the French language; and instituted the study of anatomy by means of dissection. In 1836 he was appointed head of the medical administration of the country. In 1849 he returned to Marseilles, though he revisited Egypt in 1856. He died at Marseilles on Aug. 28, 1868.

CLOTAIRE (CHLOTHACHAR), name of four Frankish kings.

CLOTAIRE I. (d. 561) was one of the four sons of Clovis. On the death of his father in 511 he received as his share of the kingdom the town of Soissons, which he made his capital, the cities of Laon, Noyon, Cambrai and Maastricht, and the lower course of the Meuse. But he was very ambitious, and sought to extend his domain. He was the chief instigator of the murder of his brother Chlodomer's children in 524, and his share of the spoils consisted of the cities of Tours and Poitiers. He took part in the various expeditions against Burgundy, and after the destruction of that kingdom in 534 obtained Grenoble, Die and some of the neighbouring cities. When Provence was ceded to the Franks by the Ostrogoths, he received the cities of Orange, Carpentras and Gap. In 531 he marched against the Thuringi with his brother Theuderich (Thierry) I., and in 542 with his brother Childebert against the Visigoths of Spain. On the death of his great-nephew Theodebald in 555, Clotaire annexed his territories; and on Childebert's death in 558 he became king of all Gaul. He also ruled over the greater part of Germany, made expeditions into Saxony, and for some time exacted from the Saxons an annual tribute of 500 cows. The end of his reign was troubled by internal dissensions, his son Chram rising against him on several occasions. Following Chram into Brittany, where the rebel had taken refuge, Clotaire shut him up with his wife and children in a cottage, to which he set fire. Overwhelmed with remorse, he went to Tours to implore forgiveness at the tomb of St. Martin, and died shortly afterwards.

CLOTAIRE II. (d. 629) was the son of Chilperic I. On the assassination of his father in 584 he was still in his cradle. He was, however, recognized as king, thanks to the devotion of his mother Fredegond and the protection of his uncle Gontran, king of Burgundy. It was not until after the death of his cousin Childebert II. in 595 that Clotaire took any active part in affairs. He then endeavoured to enlarge his estates at the expense of Childebert's sons, Theodebert, king of Austrasia, and Theuderich II., king of Burgundy; but after gaining a victory at Laffaux (597), he was defeated at Dormelles (600), and lost part of his kingdom. After the war between Theodebert and Theuderich and their death, the nobles of Austrasia and Burgundy appealed to Clotaire who, after putting Brunhilda to death, became master of the whole of the Frankish kingdom (613). He was obliged, however, to make great concessions to the aristocracy to whom he owed his victory. By the constitution of Oct. 18, 614, he gave legal force to canons which had been voted some days previously by a council convened at Paris, but not without attempting to modify them by numerous restrictions. He extended the competence of the ecclesiastical tribunals, suppressed unjust taxes and undertook to select the counts from the districts they had to administer. In 623 he made his son Dagobert king of the Austrasians, and gradually

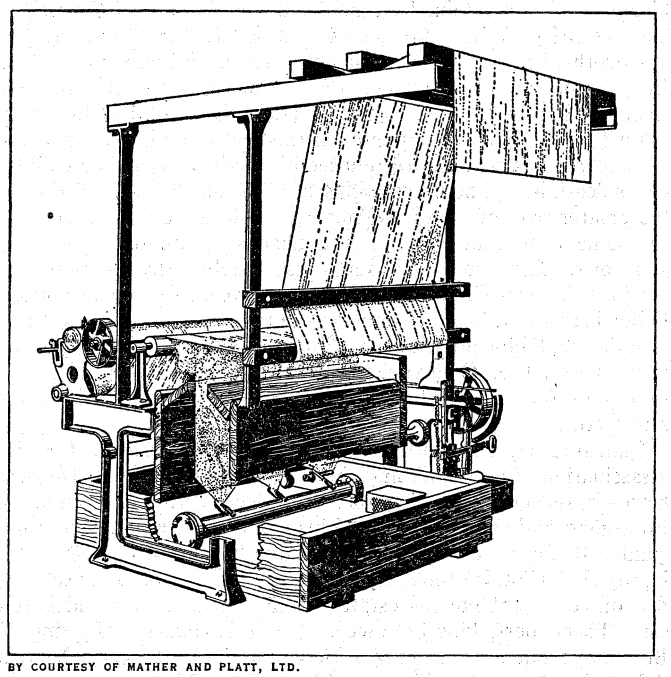
subdued all the provinces that had formerly belonged to Childebert II. He also guaranteed a certain measure of independence to the nobles of Burgundy, giving them the option of having a special mayor of the palace, or of dispensing with that officer. These concessions procured him a reign of comparative tranquillity. He died on Oct. 18, 629, and was buried at Paris in the church of St. Vincent, afterwards known as St. Germain des Prés.

CLOTAIRE III. (652–673) was a son of king Clovis II. In 657 he became the nominal ruler of the three Frankish kingdoms, but was deprived of Austrasia in 663, retaining Neustria and Burgundy until his death.

CLOTAIRE IV. (d. 719) was king of Austrasia from 717 to 719. (C. PF.)

CLOTH, any material woven of wool or hair, cotton, flax or vegetable fibre. In commercial usage, the word is particularly applied to a fabric made of wool. The word is Teutonic, though it does not appear in all the branches of the language. It appears in German as *Kleid* (*Kleidung,* clothing), and in Dutch as *kleed.* The ultimate origin is unknown; it may be connected with the root *kli*—meaning to stick, cling to, which appears in "clay," "cleave" and other words. The original meaning would be either that which clings to the body, or that which is pressed or "felted" together. The regular plural of "cloth" was "clothes," which is now confined in meaning to articles of clothing, garments, in which sense the singular "cloth" is not now used. For that word, in its modern sense of material, the plural "cloths" is used. This form dates from the beginning of the 17th century, but the distinction in meaning between "cloths" and "clothes" is a 19th century one. A curious employment of the word is in the clerical profession, its members often being spoken of as belonging "to the cloth." (*See* WOOL; COTTON AND THE COTTON INDUSTRY; etc.)

CLOTH FINISHING. In this article, the subject of finishing is treated under the two headings (1) Cotton and (2) Wool.



BY COURTESY OF MATHER AND PLATT, LTD.

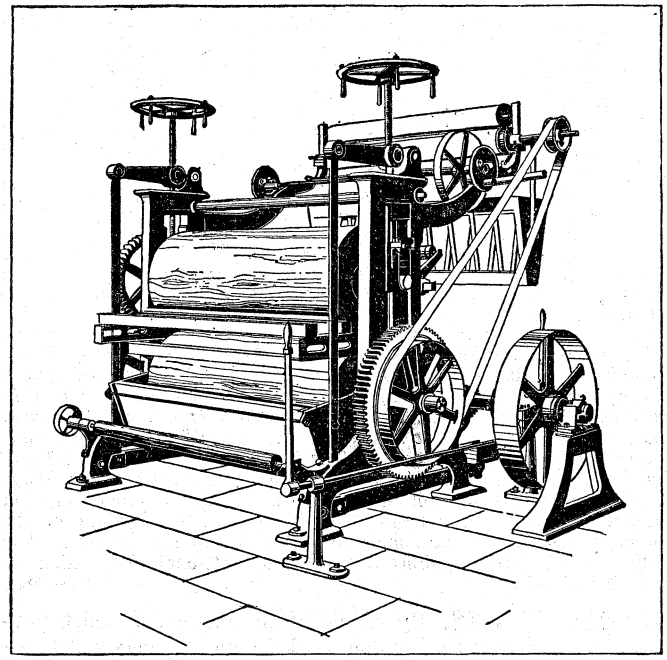
FIG. 1.—IMPROVED SPRAY DAMPING MACHINE FOR THE UNIFORM DAMPING OF COTTON, SILKS AND LINEN FABRICS

Reference should also be made to the article COTTON AND COTTON INDUSTRY, Section VI., Subsection D.

COTTON

The finishing of cotton fabrics was originally the final operation performed on the fabrics to make them ready for sale. In its modern significance, finishing comprises a large and diverse range of processes intended to produce in the fabric a desired appearance or feel; and the machines required for this purpose are correspondingly numerous and varied; finishing operations require plant for, to name some of the important processes, shearing, stretching, drying, damping, pressing, embossing, impregnating, covering and raising cotton cloths.

Classification of finishes in relation to the many different kinds of cotton fabrics is difficult, because many of the processes are applicable to a wide range of cloths. They may be considered under the following headings:— Grey goods, *i.e.,* cloth direct from



BY COURTESY OF MATHER AND PLATT, LTD.

FIG. 2.—THREE-BOWL FINISHING CALENDER ARRANGED TO GIVE A BRIGHT FINISH ON BOTH SIDES OR A GLAZED SURFACE ON ONE SIDE ONLY

the loom; white goods, *i.e.,* cloth which has undergone a bleaching process; plain dyed goods—colours and black; printed goods; raised goods.

The greater number of processes of finishing cotton goods are empirical in character; the underlying physical and chemical changes are not fully understood. A finish produced in one works may be impossible to reproduce in another works, although the same kind of plant and mixings are being used. Even in the same works, two apparently identical machines will give appreciably different results. This is not to say that finishing is a matter of chance; there are very wide differences between the various classes of finish which differences are definable in terms of plant and mixing.

The following gives some idea of the finishing machines used for the different qualities set out above:—

Grey Goods.—These may be finished pure, *i.e.,* without any additional size or stiffening. After passing through a shearing machine or a combined moting and shearing machine, the cloth may be conditioned in a damping machine of the brush type or the spray type (fig. 1) and afterwards calendered in a suitable calender, such as the three-bowl swissing calender (fig. 2) or a five or seven bowl calender arranged to give a bright finish on both sides of the cloth, or a friction calender giving a glazed surface on one side only. Grey goods which are stiffened before being calendered are passed through a range comprising a mangle and cylinder drying machine (fig. 3). The mangle may have two or three bowls, and the drying set may be horizontal or vertical.

Coloured woven goods, *i.e.,* woven from grey bleached and dyed yarns, may be treated in a manner similar to the grey, making use of the same kind of machinery. Both grey and coloured woven goods may be run through the clip-stretching machine with the object of recovering width, or straightening weft, or improving the feel by breaking down the hardness produced in an earlier process, or lifting the figure of the original weave

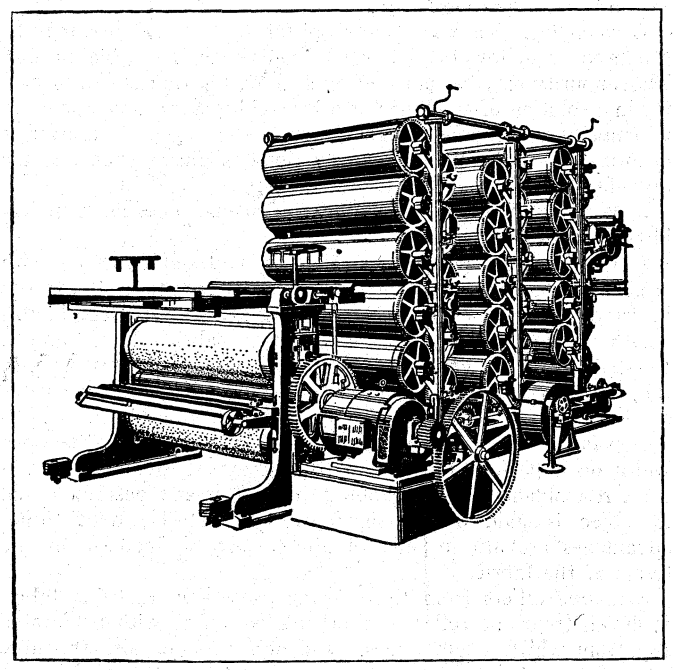
White Goods.—Here there are a very wide range of finishes requiring very extensive plant; for example

(a) Pure finish (without stiffening); these may, or may not be calendered or beetled.
(b) Finishes requiring impregnation of the cloth with the stiffening mixture.
(c) "Back-filling," that is, the stiffening is applied to the back of the cloth only.

White goods are generally passed through a water-mangle with the object of improving the appearance of the cloth, closing up the threads after the bleaching process, and preparing it for the filling mixture. After mangling, the cloth is dried on an ordinary cylinder machine (fig. 4) or for twills or figured goods, additional rollers or winces are added so that the face side does not come in contact with the cylinders. White goods are usually starched in conjunction with the drying machines, as for grey, coloured woven, dyed and printed goods. Various types of starch mangles are used for this purpose; the two-bowl mangle shown in fig. 5; the two-bowl friction calender (fig. 5) by which the filling can be forced into the cloth; the back-filling mangle.

After starching or filling, the cloth is dried over a cylinder drying machine, back-filled goods being dried over machines with the modification referred to which permits of only one side of the cloth coming in contact with the metal. Or instead of cylinder-drying, the cloth may be dried on a hot-air stentering range. The starch mangle shewn in this illustration is not usual in this combination in white-finishing. By this method, any lost width may be recovered, the feel of the cloth is better, and an elastic finish may be produced by the jigging motion of the stenter, and any weft-distortion may be corrected.

The further processes may involve the use of the damping machine (fig. 1) and various calenders similar to those given for grey and coloured finishing and possibly the beetling machine.

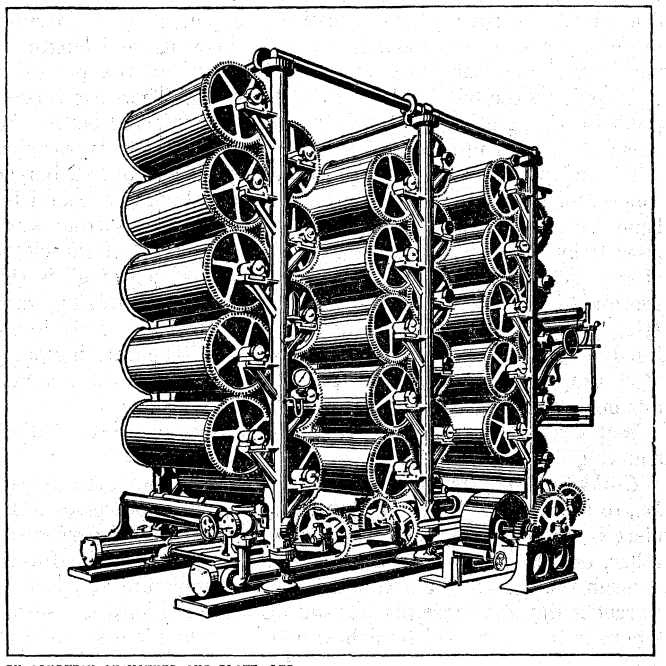


BY COURTESY OF MATHER AND PLATT, LTD.

FIG. 3.—HEAVY FINISHING RANGE WITH VERTICAL DRYING MACHINE

Plain Dyed Goods.—These also require a great variety of finishes, but the range of machines used is not so great as in the case of white goods, for instance, back-filling and friction starching is rarely employed with dyed goods. Three and four bowl water mangles are employed and a drying from these machines is generally effected on drying cylinders. The stiffening of dyed goods is carried out on a two-bowl mangle and cylinder drying machine, or preferably on a hot-air stentering range, for example, mangle cylinders and 90ft. stenter with hot-air drying. Damping machines, stretching machines, breaking machines, calenders from three to seven bowls with and without friction may be required, for certain finishes; for producing window blinds beetles are required; Schreiner calenders for silky finishes and embossing calenders for book cloths, etc.

Printed Goods.—These are finished on similar machines to those used for dyed goods. For ordinary stiffening or starching a range comprising a two-bowl starch mangle, followed by a



BY COURTESY OF MATHER AND PLATT, LTD.

FIG. 4.—VERTICAL DRYING MACHINE ON THREE PAIRS OF UPRIGHTS; FOR DRYING CLOTH AFTER MANGLING

cylinder drying machine is employed, or a hot-air stentering range consisting of a two-bowl mangle, six-cylinder drying machine and 90ft. stenter with hot-air drying. For muslins, voiles and goods requiring an elastic or batiste finish, the latter method is indispensable. Another method of stiffening known as back starching, differs from the ordinary method, in that the starch paste is applied to the back or unprinted side of the fabric by means of a brass roller partly immersed in the starch box. The drying of back starched cloth is performed by passing the cloth over the drying cylinders of large diameter, say, from 5 to 7 feet, arranged in such a manner that the starched side does not come in contact with the heated cylinders. An ordinary drying machine can be employed, but in this case, precautions have to be taken by cooling the first cylinders to prevent the starched side adhering to the cylinders. Fig. 5 shows a universal starch mangle for ordinary starching, slop starching and back starching. A back starcher or universal starcher can be used in conjunction with a hot-air stenter instead of the usual cylinder drying machine. The additional machines which may be required for finishing printed goods are similar to those already mentioned, and include clip-stretchers, swissing and friction calenders, Schreiner calenders, beetles, as for dyed goods.

Raised Goods.—In this class are included those cloths which are raised on one or both sides, such as flannelettes. Similar machines to those employed for dyed goods are used for the actual finishing, the stiffening being carried out on a mangle and drying machine, or hot-air stentering range. The conditioning clip stenter is especially useful. Calenders are not usual, brushing and lustring machines being used instead.

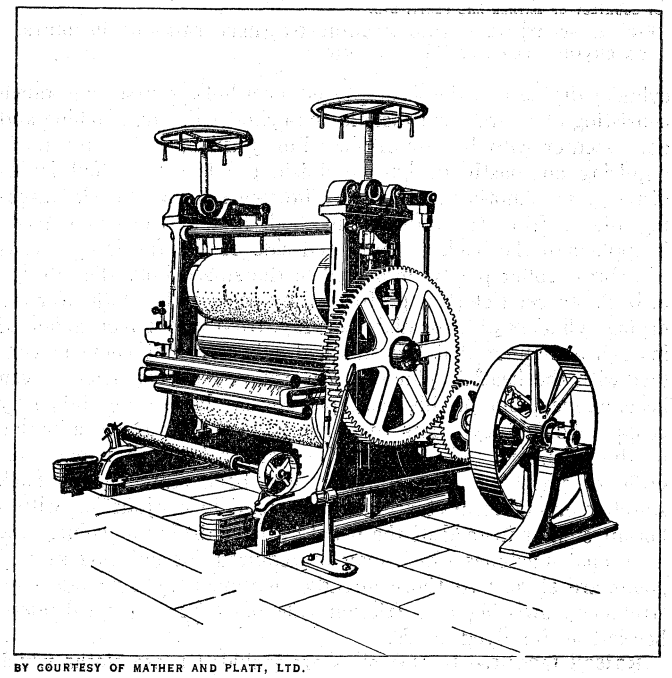
WOOLLEN GOODS

The finishing of woollen goods requires in general plant and processes entirely different from those described in connection with cotton. The methods employed naturally vary with the nature of the fabric: for example, worsted fabrics (woven from yarns produced from the longest staple fibre, and containing the

maximum of parallelism between the fibres) require in general a "clearer" finish than woollen fabrics woven from yarns composed of interlaced fibres of all lengths, which lend themselves to milling and raising. In the former case, the characteristics of the fabric structure dependent upon the nature of the weave are largely retained, and even developed, whilst in the latter case the thready appearance of the loom state fabric often gives way to a felted effect in which the individual warp and weft threads are no longer discernible, the change being usually accompanied by an increase in density and a corresponding decrease in width and length of the fabric. In wool goods, "finishing" covers all the processes undergone by the fabric after leaving the loom. There are certain preliminary operations to which the piece is subjected before the finishing process proper, which are intended to correct weaving faults and yarn defects. The pieces are "perched" over a bar or roller usually in a north light and examined by the eye and by hand feeling. "Knotting" consists in removing knots from warp or weft by first drawing these through to the back of the cloth, after which they are cut away. "Mending" or "darning" is the process of correcting defects such as holes and missing yarn (short ends and picks) by inserting new threads correctly interlaced in accordance with the weave structure. The finishing processes proper divide themselves into the two groups of wet and dry operations.

Wet Operations.—These include crabbing, scouring, milling, tentering and carbonizing.

Crabbing. The object of this process is to "set" the fabric, *i.e.*, to obviate the risk of distortion in subsequent processes. The piece is tightly wound in a stretched condition over a perforated roller, on which allow steam or hot water or both to be forced through the piece. The combined effect of moisture and heat is to render the wool fibre plastic, and in this condition the internal strains in the fabric which might produce cockling in a subsequent



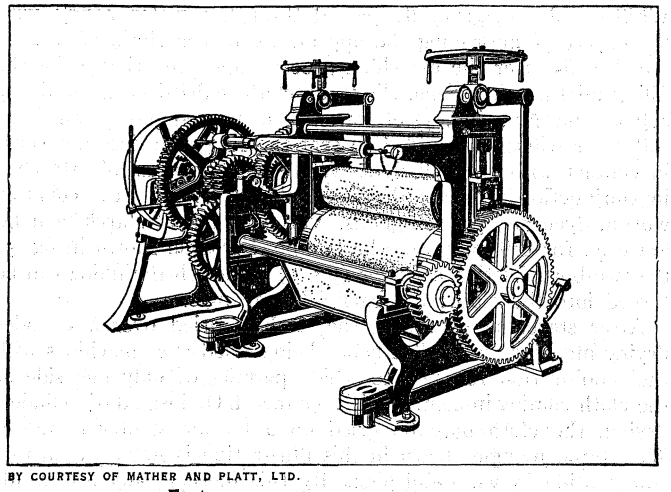
BY COURTESY OF MATHER AND PLATT, LTD.

FIG. 5.—TWO-BOWL STARCH MANGLE

wet process are released, and on cooling the fabric assumes a more or less permanent "set."

Scouring. This process is intended to remove grease and oil and mechanically adhering dirt from the wool goods. The detergents used are either soaps or alkalis depending upon the amount and character of the oil present in the wool. Some fabrics are conveniently scoured in the rope-form, whilst others—*e.g.*, those liable to crease, are best scoured in the open width.

Milling. This process makes use of a special property of the wove fibre of "felting." The woollen cloth is impregnated with a solution of soap (more rarely of acid) and subjected to pressure between rotating rollers in the milling machine, or by the action of fallers in the stilling stocks. As a result of this action, the fibres become matted or felted if the milling is carried far enough, the warp and weft threads appear to lose their identity, and the woven structure of the cloth is entirely hidden. The cloth often gains strength as a result of milling, whilst the density is increased at the expense of the width and length, the whole fabric being rendered more consistent.



BY COURTESY OF MATHER AND PLATT, LTD.

FIG. 6.—FRICTION STARCH MANGLE

Tentering. After the scouring process, the pieces may be dried by first removing the excess of water by hydro-extracting or by passing through the wringer; and afterwards subjecting to the drying action of warm air whilst stretched out between the lists or edges. In addition to drying the pieces, this operation straightens and "sets" the cloth.

Carbonizing. Some kinds of wool fabrics, *e.g.*, velours, may be produced from low quality wools containing vegetable matter. This impurity may be removed by soaking the fabric after scouring in a solution of sulphuric or other acid, drying, and raising to a temperature of about 100° C, when the vegetable matter is disintegrated and may be removed by a slight beating and air draught.

Dry Operations.—These include raising, cutting, napping, blowing, brushing, steaming and pressing.

Cutting. This operation formerly performed by hand with large shears is now carried out on a suitable machine. It consists in removing the pile of the fabric beyond a certain length, this length varying greatly with the class of fabric. For example, worsted cloths are cut close to the surface in order to enhance the effects of weave and colour. Woollen fabrics only receive as a rule a cutting sufficient to level up the projecting fibres.

Blowing consists in subjecting the pieces wound in the open width on a perforated beam to the action of steam. There is some resemblance to the crabbing process already described, and the object is again to "set" the fabric permanently, though other advantages are also usually obtained, such as increase in the lustre of the fabric.

Steaming differs from the blowing process in that the fabric is drawn from one roller to another over a box with perforated top from which steam issues. The object is to raise the fibre somewhat, and thus destroy any glaze, and to soften the feel or handle as a result of the conditioning effect of the steam, *i.e.*, by the absorption of moisture.

Raising. This is a mechanical operation in which fibres are lifted from the yarns in the cloth, or from the surface to produce a pile or nap. The raising process was formerly effected by the use of teazles (Dipsacus fullonum) applied by hand; and teazles are still used, mounted on cylinders and operated by power. In addition, cord-wire raising is now largely practised; in this form a number of raising rollers are covered with cord clothing, and revolve against the cloth which is made to pass over them by an independent motion.

Pressing is an important operation in the finishing of wool goods; it may be carried out with the object of smoothing the surface of the fibre and imparting an appearance of uniformity, or by prolonged treatment the lustre of the fabric may be greatly increased. The fabric, charged with a sufficient amount of moisture, is subjected to the combined action of (usually) heat and hydraulic pressure. Three different systems are used, (a) the vertical hydraulic press, (b) the intermittent hydraulic press, (c) the rotary press.

Shrinking. The tendency of wool garments to contract in wear is well-known. The object of the shrinking process is to bring out this contraction in dimensions before the garment is made up. It is usually effected by thoroughly wetting the material, and redyeing it at a low temperature, after which a mild pressing treatment is applied to remove creases, etc. There are many names for varieties of this "shrunk finish"; perhaps the best known being "the London-shrunk finish."

Not all the above processes are utilized in finishing a particular class of wool fabric. Worsted cloths in the main undergo the series of operations known as the clear-cut finish. These cloths include fancy vestings and suitings, striped trouserings, costume cloths and dress fabrics, fancy worsteds, etc. A finishing routine for the latter involves knotting and mending, crabbing, scouring, tentering, brushing and steaming, cutting, blowing and pressing.

BIBLIOGRAPHY.—J. Dépierre, *Traité Élémentaire des Apprêts* (1887); E. Knecht, C. Rawson and L. Loewenthal, *A Manual of Dyeing*, 2 vols. (1893, 2nd ed., 1910); R. Beaumont, *The Finishing of Textile Fabrics* (1909, 2nd ed., 1926); P. Heermann, *Technologie der Textilveredelung* (1921); A. J. Hall, *Textile Bleaching, Dyeing, Printing and Finishing Machinery* (1926); P. Bean and W. McCleary, *The Chemistry and Practice of Finishing* (1926); J. Schofield and J. C. Schofield, *Cloth Finishing, Woollen and Worsted* (1927); S. R. Trotman and E. L. Thorp, *The Principles of Bleaching and Finishing of Cotton* (1928). (F. Sc.)

CLOTHIER, a manufacturer of cloth, or a dealer who sells either the cloth or made-up clothing. In the United States the word formerly applied only to those who dressed or fulled cloth during the process of manufacture, but now it is used in the general sense, as above.

CLOTHIERS, WHOLESALE. The term Wholesale Clothiers is applied to the makers and distributors of "ready-to-wear" or "machine-made" woollen and other types of outer clothing for men and women, comprising suits and overcoats for men, costumes, dresses, skirts, and coats for women. The industry now forms the more important of the two divisions—wholesale and made-to-order—of the tailoring, or clothing trades.

The name "clothier" signified in the days of handloom weaving, the master cloth-maker or producer, but with the advent of the power-loom that designation gradually became changed to "manufacturer," prefixed generally with a qualifying name indicative of the class of fabric made, such as "cloth," woollen," or "worsted." Some makers, however, prefer to style themselves manufacturing clothiers. In America, the cloth dresser (finisher), or fuller was formerly termed a clothier.

CLOTHING MANUFACTURE. The application of the sewing-machine to tailoring made the production of ready-made clothing possible in bulk. The early demand for ready-made clothing may be traced to the older seaport towns, where such clothing was often required at short notice by persons returning from long voyages. The foundations of the wholesale clothing industry, however, may be said to rest first, on the invention of the sewing-machine; and secondly, upon the introduction of cheap (shoddy) cloth made from pulled-up rags, from which material machine-made clothing, produced in bulk, was originally made. The use of shoddy has practically disappeared, however, and the finest grades of cloth are quite generally used by the best manufacturers of ready-made clothing, who are also in a position to employ highly qualified designers.

Thimmonier's Sewing Machine.—Ready-made clothing was first made in Paris by a tailor named Thimmonier, who invented the first sewing-machine in 1830, and applied it with considerable success to the production of army clothing until 1841, when his factory was destroyed during a machinery riot. Thimmonier afterwards went to England with an improved machine which he patented in 1848. This, however, met with no success, and it was not until 1851, when the American invention of Isaac Merritt Singer was introduced into England, that the industrial potentialities of the sewing-machine were realized.

The quicker output obtained by mechanical sewing necessitated an increase in the speed of pattern cutting, and 1860 saw the invention of the cloth-cutting band-knife (based on the principle of the band-saw), which solved the problem of supplying material to keep pace with the work of the sewing-machine. This machine was made in Leeds by Messrs. Greenwood and Batley at the suggestion of Mr. (afterwards Sir) John Barran, a native of London who had settled in Leeds some years previously, where he had commenced the wholesale clothing industry in 1855. The modern machine has a knife velocity of 7,000ft. per minute, and can cut 50 thicknesses of cloth at once. A more modern style of machine still is a portable knife-cutter worked by electricity.

Other inventions, mostly in connection with sewing, followed in rapid succession; and sewing by hand for joining most parts of a garment is now almost entirely superseded by machines devised for such special purposes as felling (*i.e.*, turning over the edges of the cloth and then sewing in order to prevent fraying), sleeving, button-hole making and button stitching. A machine for marking the outlines of the patterns to prepare them for cutting, and machines for pressing have assisted further to reduce handwork to a minimum; and the transition from operating the sewing-machines by hand or foot to power driving has contributed to greatly increased output and cheaper production.

Division of Labour.—The modern factory system is highly sectionalized, and its production and output depend upon an extraordinary degree of subdivision of labour; so much so, that a coat, in making, may pass through the hands of as many as 50 persons. Subdivision of labour reduces the cost of production by causing the simpler processes to be effected by the unskilled labour of young persons, and utilizing skilled labour only for the more complicated work.

The system originates with the designing and production of the patterns in the various standard sizes by the head pattern or stock cutter, who is responsible for keeping in touch with movements in fashion and "style." The separate paper pieces comprising a pattern for a garment or suit are then formed into what is termed a "lay" by fitting them as closely together as possible (interlocking them after the manner of a jig-saw puzzle), so that in cutting out the cloth there will be a minimum of waste; the operation being termed "lay-getting." The outlines of the lay are chalked on a large piece of tough paper or linen corresponding in width to the cloth, and then these are perforated by a machine called a "process-marker," thus forming the pattern or lay from which the garments are cut in bulk. To prepare the cloth for mechanical cutting, it is automatically folded in the number of lengths required by the "laying-up" machine; the lay is placed on the top fold, and specially prepared powdered chalk is rubbed through the perforations to indicate the lines to be followed by the knife. After cutting, the pieces for each individual garment are sorted out and numbered, tied into bundles with their necessary trimmings, which have been prepared in a similar manner to that just described, and passed forward to the factory for making up. Here, the various parts are sewn and gradually assembled into the complete garment—this being a combination of hand and machine work by trimmers, finishers, machinists (who work the specialized sewing-machines) and pressers.

The industry has been built up in Great Britain very largely by the exploitation of alien Jewish labour, and in fact, the origin of the subdivisional system of work was the outcome of the necessity for finding employment for the great influx of Russian Jews to London. These unfortunate people usually carried on their occupation at home, and by reason of their poverty and consequent low standard of living worked for very low rates of payment. This quickly resulted in the "sweated labour" conditions exposed by Charles Kingsley and other social reformers. In 1909, when the first Trade Board act was passed, ready-made and wholesale bespoke tailoring was classed among the four industries having "rates of wages exceptionally low as compared

with those in other employments." The Tailoring Trade Board was established under this act in the following year with powers to determine the minimum rates of wages in all branches of the tailoring trades, and in 1920 two separate boards were constituted —one to deal with the ready-made and wholesale section, and the other to control the retail bespoke section of the industry.

Location of Industry.—Though London was the original home of the British ready-made clothing trade, Leeds is now the chief seat of the industry, and wholesale clothing with its 400 firms providing employment for over 30,000 persons forms the premier trade in the city. There is a difference, too, in the conduct of the industry in the two centres; in Leeds it is almost entirely confined to work in the factory; in London, "outworking" persists to a large extent. Leeds was the first provincial town (in 1855) to engage in the industry, and no doubt owes its present leading position largely to its advantageous geographical situation in the centre of the West Riding of Yorkshire woollen and worsted cloth manufacturing area, which supplies it with all classes of fabrics from the lowest to the highest in quality. The manufacture of clothing is also carried on in the Huddersfield and Hebden Bridge districts, Liverpool and Manchester, Bristol, Colchester, and Leicester; and in Scotland, Glasgow is now an important centre. There are nearly 6,000 firms in Great Britain with a personnel of over 200,000 persons.

It may be noted here that though ready-made clothing was identified formerly with inferior materials only, this is no longer the case, and there is now a large and increasing demand for "ready-for-service" (to use the latest description) garments of high class workmanship, made of the finest quality materials.

With regard to markets, it is generally considered that about two-thirds of the yearly British output is absorbed at home, and the remainder goes principally to the British colonies, though the United States of America is a considerable customer for the best class of British goods in spite of her own high standing in the industry.

There are two associations of British employers: (1) the Wholesale Clothing Manufacturers' Federation (founded in 1910) which has its headquarters in London, and local branches in all clothing centres; and (2) the Northern Clothing Manufacturers' Association which has its chief office at Leeds. Employes are represented by the Tailors' and Garment Workers' Union of Leeds and London and other organizations.

Technical education is provided for at the Leeds Technical college (both day and evening courses), and also by the London County Council. (A. Y.)

United States.—Clothing manufacture in the United States has passed largely out of the hands of the merchant tailor and was in 1939 conducted in modern plants equipped with labour saving machinery. The United States is the "home" of ready made clothing. It has been estimated that between 80 and 90% of the men's clothing made in the United States is of the "ready-to-wear" type. Half of this clothing is produced in the centres of population. As a result of the fact that people are buying cheaper clothing, cotton and other fabrics are being used in great amount. In recent years there has been a great migration of factories to small centres of population, where living costs are lower, in order to reduce production costs. This is rapidly decentralizing the industry. New York city is still the most important clothing market, making almost ⅓ of the total clothing produced in the country. Many out-of-town factories maintain sales offices in the metropolis. Other clothing centres are Chicago, Cincinnati, St. Louis, Philadelphia, Boston, Buffalo, and Rochester.

In New York city the greater part of the clothing is produced under the "contract" system. The manufacturer cuts up the cloth into the various patterns he desires and this cloth is sent to a contractor for fabrication into garments. This system partly accounts for the large number of clothing firms in New York city, for it enables a person to enter the business with comparatively small capital. In the other clothing centres most of the clothing manufacturers maintain their own factories.

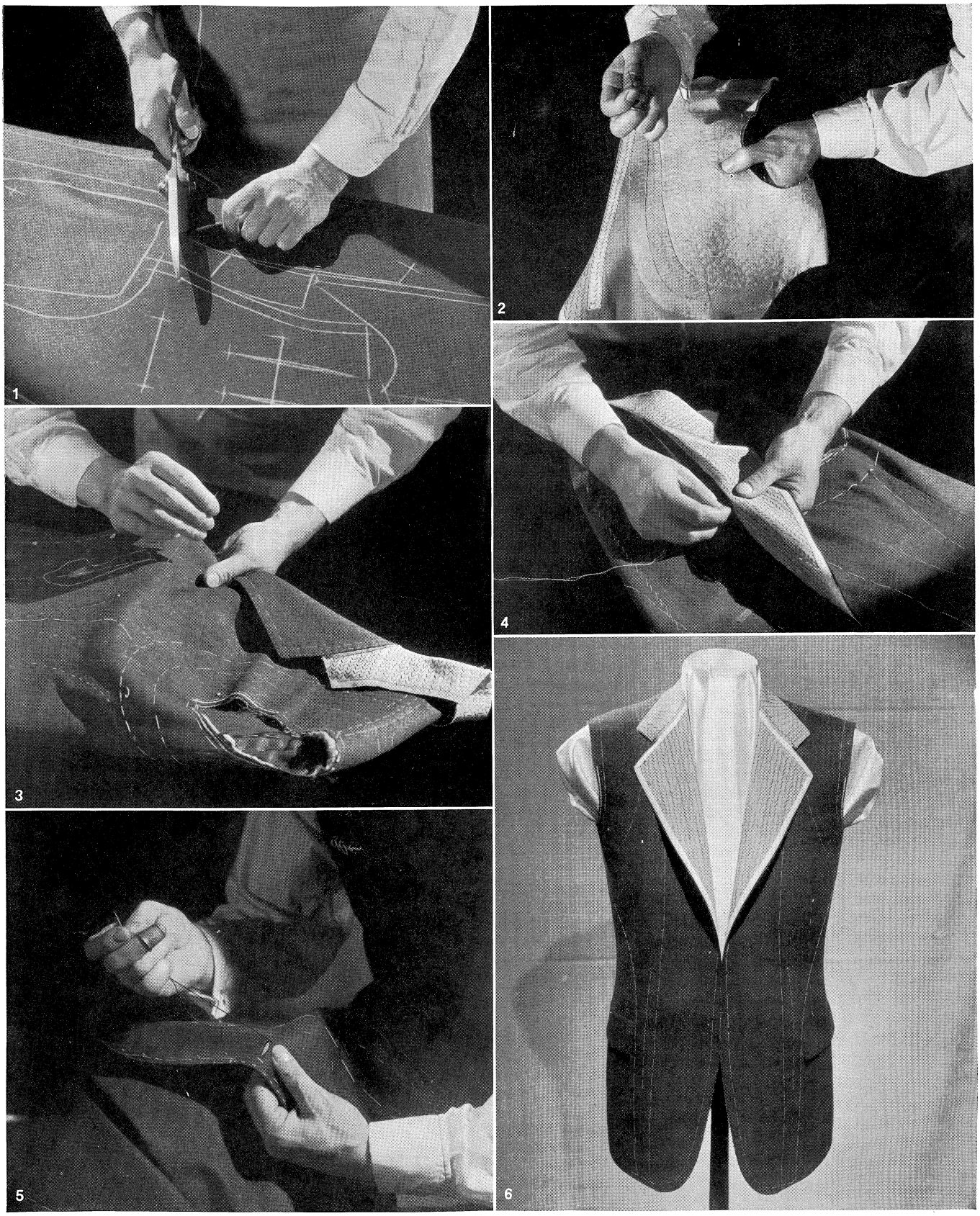
The success of mass production in the clothing industry in the United States that has developed since the 20th century began, rests upon (1) scientific pattern construction; (2) highly efficient labour saving machinery; (3) effective factory arrangement; (4) high division of labour; (5) economies effected in the purchase and fabrication of materials on a large scale, and (6) standardization of styles. The industry did not make any great progress until scientific investigations of average proportions of the human body yielded sufficient information on which to base the present art of clothing designing. Experience has disclosed that normal proportions and variations therefrom are fairly constant in any group of 100 men, and consequently, clothing manufacturers make their garments in assortments complying with such experience. In 1939 renewed effort was exerted in an attempt to standardize sizes; in this respect the Government was of great aid. A retail store stocking 1,000 suits would normally have the following assortment: 54·3% regular; 31·3% short; 4·7% long; 5·6% stout; 4·1% short stout. The sizes would range from 35 to 50 (chest) with 37, 38, 39, 40, 42, and 44 making the bulk. All stores do not carry, nor do all factories make assortments as complete as above. However, the more complete the range of sizes, the less alterations, or busheling, must be made. These busheling operations are standardized, and because of the high development of the art of making ready-to-wear clothing in the United States, changes are usually slight.

In making a new model sack-coat or overcoat, the designer visualizes the style he wishes to create and drafts a pattern, usually size 36 or 38. This pattern is used to derive a complete set of patterns for all required sizes, including regulars, shorts, longs, stouts, etc. The work of translating the basic pattern into other sizes is called "pattern grading." In many American factories the designer not only designs the models, but he also supervises the general production of the garment in the factory. Many manufacturers do not have designers and they, as well as many designers themselves, are often guilty of pirating competitors' patterns. Certain pattern houses supply patterns to the manufacturer without need of either pirating or a designer.

There are two methods of shrinking or sponging cloth in use. London or cold water shrinking is the best and most expensive. Steam or machine shrinking is cheapest and most widely used. In 1939 patent was granted on a new chemical shrinking formula which has not yet been widely adopted. In cotton goods the development of sanforizing has practically perfected shrinkage on denims for work clothing and other cotton textiles used for shirtings, dresses, and underwear.

After the cloth has been shrunk and dried, it is laid out on cutting tables in "lays" from a few thicknesses of cloth to as high as 50 or 60 in the case of work clothing; modern machines do this at high speed. The cardboard, fibreboard, or brass bound patterns are laid on the cloth in such a manner as to conserve every possible inch of cloth. After the outlines of the patterns are chalked on the top layer of the lay by a "marker" the outlines are cut by electric cutting machines. These machines are of two types; the one having a revolving disk cutter and the other having a vertical blade moving up and down; automatic knife sharpeners can be obtained. Some manufacturers still cut by hand knife, others by powerful dies.

Most cutting rooms are located on the top floor of the factory so that the cloth after cutting can pass through the assembly departments to the stock room by means of gravity or other conveyors. There are several systems of production; the bundle, the modified bundle, and the straight line. Each has its strengths and weaknesses. Newest is the straight line system which applies the automobile assembly line theory of production. This is used particularly on pants and shirts. The garment is started at one end and handed on down the line, each operator performs his or her one special operation and it comes from the line as a complete unit. In this way lost motion is minimized and a high efficiency is maintained. Different types of straight lines are used—some are "Y" shaped, others are "V" shaped. Regardless of the system of production used, modern factories are highly departmentalized and division of labour is carried out to a high degree. Each operator performs but one task on a garment, thereby gaining unusual proficiency. In the making of some pockets, for ex-



BY COURTESY OF HICKEY-FREEMAN CO.

STEPS IN THE HAND-TAILORING OF MEN'S CLOTHING

1. Cutting the cloth by hand, one garment at a time, along lines marked with chalk
2. Stitching the padding of a coat front
3. Basting a sack coat. So many thicknesses of material go into a garment of this type that careful basting is necessary to assure that the final stitching anchors each piece firmly in its proper place
4. Hand-stitching the interlining of a coat lapel
5. Making a buttonhole by hand
6. A partly finished sack coat

ample, there are 13 different operations, each one of which is performed by a single individual. One hundred persons may work on a sack coat. Not only does an operator do more work under this system, but because of the skill he develops, he does better work. This high division of labour also permits the use of workers possessing ordinary intelligence. A large percentage of the clothing factories in the United States operate on a piece work basis; *i.e.*, a unit price is fixed for each operation on a garment. Some factories use a task system, which approximates a piece work system. Still others use a set system, which is a modified form of sub-contracting to groups of workers.

Much labour saving machinery for the clothing industry has been perfected in the United States, by means of which the various operations are speeded up and the unit costs reduced. Dozens of improved types of sewing machines have been introduced which are very instrumental in reducing costs. Two-needle and four-needle machines are common. The speed of some of these new machines is amazing; literally thousands of stitches per minute. The late models of button-hole machines cut the cloth, sew and tack the button-hole in a fraction of a minute. Even buttons are sewed on by machine. Safety tables keep all movable parts of the machines, except the needles, enclosed. Needles are protected by needle guards in many plants. New blind stitch machines which render the stitching invisible and are adaptable to almost all types and weights of fabrics have been perfected. A new machine is under promotion that simulates exactly a hand stitch. One of the outstanding developments in labour saving machinery is the steam pressing machine. The machine in use is made in a variety of models having bucks shaped to fit various parts of the garment; it has very materially lowered clothing pressing costs. An automatic pressing machine used more extensively outside the United States, though made there, requires only finger control. There are many other automatic compressed air machines for varied operations; especially for shirts.

With the business depression of 1929 and subsequently, price became paramount and simplification of textiles and production was essential. Informal sportswear or roughwear made inroads into the regular clothing business. This informal wear did not require the tailoring of the regular suit and was far cheaper to produce. It was made of woollens, cottons, spun rayons or other fabrics, was susceptible to easy style change, was based primarily on comfort in clothes and was, in most cases, wholly machine made. Colour took the place of tailoring.

The U.S. Bureau of the Census reported 3,790 contractors and manufacturers of men's pants, shirts, underwear, and leather, regular, sport, and work clothing in 1937; employing 324,000 officials and workers and making products valued at $895,760,000. Contractors employed 59,000 of the above workers and their products were valued at $69,350,000. (C. Le.; H. Sim.)

CLOTILDA, SAINT (d. 544), daughter of the Burgundian king Chilperic, and wife of Clovis, king of the Franks. On the death of Gundioc, king of the Burgundians, in 473, his sons Gundobald, Godegesil and Chilperic divided his heritage. At Lyons an epitaph has been discovered of a Burgundian queen, who died in 506, and was most probably the mother of Clotilda. Clotilda was brought up in the orthodox faith. Her uncle Gundobald was asked for her hand in marriage by the Frankish king Clovis, who had just conquered northern Gaul, and the marriage was celebrated about 493. On this event many romantic stories, all more or less embroidered, are to be found in the works of Gregory of Tours and the chronicler Fredegarius, and in the *Liber historiae Francorum*. Clotilda did not rest until her husband had abjured paganism and embraced the orthodox Christian faith (496). With him she built at Paris the church of the Holy Apostles, afterwards known as Ste. Geneviève. After the death of Clovis in 511 she retired to the abbey of St. Martin at Tours. In 523 she incited her sons against her uncle Gundobald and provoked the Burgundian war. In the following year she tried in vain to protect the rights of her grandsons, the children of Clodomer, against the claims of her sons Childebert I. and Clotaire I., and was equally unsuccessful in her efforts to prevent the civil discords between her children. She died in 544, and was buried by her husband's side in the church of the Holy Apostles.

There is a mediocre *Life* in *Mon. Germ. Hist.: Script. rer. Merov.*, vol. ii. *See* also G. Kurth, *Sainte Clotilde* (2nd ed. 1897). (C. Pf.)

CLOUD, a mass of condensed vapour, either liquid or solid, hanging in the air at some height from the earth (from the same root and probably the same word, as "clod," common to Teutonic languages in various forms meaning a mass or lump; it is first applied in the more usual sense in the late 13th century; the Anglo-Saxon *clūd* is used only for "a mass of rock," *wolcen* being the A.S. word for "cloud"). This accepted definition rules out fogs and creeping mists from any classification.

Classification of Clouds.—It is reasonable to suppose that the shapes and general appearance of clouds must have been a matter of interest and speculation from earliest times. The classical writers make use of a variety of expressions for cloud forms but as no systematic early classification is known it becomes necessary to translate such expressions in general terms. Theophrastus of Erusus (*c.* 373–286 B.C.) in his *Book of Signs* (trans. J. G. Wood, 1894) certainly distinguishes "streaks of clouds" from "clouds like fleeces of wool" and uses the distinction in his weather prognostications, but the classification does not appear to have been developed. The field remained open until the 19th century when the famous French biologist Jean Baptiste, Chevalier de Lamarck, in the course of his pioneer work in weather-mapping (1801–04), made use of a scheme of cloud classification. Lamarck's climatological work was ill-appreciated in France and but little known elsewhere. In 1803 Luke Howard published his "On the modifications of clouds" in *Tilloch's Philosophical Magazine*. This was an entirely new and independent scheme in which the terms were all Latin, and were applied with such excellent judgment that his system remains as the broad basis of those in use to-day. He named three primary types of cloud—Cirrus, Cumulus and Stratus—and proposed four additional compound forms—Cirro-cumulus, Cirro-stratus, Cumulo-stratus and Cumulo-cirro-stratus or Nimbus. Thomas Forster in his *Researches about atmospheric Phenomena* (1813) gives Howard's classification and suggests English names for the various types, *e.g.* cirrus becomes curlcloud; cumulus, stackencloud; stratus, fallcloud, cirro-cumulus, sondercloud; cirro-stratus, wanecloud; cumulo-stratus, twaincloud and nimbus becomes raincloud. Howard's scheme was universally adopted, in fact, his cirrus and cumulus are the clouds still known by the same names, though his stratus which seems to have been fog, has now been given a different meaning. His compounds were modified subsequently and further subdivisions were made, which involved the use of new terms. Many new terms failed to establish themselves either because the need for the new term was not widely accepted or because the author's definition of the name was not precise enough to give his exact cloud type. Other names such as A. Poey's *pallium* to signify a uniform sheet have been fairly generally adopted. Notwithstanding the obvious importance of Howard's original paper it was either disregarded or not known to several later writers, for example, The Rev. W. Clement Ley does not refer to it though in his remarkable book *Cloudland* (1894) he describes an entirely new scheme. Instead of a classification based on the appearance of clouds, four different groupings are made which depend upon the processes of cloud formation, viz.: (1) Clouds of Radiation, chiefly fogs. (2) Clouds of Interfret, chiefly stratus. (3) Clouds of Inversion, cumulo and nimbus types. (4) Clouds of Inclination, chiefly cirro forms. Ley's definitions of his terms are that interfret comprises the interaction of two currents on one another, which currents differ in velocity or direction or both. Inversion is merely vertical convection while inclination supposes that the ice particles are falling through currents of air which have a progressive change of velocity and so draw out the crystals into the characteristic wisps and bands of the cirrus types. Modern research has proved that Ley's explanations of his interfret and inclination types are inadequate, while his radiation types are best grouped as fogs. Nevertheless his ingenious scheme possesses elements more in accordance with some desirable future scientific classification than any which preceded it, but such a scheme cannot be adopted until meteorologists are in more general agreement as to the complicated processes involved

in cloud formation.

For the purpose of other than local weather charts it was soon realized that some internationally accepted scheme had to be evolved. For many years after the institution of the International Meteorological Organization considerable attention was given to the matter and constructive proposals were contributed by a host of workers including Ley, Rotch, Mohn, Riggenbach, Teisserenc de Bort, Abercromby and Hildebrandsson. The last two meteorologists had suggested a modification of Howard's classification which differed chiefly in the introduction of a new class, which they distinguished by the use of the prefix *Alto*. Their scheme was formally adopted at the Munich International Meteorological Conference of 1891, and a committee was appointed to draw up an atlas showing the exact forms typical of each variety considered. Finally in Aug. 1894 a small sub-committee consisting of Hildebrandsson, Riggenbach and Teisserenc de Bort was charged with the task of producing the atlas. This was issued in 1896 and a second edition by Hildebrandsson and Teisserenc de Bort was published in 1910. The *International Cloud Atlas* has ten principal forms of cloud which are included in the code of telegraphic reports on cloud forms.

A. *Upper clouds,* average altitude 9,000 metres.
   1. Cirrus.
   2. Cirro-stratus.
B. *Intermediate clouds,* between 3,000 metres and 7,000 metres.
   3. Cirro-cumulus.
   4. Alto-cumulus.
   5. Alto-stratus.
C. *Lower clouds,* 2,000 metres.
   6. Strato-cumulus.
   7. Nimbus.
D. *Clouds of Diurnal Ascending Currents.*
   8. Cumulus, apex 1,800 metres, base 1,400 metres.
   9. Cumulo-nimbus, apex 3,000 to 8,000 metres, base 1,400 metres.
E. *High Fogs,* under 1,000 metres.
   10. Stratus.

Shaw's definitions of these forms in the *Manual of Meteorology*[1] (1926), differing slightly from those given in the second edition of the Atlas, may be summarized as follows:

1. *Cirrus* (Ci.).—Detached clouds of delicate appearance, fibrous (thread-like) structure and feather-like form, generally white in colour.

2. *Cirro-stratus* (Ci. S.).—A thin sheet of whitish cloud sometimes covering the sky completely and merely giving it a milky appearance; it is then called cirro-nebula or cirrus haze; at other times presenting more or less distinctly a fibrous structure like a tangled web. This sheet often produces halos around the sun and moon.

3. *Cirro-cumulus* (Ci. Cu.).—A mackerel sky with small rounded masses or white flakes without shadows, or showing very slight shadow; arranged in groups and often in lines. (*See* Plate II. fig. 3.)

4. *Alto-cumulus* (A. Cu.).—Larger rounded masses, white or greyish, partially shaded, arranged in groups or lines, and often so crowded together in the middle region that the cloudlets join. (*See* Plate II. fig. 4.)

5. *Alto-stratus* (A. S.).—A dense sheet of a grey or bluish colour sometimes forming a compact mass of dull-grey colour and fibrous structure; at other times thin like the denser forms of No. 2. (*See* Plate I. fig. 1.)

6. *Strato-cumulus* (S. Cu.).—Large lumpy masses or rolls of dull grey cloud, frequently covering the whole sky, especially in winter. It may be distinguished from No. 7 by its lumpy or rolling appearance, and by the fact that it does not tend to rain. (*See* Plate I. fig. 1.)

7. *Nimbus* (N.) (Raincloud).—A dense layer of dark shapeless cloud, with ragged edges, from which steady rain or snow usually falls. If there are any openings in the cloud an upper layer of cirro-stratus or alto-stratus may almost invariably be seen through them. Nimbus breaking into ragged cloud or into detached fragments underneath a large nimbus (the "Scud" of Sailors) is termed Fracto-Nimbus (Fr. Nb.). (*See* Plate I. fig. 2.)

[1] *Manual of Meteorology* (1926), vol. i., chap. xi.

8. *Cumulus* (Cu.) (Woolpack or Cauliflower Cloud).—Thick cloud of which the upper surface is dome-shaped and exhibits protuberances while the base is generally horizontal. (*See* Plate I. fig. 5.)

9. *Cumulo-nimbus* (Cu. N.) (The Thunder-cloud; shower-cloud).—Great masses of cloud rising in the form of mountains or towers or anvils, generally having a veil or screen of fibrous texture (false cirrus) at the top and at its base a cloud-mass similar to nimbus. From the base local showers of rain or of snow, occasionally of hail or soft hail usually fall. (*See* Plate I. fig. 3.) The front of a thunderstorm of wide extent is frequently in the form of a large arch above a region of uniformly lighter sky.

10. *Stratus* (S.).—A uniform layer of cloud, like fog, but not lying on the ground.

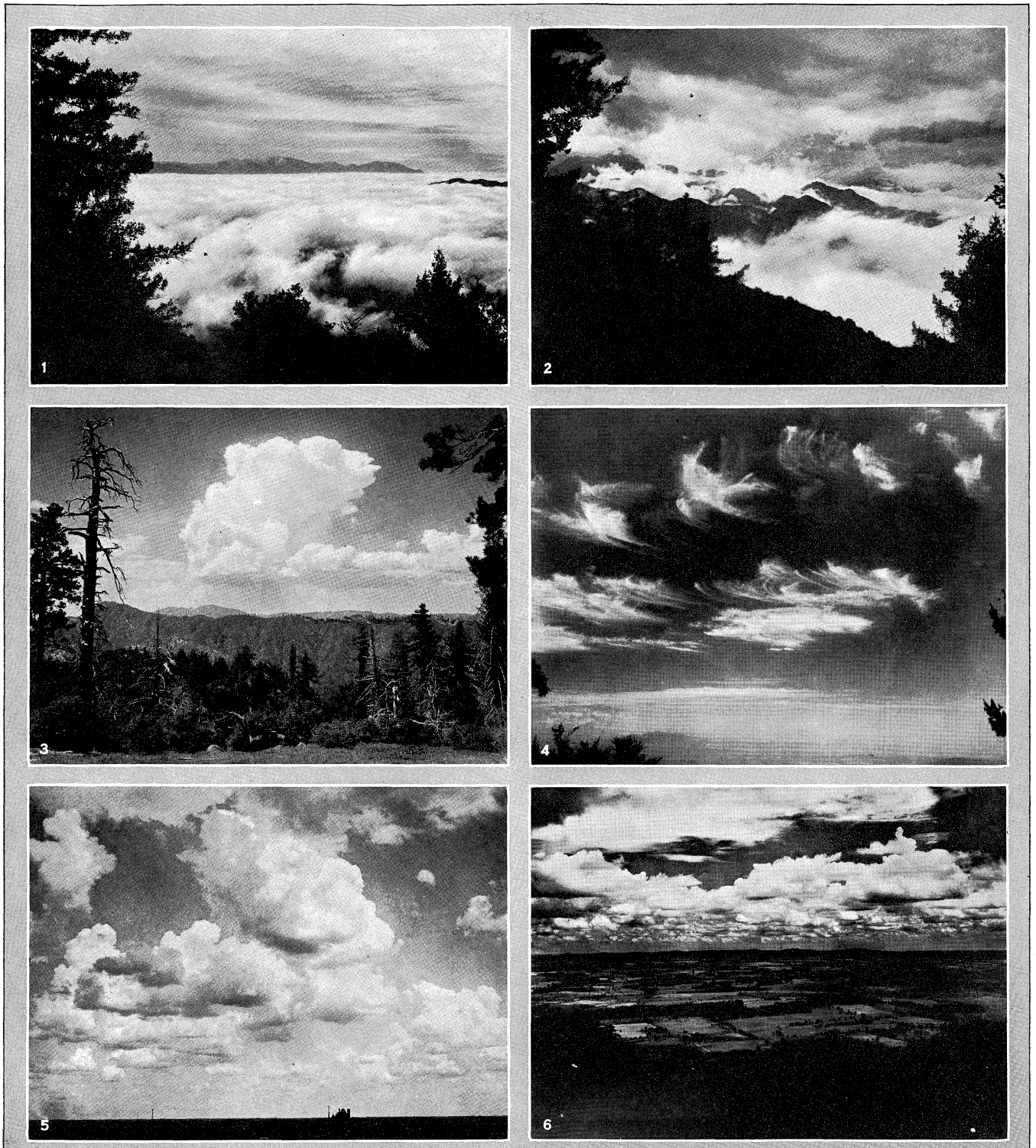
The international scheme also provides that where certain clouds take a lumpy form, the adjective *cumuliformis* shall be used, and if the base shows downward projecting bosses the word *mammato* shall be prefixed, while for clouds whose shapes approximate to that of a doubly convex lens the term *lenticularis* shall be affixed. In consequence of such modifications as these twelve other cloud forms are added to the ten principal types. Issued as it has been with the authority of an international congress this scheme has been generally accepted, and for the great majority of observations is quite detailed enough, but some specialists considered that for the minuter study of cloud forms a more elaborate scheme was needed. In 1896 H. H. Clayton of the Blue Hill Observatory, Massachusetts, published a highly detailed scheme in which the international types and a number of subdivisions were grouped under four classes—*stratiforms* or sheet clouds; *cumuliforms* or woolpack clouds; *flocciforms,* including strato-cumulus, alto-cumulus and cirro-cumulus; and *cirriforms* or hairy clouds. In 1904 F. L. Obenbach (Cleveland Observatory) devised a system, in which the International types are sub-divided into a number of species, but in the absence of any definitive atlas neither of these American schemes has come into general use.

In general, during the 20th century the tendency of independent workers has been to increase the number of forms, sometimes to an unwieldy number. The cirrus type exhibits so many diverse forms that it has been found specially prolific in sub-types, *e.g.,* Clayden in *Cloud Studies* (1905 and 1925) names nine varieties, Vincent in *Atlas des Nuages* (Brussels, 1909) gives 13 varieties, as also does Besson in *Aperçu historique sur la classification des Nuages* (1923). Improvements in photographic methods both from the ground and by aviators from above the cloud layers has considerably stimulated interest in the subject and in this connection Clayden's *Cloud Studies* is notable. Not only does it contain beautiful photographs but much information is given on camera technique. For photographs of "clouds as seen from an aeroplane" reference should be made to Douglas's article with this title in the *Q. J. R. Met. Soc.* (1920, pp. 233–242), while for an extended bibliography on the subject, which is now becoming a formidable list, *see Manual of Meteorology,* vol. i., by Shaw and Austen (1926).

CLOUDBERRY, *Rubus Chamaemorus,* a low-growing creeping herbaceous plant (family, Rosaceae) with simple obtusely lobed leaves and solitary white flowers, resembling those of the blackberry, but larger—one inch across—and with stamens and pistils on different plants. The orange-yellow fruit is about half an inch long and consists of a few large drupes with a pleasant flavour. The plant occurs in the mountainous parts of Great Britain, and is widely distributed through the more northerly portions of both hemispheres. In North America it grows in peat bogs and on mountains from Maine and New Hampshire to Arctic America and westward to Alaska and British Columbia. In Denmark and Sweden the fruit is gathered in large quantities and sold in the markets.

CLOUD-BURST, a term popularly applied to an excessively heavy fall of rain, usually of brief duration, over a small area of the earth's surface. Most so-called cloud-bursts occur in connection with thunder-storms. In these storms there are violent uprushes of air, which at times prevent the condensing raindrops from falling to the ground. A large amount of water may thus

CLOUD

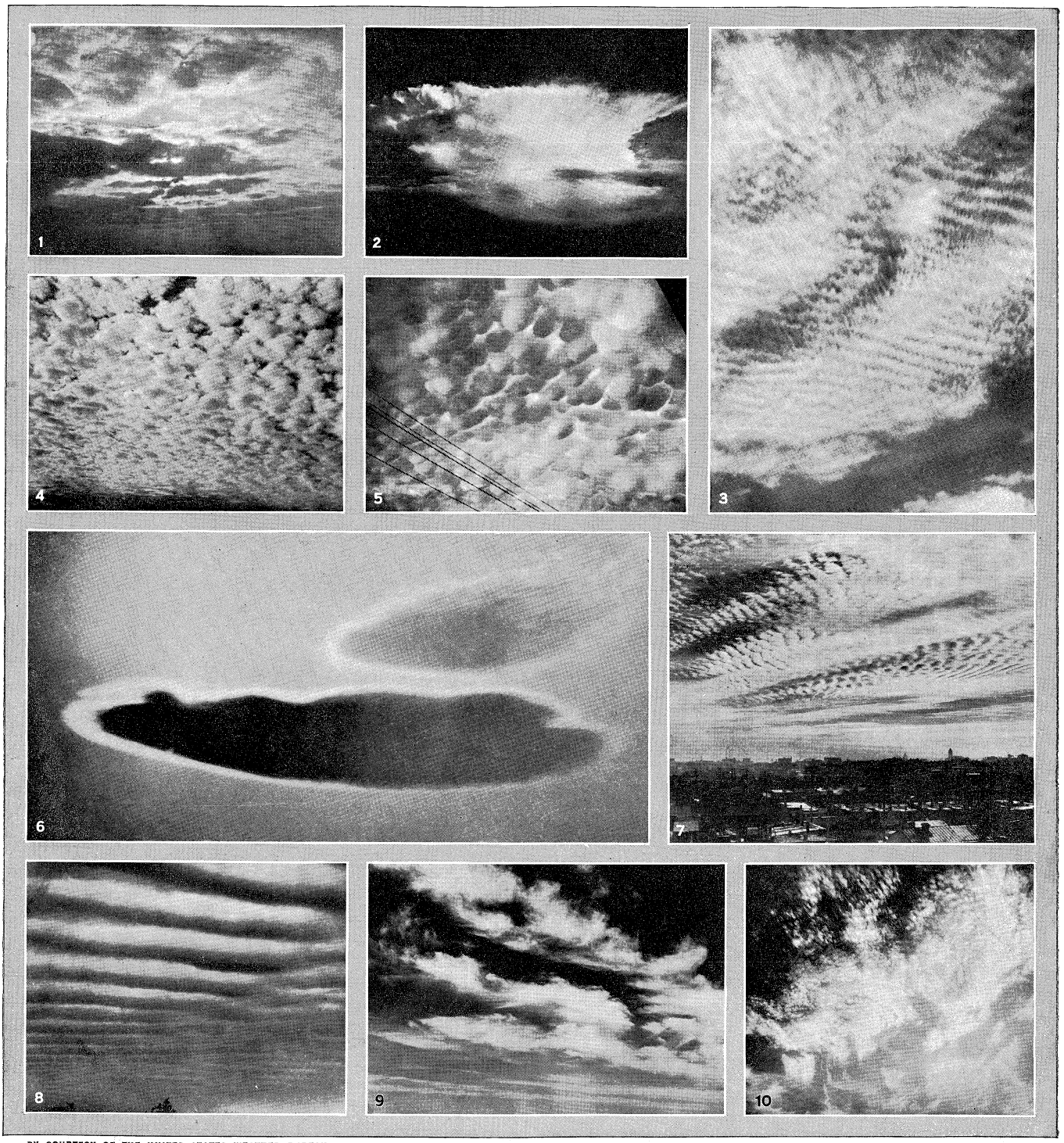


BY COURTESY OF THE UNITED STATES WEATHER BUREAU

CLOUD FORMS

1. Alto-stratus, above a layer of fog or stratus, a dense sheet of grey or bluish colour, forming sometimes a very compact and at other times a thin mass of dull grey colour and fibrous structure
2. Nimbus raincloud with fog or stratus below, a dense layer of shapeless cloud, with ragged edges, from which steady rain or snow usually falls
3. Cumulo-nimbus (thunder- or shower-cloud), just grown from cumulus. Great masses of cloud rising in the form of mountains or towers or anvils, generally having a veil or screen of fibrous texture (false cirrus) at the top and at its base a cloud-like mass similar to nimbus. From the base local showers of rain or snow usually fall
4. Tufted cirrus, detached clouds of delicate appearance, of fibrous or thread-like structure and feather-like form, generally white in colour
5. Cumulus (wool-pack or cauliflower cloud), thick cloud of which the upper surface is dome-shaped and exhibits protuberances, while the base is generally horizontal
6. Cumulus, with strato-cumulus below, thin alto-stratus above. Below strato-cumulus, appearing as lumpy rolls of dull grey cloud, such as may frequently cover the whole sky, especially in winter. Alto-stratus appears above as a dense sheet of grey or bluish colour and fibrous texture

CLOUD



BY COURTESY OF THE UNITED STATES WEATHER BUREAU

CLOUD FORMS

1. Strato-cumulus. Large lumpy masses or rolls of dull grey cloud, frequently covering the whole sky, especially in winter. It may be distinguished from a nimbus by its lumpy or rolling appearance and by the fact that it does not tend to rain
2. Cumulo-nimbus. This is a thunder-cloud, with a well-defined anvil top
3. Cirro-cumulus. A mackerel sky with small rounded masses or white flakes without shadows, arranged in groups and often in lines
4. Alto-cumulus. Large rounded masses, white or greyish, partially shaded, arranged in groups or lines, and often so crowded together in the middle region that cloudlets join
5. Mammato alto-stratus. A dense sheet of grey or bluish colour forming a fibrous mass which may be either thin or very compact. The term mammato denotes a cloud of downward-projecting bosses
6. Lenticular alto-stratus. An example of a cloud in the shape of a double convex lens (lenticularis). Dense grey or bluish in colour, compact and of fibrous texture
7. Undulated alto-cumulus. Large rounded masses of white or greyish cloud, partially shaded, arranged usually in groups or lines
8. Strato-cumulus rolls. Large lumpy rolls which frequently cover the sky, particularly in winter. Although in appearance somewhat similar to a nimbus, it is not a rain cloud
9. Dense, bunched cirrus. Generally white in colour, detached clouds of delicate appearance, of fibrous structure and feather-like form
10. Cirro-cumulus. A variation on the cirro-cumulus formation of Fig. 3. A mackerel sky with small rounded masses or white flakes without shadows, arranged in groups and often in lines

accumulate at high levels, and if the upward currents are weakened the whole of this water falls at one time. Cloudbursts are especially common in mountainous districts. This is probably because the rising air currents of a thunderstorm are more or less broken up by the passage of the storm over a mountain. The effects of heavy rain are especially striking on mountain slopes because the falling water is concentrated in valleys and gulleys. Mountain cloudbursts cause sudden and destructive floods. The intensity of rainfall in the most sévere cloudbursts can only be conjectured. A rainfall of 2.47 in. in 3 min. was registered by an automatic raingauge at Porto Bello, Panama, on Nov. 29, 1911, and one of 1.02 in. in 1 min. by two automatic gauges, placed side by side, at Opid's camp, on the west front of the San Gabriel Range, Calif., on April 5, 1926. There have been many cases, however, in which the deep excavations made in the ground by the falling water of a cloudburst appear to indicate a much greater intensity of rainfall than in the cases above noted.

CLOUDED LEOPARD, a large arboreal cat (*Neofelis nebulosa*) found in southeast Asia, Sumatra, Java, Borneo and Formosa. This cat, also called the clouded tiger, is beautifully marked with large dark patches edged with black. It has an elongate head and body (about 3 ft.), the tail nearly as long, and rather short limbs. The upper canine teeth are proportionately longer than in other living cats. Although its pattern resembles that of the marbled cat (*Felis marmorata*), they are not closely related. The clouded leopard preys on small mammals and birds.

(J. E. HL.)

CLOUET, FRANÇOIS (d. 1572), French miniature painter. The earliest reference to him is the document dated Dec. 1541 (*see* CLOUET, JEAN), in which the king renounces for the benefit of the artist his father's estate which had escheated to the crown as the estate of a foreigner. In it the younger Janet is said to have "followed his father very closely in the science of his art." Like his father, he held the office of groom of the chamber and painter in ordinary to the king, and so far as salary is concerned, he started where his father left off. A long list of drawings contains those which are attributed to this artist, but we still lack perfect certainty about his works. There is, however, more to go upon than there was in the case of his father, as the praises of François Clouet were sung by the writers of the day, his name was carefully preserved from reign to reign, and there is an ancient and unbroken tradition in the attribution of many of his pictures. There are not, however, any original attestations of his works, nor are any documents known which would guarantee the ascriptions usually accepted. To him are attributed the portraits of Francis I at the Uffizi, Florence, and at the Louvre, and drawings relating to them. He probably also painted the portrait of Catherine de' Medici at Versailles and other works, and in all probability a large number of the drawings ascribed to him were from his hand. One of his most remarkable portraits is that of Mary, queen of Scots, a drawing in chalks in the Bibliothèque Nationale, Paris, and of similar character are the two portraits of Charles IX and the one at Chantilly of Marguerite of France. Perhaps his masterpiece is the portrait of Elizabeth of Austria in the Louvre.

In 1568 he is known to have been under the patronage of Claude Gouffier de Boisy, Seigneur d'Oiron and his wife Claude de Baune. Another ascertained fact concerning François Clouet is that in 1571 he was "summoned to the office of the Court of the Mint," and his opinion was taken on the likeness to the king of a portrait struck by the mint. He prepared the death mask of Henry II, as in 1547 he had taken a similar mask of the face and hands of Francis I, in order that the effigy to be used at the funeral might be prepared from his drawings; and on each of these occasions he executed the painting to be used in the church decorations and the banners for the ceremony.

Several miniatures are believed to be his work, one remarkable portrait being the half-length figure of Henry II in the collection of the late J. Pierpont Morgan. Another of his portraits is that of the duc d'Alençon in the Jones collection at South Kensington, and certain representations of members of the royal family which were in the Hamilton palace collection and the Magniac sale are usually ascribed to him. He died on Dec. 22, 1572, shortly after the massacre of St. Bartholomew, and his will, mentioning his sister and his two illegitimate daughters, and dealing with the disposition of a considerable amount of property, is still in existence. His daughters became nuns. Like his father, he was known as JANET. His work is remarkable for the accuracy of the drawing, the elaborate finish of all the details, and the completeness of the whole portrait. He must have been a man of high intelligence, and great penetration, intensely interested in his work, and with considerable ability to represent the character of his sitter in his portraits. His colouring is not specially remarkable, nor from the point of style can his pictures be considered specially beautiful, but in perfection of drawing he has hardly any equal. (G. C. W.)

CLOUET, JEAN (1485–1541?), French miniature painter, generally known as JANET. The authentic presence of this artist at the French court is first to be noted in 1516, the second year of the reign of Francis I. By a deed of gift made by the king to the artist's son of his father's estate, which had escheated to the crown, we learn that he was not actually a Frenchman, and never even naturalized. He is supposed to have been a native of the Low Countries, and probably his real name was Clowet. His position was that of groom of the chamber to the king, and he received a stipend at first of 180 livres and later of 240. He lived several years in Tours, and there it was he met his wife, who was the daughter of a jeweller. He is recorded as living in Tours in 1522, and there is a reference to his wife's residence in the same town in 1523, but in 1529 they were both settled in Paris, probably in the neighbourhood of the parish of St. Innocent, in the cemetery of which they were buried. He stood godfather at a christening on July 8, 1540, but was no longer living in Dec. 1541, and therefore died between those two dates.

His brother, known as CLOUET DE NAVARRE, was in the service of Marguérite d'Angoulême, sister of Francis I, and is referred to in a letter written by Marguérite about 1529. Jean Clouet had two children, François and Catherine, who married Abel Foulon, and left one son, who continued the profession of François Clouet after his decease. Jean Clouet was undoubtedly a very skilful portrait painter, but it must be acknowledged without hesitation that there is no work in existence which has been proved to be his. There is no doubt that he painted a portrait of the mathematician, Oronce Finé, in 1530, when Finé was 36 years old, but the portrait is now known only by a print. Janet is generally believed, however, to have been responsible for a very large number of the wonderful portrait drawings now preserved at Chantilly, and at the Bibliothèque Nationale, Paris, and to him is attributed the portrait of an unknown man at Hampton Court, that of the dauphin Francis, son of Francis I at Antwerp, and one other portrait, that of Francis I in the Louvre. Seven miniature portraits in the *Manuscript of the Gallic War* in the Bibliothèque Nationale (13,429) are attributed to Janet with very strong probability, and to these may be added an eighth in the collection of the late J. Pierpont Morgan, and representing Charles de Cossé, Maréchal de Brissac, identical in its characteristics with the seven already known. There are other miniatures in the Morgan collection, which may be attributed to Jean Clouet with some strong degree of probability, inasmuch as they closely resemble the portrait drawings at Chantilly and in Paris which are taken to be his work. In his oil paintings the execution is delicate and smooth, the outlines hard, the texture pure, and the whole work elaborately and very highly finished in rich, limpid colour. The chalk drawings are of remarkable excellence, the medium being used by the artist with perfect ease and absolute sureness, and the mingling of colour being in exquisite taste, the modelling exceedingly subtle, and the drawing careful, tender and emphatic. The collection of drawings preserved in France, and attributed to this artist and his school, comprises portraits of all the important persons of the time of Francis I. In one album of drawings the portraits are annotated by the king himself, and his merry reflections, stinging taunts or biting satires, add very largely to a proper understanding of the life of his time and court. Definite evidence, however, is still lacking to establish the attribution of the best of these drawings and of certain oil paintings to the Jean Clouet who was groom of the chambers to the king.

The chief authority in France on the work of this artist is Louis Dimier. *See* also E. Moreau-Nelaton, *Les Clouets et leurs émulés* (1921). (G. C. W.)

CLOUGH, ANNE JEMIMA (klŭf) (1820–1892), educationalist and sister of the poet, Arthur Hugh Clough, born at Liverpool Jan. 20, 1820. When two years old she went with her family to Charleston, U.S.A., but returned to England in 1836. Her father's failure in business led her to open a school in 1841 which was carried on until 1846. In 1852, after studying in London and working at the Borough road and the Home and Colonial schools, she opened another school at Ambleside, in Westmorland. Keenly interested in the education of women, she made friends with Miss Emily Davies, Madame Bodichon, Miss Buss and others. After helping to found the North of England council for promoting the higher education of women, she acted as its secretary from 1867–70 and as president from 1873–74. When it was decided to open a house for women students at Cambridge, Miss Clough was chosen as its first principal. This hostel, started in Regent street, Cambridge, in 1871 with five students, and continued at Merton hall in 1872, led to the building of Newnham hall, opened in 1875, and to the erection of the present Newnham college, Cambridge, in 1880. Miss Clough's personal charm and high aims, together with her work at Newnham college, made her one of the leaders of the women's educational movement. She died on Feb. 27, 1892.

See B. A. Clough, *Memoir of Anne Jemima Clough* (1903).

CLOUGH, ARTHUR HUGH (1819–1861), English poet, was born at Liverpool on Jan. 1, 1819. In 1822 his father, a cotton merchant, moved to the United States, and Clough's childhood was spent mainly at Charleston (S.C.). In 1828 the family visited England, and Clough was left at school at Chester, whence he passed in 1829 to Rugby, then under Dr. Thomas Arnold. In 1837 he went with a scholarship to Balliol college, Oxford. Here his contemporaries included Benjamin Jowett, A. P. Stanley, J. C. Shairp, W. G. Ward, Frederick Temple and Matthew Arnold. Clough missed a Balliol fellowship, but obtained one at Oriel, with a tutorship, and lived the Oxford life of study, speculation, lectures and reading-parties until 1848, when he went abroad, seeing Paris in revolution and Rome in siege. In the autumn of 1849 he became principal of University Hall, a hostel for students at University college, London. He disliked London, in spite of the friendship of the Carlyles, nor did the atmosphere of Unitarianism prove any more congenial than that of Anglican Oxford to his critical and at bottom conservative temper. In 1852 encouraged by Emerson, he went to Cambridge (Mass.). Here he remained some months, lecturing and translating Plutarch for the booksellers, until in 1853 the offer of an examinership in the Education Office brought him to London once more. He married, and pursued a steady official career, diversified only by an appointment in 1856 as secretary to a commission sent to study certain aspects of foreign military education. In 1860 his health began to fail. He visited first Malvern and Freshwater, and then the East, France and Switzerland, in search of recovery, and finally came to Florence, where he died on Nov. 13, 1861. Matthew Arnold wrote upon him the exquisite lament of *Thyrsis*.

Shortly before he left Oxford, in the stress of the Irish potato-famine, Clough wrote an ethical pamphlet addressed to the undergraduates, with the title, *A Consideration of Objections against the Retrenchment Association at Oxford* (1847). His Homeric pastoral *The Bothie of Toper-na-Fuosich,* afterwards re-christened *Tober-na-Vuolich* (1848), was inspired by a long vacation reading-party after he had given up his tutorship, and is an entertaining experiment. *Ambarvalia* (1849), published jointly with his friend Thomas Burbidge, contains shorter poems of various dates from 1840, or earlier, onwards. *Amours de Voyage,* a novel in verse, was written at Rome in 1849; *Dipsychus,* a rather amorphous satire, at Venice in 1850; and the idylls which make up *Mari Magno or Tales on Board,* in 1861. A few lyric and elegiac pieces, later in date than the *Ambarvalia* complete the tale of Clough's poetry. His only considerable enterprise in prose was a revision of the 17th century translation of Plutarch by Dryden and others, which occupied him from 1852, and was published as *Plutarch's Lives* (1859).

He is rightly regarded, like his friend Matthew Arnold, as one of the most typical English poets of the middle of the 19th century. His critical instincts and strong ethical temper brought him athwart the popular ideals of his day both in conduct and religion. His verse has upon it the melancholy and the perplexity of an age of transition. He is a sceptic who by nature should have been with the believers. He stands between two worlds, watching one crumble behind him, and only able to look forward by the sternest exercise of faith to the reconstruction that lies ahead in the other. On the technical side, Clough's work is interesting to students of metre, owing to the experiments which he made, in the *Bothie* and elsewhere, with English hexameters.

BIBLIOGRAPHY.—Clough's *Poems* were privately collected, with a short memoir by F. T. Palgrave, in 1862; and his *Poems and Prose Remains* with a memoir by his widow in 1869. Selections from the poems were made by Mrs. Clough for the Golden Treasury series in 1894, and by E. Rhys in 1896. *See* monographs by S. Waddington (1883) and J. L. Osborne (1920). Clough's sister Anne Jemima Clough (1820–92) was the first principal of Newnham college, Cambridge.

CLOVELLY, a fishing village of Barnstaple bay, Devonshire, England, 11 mi. W.S.W. of Bideford. Pop. (1931) 528. It is a cluster of old-fashioned cottages in a unique position on the sides of a rocky cleft in the north coast; its main street resembles a staircase, which descends 400ft. to the pier, too steeply to allow of any wheeled traffic. All Saints' church, restored in 1866, is late Norman. The climate is very mild. Thick woods shelter the village on three sides and the surrounding scenery is famous for its richness of colour. Clovelly is described by Dickens in *A Message from the Sea.*

CLOVEN-HOOFED ANIMALS, the popular designation for members of the order Artiodactyla (*q.v.*), which includes the sheep, cattle, deer, antelopes, goats and swine (*qq.v.*).

CLOVER, the English name for plants belonging to the genus *Trifolium,* so-called from the leaf, which has three leaflets (trifoliolate). Clover is a member of the family Leguminosae and contains some 250 species. Many other plants are also called clover, but most of these belong to different genera of the legume family. Species are found on every continent, and in all except Australia certain ones form a part of the native flora. The origin of those species of agricultural importance appears to be south-eastern Europe and southern Asia Minor. The plants are small annual or perennial herbs with trifoliolate (rarely 5 or 7 foliolate) leaves with stipules adnate to the leaf-stalk, and heads or dense spikes of small red, purple, white or yellow flowers or shades thereof; the small few-seeded pods are enclosed in the calyx. Clovers are best adapted to cool humid climates. These may be the summer months of the temperate zones or the winter months of equatorial countries. The perennials may behave as annuals, depending upon the severity of unfavourable climate. Many species are extensively cultivated for hay, pasture and green manure in all countries of the world, while others form an important part of the native vegetation.

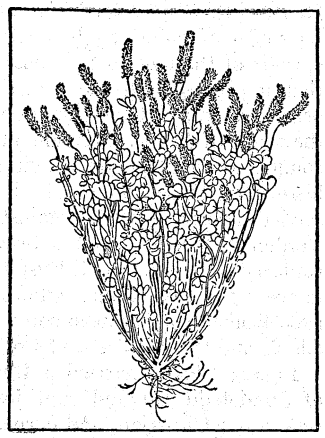


COURTESY OF THE BUREAU OF PLANT INDUSTRY, SOILS AND AGRICULTURAL ENGINEERING, U.S. DEPT. OF AGRICULTURE

FLOWER HEADS OF RED CLOVER, T. PRATENSE

The most important agricultural species are red clover, *T. pratense,* with round, light to dark purplish red flower heads, the most widely cultivated of species from Siberia to Chile, botanically a perennial but agriculturally more of a biennial; white clover, *T. repens,* a creeping, node-rooting perennial, abundant in good pastures, meadows and lawns, the most widely naturalized species, with flowers, borne on small round heads, white to pinkish, becoming brown and reflexing as the seed matures; alsike clover, *T.*

hybridum, common in meadows and moist habitats, botanically a perennial but under agricultural conditions mostly a biennial, with flower heads resembling those of white clover; crimson clover, *T. incarnatum,* with pointed heads of bright crimson flowers, a winter annual in climates where winters are not severe, or a restricted summer annual in high latitudes; low hop clover, *T. procumbens,* mostly a winter annual widely naturalized in pastures and along roadsides, with small round heads of bright yellow flowers; least hop clover, *T. dubium,* in Europe synonymous with *T. minus* and commonly called shamrock, similar in all respects to low hop clover but with smaller and fewer flowers per head; sub clover, *T. subterraneum,* a winter annual with decumbent stems, and heads of few, cream-coloured flowers borne inconspicuously under the foliage (after fertilization the flowers reflex and bury the developing seed under the surface of the soil); Persian clover, *T. resupinatum,* mostly a winter annual, having small flat heads of lavender flowers with calyx inflating as maturing; strawberry clover, *T. fragiferum,* a creeping, node-rooting perennial with round, slightly pointed heads, with pinkish flowers, calyx inflating as maturing, tolerant to soil salinity, preferring moist habitats; berseem clover, *T. alexandrinum,* a winter annual having spike-like heads of white to cream flowers, not tolerant of heavy frosts; and cluster clover, *T glomeratum,* a winter annual having small round heads of dull rose coloured inconspicuous flowers, with heads borne on short stems in leaf axils, rough and spine-like upon maturity



COURTESY OF THE BUREAU OF PLANT INDUSTRY, SOILS AND AGRICULTURAL ENGINEERING, U.S. DEPT. OF AGRICULTURE

CRIMSON CLOVER, T. INCARNATUM

Clover was cultivated in the Netherlands about the middle of the 16th century and it is possible that its culture occurred among the ancient Letts a thousand years earlier. It was originally introduced from Flanders into England as a field crop about the middle of the 17th century by Sir Richard Weston. He has the distinction of being the first to introduce into England the rotation of crops, using clover as a soil improving crop. Clovers are grown alone or in mixtures with different grasses and other legumes. They thrive in soils having a high content of phosphorus, calcium and potassium, either of natural origin or supplied by fertilizers. The forage is highly palatable to livestock and is high in protein and in phosphorus and calcium, thus making valuable livestock feed either in the green or dry stage and a good soil improving crop when plowed under as green manure.

Many varieties and strains of each species occur, representing forms best adapted to the environments where grown. These were developed principally by natural selection through the survival of the fittest. No authentic hybrids between species are known. The basic chromosome numbers of the genus appear to be seven and eight. Of the species studied, the somatic numbers of chromosomes range from 14 to about 130. Many of the important species such as red clover, white clover and alsike clover are principally self-sterile. Cross pollination resulting in seed setting is brought about by insect visits, principally bees, which visit the flowers for nectar and pollen. Other species such as the hop clovers and Persian clover are self-fertile, self-pollinating, while still others, such as crimson clover, are self-fertile but not self-pollinated.

Diseases and insects play an important role in the production of clovers, affecting the length of life of the plant and its reproduction; many are world-wide where clovers occur, while others are limited to specific countries. The length of the photoperiod where the strain or variety originates also has an important relationship to its adaptation in different locations.

All of the above mentioned clovers are grown in the United States. Berseem clover is grown only in limited places of southern Arizona and California; cluster clover in localities of Mississippi, Georgia, Louisiana and Alabama; sub clover in the coastal section of the Pacific states and limited areas of the southern states. The other, more widely grown species are Persian, on the heavy low-lying soils of the southern states; the hop clovers from Kentucky southward and the Pacific northwest; strawberry clover throughout the irrigated lands of the western states; crimson clover from New Jersey and Kentucky southward as a winter annual and in Northern Maine as a summer annual; white clover in all states where there is sufficient moisture and required plant foods; Ladino clover, a large-growing variety of white clover of major importance in the northeastern and western states which appears to have a place in the lake and south Atlantic states. The principal red clover belt is east of 98° longitude and north of 35° latitude, in the Pacific northwest and irrigated lands of the western states; and alsike clover is in the same general region.

Cultivation.—Red clover and alsike clover are generally seeded with companion grain crops. If adequate moisture is available after the harvesting of the grain, light grazing or a small hay crop may be produced the first year. The heavy crop occurs from the second year's growth. If seeded with grass the stands are usually left through the third year; otherwise the aftermath is plowed under for cultivated row crops in the fall of the second year or the next spring. Failures to establish and maintain stands may be due to improper seed bed preparation, heavy seedings of rank, late-maturing grain crops, deficiencies of plant foods, phosphorus, potassium and calcium, diseases and insects and the use of unadapted varieties and strains. Most of the other clovers are used principally for pastures and are seeded on turf or with grasses. Successful seedings are obtained more generally when the grass is closely grazed or clipped and where adequate quantities of phosphate and potash fertilizers and limestone are applied.

In America two common forms of red clover are recognized, medium and mammoth, better called double- and single-cut respectively. These are comparable with but not the same as the English double-cut and single-cut clovers. To conditions in the U.S. none of the European clovers is adapted, and their use leads to poor stands and low yields. Likewise, strains adapted to one section of the red clover belt do poorly in another. Improved varieties are developed by state agricultural experiment stations and the U.S. department of agriculture. Seed of two red clover varieties, Cumberland and Midland, adapted to the southern and central sections of the principal red clover belt, are available. In Canada the Dollard, Ottawa, Altaswede and Manhardy represent improved varieties. No marked differences have been found between strains of alsike clover. White clover strains differ widely, varying from low-growing types to Ladino clover. Strains of crimson clover vary in adaptation. The superiority of certain strains of sub clover brought about its adaptation and increased use in the Pacific northwest.

Red clover seed is produced over most of the main U.S. clover area, and large yields are obtained in the irrigated region of the west. It is commonly taken from the second crop. Alsike clover seed is produced in the same region as red clover seed but is taken from the first crop, since this species does not commonly produce two cuttings in a season. The winter annual species produce seed in the spring and are perpetuated by the seed that volunteers in the fall. White clover seed is produced principally in the southern, midwestern and western states. In the humid states the first crop is more generally harvested, while in the west two seed crops are frequently obtained.

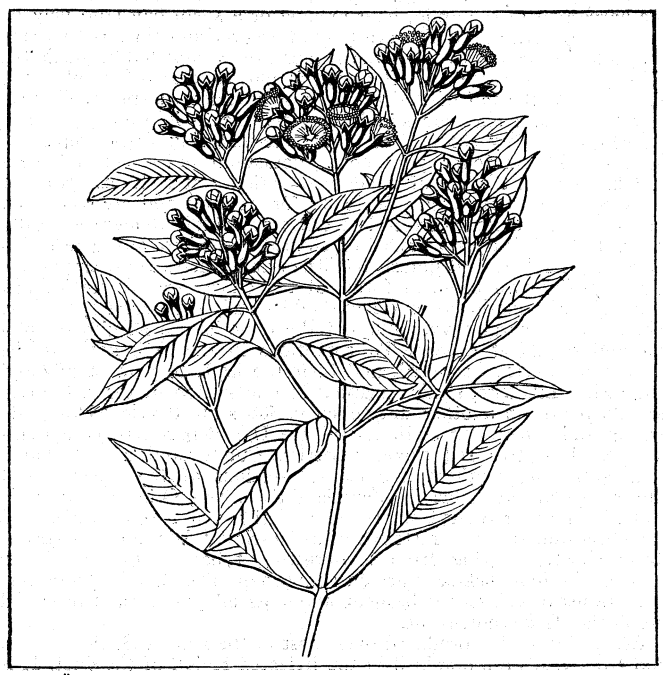
Upward of 50 native species of clover occur on the Pacific coast and in the Rocky mountain region, but east of the Mississippi river only four native species occur.

See publications of the state agricultural experiment stations and the U.S. department of agriculture. (E. A. H.)

CLOVES, the dried, unexpanded flower-buds of *Eugenica aromatica,* a tree belonging to the family Myrtaceae. The clove tree is a beautiful evergreen which grows to a height of 40 ft., having large oval leaves and crimson flowers in numerous groups of terminal clusters. The flower-buds are at first of a pale colour and gradually become green, after which they develop into a bright red, when they are ready for collecting. Cloves are rather more than half an inch in length and consist of a long cylindrical calyx, terminating in four spreading sepals, and four unopened petals which form a small ball in the centre. The tree is a native of the Moluccas, or Spice Islands, but it was long cultivated by the Dutch in Amboyna and two or three small neighbouring islands. The Portuguese, by doubling the Cape of Good Hope, obtained possession of the principal portion of the clove trade, which they continued to hold for nearly a century, when, in 1605, they were expelled from the Moluccas by the Dutch. Holland exerted great efforts to obtain a complete monopoly of the trade, attempting to extirpate all the clove trees growing in their native islands and to concentrate the whole production in the Amboyna Islands. With great difficulty the French succeeded in introducing the clove tree into Mauritius in the year 1770; subsequently the cultivation was introduced into Guiana, Brazil, most of the West Indian islands and Zanzibar. The chief commercial sources of supply were for a long time Zanzibar and its neighbouring island Pemba on the east African coast, but the competition of Java and Sumatra is severe and the synthetic production of eugenol (*see* below) has affected the trade. Madagascar is the principal source of the oil for the U.S. Imports in 1940 were 307,-

289 lb., of which Madagascar supplied more than 302,000 lb.

Cloves as they come into the market have a deep brown colour, a powerfully fragrant odour, and a hot acrid taste. When pressed they exude a volatile oil which is obtained as a commercial product by submitting the cloves with water to repeated distillation. This is, when new, a pale yellow or almost colourless fluid, becoming brown after some time; it possesses the odour and taste



FROM KÖHLER, "MEDIZINAL PFLANZEN"

BRANCH OF A CLOVE TREE SHOWING THE FLOWER BUDS WHICH, WHEN DRIED, MAKE THE CLOVES OF COMMERCE

peculiar to cloves. The essential oil of cloves—the *Oleum Caryophylli* of the British Pharmacopoeia—is a mixture of two substances. *Eugenol* or eugenic acid, $C_{10}H_{12}O_2$, is the chief constituent. Oil of cloves is soluble in alcohol and ether. Cloves are employed as a condiment in culinary operations, in confectionery, and in the preparation of *liqueurs*. In medicine they are tonic and carminative but they are little used except as adjuncts to other substances. The oil forms a convenient medium for using cloves for flavouring purposes, possesses the medicinal properties characteristic of a volatile oil, and is frequently employed to relieve toothache. Oil of cloves is regarded by many dental surgeons as the most effective local anaesthetic they possess. Clove oil must have a eugenol content of at least 82%.

CLOVIO, GIORGIO GIULIO (1498–1578), Italian painter of portraits and historical pieces, by birth a Croat and by profession a priest, is said to have studied at Rome under Giulio Romano, and at Verona under Girolamo de' Libri. His book of 26 pictures representing the procession of Corpus Domini, in Rome, was the work of nine years, and the covers were executed by Benvenuto Cellini. The British Museum has his twelve miniatures of the victories of the Emperor Charles V. In the Vatican library is preserved a manuscript life of Frederick, duke of Urbino, superbly illustrated by Clovio, who is *facile princeps* among Italian miniaturists. He was called Macedo, or Macedone, to connect him with his supposed Macedonian ancestry.

CLOVIS (*Chlodovech*) (*c.* 466–511), king of the Salian Franks, son of Childeric I., whom he succeeded in 481 at the age of 15. At that date the Salian Franks had advanced as far as the river Somme, and the centre of their power was at Tournai. On the history of Clovis between the years 481 and 486 the records are silent. In 486 he attacked Syagrius, a Roman general who, after the fall of the western empire in 476, had carved out for himself a principality south of the Somme, and is called by Gregory of Tours "rex Romanorum." After being defeated by Clovis at the battle of Soissons, Syagrius sought refuge with the Visigothic king Alaric II., who handed him over to the conqueror. Henceforth Clovis fixed his residence at Soissons, which was in the midst of public lands, *e.g.*, Berny-Rivière, Juvigny, etc. The episode of the vase of Soissons[1] has a legendary character, and all that it proves is the deference shown by the pagan king to the orthodox clergy. Clovis undoubtedly extended his dominion over the whole of Belgica Secunda, of which Reims was the capital, and conquered the neighbouring cities in detail. Little is known of the history of these conquests. It appears that St. Genevieve defended the town of Paris against Clovis for a long period, and that Verdun-sur-Meuse, after a brave stand, accepted an honourable capitulation thanks to St. Euspitius. In 491 some barbarian troops in the service of Rome, Arboruchi (Ἀρμόρυχοι) Thuringians, and even Roman soldiers who could not return to Rome, went over to Clovis and swelled the ranks of his army.

In 493 Clovis married a Burgundian princess, Clotilda, niece of Gundobald and Godegesil, joint kings of Burgundy. This princess was a Christian, and earnestly desired the conversion of her husband. Although Clovis allowed his children to be baptized, he remained a pagan himself until the war against the Alamanni, who at the time occupied the country between the Vosges, and the Rhine and the neighbourhood of Lake Constance. By pushing their incursions westward they came into collision with Clovis, who marched against them and defeated them in the plain of the Rhine. The legend runs that, in the thickest of the fight, Clovis swore that he would be converted to the God of Clotilda if her God would grant him the victory. After subduing a part of the Alamanni, Clovis went to Reims, where he was baptized by St. Remigius on Christmas day 496, together with 3,000 Franks. The story of the phial of holy oil (the *Sainte Ampoule*) brought from heaven by a white dove for the baptism of Clovis was invented by archbishop Hincmar of Reims three centuries after the event.

The baptism of Clovis was an event of very great importance. From that time the orthodox Christians in the kingdom of the Burgundians and Visigoths looked to Clovis to deliver them from their Arian kings. Clovis seems to have failed in the case of Burgundy, which was at that time torn by the rivalry between Godegesil and his brother Gundobald. Godegesil appealed for help to Clovis, who defeated Gundobald on the banks of the Ouche near Dijon, and advanced as far as Avignon (500), but had to retire without being able to retain any of his conquests. Immediately after his departure Gundobald slew Godegesil at Vienne, and seized the whole of the Burgundian kingdom. Clovis was more fortunate in his war against the Visigoths. Having completed the subjugation of the Alamanni in 506, he marched against the Visigothic king Alaric II. in the following year, in spite of the efforts of Theodoric, king of the Ostrogoths, to prevent the war. After a decisive victory at Vouillé near Poitiers, in which Clovis slew Alaric with his own hand, the whole of the kingdom of the Visigoths as far as the Pyrenees was added to the Frankish empire, with the exception of Septimania, which, together with Spain, remained in possession of Alaric's grandson Amalaric, and Provence, which was seized by Theodoric and annexed to Italy. In 508 Clovis received at Tours the insignia of the consulship from the eastern emperor, Anastasius, but the title was purely honorific. The last years of his life Clovis spent in Paris, which he made the capital of his kingdom; here he built the church of the Holy Apostles, known later as the church of St. Geneviève. By murdering the petty Frankish kings who reigned at Cambrai, Cologne and other residences, he became sole king of all the Frankish tribes. He died in 511.

Clovis was the true founder of the Frankish monarchy. He reigned over the Salian Franks by hereditary right; over the other Frankish tribes by reason of his kinship with their kings and by the choice of the warriors, who raised him on the shield, and he governed the Gallo-Romans by right of conquest. He had the

[1] The story is as follows. The vase had been taken from a church by a Frankish soldier after the battle of Soissons, and the bishop had requested Clovis that it might be restored. But the soldier who had taken it refused to give it up, and broke it into fragments with his *francisca*, or battle-axe. Some time afterwards, when Clovis was reviewing his troops, he singled out the soldier who had broken the vase, upbraided him for the neglect of his arms, and dashed his *francisca* to the ground. As the man stooped to pick it up, the king clove his skull with the words "Thus didst thou serve the vase of Soissons."

Salic law drawn up, doubtless between the years 486 and 507, and seems to have been represented in the cities by a new functionary, the *graf, comes,* or count. He owed his success in great measure to his alliance with the church. He took the property of the church under his protection, and in 511 convoked a council at Orleans, the canons of which have come down to us. But while protecting the church, he maintained his authority over it. He intervened in the nomination of bishops, and at the council of Orleans it was decided that no one, save a son of a priest, could be ordained clerk without the king's order or the permission of the count.

The chief source for the life of Clovis is the *Historia Francorum* (bk. ii.) of Gregory of Tours, but it must be used with caution. Among modern works, *see* W. Junghans, *Die Geschichte der fränkischen Könige Childerich und Clodovech* (1857); F. Dahn, *Urgeschichte der germanischen und romanischen Völker,* vol. iii. (1883); W. Schultze, *Deutsche Geschichte v.d. Urzeit bis zu den Karolingern,* vol. ii. (1896); G. Kurth, Clovis (1901). (C. Pf.)

CLOVIS, a city of New Mexico, U.S.A., near the centre of the eastern boundary of the state; the county seat of Curry county. It is on federal highways 60, 70 and 84, and state highway 18, and is served by the Santa Fe railroad. The population was 8,027 in 1930 and 10,065 in 1940 by the federal census. It is the state's most important livestock and dry farming area, with crops of wheat, sorghum grains, broomcorn, sudan, etc. Clovis was settled about 1907; incorporated in 1908; and in 1921 adopted a commission form of government.

CLOWES, SIR WILLIAM LAIRD (1856–1905), British author and journalist, was born at Hampstead, London, on Feb. 1, 1856, the son of William Clowes, a former registrar in chancery, and died at St. Leonards-on-Sea on Aug. 14, 1905. He was entered at Lincoln's Inn in 1877, but was never called, and began journalism in 1879, devoting himself especially to the study of naval matters. As special correspondent of the *Daily News* (1885), the *Standard* (1887–90), and *The Times* (1890–95), he was present at naval manoeuvres and had opportunities of close and first-hand studies. His review and newspaper articles, written often under the pen-name "Nauticus," were regarded as authoritative both in England and on the Continent. He founded, and for a time edited, the *Naval Pocket Book,* and with Sir Clements Markham, Captain A. T. Mahan and others, wrote *The Royal Navy; its History from the Earliest Times* (7 vols., 1897–1903).

See a notice by S. E. Fryer in the *Dict. Nat. Biog.* (*Supplement* for 1901–11).

CLOWN, a rustic or boorish person; in pantomime, a comic character, always dressed in baggy costume, with face whitened and eccentrically lined with black and red paint. The character probably descends from representations of the devil in mediaeval miracle-plays, developed through the fools or jesters of the Elizabethan drama. The whitened face and baggy costume indicate a connection also with the Pierrot of Italian comedy. The prominence of the clown in pantomime (*q.v.*) is a comparatively modern development as compared with that of Harlequin.

CLOYNE, small market town, Co. Cork, Eire, 15 mi. E.S.E. of the city of Cork. Pop. (1936) 684. An ecclesiastical foundation of the 6th century, it has an ancient oratory and a cathedral (mainly 14th century) dedicated to St. Colman, disciple of St. Finbar of Cork. Opposite the cathedral is a fine round tower 100 ft. high. The town suffered from Scandinavian raids in the 9th century and was laid waste by Dermot O'Brian in 1071 and burned in 1137. In 1430 the bishopric was united to that of Cork, in 1638 it became independent, and in 1660 it was again united to Cork and Ross. It became independent once more in 1678 and so continued until its reunion with Cork in 1835. The name *Cluain-Uamha* signifies "the meadow of the cave," from the limestone caves of the vicinity. The Pipe Roll of Cloyne compiled by Bishop Swaffham in 1364 is a valuable record of mediaeval land tenure. It is now in the Record Office, Dublin, and was edited by Caulfield in 1859. The cathedral contains a memorial to Bishop Berkeley, the philosopher (1685–1753). The town gives its name also to a Roman Catholic diocese with a cathedral at Cobh.

CLUB-FOOT (*talipes*), the name given to deformities of the foot, some of which are congenital, others acquired—the latter being chiefly due to infantile paralysis. *Talipes equinus* is that form in which the heel does not touch the ground, the child resting on the toes. In *talipes varus* the foot is turned inwards and shortened, the inner edge of the foot is raised, and the child walks on the outer edge. These two conditions are often combined, the heel being drawn up and the foot twisted inward; the name given to the twofold deformity is *talipes equino-varus.* It is the most usual congenital form. In *talipes calcaneus* the toes are pointed upwards and the foot rests on the heel. This is always an acquired (paralytic) deformity.

The treatment of congenital club-foot, which is almost invariably *varus* or *equino-varus,* should be begun as soon as the abnormal condition of the foot is recognized. The nurse should be shown how to twist and coax the foot into the improved position, and should so hold it in her hand many times a day. And thus by daily, or, one might almost say, hourly manipulations, much good may be accomplished without distress to the infant. If after weeks or months of these measures insufficient progress has been made, the subcutaneous division of a tendon or two, or of some tendons and ligaments, may be necessary, the foot being subsequently fixed up in the improved position in plaster of Paris. If these subcutaneous operations also prove disappointing, or if, after their apparently successful employment, the foot constantly relapses into the old position, a more radical procedure will be required. Of the many procedures which have been adopted there is, probably, none equal to that of free transverse incision introduced by the late Dr. A. M. Phelps, of New York. By this "open method" the surgeon sees exactly what structures are at fault and in need of division—skin, fasciae, tendons, ligaments; everything, in short, which prevented the easy rectification of the deformity. After the operation, the foot is fixed, without any strain, in an over-corrected position, between plaster of Paris splints.

Talipes valgus is very rare as a congenital defect, but is common as a result of infantile paralysis, and is apt to be combined with the calcanean variety. "Flat-foot" is sometimes called *spurious talipes valgus;* it is due to the bony arches of the foot being called upon to support a weight beyond their power. The giving way of the arches may be due to weakness of the muscles, tendons or ligaments—probably of all three. It is often met with in feeble children, and in nurses, waiters, policemen and others whose duties demand much standing. Exercises on tip-toe, especially with a skipping rope, massage, rest, and tonic treatment will give relief, and shoes or boots may be supplied with the heel and sole thickened along the inner borders to throw the weight on the strong outer border of the foot. When the flat-footed individual stands, it should be upon the outer borders of his feet, or better still, on tip-toe, as this posture strengthens those muscles of the leg which hold up the bony arches.

Morton's Disease.—In some cases of flat-foot severe neuralgia at the root of the toes, comes on after much standing or walking. The pain is due to pressure on the nerves of the toes by the rounded ends of the long bones of the foot near the web of the toes. It does not generally yield to palliative measures; the only effectual remedy is resection of the head of one of the metatarsal bones, after which relief is complete and permanent.

For paralytic club-foot, in which distressing corns have developed over the unnatural prominences upon which the sufferer has been accustomed to walk, conservative measures are usually disappointing, and relief may be obtainable only after a Syme's amputation through the ankle-joint.

CLUB-MOSS, the common name for plants of the genus *Lycopodium,* and often extended to cover all the Lycopodiales, which form one of the main divisions of the Pteridophyta (*q.v.*), a group which also includes the ferns. Club-mosses are also called staghorn-mosses.

CLUBS. Although the club as an institution was known to the Greeks and Romans, to the former as *hetaireia,* to the latter as *sodalitas,* and was, indeed, recognized in nearly all the states of the ancient civilized world, its organization and aims differed essentially from those of modern times. Such centres were, indeed,

associations rather than clubs, as we understand the term, and may be more appropriately likened to the trade guilds of later days, their chief purpose being religious observances, trade organization, and even privateering, as is proved by certain references to them in one of the laws of Solon; while those associated with the pleasures of the table seem to have approximated to the modern *table d'hôte,* where a number of people gathered together for meals in common, probably as much from economical purposes as for anything else. The religious clubs of the Greeks were the most important, and were in effect the parents of all such collocations of men, but had little in common with the club of modern times, although certain contemporary political organizations of the kind do appear to have had more or less affinity to the recognized objects of many later clubs instituted for similar purposes.

Grote (*Hist. of Greece*) and others show, however, that even when connected with politics the clubs of the Greeks were fundamentally unlike the modern conception of the political club; for even if legal and harmless at first they degenerated, owing to party struggles, into actively hostile associations.

The religious clubs of the Greeks were combinations of men drawn together for some specific object, such as the worship of some particular deity of an esoteric character; *i.e.,* one not recognized by the State; and thus approximating to the various sects of our own established religion rather than to clubs as we understand the term. Such cults as those of Isis and Serapis, Attis and the rest, were carried on by associations specially organized for their support—support to which the State had no objection so long as they did not infringe the laws or were not subversive of its moral well-being. That the organization of such sects should be on not very different lines from those of modern clubs, possessing as they did equivalents to our committee, chairman, secretary, etc., is only what obtains in any body of men meeting together for such purposes; but otherwise these Greek clubs had nothing in common with the modern club, as M. Foucourt's account of the subject (*Les Associations Réligieuses chez les Grecs,* 1873), is sufficient to show.

With the Romans, too, what are described as clubs in those days should more properly be entitled trade guilds, in which the basic idea was the furtherance of the special commercial activity in which the members were interested. The political clubs of Cicero's time had a closer analogy to ours, but even then their activities were of such a very different character that we find them suppressed by Julius Caesar as being dangerous to public order. The Romans had, too, like the Greeks, their religious sects (*sodalitates*), but they bring us no nearer to our conception of a club; and one of the few of these whose objects can be said to have survived in our day is the Burial Club associated with the poorer classes who were much preoccupied with a decent sepulture. As a matter of fact it is probable that the true clubs of ancient Rome were to be found in the baths, where, without committees or secretary or club-houses of their own, the wealthy and important congregated for ease and conversation, as men and women do in existing clubs throughout the world.

Justus Lipsius does, however, mention a Roman club which had an obviously nearer affinity, at least in its rules and regulations, to those of our own day; and which was similar to the *symposia,* referred to by Cicero in his *De Senectute,* which he says he enjoyed less for their gastronomical attractions than for the opportunities they afforded him of talking, which incidentally shows that he was probably the first of the redoubtable army of club-bores.

When the word "club" first began to take on its present signification is an open question; for, although Carlyle (*Frederick the Great*) indicates that it had its equivalent in the *gelübe* of the chivalric orders in Germany, on the other hand the German *klubbe* is directly borrowed from our own word. In the 17th century *club* is found used, in the connection it now connotes, by Aubrey and Pepys, the former remarking that "we now use the word clubbe for a sodality in a taverne," and the latter speaking of a tavern in Pall Mall as the place whither he and his friends resorted "for clubbing."

It was, however, in the 18th century that the club, more or less on the lines familiar to us, first rose into general prominence and favour, although it had certain forerunners which possessed characteristics common to it in its later development. The earliest of these was *Le Court de Bone Compagnie,* which flourished in the reign of Henry IV., of which the poet Hoccleve, who was a member, has left some poetical data. It was obviously in the nature of what we should now call a dining club, as were certain famous successors in the time of Elizabeth, notably the *Friday Street* or *Bread Street Club,* traditionally supposed to have been founded by Sir Walter Raleigh, but now chiefly remembered from the name of its meeting-place, the Mermaid Tavern. A contemporary club was the *Apollo,* whose members foregathered at The Devil Tavern by Temple Bar, where Ben Jonson, who drew up its rules, dominated the meetings as Dryden was to do at Will's a century later.

With the introduction of coffee-houses, about the middle of the 17th century, clubs found more or less permanent headquarters, and their great development at the beginning of the following century may be directly ascribed to this circumstance, although one of a specialized character, *The Royal Navy Club,* inaugurated in 1674, was the parent of those service clubs which only came into existence during the early years of the 19th century.

Of the few other clubs of Stuart times whose names have survived, *The Rota,* which Pepys calls the Coffee Club, no doubt because it met at Miles' Coffee House, in Westminster, founded by James Harrington in 1659, is the best known. Its principles were republican, whereas those of another somewhat later club, *The Sealed Knot* (1688), were distinctly royalist. *The Civil Club* (1669) may be regarded as the direct forerunner of the City of London Club which did not come into existence till 1832. At the *Wednesday Club,* which met in Friday street, William Paterson directed the conferences which went by its name and ultimately resulted in the establishment of the Bank of England. Such associations as these had no actual home of their own, nor was there any financial obligation on the part of the members beyond the payment of their "scot"; a room being freely allocated for their use by the landlord of a coffee-house, who found generally an adequate return in the food and wine consumed by the members, and where the members were notable men, in the attraction to his premises of the general public through their means.

CLUBS IN THE EIGHTEENTH CENTURY

With the beginning of the 18th century there was a sudden and large increase of clubs in London. Passing over the notorious *Calves' Head Club* (*q.v.*) we may note that a number of clubs arose whose doings are mentioned in *The Tatler* and *The Spectator,* and with some of which the names of Swift and Bolingbroke are closely associated. Of these the *October Club* (1710–11), which gave no little trouble to Harley's administration, and its more advanced offshoot, the *March Primitive October Club;* the *Saturday Club,* inaugurated by Bolingbroke in 1711; the *King's Head,* or *Green Ribbon Club,* due to Shaftesbury's efforts; and the *Hanover Club,* organized to support the new dynasty, are examples. Such contemporary ones as *The Society,* or *Brothers' Club,* of which Swift was a leading light; the *Scriblerus Club,* which he actually founded; and the better remembered *Kit Cat Club,* due to Jacob Tonson's exertions, whose list of famous members, its toasts and its portraits, have made it something of a thing apart, were in the nature of literary reunions where politics occupied a subsidiary place. Nor should those associations known as *Mug House Clubs* be overlooked. The disorderly doings to which they gave rise enter largely into the social and political annals of the period, for however peaceful may have been their original intention, they degenerated into hot-beds of strife and were eventually suppressed with all the rigour of the outraged law. To call them clubs at all shows what a wide significance was given to the term, a significance still wider when we find it applied even to the disorderly illegalities of such fraternities as the notorious Mohocks, Scourers, Nickers, *et hoc omne genus,* which made London a place of danger and fear to law-abiding citizens; and against the terrorism of which what were called *street clubs, i.e.,* places where the Londoner might find ready refuge, came into existence.

Of the number of clubs (so to call them) of a profane or at least eccentric character which existed at this period, the pages of *The Spectator* and the two books on the subject written by Ned Ward give sufficiently suggestive accounts. For although many of those recorded by the latter were but figments of his imagination, they were based on many actually existing, and may thus be regarded as typical. It will be recalled that it was to a club of this character held at the Boar's Head Tavern, that at a later date Johnson advised Boswell not to belong, lest it should damage his reputation.

Lesser-known clubs of the earlier half of the 18th century were *The Mourning Bush,* or, as it was afterwards re-named, *The Fountain* (it is satirically referred to by Tom Brown), of Jacobite tendencies; *The Board,* which Walpole (*Letter to Mann,* 1743) mentions; the *Coterie,* started in 1764; *The Revolution* and *The Independents,* of rather later date, but all having a marked political and even militant character.

During the second half of this period, clubs began to take on a more regularized system of life, and embraced all sorts of wants, from the famous *Dilettanti Society* (still existing) and *The Thespian,* whose names indicate their character, to the *Sons of the Thames,* a pioneer of later aquatic clubs; the *Je ne sçai quoi,* which met at the Star and Garter in Pall Mall with George, Prince of Wales, as its perpetual chairman, to the *No Pay No Liquor Club,* whose members were obliged to wear a hat of peculiar construction and to drink from a cup of peculiar shape. Such clubs were as the sands of the sea, and there could have been few directions of human interest to which one or other of them did not appeal.

The literary and purely social club is most characteristic of this period. Of the former Dr. Johnson is the protagonist. In the winter of 1749 he founded the *Ivy Lane Club;* 14 years later the far more famous *Literary Club* or *The Club,* whose annals fill so large a space in the record of his career, and which still exists, having enrolled among its members nearly all the outstanding men of two centuries. In 1783, not long before his death, Johnson founded yet another club, *The Essex Head,* so named from the tavern where its members foregathered.

Of more specialized character may be mentioned the *Royal Society Club* (1731), not, of course, to be confounded with the existing *Royal Societies Club,* parodied by Ned Ward as The Virtuosos; the *Noviomagians Club,* standing in the same relation to the Society of Antiquaries as the former did to the Royal Society. There were also a number of subsidiary clubs meeting at Will's and Tom's coffee-houses, in a description of which by Macky (*Journey through England*) we recognize various similarities to the club as it exists to-day. The *Sublime Society of Beefsteaks* (1735–1867), of which the present Beefsteak Club is a kind of successor; the *Robin Hood Club,* whose beginnings were in far-off days but which only emerged into prominence when Burke was an eloquent member; the *Wittanagemot,* a small and little-known society, something on the lines of our present-day dining societies, are types of the clubs of this period; while the *Blue Stockings,* of which more than one was in existence about this time (the latter half of the 18th century), formed a link between the fashionable and literary society of the day. To these may be added Goldsmith's Wednesday Club, and such quasi-debating, quasi-social institutions as the *Cogers* in the east and the *Clifford Street Club* and the so-called *King of Clubs* (1801) in the west.

With the beginning of the 19th century, clubs, as a general rule, although there had been one or two pioneers in this direction, such as White's and Brooks's, first began to have their own headquarters and consolidated themselves on those lines which in many instances still obtain. The close of the Napoleonic Wars resulted in numbers of officers of both services being at large in London, and needing centres where they could meet, and where food and general amenities could be obtained at a reasonable rate. Hence the rise of the Service clubs, which, once inaugurated, increased gradually, with the result that *The United Service* came into existence in 1815; *The Guards* in 1813; the *Junior United Service* in 1827; *The Oriental* in 1824; the *Army and Navy* in 1837; and the *East India United Service* in 1850; to be followed by others now existing or defunct.

Regency days were, too, notable for regular gambling clubs, as differentiated from the card-playing at other centres, and *Watiers,* where Brummell was an outstanding figure, started its hectic career in 1805, which lasted till 1823, when Crockford took it, but gave it up on opening his splendid structure in St. James's street some five years later—a building which is now, after many vicissitudes, the home of *The Devonshire Club* (1875). Other small but fashionable clubs of the time were *Weltzie's* (named after a cook to the Prince of Wales) and *The Alfred* (1808), which the wits called *The Half-Read* and of which Byron was a member.

CLUBS AND THE PROFESSIONS

A change was by now coming over the institution of the club. With the increase in population and more grandiose ideas, it was found necessary to allocate such centres to varied tastes and occupations, and thus whereas previously the statesman and the soldier, the literary man and the artist, had more or less congregated in common centres, clubs specially designed for different professions and callings began to be established, and club-houses of splendid proportions sprang up under the hands of well-known architects about that area of Pall Mall and St. James's which has for long been the special home of such places. At the same time the taste for bohemianism, which reached its height during the first half of the 19th century, resulted in the foundation of a variety of clubs which enjoyed a more or less extended life, and a few of which still exist although in a gradually increasing state of sophistication. Before speaking of these, the great political clubs must be noticed. Of these, in virtue of its age and wealth of associations, comes White's, evolved from the Chocolate House of that name and started by Francis White in 1693 in a house on the site of Boodle's. Later it crossed the road to a spot now forming the northern portion of Arthur's. In 1755 another move was made, to where its rebuilt club-house now stands with all its memories of over two centuries on its head, and its famous betting book. Brooks's, which represents the opposite political camp, originated in an establishment set up by Almack (not to be confounded with his more famous Assembly Rooms, in King street) in Pall Mall under his own name, that of Brooks appearing first in 1774, four years after which date the club was moved to St. James's street, to premises built for it by Holland.

Another club which inhabits its original home is *Boodle's* (1762), first known as *The Sçavoir Vivre,* but taking its present name from Boodle, who succeeded to the management about 11 years later. Boodle's club-house is so much in the style of the Adam brothers that it has always been regarded as their work, although there is a question as to whether or not they really had a hand in its design. It should perhaps rather be included among social clubs, such as the *St. James's* (which has also a diplomatic air), known once as the *Coventry House Club* from the beautiful mansion in Piccadilly which it has occupied since 1769, 12 years after its foundation; or *The Travellers* (another diplomatic centre) in Pall Mall, which was started in 1819, but did not blossom forth in Barry's club-house till 1832; or those other social centres such as *The Windham* (1828); *The Bachelors'* (1881); *Arthur's* (1811); *The Union* (1804), once in Pall Mall, then in Trafalgar square, and now in Carlton House terrace; the *Wellington* (1885); the *Cocoa Tree* (1746), *The Thatched House* (on the site of the famous Thatched House Tavern), which grew out of the Civil Service Club, in 1865, etc.

Of the political clubs, other than White's and Brooks's, the *Carlton* (1831) and the *Reform* (1834) are the two outstanding examples, and both occupy premises of important architectural character: the last named being probably from this point of view the most impressive structure of its kind in London. To these may be added the *Junior Carlton* (1864); the *Constitutional* (1883); the *St. Stephen's* (1870); the *National Liberal* (1882); and the *Conservative* (1840); in which connection the *Eighty* (1880); the *United* (1890); *The Cobden* (1866); and the *"1920" Club,* are among a variety of others connected with political affairs; these west-end clubs having their equivalents in the City,

where the *City Carlton* (1868); the *City Liberal,* and others, have a special object in this respect; and where the *City of London Club* (1832) and the *Gresham* (1843) are based on broader lines.

LITERARY AND ARTISTIC CLUBS

To turn to another form of specialization in this direction, there are a large number of literary and artistic clubs in London, of which *The Athenaeum* is the most important. This famous centre was founded by John Wilson Croker, at Mr. Murray's house in Albemarle street, in 1823, most of the leading literary men of the day—Scott and Moore among them—being members of the original committee. It was first (when it was called The Society), domiciled in Waterloo place, but in 1831 took possession of the clubhouse designed for it by Decimus Burton in Pall Mall.

Another well-known literary club is *The Savile,* or *New Club* as it was first called and generally regarded as a "waiting place" for the Athenaeum, which was opened in 1868 and for long occupied the small bay-fronted house in Piccadilly till it went to 69, Brook street.

A literary and artistic centre of more or less Bohemian character is the *Savage* (1857), which, after many temporary homes, has since 1890 been installed in Adelphi Terrace. Of a more theatrical character is the *Garrick* (1831). The "Little Garrick" of Thackeray, was in King street, Covent Garden, but the present premises have been occupied by the club since 1862. The *Authors' Club* is a more modern example, dating only from 1891; while *The Royal Societies Club* is three years younger.

Another phase of energy is more specially indicated by a number of clubs of which artists and connoisseurs and those interested in analogous subjects are members. Of these the *Arts Club* (1863) may be taken as the representative; as the *P.E.N. Club* (1921) may be of the more modern conception of what should be termed perhaps a working literary club.

The theatre has, too, besides the *Garrick,* a goodly array of such centres; the *O.P. Club* (1900); the *Green Room* (1877); the *Rehearsal* (1892) and the *Vaudeville* (1901) among them.

'Varsity clubs are, too, prominent, the four principal ones, restricted to members of the Universities, being the *United University* (1822); the *Oxford and Cambridge* (1830); the *New University* (1822) and the *New Oxford and Cambridge* (1883).

In another direction, that of sport, the *National Sporting Club* is dedicated to boxing; the *Sports Club* (1893) has a wider interest in varied aspects of sport; the *Turf* (1868), emanating from an earlier club known as the Arlington, speaks for itself as to its particular point of view; while there are various clubs specially connected with racing, such as the *Sandown, Hurst Park* and *Kempton Park.* The *Badminton* and the *Beaufort* have an *aura* of the hunting-field about them as their names connote; and such clubs as the *Coaching* and *Four-in-Hand,* and above all *The Jockey* (1750), which has for nearly two centuries laid down the law upon all matters pertaining to horse-racing, and has done so much to keep the turf an honourable institution, are *sui generis.* Besides these there is hardly a form of sport which does not possess its special club, from yachting in the Solent and the Thames to model yacht racing on the Round Pond in Kensington Gardens; from motoring, the *Royal Automobile Club* (1897), whose home in Pall Mall is the largest and most luxurious in London, to golfing (*The Golfers' Club,* 1893); from winter sports to dry fly-fishing; while the *Kennel Club* (1873); the *Farmers' Club* (1842); the *United Sports* (1903); the *Royal Aero Club* (1901); the *Alpine Club* (1858); the *Fencing* (1848) and *The Sword* (1905), and many others, including the *Smithfield Club* and the *Bath Club,* all attest that widespread interest in every variety of sport which has always characterized this country.

Apart from the clubs which have their own premises there are certain dining clubs inaugurated to do honour to the memory of some great man or which have for their object the bringing together, at stated intervals, of those interested in some special form of collecting. The most important of these is the *Society of Dilettanti,* dating from 1734; the collection of pictures belonging to this famous club, painted by Reynolds and Knapton, now being housed in the St. James's club, where the Dilettanti hold their dinners. *Grillions Club* (1813), of which so many illustrious men have been and are members, is another example of this more intimate view of sodality approximating in many respects to the clubs of Swift and Johnson. Others of the kind are *The Roxburghe* (1812), connected with book-collecting; the *Breakfast Club* (1866), a very select society; and such specialized examples as the clubs named after Johnson and Pepys, and Butler (*The Erewhon*); Omar Khayyám and Dickens (the *Boz Club*); Rabelais and Lamb and Thackeray (*The Titmarsh*). The Sette of Odde Volumes, The Rhymers, the "Connozzers," the Grolier, the First Edition, and the Urban; The Goat and the Hardwicke (associated with the law); and so forth, represent other phases of hero worship or the worship of inanimate objects.

Many as are the existing clubs, those that during the last 100 years have arisen, flourished for awhile, and disappeared, are as numerous, some of which, like the *Arundel* and the *Raleigh,* to take but two examples, are still remembered by many.

BRITISH LADIES' CLUBS

Although not exactly a departure, one that has in recent years developed with surprising energy and completeness is the ladies' club. The earliest of these (putting aside the *Ladies' Club* of the 18th century, "the female Almacks" referred to by Walpole) was the *Alexandria* (1883), into which no man was permitted to enter (the Prince of Wales, afterwards King Edward, was once refused admittance on accompanying the Princess who was a member there, and Lord Roberts used to be seen waiting outside for Lady Roberts); then came the *Pioneer* (1892), the *Victoria,* the *New Century,* the *Halcyon,* the *Lyceum,* the *Forum,* and so on. To-day there are numbers of these clubs dedicated to the ladies or in some cases, as in that of the *Garden Club* and others, open to members of both sexes.

With regard to the internal economy of clubs, this varies as much as does the character of the aims and objects of such associations or as does the nature and architectural features of their club-houses. In some the committees possess the power of election; in others this is by ballot; some, like the Athenaeum, have the right of electing annually a certain number of members on account of their distinguished eminence, services to the State, literature, art, and so forth. Once a year a general meeting is held, to which a report of the annual working is submitted. The committee is a responsible body, but the conduct of the club is largely in the hands of the secretary. The law concerning clubs is to be found laid down by J. Wertheimer in his *Law relating to Clubs* (1903), and by Sir E. Carson in the chapter on the subject in his *The Laws of England* (1909). It may be noted that the Licensing Act of 1902, passed primarily to prevent clubs from being formed merely as a cloak for the sale of intoxicants, brought every club, the largest to the smallest, within its scope.

(*See* also WORKING MEN'S CLUBS.) (E. B. C.)

BIBLIOGRAPHY.—*General:* Charles Marsh, *The Clubs of London* (1828); Anon., *The London Clubs, their Anecdotes and History* (1853); John Timbs, *Club-Life of London* (1860); Rev. A. Hume, *Learned Societies and Private Clubs* (1847); Ned Ward, *The Secret History of Clubs of all Description;* (1709), *Complete Account of all the Remarkable Clubs* (3rd Edit., 1746); J. Hatton, *Clubland, London and Provincial* (1890); Major Arthur Griffiths, *Clubs and Clubmen* (1907); J. Escott, *Club Makers and Club-members* (1914); Ralph Nevill, *London Clubs, their History and Treasures* (1911); E. Beresford Chancellor, *The Clubs of London, Past and Present* (1928).

Special: Hon. A. Bourke, *The History of White's* (1892); Anon., *Memorials of Brooks's* (1907); A. Baillie, *The Oriental Club;* H. T. Waddy, *The Devonshire Club and Crockford's* (1919); Admiral W. H. Smyth, *The Royal Society Club* (1860); Rev. F. G. Waugh, *The Athenaeum Club* (privately printed n. 2); Humphrey Ward, *History of the Athenaeum Club* (1925); Percy Fitzgerald, *The Garrick Club* (1904); Anon., *The Savile Club* (1925); Louis Fagan, *The Reform Club* (1887); Walter Arnold, *The Sublime Society of Beefsteaks* (1871).

UNITED STATES

The various clubs which were formed in the United States previous to the Civil War were largely reproductions of those of England. Among these were the Old Colony Club of Boston, the Old South Club, the Puritan Club, the Temple Club and others of the same city. The Sans Souci Club of Boston (1785), and

the Turtle Club of Hoboken (1797), are names suggesting the pleasanter phases of life. The Union Club of New York (1836) remains as a picture of the older social type, as does the New York Yacht Club (1844). The Union League of New York was organized in 1863 to preserve the union of the States and has remained a Republican club. In opposition, the Manhattan was organized in 1865 as a Democratic club. There were in 1928 about a hundred important clubs in New York city, representing the army, the navy, the universities, finance, engineering, athletics, the arts and society. Washington is notable for its clubs, including the Army and Navy, the Cosmos, the Century, the Press, the Metropolitan, the University, the Country and the Riding and Hunt. One notable extension of the club in all large American cities has been the interchange of membership by which a member in one city may automatically become a member in another during the time of his visit. This in many instances also applies to country club facilities. Many of the larger clubs have not only their main city establishment but own country clubs as well. Principles of business organization are applied in such degree that clubs show revenues, instead of deficits, and often become wealthy through restaurant and other charges.

Among the clubs that retain the old-time flavour may be mentioned two, the Lambs', in New York, founded in 1874, and the Bohemian Club, of San Francisco, founded in 1887. The Lambs', which had in 1928 a membership of 1,650, maintains its table and its story-tellers; it is rich with kindly feelings and reveals its fund of jokes each year in its gay gambols—performances in which its wittiest and best actors take part. The Bohemian Club is frankly a place of freedom and joy. Far from the city it has its bohemian grove where, among redwood trees, its members and guests are totally free in their fun, speech and actions. The older clubs often had their inception in a spirit of fun, the wish to do something odd, unusual. One such was the Lantern Club, organized in 1893 by Edward Marshall, Stephen Crane, David Graham Phillips, Irving Bacheller and other notable writers of the day. It had its home at 32 South William street, N.Y., where had lived the famous Captain Kidd, hanged as a pirate on Bedloe's island. This club collected hundreds of ship's lanterns during its existence, and entertained many of the distinguished visitors from Europe and other lands. The United States has had its share of suicide, burial, bachelor, Dutch treat and other clubs, not unlike the Club of Ugly Faces that was formed in the early days of English clubdom. Modern clubs may be regarded as comfortable and reasonably exclusive hotels that look to the physical needs of men and women, and that may be a substitute for their homes.

The historical concept of the club, the association of a group of persons for good-fellowship, or the promotion of political and welfare aims, is found in the widely diversified clubs maintained by, or for boys, girls, women and men. The usefulness and prosperity of the club, indeed, is due to the principle of large membership drawn from people of mutual interests. This principle has led to the formation of many women's clubs. In 1867, when Charles Dickens was given a dinner in New York, at the Press Club, no women were officially placed among the guests. The year following women organized the Sorosis, which in 1889 was expanded into the General Federation of Women's Clubs. In 1939 there were more than 15,000 local clubs for women, with a membership of more than 2,000,000.

As an example of the American club idea, the Elks may be cited. The original club was founded in New York in 1866 as a jolly group of men who wished to protest against the excise laws and who took as their emblem the head of an animal in Barnum's old museum. Gradually this good-fellowship club took on the benevolent aspects of helping its members, though never losing sight of the pleasures of informal meetings at a common place. In 1939 there were more than 1,300 of these clubs and lodges having in all a membership of 497,000. Each year millions of dollars are donated to charity by this membership. The good-fellowship club has passed from the city to the country, where members meet less frequently and for special occasions. It has become a hunting club, or a fishing club, or one of the approximately 6,000 golf clubs scattered throughout the country.

The expansion of the United States overseas has led to the formation of purely American clubs after the custom of the English. There is the Army and Navy Club in Manila, the University Club at Honolulu. So there is the American Club at Mexico City, and similar clubs in London and Paris and other foreign centres. (W. S. HI.)

CLUE or **CLEW,** the thread of life, which, according to the fable, the Fates spin for every man (O.E. *cluwe,* a ball of thread). The figurative meaning, a piece of evidence leading to discovery, is derived from the story of Theseus, who was guided through the labyrinth by the ball of thread held by Ariadne.

CLUENTIUS HABITUS, AULUS, of Larinum in Samnium, the hero of a Roman *cause célèbre.* In 74 B.C. he accused his step-father Statius Albius Oppianicus of an attempt to poison him, and Oppianicus was condemned. But there had been bribery; Cluentius was degraded, and in 66 charged with having caused his step-father to be poisoned. Cicero defended Cluentius, who was acquitted. The speech is considered one of Cicero's best, and is more quoted by Quintilian than any other.

See Quintilian, *Inst.* ii. 17, 21. Editions of the speech by W. Y. Fausset (1887), W. Ramsay (1883); *see* also H. Nettleship, *Lectures and Essays* (1885).

CLUJ (Ger. Klausenburg; Hung. Kolozsvár), a city of Transylvania, capital of the department of Cluj, and formerly of the principality of Transylvania. Pop. (1939) 100,274, mostly Magyars, Rumanians and Jews. Cluj lies mainly on the right bank of the Somos Mic, among considerable hills. On the left bank is the "Bridge Suburb" and the citadel. The streets have a modern appearance. In the central square is the fine Gothic church of St. Michael (1396–1432), and in front of it a statue of Matthias Corvinus (1902). One side of the square is formed by the Batthanyi palace, formerly of the princes of Transylvania. Other noteworthy buildings are the Reformed church, built by Matthias Corvinus in 1486 and ceded to the Calvinists by Gabriel Bethlen in 1662, containing the coats of arms of the old Hungarian dominant families, the house in which Matthias Corvinus was born (1443), now an ethnographical museum, and many palaces of the Hungarian nobility. Cluj is an orthodox bishopric, also a bishopric of the Reformed and Uniate Churches; and possesses a university, a court of appeal, a theatre, opera and several museums. Its industry includes textile, paper, sugar, candle, soap and earthenware factories, breweries and distilleries.

Cluj is believed to occupy the site of a Roman settlement named Napoca. It was colonized by Saxons in 1178, and at first enjoyed many privileges and great prosperity; but many Saxons left it in the 16th century in consequence of the introduction of Uniate doctrine, and it presently became the centre of the Magyar element in Transylvania. It was capital of Transylvania and seat of the Transylvanian diets.

Cluj, coveted by Hungary since World War I, was ceded to that country by Rumania Aug. 30, 1940, by the award of Vienna. This award was dictated by Germany and Italy.

CLUMP, a lump, group or cluster, *e.g.,* of trees. A clumsy shoe worn by German peasants, made from a single piece of wood; the thick extra sole added to heavy boots for rough wear. Shoemakers speak of clumping a boot when a new sole is nailed, not sewn by hand, to the old sole.

CLUNES, a borough of Talbot county, Victoria, Australia, 97½ m. by rail N.W. of Melbourne. Pop. (1933) 1,182. It is the centre of an agricultural, pastoral and mining district, in which gold was first discovered in 1851. It lies in a healthy and picturesque situation at an elevation of 1,081 feet. An annual agricultural exhibition and large weekly cattle sales are held in the town.

CLUNY or **CLUGNY,** a town of east central France, in the department of Saône-et-Loire, on the left bank of the Grosne, 14 mi. N.W. of Mâcon. Pop. (1936) 3,678. The interest of the town lies in its specimens of mediaeval architecture, which include, besides its celebrated abbey, the Gothic church of Notre-Dame, the church of St. Marcel with its beautiful Romanesque spire, portions of the ancient fortifications and a number of old houses. Cluny

gradually increased in importance with the founding of the abbey (910) and the development of the religious fraternity, and in 1090 received a communal charter from the abbot St. Hugh. In 1471 the town was taken by the troops of Louis XI. In 1529 the abbey was given "in commendam" to the family of Guise. The town and abbey suffered during the Wars of Religion of the 16th century, and the abbey was closed in 1790.

The chief remains of the abbey are the ruins of the basilica of St. Peter and the abbot's palace. The church was a Romanesque building, completed early in the 12th century, and until the erection of St. Peter at Rome was the largest ecclesiastical building in Europe. It was in great part demolished under the First Empire, but the south transept, a high octagonal tower, the chapel of Bourbon (15th century), and the ruins of the apse still remain. In 1750 the abbey buildings were largely rebuilt. The abbot's palace (15th century) serves as *hôtel-de-ville,* library and museum. The town has quarries of limestone and building-stone, and manufactures pottery, leather and paper.

The Order of Cluniac Benedictines.—The Monastery of Cluny was founded in 910 by William I. the Pious, count of Auvergne and duke of Guienne (Aquitaine). The first abbot was Berno, who had under his rule two monasteries in the neighbourhood. Before his death in 927 two or three more came under his control, so that he bequeathed to his successor the government of a little group of five or six houses, which became the nucleus of the order of Cluny. Berno's successor was Odo: armed with papal privileges he set to work to make Cluny the centre of a revival and reform among the monasteries of France; he also journeyed to Italy, and induced some of the great Benedictine houses (*see* BENEDICTINES), and among them St. Benedict's own monasteries of Subiaco and Monte Cassino, to receive the reform and adopt the Cluny manner of life. The process of extension, partly by founding new houses, partly by incorporating old ones, went on under Odo's successors, so that by the middle of the 12th century Cluny had become the centre and head of a great order embracing 314 monasteries—the number 2,000, sometimes given, is an exaggeration—in all parts of Europe, in France, Italy, the Empire, Lorraine, Spain, England, Scotland, Poland, and even in the Holy Land. And the influence of Cluny extended far beyond the actual order: many monasteries besides Monte Cassino and Subiaco adopted its customs and manner of life without subjecting themselves to its sway. Fleury and Hirsau may be mentioned as conspicuous examples.

If its influence on the subsequent history of monastic and religious life and organization be considered, the most noteworthy feature of the Cluny system was its external polity, which constituted it a veritable "order" in the modern sense of the word, the first that had existed since that of Pachomius (*see* MONASTICISM). All the houses that belonged, either by foundation or incorporation, to the Cluny system were absolutely subject to Cluny and its abbot, who was "general" in the same sense as the general of the Jesuits or Dominicans, the practically absolute ruler of the whole system. The superiors of all the subject houses (usually priors, not abbots) were his nominees; every member of the order was professed by his permission, and had to pass some of the early years of his monastic life at Cluny itself; the abbot of Cluny had entire control over every one of the monks—some 10,000, it is said; it even came about that he had the practical appointment of his successor. For a description and criticism of the system, *see* F. A. Gasquet, *Sketch of Monastic Constitutional History,* pp. xxxii.–xxxv. (the Introduction to 2nd ed. [1895] of the English trans. of the *Monks of the West*); here it must suffice to say that it is the very antithesis of the Benedictine polity.

The greatness of Cluny is really the greatness of its early abbots. If the short reign of the unworthy Pontius be excepted, Cluny was ruled during a period of about 250 years (910–1157) by a succession of seven great abbots, who combined those high qualities of character, ability and religion that were necessary for so commanding a position; they were Berno, Odo, Aymard, Majolus (Maieul), Odilo, Hugh, Peter the Venerable. Sprung from noble families of the neighbourhood; educated to the highest level of the culture of those times; taking part in all great movements of ecclesiastical and temporal politics; refusing the first sees in Western Christendom, the cardinalate, and the papacy itself, they ever remained true to their state as monks, without loss of piety or religion. Four of them, indeed, Odo, Maieul, Odilo and Hugh, are venerated as saints.

In the movement associated with the name of Hildebrand the influence of Cluny was thrown strongly on the side of religious and ecclesiastical reform, as in the suppression of simony and the enforcing of clerical celibacy; but in the struggle between the papacy and the Empire the abbots of Cluny seem to have exercised a moderating influence. Hildebrand himself, though probably not a monk of Cluny, was a monk of a Cluniac monastery in Rome; his successor, Urban II., was actually a Cluny monk, as was Paschal II. It may safely be said that from the middle of the 10th century until the middle of the 12th, Cluny was the chief centre of religious influence throughout Western Europe, and the abbot of Cluny, next to the pope, the most important and powerful ecclesiastic in the Latin Church.

During the abbacy of Peter the Venerable (1122–1157) it became clear that, after a lapse of two centuries, a renewal of the framework of the life and a revival of its spirit had become necessary. Accordingly he summoned a great chapter of the whole order whereat the priors and representatives of the subject houses attended in such numbers that, along with the Cluny community, the assembly consisted of 1,200 monks. This chapter drew up the 76 statutes associated with Peter's name, regulating the whole range of claustral life, and solemnly promulgated as binding on the whole Cluniac obedience. But these measures did not succeed in saving Cluny from a rapid decline that set in immediately after Peter's death. The rise of the Cistercians and the mendicant orders were contributory causes, and also the difficulties experienced in keeping houses in other countries subject to a French superior. And so the great system gradually became a mere congregation of French houses, which was dissolved in 1790.

Cluniac houses were introduced into England under the Conqueror. The first foundation was at Barnstaple; the second at Lewes by William de Warenne, in 1077, and it counted as one of the "Five Daughters of Cluny." Though the bonds with Cluny seem to have been much relaxed if not wholly broken, the Cluniac houses continued as a separate group up to the dissolution, never taking part in the chapters of the English Benedictines.

Abridged accounts, with references to the most recent literature, may be found in Heimbucher, *Orden und Kongregationen* (1896), i. § 20; Herzog-Hauck, *Realencyklopädie* (ed. 3), art. "Cluni" (Grutzmacher); and the *Catholic Encyclopaedia, art.* "Cluny" (*Seckur*); *Die Cluniacenser* (1891–1894). An account is given in Maitland, *Dark Ages,* §§ xviii.–xxvi. The story of the English houses is briefly sketched in the second chapter of F. A. Gasquet's *Henry VIII. and the English Monasteries* (the larger ed., 1886); *see* also the same writer's *English Monastic Life.*

CLUSERET, GUSTAVE PAUL (1823–1900), delegate for war of the Paris Commune, was born in Paris, on June 13, 1823. He was an officer of the *garde mobile* during the second republic (1848), joined Garibaldi's volunteers in 1860 and in 1861 went to the United States to take part in the Civil War. After this campaign he assumed the title of General, which he said had been granted to him personally by Abraham Lincoln. He also took part in the Fenian insurrection in Ireland of 1866–67. On his return to France he became a member of the International Working Men's Association (*see* INTERNATIONAL, THE), and on the news of the Communard revolt of March 18, 1871, hurried to Paris. His military title, his advanced opinions, and his presumed talents gave him great influence among the Paris workers; he was not, however, elected a member of the Commune till the supplementary elections of April 16. After the disastrous failures of Lullier and Bergeret, the Commune appointed him to the charge of the Department of War, trusting to his record and his own assertions. But, brave though he was personally, Cluseret was hopelessly unfit to organize any military operation. He failed to introduce order into his department, to prevent the continual meddling and contradiction by the central committee of the National Guard, to organize a park of artillery, or even to relieve the men in the trenches. Under his direction, with a nominal force of 100,000

guards, the defence of Paris was maintained by no more than about 10,000, usually the same 10,000. When the Commune realized the extent of his incompetence and arrested him, on May 1, the fate of the insurrection was already decided. Cluseret had been charged with treason, but his crime was inefficiency. On May 24 the entry of the Versailles troops into Paris saved him from condemnation by the Communard courts and he escaped from France. He returned in 1884, sat as deputy for Toulon in 1888–89, and died on Aug. 21, 1900. (*See* COMMUNE.)

See *Mémoires du Général Cluseret: le deuxième siège de Paris, la fin de l'empire* (1887–88); P. Lissagaray, *History of the Commune of 1871* (1902); G. da Costa, *La Commune Vécue* (1903); R. W. Postgate, *Revolution from 1789 to 1906* (1920). (R. W. P.)

CLUSIUM (mod. Chiusi, *q.v.*), an ancient town of Italy, one of the 12 cities of Etruria, on an isolated hill at the South end of the valley of the Clanis (Chiana). It first appears in Roman history at the end of the 7th century B.C., when it joined the other Etruscan towns against Tarquinius Priscus; and at the end of the 6th century B.C. it placed itself, under its king Lars Porsena, at the head of the attempt to re-establish the Tarquins in Rome. At the time of the invasion of the Gauls in 391 B.C., the Roman envoys who had come to intercede for the people of Clusium with the Gauls took part in the battle which followed; and this determined the Gauls to march on Rome. Clusium came under Roman supremacy before 225 B.C., when the Gauls advanced thus far. The Via Cassia, constructed after 187 B.C., passed just below the town. In imperial times its grain and grapes were famous. Christianity found its way into Clusium as early as the 3rd century. In A.D. 540 it is named as a strong place to which Vitiges sent a garrison of a thousand men.

Fragments of the Etruscan town walls are built into the mediaeval fortifications. Under the town extends an elaborate system of rock-cut passages, probably drains. Extensive Etruscan cemeteries surround the city on all sides. The prevalence of cremation in the early period led to the development of the so-called *tombe a ziro*, in which the cinerary urn (often with a human head) is placed in a large clay jar (*ziro*, Lat. *dolium*). This was followed by the *tombe a camera*, in which the tomb is a chamber hewn in the rock. From one of the earliest of these came the famous François vase; another is the Tomba della Scimmia (the monkey), with a painted frieze in the central chamber. The most remarkable group of tombs is, however, that of Poggio Gaiella, 3m. to the N., where the hill is honeycombed with chambers in three storeys, partly connected by a system of passages. Other noteworthy tombs are those of the Granduca, with a single subterranean chamber carefully constructed in travertine, and containing eight cinerary urns of the same material; of Vigna Grande; of Colle Casuccini (the ancient stone door of which is still in working order), with two chambers, containing paintings representing funeral rites. Nearly 3,000 Etruscan inscriptions have come to light from Clusium and its district alone, while the part of Etruria north of it as far as the Arno has produced barely 500. Among the later tombs bilingual inscriptions are by no means rare, and both Etruscan and Latin inscriptions are often found in the same cemeteries. Many inscriptions are painted upon tiles which closed the niches containing the cinerary urns. In Roman times the territory of Clusium seems to have extended as far as Lake Trasimene. The local museum contains important objects from the necropolis, *bucchero*, sepulchral urns, painted vases, and stone *cippi* with reliefs.

Two Christian catacombs have been found near Clusium, one in the hill of S. Caterina near the railway station, the inscriptions of which seem to go back to the 3rd century; another 1m. to the E. in a hill on which a church and monastery of S. Mustiola stood, which goes back to the 4th century, among its numerous inscriptions being one with the date A.D. 303, and the tombstone of L. Petronius Dexter, bishop of Clusium, who died in A.D. 322. To the west and north-west of Chiusi-at Cetona, Sarteano, Chianciano and Montepulciano other Etruscan cemeteries have been discovered; the objects from them have mostly passed to large museums or been dispersed.

See R. Bianchi-Bandinelli in *Monumenti dei Lincei* for a detailed account of the tombs; and *cf.* D. Randall MacIver, *Villanovans and Early Etruscans* (Oxford, 1924). (T. A.)

CLUTCH, a device by means of which connected shafts or other mechanisms, such as engaging pulleys, gears and other rotating parts, may be disconnected at will. A clutch is frequently required to operate many times in the course of a minute and, as in the spindle of the automatic screw machine, which often runs at 5,000 r.p.m., it may be required to reverse its action several times within a few seconds. Clutches may be divided into two general classes, namely: Positive clutches and friction clutches.

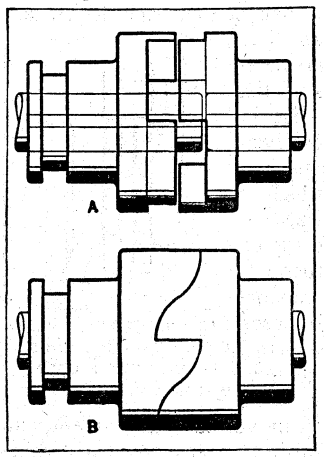


FIG. 1.—(A) CLAW OR JAW CLUTCH, (B) SPIRAL CLAW, OR RATCHET CLUTCH
The oldest form, the claw or jaw clutch, can only be put in when the mechanism is running at low speed, while with the spiral clutch, the drive cannot be reversed

Positive Clutches.—The simplest form of positive clutch is the jaw or claw type shown in fig. 1. One part of the clutch is keyed or pinned rigidly to the shaft while the other part is slotted, thus permitting it to be engaged with, or disengaged from, the first part by sliding it along the shaft. The interlocking jaws upon the abutting faces of the clutch may have various forms.

In machine tools the jaw clutch is applied extensively and is used for instantaneous disconnection of a drive to a feed screw. An automatic trip device jerks the clutch teeth out of mesh. A spiral claw clutch is utilized so that a drive cannot be reversed, this act forcing the teeth apart. Both types are shown in fig. 1.

The number of jaws on clutches depends upon the promptness with which a clutch must act. In punching and shearing machinery, the number varies from two to four, while in other classes of machinery the number of jaws may run as high as 24.

The freewheel clutch, commonly applied to bicycles, but having other mechanical applications, is another form of positive clutch. This engages the rear sprocket with the rear wheel when the pedals are rotated forwards and permits the rear wheel to revolve free from the rear sprocket when the pedals are stopped.

Friction Clutches.—The object of a friction clutch is to connect a rotating member to one that is stationary, to bring it up to speed, and to transmit the required power with a minimum amount of slippage. In connection with machine tools, a friction clutch introduces what might be termed a safety device in that it will slip when the pressure on the cutting tool becomes excessive, thus preventing the breaking of gears or other parts. According to the direction in which the pressure between the contact surface is applied, friction clutches may be further divided into axial clutches and rim clutches.

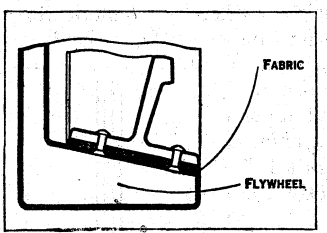


FIG. 2.—CONE CLUTCH FOR MOTOR LORRY OR MOTOR TRUCK
Used in machine tools, other apparatus and heavy automobiles. A lorry clutch is shown within the fly-wheel, with fabric lining riveted on

Axial clutches manufactured by the various builders of transmission machinery, machine tools and motor cars, are usually of one of the following three types: Cone, disc and combined conical disc. The cone clutch is the simplest form of friction clutch that can be devised, and if properly designed will give entire satisfaction in many mechanisms such as lathes, machine tools, hoisting apparatus, lorries, heavy automobiles. Two types of cone clutches, the single-cone and the double-cone, are usually met with. The single-cone clutch consists of a "male" cone of cast iron or specially treated steel keyed rigidly to a driving shaft with a second or "female" cone faced with cork, leather, asbestos, or other material, which is fitted to the driven shaft by means of a

feather key. This key permits the driven cone to be engaged with the driving cone, thus transmitting the power from one shaft to the other. The hub of the driven cone is fitted with a groove into which a shifter collar is operated by the engaging lever or toggle as shown in fig. 2. When applied to vehicles the operating lever is usually replaced by a strong spring which performs the same function. The double-cone clutch is based on similar principles.

The disc-clutch—known also as the plate clutch (fig. 3)—is a series of discs arranged in such a manner that each driven disc is located between two driving discs. The two types in common use are the single-disc in which a single disc serves as the driven member and the multiple-disc in which two or more discs act as the driven member. The single-disc clutch construction includes a fabric-faced disc which is gripped on each side between a fly-wheel or other member and a pressure disc forced up by springs, toggle levers or other devices. Multiple-disc clutches are capable of transmitting large powers at high speeds and have wide usage in motor cars, lorries (trucks), cranes, hoists and heavy gearing. A special form of hydraulically operated disc clutch is used in some American vessels, such as torpedo boat destroyers, to disconnect the cruising engines from the turbine shafts without stopping the propelling machinery.

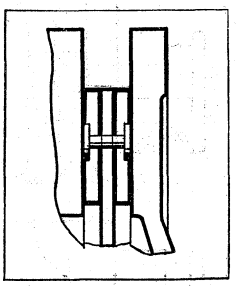


FIG. 3.—SINGLE PLATE CLUTCH, OR DISC-CLUTCH, MUCH USED IN MOTOR CARS

In addition to the asbestos-fabric faced steel disc used for the friction surfaces, the following are sometimes used: Steel against steel; steel against steel with cork inserts; steel against bronze. A combination of steel and bronze working in oil or dry steel and fabric may be used.

A combined conical-disc clutch is one in which the contact surfaces of the disc or discs are conical. In the Hele-Shaw conical disc clutch, shown in fig. 4, the driving and driven discs have a V-shaped annular groove, the sides of which form the surfaces in contact. Phosphor-bronze driving discs are provided with notches on the outer periphery which engage with suitable projections on the pressed steel casing. The mild steel driven discs have notches on the inner bore which engage with the corresponding projections on a steel spider which is splined to the shaft. The V groove in the discs permits a free circulation of oil, and at the same time ensures fairly rapid dissipation of the heat generated when the clutch is allowed to slip.

One of the recent developments with the disc type is the magnetic clutch. No toggles, lever or mechanical movements are fitted, but the friction surfaces are brought together by magnetic force when the current is switched on. As may be seen in fig. 5 the driven disc is held a little way off by a spring plate. As the coils in the driving disc are energized the resulting magnetic pull draws the driven disc against the friction lining. The magnetic pull does not attain its full value immediately and consequently the start is made without grabbing.

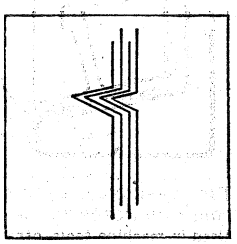


FIG. 4.—HELE-SHAW CLUTCH PLATES, WITH V-SHAPED GROOVES, THE ONLY PARTS MAKING FRICTIONAL CONTACT

In the rim-clutches pressure is obtained on the periphery of a rim and the various designs are known as block, split-ring, band, and roller, depending upon the manner in which the pressure is applied to the exterior or interior of the rim. Block clutches are used chiefly on line shafts and countershafts, although there are several designs that have given good service on machine tools. Split-ring clutches are used for all classes of service but their greatest field of application appears to be in connection with machine tools, or in places where the diameter of the clutch as well as the space taken up by the clutch is limited. Band clutches are usually installed when it is necessary to transmit heavy loads accompanied by shocks, as for example, in the drives of rolling mills and heavy mine hoist. The roller clutch is used principally for punching presses.

A block clutch used for shaft work consists of a shell running loose on the shaft, into which are fitted two brass or bronze shoes. The shoes are fastened loosely to a sleeve, which in turn is slotted to the shaft. The shoes are pressed against the inner surface of the shell by means of an eccentric screw or wedge.

The split-ring clutch consists of an outer shell running loose on a shaft or sleeve; into this shell is fitted a split-ring. The latter may be expanded by the action of a pair of levers as shown

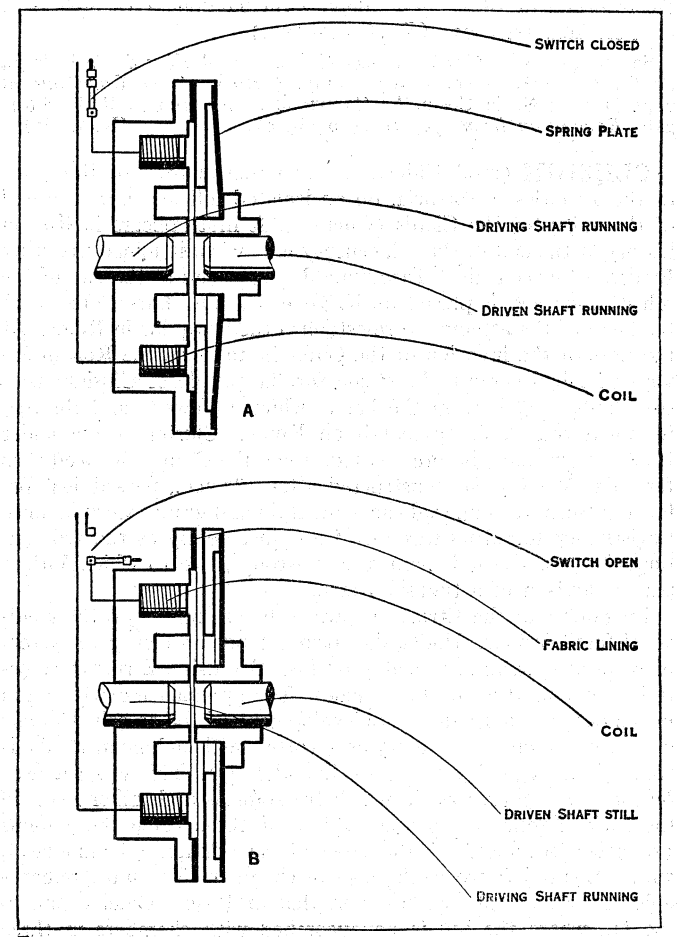


FIG. 5.—VIEWS OF MAGNETIC CLUTCH, A. SHOWING CLUTCH WITH CURRENT ON, B. WITH CURRENT OFF, IN WHICH MAGNETIC PULL BRINGS SURFACES TOGETHER WHEN THE CURRENT IS TURNED ON, TRANSMITTING OVER 2,000 HORSE-POWER IN THE LARGE CLUTCHES

in the Heywood and Bridge clutch in fig. 6, or by means of a wedge. A sliding sleeve forms a convenient means of engaging a suitable lever. A sliding sleeve, operated by a suitable lever, forms a convenient means of engaging the split ring with the outer shell.

In general, a band clutch consists of a flexible steel band, either plain or faced with wood or asbestos fabric, one end of which is fixed and the other is free to move in a circumferential direction. Due to the pull exerted by the operating mechanism on the free end of the band, the latter is made to grip the driving or driven member.

The roller clutch has a cam keyed to the crankshaft on the circumference of which a number of recesses, forming inclined planes, have been cut. Rollers, rolling up these inclined planes due to the action of a shell, wedge themselves between the cam and the clutch ring, thus causing the crankshaft to rotate with a flywheel. The rollers are held in place and controlled by a shell which is connected with the crankshaft by means of a spring, which is in turn operated by a treadle.

In rolling mills a special friction clutch, known as a "coil-clutch," having a flexible steel coil connected with the driven shaft and a cone on the driving shaft has been brought into use. This type of clutch has very sensitive control. On a test made in a rolling mill, a load of 11 tons was lowered by means of a crane on to an egg without crushing it and held there for three minutes

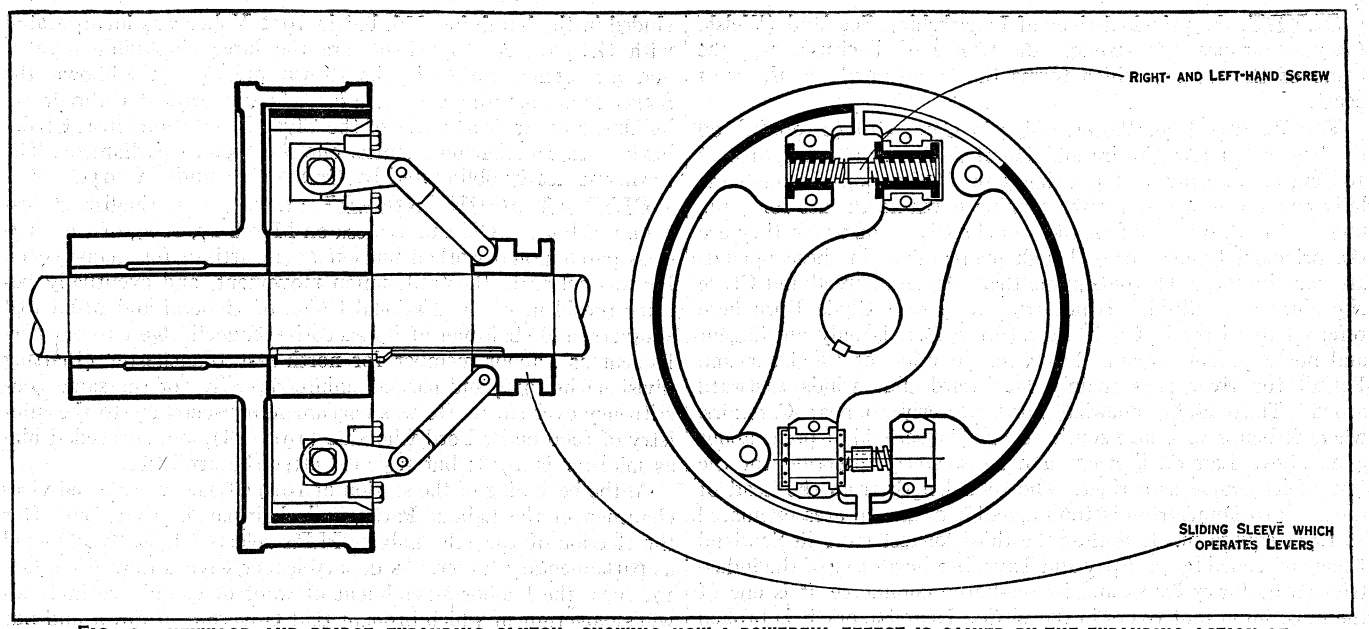
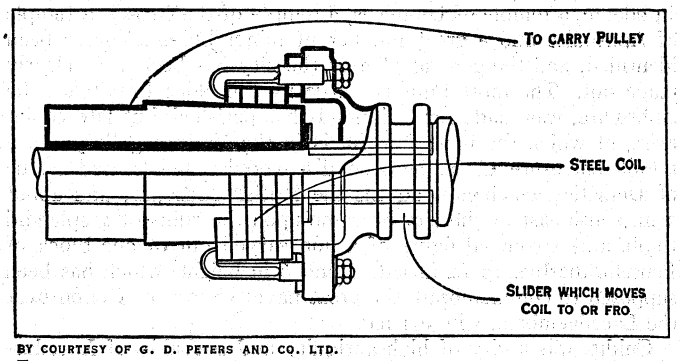


FIG. 6.—HEYWOOD AND BRIDGE EXPANDING CLUTCH, SHOWING HOW A POWERFUL EFFECT IS GAINED BY THE EXPANDING ACTION OF RIGHT AND LEFT HAND SCREWS IN DUPLICATE: AS THE SLIDING SLEEVE IS MOVED ALONG THE SHAFT, IT WORKS THE LEVERS GIVING A PARTIAL ROTATION TO THE SCREWS, AND EXPANDS THE BAND WITHIN THE SHELL. PERMISSION OF D. BRIDGE AND CO., MANCHESTER

A special application of the block clutch is the "centrifugal-clutch" which, by utilizing the principle of centrifugal force, throws out slipper-blocks against the interior wall of the clutch to enable an electric motor to obtain a proper start before picking up the load. The weight of the shoes is so regulated that when the motor is running at full speed the power transmitted by the shoes equals the power of the motor and all slip ceases.

In motor car service, it is very desirable that the car be started without jerks. In order to secure smooth clutch engagement, the designers of clutches were compelled to originate devices that insured evenness of contact between the friction surfaces. In general the function of these devices is to raise slightly the cone facing at intervals around the periphery so that upon engagement only a small portion of the friction surface comes into contact with the flywheel rim. As soon as the full spring pressure is exerted, the facing is depressed and the entire surface of the cone becomes active. In addition to securing smooth and easy clutch engagement some means must be provided to prevent the spinning of the clutch when it is disengaged. By keeping the size and weight down to a minimum spinning may be reduced slightly. To overcome the spinning action completely small brakes that are brought into action when the pedal is depressed must be provided. (F. H.)



BY COURTESY OF G. D. PETERS AND CO. LTD.

FIG. 7.—COIL CLUTCH, WHICH CAUSES GREAT FRICTION BY THE GRIP OF THE COIL WHEN IT IS THRUST ON TO A CONE ON THE DRIVING SHAFT

CLUWER (CLUVER, CLUVIER, CLUVERIUS), **PHILIP** (1580–1623), German geographer and historian, was born at Danzig. He studied law at Leyden, but soon turned his attention to history and geography, which were then taught there by Joseph Scaliger. He finally settled in Holland, where (after 1616) he received a regular pension from Leyden academy. In 1611 he began to publish his works. He died at Leyden in 1623. His principal writings are: *Germania Antiqua* (1616), *Siciliae Antiquae libri duo, Sardinia et Corsica Antiqua* (1619), and the posthumous *Italia Antiqua* (1624) and *Introductio in Universam Geographiam* (1629).

CLYDE, COLIN CAMPBELL, BARON (1792–1863), British soldier, was born at Glasgow on Oct. 20, 1792. He received his education at the Glasgow high school, and when only 16 years of age obtained an ensigncy in the 9th Foot. He fought under Sir Arthur Wellesley at Vimiera, took part in the retreat of Sir John Moore, and was present at the battle of Corunna. He shared in all the fighting of the Peninsular campaigns, and was severely wounded while leading a storming-party at the attack on San Sebastian. He was again wounded at the passage of the Bidassoa, and compelled to return to England. Campbell held a command in the American expedition of 1814; and after the peace of the following year he devoted himself to studying the theoretical branches of his profession. In 1823 he quelled the negro insurrection in Demerara. In 1832 he became lieutenant-colonel of the 98th Foot, and with that regiment rendered distinguished service in the Chinese War of 1842. Campbell was next employed in the Sikh War of 1848–49, under Lord Gough. At Chillianwalla, where he was wounded, and at the decisive victory of Gujarat, his skill and valour largely contributed to the success of the British arms. He was made a K.C.B. in 1849, and specially named in the thanks of parliament.

Sir Colin Campbell returned home in 1853. In the Crimean War he commanded the Highland brigade, which formed part of the duke of Cambridge's division. The brigade and its leader distinguished themselves very greatly at the Alma; and with his "thin red line" of Highlanders he repulsed the Russian attack on Balaklava. At the close of the war Sir Colin was promoted G.C.B.

The outbreak of the Indian Mutiny called for a general of tried experience; and on July 11, 1857, the command was offered to him by Lord Panmure. On being asked when he would be ready to set out, the veteran replied, "Within twenty-four hours." He left England the next evening, and reached Calcutta on Aug. 13. He started for the front on Oct. 27 and on Nov. 17 relieved Lucknow for the second time. He continued in charge of operations in Oudh until the end of the mutiny. For these services he was raised to the peerage, in 1858, as Lord Clyde; and, returning to England in the next year, he received the thanks of both Houses of Parliament and a pension of £2,000 a year. He died on Aug. 14, 1863.

See Sir Owen Tudor Burne, *Clyde and Strathnairn* ("Rulers of India" series, 1891); and L. Shadwell, *Life of Colin Campbell, Lord Clyde* (1881).

CLYDE, the principal river of Lanarkshire, Scotland (Welsh, *Clwyd,* "far heard," "strong," the *Glotta* of Tacitus), also the name of the estuary which forms the largest firth on the west coast.

The River.—Daer Water, rising in Gana Hill (2,190 ft.) on the borders of Lanarkshire and Dumfriesshire, after a course of 10½ m., and Potrail Water, rising 3 m. farther west in the same hilly country (1,928 ft.) after running north-north-east for 7 m., unite 3½ m. S. of Elvanfoot to form the Clyde, of which they are the principal headstreams, though many burns in these uplands are contributory. The old rhyme that "Annan, Tweed and Clyde rise a'out o'ae hillside" is not true, for Little Clyde Burn here referred to, rising in Clyde Law (2,190 ft.), is only an affluent and not a parent stream. From the junction of the Daer and Potrail the river runs mainly northward, but winds eastward around Tinto Hill, somewhat north-westerly to near Carstairs, where it bends west and south. From Harperfield, a point about 4 m. above Lanark, it keeps a north-westerly direction for the rest of its course as a river. The total length from the head of the Daer to Dumbarton is 106 m., and it drains an area estimated at 1,481 square m. It is thus the third longest river in Scotland (being exceeded by the Spey and Tay), but in respect of the industries on its lower banks and its sea-borne commerce, it is one of the most important rivers in the world. Near Lanark it is broken by four celebrated falls (Bonnington, Corra, Dundaff and Stonebyres Linns) within a distance of 3¾ m. Within this distance the river falls 230 ft. From Stonebyres Linn to the sea the fall is practically 4 ft. in every mile. The chief villages and towns on or close to the river between its source and Glasgow are Crawford, Lamington, New Lanark, Lanark, Hamilton, Bothwell, Blantyre and Uddingston. At Bowling (pop. 1,018)—the point of transhipment for the Forth and Clyde Canal—the river widens, the fairway being indicated by a stone wall continued seawards as far as Dumbarton. Dunglass Point, near Bowling, is the western terminus of the wall of Antoninus, or Grim's Dyke.

As far down as the falls the Clyde remains a pure fishing stream, but from the point at which it becomes an industrial river its waters are contaminated. Towards the end of the 18th century the river was yet fordable at the Broomielaw in the heart of Glasgow, but since that period the stream has been converted into a waterway deep enough to allow large ships to anchor in the harbour (*see* GLASGOW). Clydesdale, as the valley of the upper Clyde is called, begins in the district watered by headstreams of the river, the course of which in effect it follows as far as Bothwell, a distance of 50 m. It is renowned for its breed of cart-horses (specifically known as Clydesdales), its orchards, fruit fields and market gardens, its coal and iron mines.

The Firth.—From Dumbarton, where the firth is commonly considered to begin, to Ailsa Craig, where it ends, the fairway measures 64 m. Its width varies from 1 m. at Dumbarton to 37 m. from Girvan to the Mull of Kintyre. The depth varies from a low-tide minimum of 22 ft. in the navigable channel at Dumbarton to nearly 100 fathoms in the Sound of Bute and at other points. The Cumbraes, Bute and Arran are the principal islands in its waters. The sea lochs all lie on the Highland shore, and comprise Gare Loch, Loch Long, Loch Goil, Holy Loch, Loch Striven, Loch Riddon and Loch Fyne. The only rivers of any importance feeding the Firth are the Ayrshire streams, of which the chief are the Garnock, Irvine, Ayr, Doon and Girvan. The tide ascends above Glasgow, where its farther rise is barred by a weir. The head-ports are Glasgow, Port Glasgow, Greenock, Ardrossan, Irvine, Troon, Ayr and Campbeltown. In addition to harbour lights, beacons on rocks and light-ships, there are lighthouses on Ailsa Craig, Sanda, Davaar, Pladda, Holy Isle and Little Cumbrae, and at Turnberry Point, Cloch Point and Toward Point. Health and holiday resorts on the lochs, islands and mainland coast are numerous.

CLYDEBANK, a large burgh, Dumbartonshire, Scotland, on the right bank of the Clyde, 6 mi. from Glasgow, served by the L.N.E.R. and by the L.M.S.R. Pop. (est. 1938) 47,912. In 1875 the district was almost purely rural, but after that date many industries were established. Dalmuir, Kilbowie and Yoker were included in the burgh in 1886, but in 1912 Yoker was incorporated with Glasgow. At Clydebank are the large shipbuilding yards and engineering works of John Brown and Co.; at Kilbowie the Singer Manufacturing Co. has a large factory, and at Dalmuir are building and repairing yards of the Clyde Navigation trust. Clydebank, with Dumbarton, returns one member to parliament. The town was nearly obliterated by German air raids in 1941.

CLYNES, JOHN ROBERT (1869–), English statesman, was born at Oldham, Lancs., on March 27, 1869, of working-class parents, and worked himself as an artisan for many years. He was active in the trade-union movement, and eventually became president of the National Union of General and Municipal Workers, and chairman of its executive council. He entered parliament as Labour member for north-east Manchester (Platting division) in 1906, and has sat uninterruptedly for the same constituency ever since. He was parliamentary secretary to the ministry of food under Lord Rhondda (1917–18), and succeeded him as minister in 1918; but resigned after the armistice.

At the beginning of the session of 1919 Clynes was elected vice-chairman of the Labour Party, and chairman in 1921, but after the election of 1922 the Labour M.P.s selected J. R. MacDonald as parliamentary leader. As deputy leader Clynes moved on Jan. 17, 1924, the Labour amendment of want of confidence in Baldwin's Government which brought that Government down and put the Labour Party in office. He became lord privy seal and deputy leader of the House of Commons. Whether leader or deputy leader of his party, Clynes always spoke in the House of Commons with moderation, and was always heard with respect. He was secretary of state for home affairs from 1929 to 1931.

CNIDUS, an ancient city of Caria in Asia Minor, situated at the extremity of the long peninsula that forms the southern side of the Sinus Ceramicus or Gulf of Cos. It was built partly on the mainland and partly on the Island of Triopion or Cape Krio, which anciently communicated with the continent by a causeway and bridge, and now by a narrow sandy isthmus. By means of the causeway the channel between island and mainland was formed into two harbours, of which the larger or southern, was further enclosed by two strongly-built moles. The extreme length of the city was little less than a mile, and the whole intramural area is thickly strewn with architectural remains. The walls, both insular and continental, can be traced throughout their whole circuit; and in many places, especially round the acropolis, at the north-east corner of the city, they are remarkably perfect. Our knowledge of the site is largely due to the excavations executed by C. T. Newton in 1857–1858; but of recent years it has become a frequent calling station of touring steamers. The agora, the theatre, an odeum, a temple of Dionysus, a temple of the Muses, a temple of Aphrodite and a great number of minor buildings have been identified, and the general plan of the city has been very clearly made out. The most famous statue by the elder Praxiteles, the Aphrodite, was made for Cnidus. It has perished, but late copies exist, of which the most faithful is in the Vatican gallery. In a temple-enclosure C. T. Newton discovered a fine seated statue of Demeter, which now adorns the British Museum; and about 3 m. south-east of the city he came upon the ruins of a splendid tomb, and a colossal figure of a lion carved out of one block of Pentelic marble, 10 ft. in length and 6 in height, which has been supposed to commemorate the great naval victory of Conon over the Lacedaemonians in 394 B.C.

Cnidus was a city of high antiquity and probably of Lacedaemonian colonization. Along with Halicarnassus and Cos, and the Rhodian cities of Lindus, Camirus and Ialysus it formed the Dorian Hexapolis, which held its confederate assemblies on the Triopian headland, and there celebrated games in honour of Apollo, Poseidon and the nymphs. The city was at first governed by an oligarchic senate, composed of sixty members, known as ἀμνήμονες, and presided over by a magistrate called an ἀρεστήρ but, though it is proved by inscriptions that the old names continued to a very late period, the constitution underwent a popular transformation. The situation of the city was favourable for commerce, and the Cnidians acquired considerable wealth, and were able to colonize the island of Lipari, and founded the city of

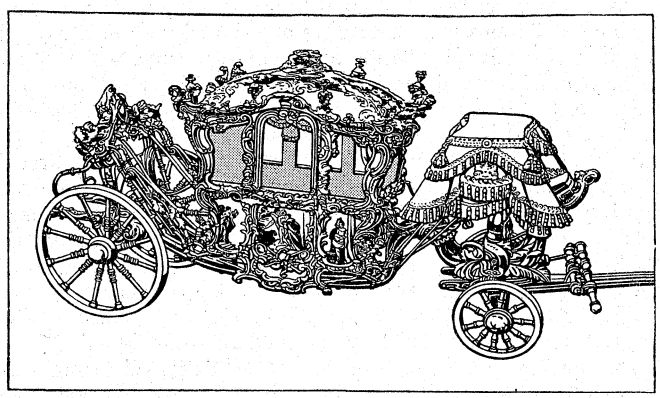
Corcyra Nigra in the Adriatic. They ultimately submitted to Cyrus, and from the battle of Eurymedon to the latter part of the Peloponnesian War they were subject to Athens. In 394 B.C. Conon fought off the port the battle which destroyed Spartan hegemony. The Romans easily obtained their allegiance, and rewarded them for help given against Antiochus by leaving them the freedom of their city. During the Byzantine period there must still have been a considerable population, for the ruins contain a large number of buildings belonging to the Byzantine style, and Christian sepulchres are common in the neighbourhood.

Eudoxus, the astronomer, Ctesias, the writer on Persian history, and Sostratus, the builder of the celebrated Pharos at Alexandria, are the most remarkable of the Cnidians mentioned in history.

See C. T. Newton and R. P. Pullen, *Hist. of Discoveries at Halicarnassus, Cnidus* etc. (1863).

COACH, a large roofed or enclosed carriage for passengers, which originated in Hungary at a place named Kocs, from which the name itself is derived through the French *coche*. As a general term, it is used (as in "coach-building") for all carriages, and also in combination with qualifying attributes for particular forms (as in stage-coach, mail-coach, motor-coach, etc.); but the typical coach implies four wheels, springs and a roof. The stage-coach, with seats outside and in, was a public conveyance which was known in England from the 16th century, and before railways the stage-coaches had regular routes (stages) all over the country; through their carrying the mails (from 1784) the term "mail-coach" arose. Similar vehicles were used in America and on the European continent. The *diligence*, though not invariably with four horses, was the Continental analogue for public conveyance, with other minor varieties such as the *Stellwagen* and *Eilwagen*.

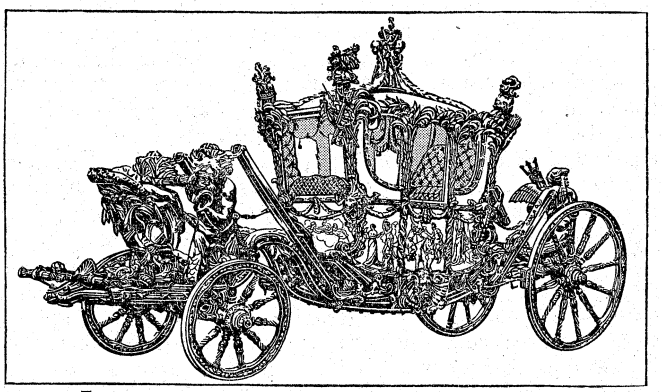
The driving of coaches with four horses was a task in which a considerable amount of skill was required, and English literature is full of the difficulties and humours of "the road" in old days. A form of sport thus arose for enterprising members of the nobility and gentry, and after the introduction of railways made the mail-coach obsolete as a matter of necessity, the old sport of coaching for pleasure still survived, though only to a limited extent. The Four-in-Hand Club was started in England in 1856 and the Coaching Club in 1870, as the successors of the old Bensington Driving Club (1807–52), and Four-Horse Club (1808–29); and in America



STATE COACH OF THE LORD MAYOR OF LONDON, BUILT IN 1757

the New York Coaching Club was founded in 1875. But coaching remains the sport of the wealthier classes, although in various parts of England (*e.g.*, London to Brighton, and in the Lake district), in America, and in Europe, public coaches still have their regular times and routes for those who enjoy this form of travel. The earliest railway vehicles for passengers were merely the road coaches of the period adapted to run on rails, and the expression "coaching traffic" is still used in England to denote traffic carried in passenger trains.

Of coaches possessing a history the two best known in Great Britain are the king's state coach, and that of the lord mayor of London. The latter is the older, having been built, or at least first used, for the procession of Sir Charles Asgil, lord mayor elect, in Nov. 1757. The body of this vehicle is not supported by springs, but hung on leather straps; and the whole structure is very richly loaded with ornamental carving, gilding and paint-work. The different panels and the doors contain various allegorical groups of figures representing suitable subjects, and heraldic devices painted in a spirited manner. The royal state coach, which is described as "the most superb carriage ever built," was designed by Sir William Chambers, the paintings on it were executed by Cipriani, and the work was completed in 1761. During the later part of Queen Victoria's reign it was hardly ever seen,



THE BRITISH ROYAL STATE COACH, COMPLETED IN 1761
This coach is used only for ceremonial occasions such as the opening of parliament. The panels and door are covered with emblematic devices

but on the accession of Edward VII. the coach was once more put in order for use on state occasions. The following is an official description of this famous coach:

"The whole of the carriage and body is richly ornamented with laurel and carved work, beautifully gilt. The length, 24 ft.; width, 8 ft. 3 in.; height, 12 ft.; length of pole, 12 ft. 4 in.; weight, 4 tons. The carriage and body of the coach is composed as follows:—Of four large tritons, who support the body by four braces, covered with red morocco leather, and ornamented with gilt buckles, the two figures placed in front of the carriage bear the driver, and are represented in the action of drawing by cables extending round their shoulders, and the cranes and sounding shells to announce the approach of the monarch of the ocean; and those at the back carry the imperial fasces, topped with tridents. The driver's foot-board is a large scallop shell, ornamented with bunches of reeds and other marine plants. The pole represents a bundle of lances; the splinter bar is composed of a rich moulding, issuing from beneath a voluted shell, and each end terminating in the head of a dolphin; and the wheels are imitated from those of the ancient triumphal chariot. The body of the coach is composed of eight palm-trees, which, branching out at the top, sustain the roof; and four angular trees are loaded with trophies allusive to the victories obtained by Great Britain during the late glorious war, supported by four lions' heads. On the centre of the roof stand three boys, representing the genii of England, Scotland and Ireland, supporting the imperial crown of Great Britain, and holding in their hands the sceptre, sword of state, and ensigns of knighthood; their bodies are adorned with festoons of laurel, which fall from thence towards the four corners. The panels and doors are painted with appropriate emblematical devices, and the linings are of scarlet velvet richly embossed with national emblems."

We may observe how the difficult art of driving a coach was responsible for the use of the terms "coach" and "coaching" to mean tutor or training for examinations or athletics.

See the Badminton *Driving*, by the duke of Beaufort (1888); Roger's *Manual of Driving* (Philadelphia, 1900); and "Nimrod's" *Essays on the Road* (1876).

COACHING. The 20th century witnessed in its first quarter the passing of a style of conveyance which was at one time universal, and has inspired the artist, the poet and the author to work that will remain long after the last coach has ceased to be seen on the roads. To say that four-in-hand driving will die out entirely is to take an extreme view, but while railways and motor cars hold their own there will be little chance for the art on our country roads—at any rate in comfort.

The reader need hardly be told that in early days the roads were so bad in Great Britain that wheeled traffic literally made slow progress, and nearly everybody rode; but towards the end of the Commonwealth period social life had demanded a better means of communication from place to place. Accordingly the stage coach made its general appearance, and in spite of a good

deal of opposition, and the usual charge of effeminacy, remained. As might be expected the pace for many years was not great, and at first the coaches travelled only by day, the "flying coaches," as they were called, covering between forty and fifty miles in the day of 12 hours—in fine weather.

It must be remembered that coaching even in its palmiest days had its detractors, for the weather had to be taken into consideration, while the roads themselves till the days of Telford and Macadam left much to be desired, and accidents were much more numerous than is the case to-day with railways. Still its utility was beyond argument, but the question of speed arose, and it should also be borne in mind that the slowness of the pace rendered the stage coach an easy prey to the highwaymen, who then abounded. The post office at the time favoured the plan of mounted "expresses," and the slowness of the postal service was especially noticeable on the Great North Road, it being said that "every common traveller passes the King's Mail on the first road in the kingdom." Indeed at that time the stage coach itself was a speedier conveyance than the ordinary postal system.

The moment brought the man, and it was John Palmer, the proprietor of the theatre at Bath, who in 1784 put the first mail coach on the road, running from Bristol to London at the rate of about seven miles an hour. The mail coach speedily found favour, and, as its name implies, it may be termed the special *protégé* of the post office; of course it did not exterminate the stage coach, the two existing side by side till the advent of railways drove them both off the road together.

The driving of four horses appealed to the sporting gentlemen of the day, who drove their own vehicles, or who would take a stage or two on the regular coaches, with the connivance of the professional driver. Some well-known amateur coaching clubs were formed, including the Four Horse and the Bensington driving clubs, both of which in due course passed away. It was in 1856 that the Four-in-Hand driving club was formed and lasted down to 1927, while in 1870, owing to the Four-in-Hand driving club only receiving a limited number of members, the still existing coaching club was established. Though its members do not turn out in as great numbers as they did, it still keeps the spirit of the pastime alive at the meets at the Magazine in Hyde Park. Here, however, the pleasure of driving four horses is the only consideration and no "passengers" are taken for remuneration.

Later on a number of what may be termed subscription coaches were placed upon the road, which usually ran to various places within a radius of something like 50 miles of London, and till the appearance of the motor car they were very popular. They have, however, practically disappeared, with the death of the last of the London enthusiasts who was able to indulge his hobby, though two roads were kept open in 1927.

In the past many private gentlemen, especially masters of hounds, would indulge in driving tours through various parts of the country, and in 1926 one well known master in the North afforded his friends and subscribers a very pleasant afternoon's outing. At the holding of some of the great horse shows, notably Richmond and Olympia, coaching classes are popular and often well patronised, for it must be remembered that the regimental coaches, that is coaches kept up by various regiments in the service, have not yet gone out of fashion. Indeed it will probably be very many years before the art of driving four horses is lost entirely in Great Britain. (*See* DRIVING.)

The great enemy of the harness horse to-day is the motor car, to assist which tarred roads have been laid down. This undoubtedly adds to the discomfort of driving, and horse vehicles of all descriptions are becoming scarcer every year, except for slow work or where constant stoppage is necessary. Still, the coaching period has been a brilliant one, and its passing will be regretted by every lover of the horse.

COAHUILA, a northern frontier State of Mexico, bounded N. and N.E. by Texas, U.S.A., E. by Nuevo León, S. by San Luis Potosí and Zacatecas, and W. by Durango and Chihuahua. Area, 58,052 sq.mi. The population in 1940 was 550,717. Its surface is a roughly broken plateau, traversed by several ranges of mountains and sloping gently toward the Rio Grande. In the western part there exist extensive areas of level land, many of them enclosed drainage basins, the largest of which is the Bolsón de Mapimí, a great depression which was long considered barren and uninhabitable. Experiments with irrigation, however, have been highly successful and considerable tracts have since been brought under cultivation. In general the State is insufficiently watered, the rainfall being light and the rivers small. The rivers flow eastward to the Rio Grande. The climate is hot and dry, and generally healthy. Stock-raising was for a time the principal industry, but agriculture has been largely developed in several localities, among the chief products of which are cotton—Coahuila is the principal cotton-producing State in Mexico—Indian corn, wheat, beans, sugar and grapes. The Parras district in the southern part of the State has long been celebrated for its wines and brandies. The mineral products include silver, lead, coal, copper and iron. The mining operations are chiefly centred in the Sierra Mojada, Sierra Carmen and in the Santa Rosa valley. The modern industrial development of the State is due to the railway lines constructed across it during the last quarter of the 19th century, and to the investment of foreign capital in local enterprises. The first Spanish settlement in the region now called Coahuila was at Saltillo in 1586, when it formed part of the province of Nueva Viscaya. The capital of the State is Saltillo. Among the more important towns are Parras, pop. (1940) 15,555, 98 mi. W. by N. of Saltillo, one of the largest railway centres in the country, and Piedras Negras (formerly Ciudad Porfirio Díaz) on the Rio Grande.

COAL AND COAL MINING. By coal is comprehended all the fossil fuels contained in the earth's crust. Being an amorphous substance of variable composition it cannot be as strictly defined as can a crystallized or definite mineral. Coal, strictly speaking, is not a mineral but a rock, and, further, it is a sedimentary rock; the mineral substance, consisting mainly of complex carbon compounds, is amorphous. There is no standard coal: there is an almost endless series of varieties, from brown coal at the one extreme to anthracite at the other; and even the brown and the anthracite vary greatly in character and composition as do all the coals coming between them. Peat is sometimes included under the term coal, but erroneously so, seeing it cannot be regarded as a fossil fuel.

The substance coal has been known in the common language of Britain from earliest historical times by specific names. That the ancient Britons in general were acquainted with coal as such is evident from its appellation at the present time, which is not Saxon but British, and subsists among the Irish as *gual,* amongst the Cornish in *kolan* and in Welsh as *glo* to this day. That the word *kohle* to designate coal was in general use in England before the Norman invasion is proved by the fact that the French (*charbon*) or Latin (*carbo*) name was not adopted. The derivation is referable to a pretty widely spread root signifying simply "black," *e.g.,* the Arabic *kálá,* Turkish *kárá* (thus *Kara-on,* the black water; *Kárá Denghoz,* the Black Sea, etc.), the Greek κελαινος, used by Homer for black. The spelling "cole" or "coalle" was generally used up to the middle of the 17th century, when it was gradually superseded by the modern form "coal."

The word anthracite—a form of coal of high fixed carbon content—is from the Greek ἀνθρακίτης. About 371 B.C. Theophrastus, pupil of Aristotle, uses the word in his treatise "On Stones," where he mentions fossil substances "that are called coals, which kindle and burn like woodcoals." "These are found in Liguria and in Elis, in the way to Olympias, over the mountains; they are used by the smiths." This is probably the earliest mention of true coal (not charcoal) on record. The term *lithanthrax,* stone coal, still survives, with the same meaning, in the Italian *litantrace.* The first record of the use of coal in Great Britain is frequently stated to be in A.D. 852, when it is recorded in the Saxon Chronicle of the Abbey of Peterborough that the Abbot Ceobred let the land of Sempringham to Wulfred, who was to send each year to the monastery "60 loads of wood, 12 loads of coal, 6 loads of peat, etc." It is most probable, however, that the Romans were acquainted with the use of coal during their occupation of Britain from the fact that we find coal cinders among the ruins

of Roman towns, forts and villas, especially in Northumberland in the neighbourhood of the Roman Wall, near to the course of which well-known seams outcrop.

In the following pages the subject of coal and coal mining in all its aspects is treated under the following headings:—

Section I.—*Coal: Origin and Occurrence; Composition and Varieties; Chemical and Physical Characteristics.*
„ II.—*The World's Coal Reserves; Output, Consumption and Production Costs.*
„ III.—*Utilization and Conservation of Coal; Electrical Power Uses; Coal Carbonization.*
„ IV.—*Coal Miners: Their Characteristics and Occupations.*
„ V.—*Coal Mining: The Actual Operations; Colliery Outputs.*
„ VI.—*Coal Mining Accidents and their Prevention; the Record of Casualties.*
„ VII.—*Lignite: Its Production and Utilization.*
„ VIII.—*Coal: Its Sale, Distribution and Export.*
„ IX.—*Coal: History of Legislation and Commissions of Enquiry.*
„ X.—*Coal: The Question of Nationalization.*
„ XI.—*Coal: Control Methods in the World War.*
„ XII.—*Coal Industry: United States.*

SECTION I.: COAL: ORIGIN AND OCCURRENCE; COMPOSITION AND VARIETIES; CHEMICAL AND PHYSICAL CHARACTERISTICS

Coal is the outcome of a process of transformation whereby the oxygen and hydrogen contained in the woody fibre and other vegetable matter are eliminated in proportionally larger quantity than carbon, so that the percentage of the latter element is increased. This is excellently demonstrated in the following table prepared by the late Dr. Percy. The mineral matter is also changed by the removal of the silica and alkalis and the substitution of substances analogous in composition to fireclay.

Composition of Fuels (Assuming Carbon = 100)

Substance	Carbon	Hydrogen	Oxygen	Disposable hydrogen
Wood	100	12·18	83·07	1·80
Peat	100	9·85	55·67	2·89
Lignite	100	8·37	42·42	3·07
Thick coal of South Staffordshire	100	6·12	21·23	3·47
Hartley steam coal	100	5·91	18·32	3·62
South Wales steam coal	100	4·75	5·28	4·09
American anthracite	100	2·84	1·74	2·63

The causes and methods of these changes are not yet fully understood; indeed, perhaps of all the problems connected with the natural history of coal we know least about the means of its conversion, although the researches of B. Renault ("Sur quelques Micro-organismes des combustibles fossiles," *Bull. Soc. Indust. Miner.*, Sér. 3, vol. xiii., p. 868, 1899; vol. xiv. p. 5, 1900, and "Recherchés sur les Bactériacées fossiles," *Ann. Sci. Nat.*, Sér. 8, Bot. vol. ii. p. 275, 1896) have gone a long way towards helping us to an understanding of the processes involved in the transformation of the original vegetable matter into coal. The product coal is evidently the result of biochemical action, the agents of the transformation of the cellulose into peaty substance being saprophytic fungi and bacterial ferments. The ultimate term of bacterial activity seems to be the production of ulmic acid, containing carbon 65·31% and hydrogen 3·85%, which is a powerful antiseptic. By the progressive elimination of oxygen and hydrogen, partly as water and partly as carbon dioxide and marsh gas, the ratios of carbon to oxygen and hydrogen in the reduced product increase according to the age of the formation in the following manner:—

	C:H	C:O
Cellulose	7:2	0:9
Peat	9:8	1:8
Lignite, imperfect	12:2	2:4
Lignite, perfect	12:6	3:6

The resultant product of the action of the bacteria and fungi is a brown pasty or gelatinous substance which binds the more resisting parts of the plants into a compact mass.

It would certainly seem beyond dispute that these extremely microscopic organisms existed in carboniferous times, particularly in the case of some coprolites or fossilized excreta of Permo-Carboniferous fish or reptiles, for in them Renault and Prof. Bertrand demonstrated the actual bacillus. But apart from actual identification of the bacteria, there appears almost conclusive evidence to the effect that the tissues, included in the plant petrifactions, exhibit all the indications of cells attacked and destroyed

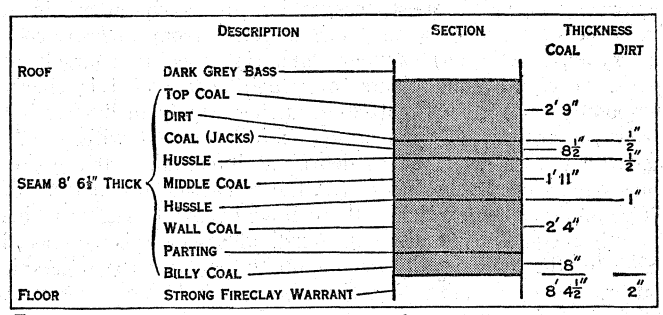


FIG. 1.—CHARACTERISTIC SECTION OF BULLHURST SEAM AT SILVERDALE COLLIERY, NORTH STAFFORDSHIRE, ENGLAND

by bacteria. The brown or black opaque ground substance of the coal is to be accounted for as the final product of the destruction of the tissues by the bacteria.

Laboratory research has shown that the alkalinity of a medium can be maintained for a considerable length of time by the hydrolysis of sodium-clay, and that a roof containing hydrolysing sodium-clay is impermeable to gases and water; that the conditions under such a roof are what is termed anaerobic (non-aerated), and that the alkaline medium produced under such a roof is suitable for continuous decomposition of organic matter. An examination of roofs of coal seams has shown that they are alkaline and contain sodium-clay. Mature leaves have been submitted to bacterial decomposition under a sodium-clay roof, with the result that the residual solid product was black and possessed the typical fusain structure. (E. Mackenzie Taylor, "Base Exchange and the Formation of Coal," *Nature,* vol. cxx., pp. 448, 449, 1927.)

The actual conversion of this product into coal, it is supposed, is due to what is termed regional metamorphism. The mass of decomposed vegetable matter being over-laid by the deposition of layers of sand and mud due to the sinking of the land, it is subjected to an ever increasing weight of superincumbent strata compressing it into a much smaller compass and profoundly affecting it in other ways. We know, also, that towards the close of Palaeozoic times the regions occupied by the British coalfields were subjected to great earth movements due to volcanic disturbance, to such an extent that the horizontal deposits—coals, sandstone and shale—became tilted, faulted, folded or contorted. The sandstones and shales, being hard rocks, were not altered structurally to any great extent, but the comparatively soft altered vegetable layers, as the result of the pressure and the heat caused by the pressure, would undergo great physical and chemical changes. The changes due to these geological causes have been rapidly accomplished, as pebbles of completely formed coal are found sometimes in the sandstones and coarser sedimentary strata alternating with the coal seams in many coalfields.

Different views have, from time to time, been held as to the nature and growth of the plant life which constitutes the mother substance of the coal seams. In 1870, Huxley, in an article in the *Contemporary Review,* described the "Better Bed" coal seam of Bradford, Yorkshire, as being composed chiefly of sporangia and spores, but as Prof. W. C. Williamson of Manchester afterwards showed him, the sporangia were really megaspores of cryptogamic plants. Megaspores (female spores) and microspores (male spores) are very largely in evidence in British and many other coals, whereas in some others no trace of spores can be found. Woody matter must have entered very largely into the composition of the original vegetable mass of some coals, as for instance the coalfield of St. Étienne in Central France, where, as M.

Grand' Eury has shown, some of the coals are homogeneous deposits composed of the bark of Cordaites, or of species of Calamites. Dr. Marie Stopes has shown the same to be true of many British coals. According to Goeppert, seams of coal in Upper Silesia appear to be largely, if not entirely, composed of Sigillarian wood, impressions of the bark of this plant, and sometimes impressions of the leaves, being recognized between the layers of coal.

It is clear, therefore, that coal is made up of many constituents: (*a*) woody or xyloid substances, which are so characteristic of lignite coal, called by some "anthraxylon" (from *anthrax,* coal, and *xylon,* wood); (*b*) canneloid material, consisting largely of spores of cryptogamic plants, of which cannel coal is chiefly composed; (*c*) resinous matter, occurring largely in lignites but rarely in cannels; (*d*) macerated material mixed with woody matter and best described as débris, as it contains all the previously mentioned substances; (*e*) the "fundamental matter" of White and Thiessen, which is the colloidal ground mass in which the other constituents are embedded, and which is composed chiefly of the more readily decomposable parts of the vegetable matter. The vegetable constituents of coal are, therefore, cellulosic and resinous.

A seam of coal—quite apart from the interstratified thin bands of argillaceous or more rarely of arenaceous matter (which occur in the case of many coal seams—layers variously termed bands of "dirt," "clod," "clift," "hussle," or "stone")—consists of layers of different classes of coal, a seam seldom being homogeneous in point of chemical composition or physical character throughout. But even where the seam comprises but one class of coal, as has been long known, it is made up of laminae of "bright coal" (the *Glanz Kohle* of Germany) and "dull coal" (*Matt Kohle*), the laminae being divided by an amorphous powdery substance known as "mineral charcoal." Of late years, and for no very obvious reason, it has become customary to designate these varieties by the French words "vitrain" and "clarain" for the bright coal, "durain" for the dull coal, and "fusain" for the mineral charcoal. The exact origin of these substances, which vary in composition, is not quite clear. Thus the following is a typical section of the Bullhurst seam of coal at the Silverdale colliery in North Staffordshire (*see* fig. 1):—

Description	Thickness			
	Coal		Dirt	
	ft.	in.	ft.	in.
Roof—Dark grey bass:				
Top coal	2	9	..	..
Dirt	..	..		½
Coal (jacks)	0	8½	..	..
Hussle	..	..	..	½
Middle coal	1	11	..	..
Hussle	..	..		1
Wall coal	2	4	..	..
Parting	..	..	..	..
Billy coal	0	8	..	..
Floor—Strong fireclay warrant	8	4½	0	2

In this seam several classes of coal are divided from each other by thin strata of argillaceous (shaly) matter, the coal itself being composed of bright and dull coal with interposed bands of mineral charcoal.

The Formation of Coal Seams and Variation in the Character of Coal.—It might naturally be supposed that if the origin of the coal seams was the same in each case, that is to say, if they were the result of the submergence of forests of cryptogamic and cotyledonous plants, in point of chemical composition there would be no, or at any rate almost imperceptible, variation; but such is not the case. Not only is there variation in composition as between different coal seams, but the same seam in a given coalfield in some cases—notably in South Wales—shows considerable variation in different areas.

A given seam may—frequently does—vary in character vertically and laterally. The reason for the variation in the character of the coal in the different horizons of a given seam, and in the genus of the plant remains, may probably be explained to some extent by what is to be observed in some peat bogs (F. J. Lewis, "The Plant Remains in the Scottish Peat Mosses," *Trans. Roy. Soc. Edinburgh,* vols. xli.; xlv.; xlvi.; 1906, 1907), where the sequence can be diagrammatically represented in the following manner (*see* fig. 2):—

Upper Turbarian or Sixth Glacial Stage	Recent peat chiefly Scirpus and Sphagnum
Upper Forestian	Pinus sylvestris Sphagnum Eriophorum
Lower Turbarian or Fifth Glacial Stage	Arctic Willow and Eriophorum Eriophorum Sphagnum
Lower Forestian	Betula alba Salix and Calluna
Fourth Glacial Stage	Coarse sand Morainic material

With regard to lateral variation, in some cases, undoubtedly, the change is properly attributable to metamorphism consequent upon igneous intrusion, earth movements, and other kinds of geothermic action, causing greater or less loss of volatile constituents during, or it may be subsequent to, the period of coal transformation, conditioned by differences of permeability in the enclosing rocks, which is greater for sandstones than for argillaceous strata; but these agencies would not meet the whole problem and none of them appears to be applicable over more than comparatively limited areas. In the investigation of this problem of difference, we are inevitably forced to consider the question of the mode of formation of coal seams.

There are in this connection two schools of thought, that which advocates the terrestrial theory, that is, the accumulation of the vegetable matter on dry or marshy land and its subsequent submergence, sometimes termed the "growth in place," "the peat to anthracite theory," as Arber terms it. "This hypothesis," he says, "assumes that all coals 'started life,' so to speak, with an initial stage of Peat. The Peat later became converted into Brown coal, next Brown coal passed into Humic or Bituminous coal, and finally, at least in some cases, Anthracite resulted." This was the original and most commonly accepted explanation of the origin of coal, but there have always been those who advocated another theory, namely, that known as the "drift theory," which asserts that the material which formed the coal seams was drifted into position, being transported from a distance. This explanation of the mode of formation of coal seams was advocated by H. Link as far back as 1838.

The advocates of the *in situ* theory point to the Great Dismal Swamp of North Carolina and Virginia and to the great peat beds of Northern Europe. The Dismal Swamp is a fresh-water swamp of peat and forest, the area of the inundated portion of which is about 38 m. north and south by 25 m. east and west (N.S. Shaler, "Geology of the Dismal Swamp District of Virginia and North Carolina," *U.S. Geol. Survey,* Tenth Ann. Rept., pt. 1, pp. 313–339, 1888–89), and was extending its borders before drainage and cultivation by man began. Osborne estimates that the original area of the Swamp was 2,200 sq.m., of which 700 have now been drained. (C. C. Osborne, "Peat in the Dismal Swamp, Virginia and North Carolina," *U.S. Geol. Survey, Bull.,* 711-C. 1919.) Shaler outlines the series of geological events in connection with this swamp as follows: (1) a subsidence causing the formation of the Pliocene plateau, (2) elevation permitting of erosion of the Plateau, (3) subsidence permitting of the deposition of non-fossiliferous sands, (4) elevation permitting carving of the surface, (5) subsidence and the formation of the nausemond escarpment, (6) re-elevation and development of valleys and streams, (7) sinking now taking place.

The late Sir Charles Lyell, writing in 1845 in his *Travels in North America, Canada, and Nova Scotia, with Geological Observations,* describes the possible formation of coal seams as follows:

"Huge swamps in a rainy climate, standing above the level of the surrounding firm land, and supporting a dense forest, may have spread far and wide, invading the plains, like some European peat-mosses when they burst; and the frequent submergence of these masses of

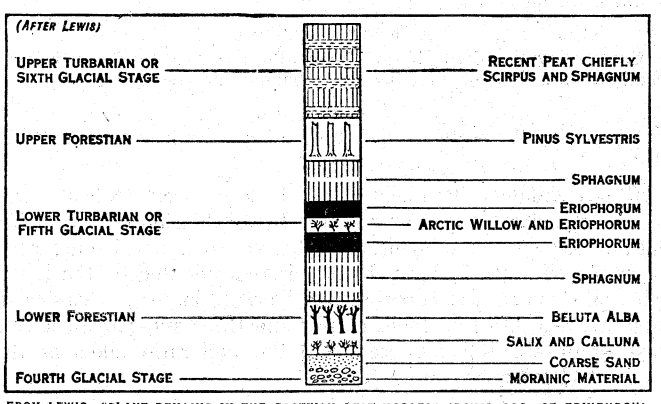
vegetable matter beneath seas or estuaries, as often as the land sunk down during subterranean movements, may have given rise to the deposition of strata of mud, sand or limestone immediately upon the vegetable matter. The conversion of successive surfaces into dry land, where other swamps supporting trees may have formed, might give origin to a continued series of coal measures of great thickness."

A possible explanation of the variation in quality of the coal in the same seam is afforded by Lemière in the *Bulletin de la Société de l'Industrie Minérale,* Sér. 4, vol. iv., pp. 851 and 1299, vol. v., p. 273, where he maintains that the differences in composition are mainly original, the denser and more anthracitic varieties representing plant substance which has been more completely macerated and deprived of its putrescible constituents before submergence, or of which the deposition had taken place in shallow water more readily accessible to atmospheric oxidizing influences than the deeper areas where conditions favourable to the elaboration of compounds richer in hydrogen prevailed.

On the other hand the advocates of the drift theory say, (1) seeing that the great mass of the rocks forming the coal measure series are formed of water-borne and water-deposited material, it is only reasonable to suppose that coal was likewise so borne and deposited; (2) that the areas occupied by the coal-bearing rocks are too extensive to have originated under estuarine conditions such as exist to-day; (3) that coal is usually a stratified rock, and so it would be were it derived from drifted material; and (4) that the splitting up of seams is difficult to account for under the *in situ* theory, but is explainable under the drift theory. These are, perhaps, the chief arguments advanced against the growth *in situ* theory. Probably both theories are applicable; some coalfields being formed *in situ,* others being the result of water-borne and water-deposited vegetable matter. Certainly the carbonaceous material in the small coalfields in south-western France, deposited in basins formed in the metamorphic rocks and resting directly thereon without the intervention of sedimentary rocks was water-borne; and it is possible that the coal seams in Natal are likewise the result of vegetable matter carried and deposited by water—to mention two cases; but the evidence in favour of the growth *in situ* of many, and especially in respect of the British, coalfields of the Carboniferous period would appear to be overwhelming. E. A. Newell Arber, in *The Natural History of Coal* (1911, pp. 115–118), has put forward a possible explanation of the origin of estuarine coals, and an explanation of the varied nature of the flora of a coal seam based on the belief that the material may have originated partly *in situ* and partly from drifted vegetation. He points to the fact that the carboniferous period was admittedly one of "ups and downs," the surface of the land either slowly sinking or being gradually raised, there being a great number of these alternating periods; that during periods of elevation, the surface was covered with dense vegetation of varied forms, tree forms predominating. He thinks there is no reason why such typical representatives of the classes Lycopodiales, Cordaitales and Pteridospermeae as *Lepidodendron, Cordaites* and *Lyginodendron* should have been confined to marshes, and that there were in Carboniferous times as now varied upland associations as well as hygrophytic and halophytic, lowland assemblages. During periods of elevation, there existed, as to-day, fresh-water, brackish-water, or marine conditions. When the land began to sink two changes took place: the estuaries and swamps were invaded, becoming salt and brackish instead of, as formerly, brackish and fresh water, and secondly, the swamps invaded those portions of the land which were formerly elevated ground but were now sinking. Consequently, large areas of almost level surface sank to near sea-level, or even below, and the boundaries of the future coalfield were initiated. The extent of the existing delta and fresh-water swamps became greatly magnified, and they were finally merged into one great swamp, and on this area vegetable débris accumulated. The débris, which accumulated on the floor of the submerged surface would be almost entirely derived from vegetation, as owing to the subsidence of the land the streams would deposit their loads of earthy detritus far inland, and not as formerly at their mouths, now submerged. So an accumulation of purely vegetable origin would result, just as is found to-day in the Great Dismal Swamp. This accumulation would be derived in part from the former vegetation which grew *in situ* and was essentially of an estuarine character, and in part from plants which still flourished on the sinking land; in addition to which the vegetation from the higher lands became involved, for the trees there could no longer flourish on invasion by the swamp.

Mineral Matter Contained in Coal Seams.—Besides the purely carbonaceous matter constituting what we understand by the term coal, there is a variable quantity of mineral matter which goes to form the ash. This foreign matter consists of silica, calcite, gypsum, ankerite, barytes, iron, iron-pyrites and phosphorus. The gypsum, calcite, ankerite and barytes occur in thin films in the divisional planes, vertical and horizontal, of the coal. It remained for Crook (T. Crook, "On the frequent occurrence of Ankerite in Coal," *Mineralogical Magazine,* vol. xvi., No. 75, pp. 219–223, 1912) to show that the white carbonate (commonly referred to by scientific writers on coal as calcium carbonate) which is so common in coals, and is peculiarly characteristic of the steam coals of Northumberland, is in point of fact the mineral ankerite, the amount of free calcite being comparatively small. These sheets or plates of ankerite, with which are associated calcite, barytes, pyrites, and even zinc blende and galena in very small quantities are less than a millimetre in thickness and constitute minute mineral veins. As a rule the dominant mineral is ankerite. The pyrites also occurs in divisional planes in the coal, though in the form of marcasite (a form of iron pyrites which crystallizes in prisms and is paler than "pyrite," which crystallizes in cubes); it is dispersed throughout the coal substance.

In small part these impurities are derived from the original vegetation itself, *e.g.,* to some extent the sulphur and silica. Decaying vegetable matter has the property of converting the iron in its composition into iron pyrites, but the sulphur may, in part, have an extraneous origin and be due to the infiltration of mineral solutions from overlying rocks. As Thiessen has pointed out, sulphur exists in the proteins of practically all plants and there is in addition some non-protein sulphur in the majority of plants. Moore divides the sulphur contained in coal into inorganic and organic, pointing to the fact that, as has been recognized for many years, a portion of the sulphur contained in coal must exist in some form other than mineral sulphides and sulphates, as in some coals it does not exist in such proportions as can be combined with the elements necessary to form these mineral com-



FROM LEWIS, "PLANT REMAINS IN THE SCOTTISH PEAT MOSSES" (ROYAL SOC. OF EDINBURGH)

FIG. 2.—DIAGRAM SHOWING A SECTION OF A PEAT BOG IN KIRKCUDBRIGHTSHIRE AND AYRSHIRE, SCOTLAND

pounds (E. S. Moore, *Coal,* pp. 33–34, 1922). The inorganic type is most common. The sulphur exists as sulphide or sulphates—chiefly the former—usually of iron, and as free sulphur, and is very detrimental to smelting and gas making.

The occurrence of phosphorus in coal may be due in part to the infiltration of water from rocks containing calcium phosphate, but some of it, at any rate, is derived from the vegetation itself, for spores are known to contain phosphorus. It occurs only in minute quantity in coal, but that quantity is very detrimental in coal or coke used for metallurgical purposes.

Hydrocarbons, such as petroleum, bitumen, paraffin, etc., are found occasionally in coal seams, but more generally in the asso-

ciated strata of sandstones and in the lower carboniferous limestones. Gases, consisting principally of methane (light carburetted hydrogen or marsh gas) are commonly present in an occluded form, sometimes existing under conditions of considerable pressure, in the coal, and constituting a most formidable danger in the mine. The subject of ash in coal is dealt with more fully in the article on COKE. (*See* also Section III.)

Geological Formations in Which Coal Occurs.—Although by far the greater stores of coal and those of highest quality are contained in the great Carboniferous formation, and in particular in that part known as the Coal Measure series, yet the occurrence of coal is by no means limited to the carboniferous system. Eliminating lignite, which is chiefly a formation of Tertiary age, coal deposits are found as low down in the geological scale as the Silurian system, and in rocks as late as the Cretaceous age. Thus, the little coalfield of Brora in Sutherlandshire is of lower oolitic age. In Canada the coal of the Pacific Coast is of Cretaceous age. The coalfields of Cape Colony, the Transvaal and Natal are probably of Triassic origin. The coalfields of Russia were considered by Sir R. Murchison to belong to the Lower Carboniferous period, but others regard them as of Old Red Sandstone age. But in Great Britain the geological divisions which in this respect chiefly demand our notice are the Coal Measures, the Millstone Grit, and the Carboniferous Limestone Series, which together constitute the great carboniferous formation of Great Britain.

In England all the coalfields, with the exception of northern and western Northumberland, are in the Coal Measures. The British coalfields may conveniently be divided in the following manner:—

1. English Coalfields

The Great Northern Group.—Comprising the limestone coals, Northumberland and Durham coalfield and the Cumberland field.

The North Western Group.—Comprising the Lancashire and East Cheshire field, the Coalbrookdale (or Shropshire) field, and the Forest of Wyre field.

The North Midland Group.—Comprising the Yorkshire, Derbyshire and Nottinghamshire field.

The Midland Group.—Comprising the North and South Staffordshire coalfields, the Leicestershire field, and the Warwickshire field.

The Western Group.—Comprising the Bristol and Somersetshire fields and the Forest of Dean.

2. Welsh Coalfields

Comprising the South Wales field, the Denbighshire field, and the Flintshire field.

3. Scottish Coalfields

Comprising the Clyde basin, the Midlothian, the Haddingtonshire, the Fifeshire, the Ayrshire, the Lesmahagow and the Canobie fields.

4. Irish Coalfields

Comprising the northern and the southern group of detached coal areas.

Classification.—Frequent attempts have been made towards a scientific classification of coal, the broad division of anthracite, bituminous coal, and lignite and brown coal, not having been deemed sufficient. Perhaps the best is that adopted by the International Geological Congress held at Toronto in 1913. Coals were then divided into four main classes and three sub-classes, letters instead of names being used, and the fuel ratio taken as the basis of classification, thus,

$$\frac{\text{Fixed carbon}}{\text{Volatile matter}}$$

and, in the cases of B_3, D_1 and D_2, the split volatile ratio of

$$\frac{\text{Fixed carbon} + \text{volatile combustible}}{\text{Hygroscopic moisture} + \frac{1}{2}\text{ volatile combustible.}}$$

The classes were as follows:—

CLASS A

(1) Burns with short blue flame; gives off 3 to 5% volatile combustible matter.
Fuel ratio 12 and over.
Calorific value 8,000 to 8,330 calories or 14,500 to 15,000 B.T.U.
Mean composition:—
Carbon . . . . . 93 to 95%
Hydrogen . . . . . 2 to 4%
Oxygen and nitrogen . . . . . 3 to 5%

(2) Burns with slightly luminous short flame and little smoke, does not coke and yields from 7 to 12% of volatile matter.
Fuel ratio 7 to 12.
Calorific value generally 8,300 to 8,600 calories or 15,000 to 15,500 B.T.U.
Mean composition:—
Carbon . . . . . 90 to 93 %
Hydrogen . . . . . 4 to 4·5%
Oxygen and nitrogen . . . . . 3 to 5·5%

CLASS B

(1) Burns with short luminous flame and yields 12 to 15% volatile matter; does not readily coke.
Fuel ratio 4 to 7.
Calorific value generally 8,400 to 8,900 or 15,200 to 16,000 B.T.U.
Mean composition:—
Carbon . . . . . 80 to 90%
Hydrogen . . . . . 4·5 to 5%
Oxygen and nitrogen . . . . . 5·5 to 12%

(2) Burns with luminous flame and yields from 12 to 26% volatile matter; generally cokes.
Calorific value 7,700 to 8,800 calories or 14,000 to 16,000 B.T.U.
Mean composition:—
Carbon . . . . . 75 to 90 %
Hydrogen . . . . . 4·5 to 5·5%
Oxygen and nitrogen . . . . . 6 to 15 %

(3) Burns freely with long flame; withstands weathering but fractures readily and occasionally has moisture content up to 6%; volatile matter up to 35%; makes porous, tender coke.
Fuel ratio (split volatile) 2·5 to 3·3.
Calorific value 6,600 to 7,800 calories or 12,000 to 14,000 B.T.U
Mean composition:—
Carbon . . . . . 70 to 80%
Hydrogen . . . . . 4·5 to 6%
Oxygen and nitrogen . . . . . 18 to 20%

CLASS C

Burns with long smoky flame and yields 30 to 40% volatile matter on distillation, leaving very porous coke.
Fracture generally resinous.
Calorific value 6,600 to 8,800 calories or 12,000 to 16,000 B.T.U.

CLASS D

Contains generally over 6% of moisture; disintegrates on drying; streak brown or yellow. Cleavage indistinct.

(1) Moisture in fresh mined, commercial output, up to 20%.
Fracture: generally conchoidal.
Drying: cracks irregular, curved lines.
Colour: generally lustrous black, occasionally brown.
Fuel ratio (split volatile) 1·8 to 2·5.
Calorific value 5,500 to 7,200 calories or 10,000 to 13,000 B.T.U.
Average composition:—
Carbon . . . . . 60 to 75 %
Hydrogen . . . . . 6 to 6·5%
Oxygen and nitrogen . . . . . 20 to 30 %

(2) Moisture in commercial output over 20%.
Fracture: generally earthy and dull.
Drying: cracks generally separate along bedding planes and often show fibrous (woody) structure.
Colour: generally brown, sometimes black.
Calorific value 4,000 to 6,000 calories or 7,000 to 11,000 B.T.U.
Average composition:—
Carbon . . . . . 45 to 65 %
Hydrogen . . . . . 6 to 6·8%
Oxygen and nitrogen . . . . . 30 to 45 %

This classification, giving names to the letters, may be interpreted thus:—

A_1 corresponds to anthracite.
A_2 corresponds to semi-anthracite.
B_1 corresponds to semi-bituminous coal (in this class would be included the so-called smokeless steam coal of South Wales).
B_2 corresponds to bituminous coal.
B_3 corresponds to bituminous coal of low fixed carbon content.
C corresponds to cannel coal.
D_1 corresponds to sub-bituminous coal or compact black lignite.
D_2 corresponds to lignite or brown coal.

Eliminating from consideration peats, brown coals, lignite and anthracite (*see* articles LIGNITE and ANTHRACITE), bituminous coal is divisible, for commercial purposes, into Gas, Coking, House, Manufacturing and Steam Coal.

Gas and Cannel Coals.—In the following two tables are given the analyses of some typical (British) gas and cannel coals. (*See* also article GAS MANUFACTURE.)

Composition of Gas Coals

Colliery	Coalfield	Percentage composition					Percentage of coke	Yield of gas per ton of coal in cubic feet	Illuminating power in standard candles
		Fixed carbon	Volatile hydro-carbons	Sulphur	Ash	Moisture			
Durham (England)	Holmside	70·73	26·79	1·04	1·44	..	72·25	12,130	13·10
North Bitchburn	„	62·32	31·32	0·41	4·35	1·60	67	10,800	18·10
Mirfield, Low Moor Blackbed	Yorkshire	66·32	29·53	..	3·55	0·60	..	11,584	18·76
Mitchell Main	„	64·30	29·53	1·53	4·5	1·67	67	11,500	18·10
Bamfurlong, Trencherbone Seam	Lancashire	60·00	34·8	0·9	1·9	2·4	61·9	11,000	17·5
Blainscough, Arley Seam	„	60·31	31·63	0·17	4·14	3·75	..	11,552	19·32
Argoed Red Ash Vein Seam	Monmouth (S. Wales)	64·47	32·50	..	3·03	..	..	10,221	16·05
Llanerch Meadow Vein Seam	„	62·53	33·66	..	2·77	1·04	..	9,835	14·50
Auchlochan, Six Feet Splint Coal	Lanarkshire (Scotland)	49·96	37·14	0·34	4·26	8·30	67	10,580	22·18
Muirbeath Three Feet	Fifeshire „	51·77	36·79	0·24	2·00	9·20	..	10,995	23·30

Composition of Boghead and Cannel Coals

Colliery	District	Ultimate analyses						Proximate analyses					Gas per ton at 60° F and 30° bar.	Illuminating power of gas	Coke yield
		Carbon	Hydrogen	Nitrogen	Oxygen	Ash	Sulphur	Volatile hydrocar-bons	Fixed carbon	Sulphur	Ash	Moisture			
1. Collins Green Colliery	Lancashire	..	..	..	..	..	..	46·14	47·18	0·17	2·76	3·75	13440	35·78	..
2. St. Helens	„	79·0	6·05	..	14·97	3·05*	..	52·75	47·25	..	..	..	..	..	..
3. Wigan	„	82·4	5·70	..	11·90	2·70*	..	..	..	..	..	..	..	..	..
4. Clifton colliery	Nottinghamshire	71·77	6·12	0·49	11·87	8·30	..	..	..	..	..	..	12800	23·4	..
5. Howley Park	Yorkshire	..	..	..	..	1·45	..	43·04	47·60	2·01†	7·90	1·46	12101	27·4	..
6. Old Roundwood	„	..	..	..	..	..	..	42·04	46·32	2·32†	10·85	0·79	12100	28·04	58·73
7. Caprington, Parrot Seams	Ayrshire	..	..	..	..	..	..	37·40	48·27	0·23	8·30	5·80	11320	27·33	..
8. Arniston Cannel	Edinburgh	..	..	..	..	..	..	52·88	42·48	0·22	3·10	1·32	14135	37·36	..
9. Newbattle „	„	..	..	..	..	..	..	50·23	44·06	0·24	4·33	1·14	13720	35·24	..
10. Lochgelly „	Fifeshire	..	..	..	..	..	..	34·17	56·49	0·17	5·75	3·43	10870	26·43	..
11. Boghead (Torbane Hill)	Linlithgowshire	78·1	10·43	..	11·47	33·00*	..	87·80	12·20	..	..	..	..	..	..

(1), (4) to (10) *Analyses of British Coals and Coke.* By Allan Greenwell and J. V. Elsden, 1909.
(2), (3), (11) *Fuel.* By J. S. S. Brame, 1919.
*Ash on dry coal. †Total sulphur in coal.

Composition of Steam Coals

Description of coal	District	Ultimate analyses							Proximate analyses					Water evap. at 100° C per lb. of coal	Coke
		Carbon	Hydrogen	Oxygen	Nitrogen	Sulphur	Ash	Moisture	Moisture	Volatile Hydro-carbons	Ash	Fixed carbon	Calories		
														Lb.	
1. Gt. Western Colliery Navigation Smokeless	Glamorganshire	86·48	4·04	3·62	0·88	0·70	3·04	1·24	1·24	18·53	3·04	77·19	77·55	14·44	..
2. Cwmammam Smokeless	„	91·11	3·95	1·55	0·90	0·52	1·97	..	0·70	11·76	1·97	85·57	..	13·93	..
3. Ebbw Vale	Monmouthshire	87·47	5·48	2·68	1·11	0·62	0·63	..	..	..	..	..	..	..	..
4. Hastings Hartley Main	Northumberland	79·63	5·05	10·75	1·02	0·75	2·81	..	..	34·17	..	65·83	77·09	14·35	..
5. Bothal West Hartley	„	80·90	5·33	9·64	0·96	0·77	2·40	..	..	..	..	..	79·55	14·66	..
6. Cowpen West Hartley	„	79·46	4·89	11·07	1·02	0·83	2·73	8·17	..	..	..	..	76·27	14·2	68·27
7. S. Hetton Hartley	Durham	81·82	5·20	6·17	1·65	0·88	2·20	2·08	..	..	..	..	..	14·9	66·00
8. Brockwell Screened Coal	„	61·01	..	29·93	..	0·60	5·33	3·13	..	..	..	..	78·99	..	..
9. West Auckland 5-4th seam	„	..	..	..	0·77	..	..	..	1·76	33·51	3·44	60·52	81·29	..	..
10. Forth Crown Hartley	Haddingtonshire	69·12	4·53	9·97	1·35	0·40	4·65	9·98	..	..	..	..	67·19	12·44	..
11. Lochgelly	Fifeshire	..	..	..	..	0·30	..	..	..	41·87	2·75	55·08	..	..	57·98
12. Lochgelly Navigation	„	82·63	5·05	6·10	1·69	0·66	1·42	2·45	..	..	..	..	76·79	14·30	74·00
13. Alloa Splint	Clackmannanshire	76·48	6·18	6·46	1·52	0·34	4·46	4·56	4·56	35·85	4·46	54·79	..	13·57	59·42
14. Fergushill Main Seam	Ayrshire	75·78	5·53	12·02	1·06	1·65	3·96	..	..	..	..	..	..	..	60·13
15. Fergushill Ell Seam	„	80·77	5·28	8·09	1·33	1·14	3·39	..	..	..	..	..	..	..	63·91
16. Wharncliffe Woodmoor Kents Thick	Yorkshire	81·4	4·1	8·2	2·7	0·7	2·9	..	..	..	..	..	..	15·45	..
17. Beeston Best Coal	„	..	..	..	..	0·83	..	..	8·75	34·37	0·93	55·95	..	..	..
18. Sherwood Top Hard Bright	Nottinghamshire	72·44	5·26	7·80	1·71	1·21	2·08	9·50	9·50	34·24	2·08	54·18	..	12·4	56·26
19. Rishton Lower Mountain Mine	Lancashire	81·68	4·99	5·81	1·86	0·45	2·86	2·35	..	..	..	..	..	15·0	..
20. Natal Navigation Col.	S. Africa	81·37	5·44	2·82	1·97	1·06	7·31	0·92	..	..	..	..	..	14·54	78·78

(1), (2), (4) *Modern Practice in Mining.* By R. A. S. Redmayne., vol. i., 1919.
(5) to (9) *Supplement to Plotted Vertical Sections of Northumberland and Durham Coalfields.* By J. Kirsopp, 1908.
(3), (10) to (19) *Analyses of British Coals and Coke.* By Allan Greenwell and J. V. Elsden, 1909.
(20) *South African Engineering Journal*—Coal No., Dec. 1919, p. 87.

The cannel coals, which yield a great quantity of gas, differ in character from ordinary bituminous coals for they are dull pitchy to dark brown in appearance, break with a conchoidal fracture, are hard and dense, and devoid of coking properties. They are sometimes called "Parrot coals" because of their quality when heated of decrepitating with a crackling sound.

Coking Coal.—Certain bituminous coals under the application of heat possess the quality of intumescing, or coking, as it is termed (see *post.* Section III.). What determines the coking or caking property is not fully understood. It does not depend on the relative quantities of carbon and oxygen present, though coals rich in carbon and low in oxygen (*e.g.,* anthracite high in carbon content and low in oxygen), also coals comparatively low in carbon and high in oxygen content (lignite), do not cake. That physical conditions play some part in the coking property of coal would seem to be borne out by the fact that certain coals which do not readily coke, when ground fine enough and subjected to pressure do so. The principal requirement in respect of a *house coal* is that whilst it should produce a good bright fire it should not be too fierce, for which reason a steam coal and a furnace coal are not desirable. Owing to its intumescent quality a coking coal is also undesirable.

Manufacturing, Steam or Furnace Coals.—These should be capable of producing considerable heat, for which reason they should have a fairly high fixed carbon content but a low sulphur content. The most important characteristic of a steam coal is agreed to be inherent great heating power, and, whilst the fixed carbon content should be high, there should also be present a sufficient percentage of volatile hydrocarbons to permit of easy ignition and consumption of the fixed carbon. The ash content should be low, as being non-combustible it detracts from the calorific value of the fuel, and sulphur is detrimental as being destructive to the firebars. The coal should not be friable and should stack well. The tables on page 873 give the composition of some of the principal British steam coals.

Composition of Coal and Recent Scientific Research Thereon.—Coal being a complex colloidal organic substance of high molecular aggregation, requires for the elucidation of its chemical constitution the application of the best trained minds in organic chemistry, and although research work of late years has been greatly intensified in Great Britain, the United States, Germany, France and Canada, but little more has been discovered than was known at the commencement of the 20th century.

Chemists employ three experimental methods for the investigation of the coal substance: (A) thermal decomposition, (B) fractionation by a sequence or combination of solvents, and (C) oxidation of the coal, hydrogenation, halogenation, etc. The principal facts which have been established by these methods are:—

(A) M. J. Burgess and R. V. Wheeler (*Chem. Soc. Trans.,* vol. xcvii., 1910; vol. xcix., 1911; vol. cv., 1914) by thermal decomposition applied up to a temperature of 1100° C determined:—

(1) That the decomposition of the coal substance commenced about 350° C;

(2) That in respect of the coals examined, whether bituminous, semi-bituminous or anthracitic, there is a well-defined critical temperature between 700° C and 800° C which corresponds with a marked and rapid increase in the quantity of hydrogen evolved; and

(3) That the evolution of methane and other paraffin hydrocarbons almost entirely ceases at about 700° C.

They concluded that the coals examined by them contained two types of compounds of different degrees of stability, viz., the "resinic" or less stable, which on thermal decomposition yield principally paraffins and no hydrogen, and the "cellulosic" which yield principally hydrogen. The facts hold good, but the interpretation of them as given above is not universally accepted. For instance, H. C. Porter and G. B. Taylor, who have carried out researches on American coals (*Proc. Amer. Gas Inst.,* vol. ix. [1], 1914) repudiate the suggestion that the "resinic" constituents of coal would be less than the "cellulosic" and attribute the great increase in the evolution of hydrogen between 700° C and 800° C to secondary decomposition, and they found that more than two-thirds of the organic substance of coals is decomposable below 500° C. Their views about the composition of coal are best expressed in their own words:—

"All kinds of coal consist of cellulosic degradation products more or less altered by the process of ageing, together with derivatives of resinous substances, vegetable waxes, etc., in different proportions, more or less altered. They all undergo decomposition by a moderate degree of heat, some, however, decompose more rapidly than others at the lower temperature. The less altered cellulosic derivatives decompose more easily than the more altered derivatives, and also more easily than the resinous derivatives. The cellulosic derivatives decompose so as to yield H_2O, CO_2, CO and hydrocarbons, giving less of the first three products the more matured and altered they are. The resinous derivatives, on the other hand, decompose on moderate heating so as to yield principally the paraffin hydrocarbons, with probably hydrogen as a direct decomposition product. The more mature bituminous coals, having good coking properties, contain a large percentage of resinous derivatives and their cellulosic constituents have been highly altered. The younger bituminous or sub-bituminous coals are constituted of cellulosic derivatives much less altered than those in older coals. They undergo a large amount of decomposition below their fusion point, and possibly for that reason many of them do not coke."

Prof. W. A. Bone pointed out (*Soc. Chem. Ind.,* June 19, 1925) in his paper on the "Constitution of Coal," that in most recent coal research work little, if any, importance appears to have been attached to the nitrogenous constituents of coal, and there seems to be at least some room for doubt whether the supposed "resinic" constituents of coal have been rightly so called. He was inclined to think that our whole coal-nomenclature might be overhauled with advantage. Though there may be some doubt as to the feasibility of drawing a sharp line between the evolution of the various gaseous products in the case of a highly matured type of coal when under thermal decomposition, it is otherwise in the instance of an immature brown coal or lignite, as Bone's work has shown. The results being: (*a*) that up to a certain temperature (in the case of a dried sample of brown coal, from Morwell, near Melbourne, 375° C) the only gases expelled from the dried coal are steam and oxides of carbon, which evolution continues right up to (and perhaps beyond) 700° C; (*b*) that at a somewhat higher temperature range (in the case of the Morwell coal, 375°–500° C) methane and other hydrocarbons (without oxygen) appear; and (*c*) it is not until the temperature exceeds 500° C that hydrogen appears among the products.

(B) In 1899, Bedson discovered the solvent action of pyridine on coal, and much later, A. H. Clark and R. V. Wheeler (*Chem. Soc. Trans.,* vol. ciii., 1913) fractionated coal substance into three parts by first dissolving it with pyridine, then treating the pyridine extract with chloroform. The coal substance was divisible into: (1) that insoluble in pyridine, (2) that soluble in pyridine but insoluble in chloroform, (3) that soluble in both pyridine and chloroform. These fractions are frequently referred to as *alpha, beta* and *gamma* constituents respectively, as though they were distinct and definitely separate chemical substances, which is unfortunate seeing that they all contain carbon, hydrogen, nitrogen, oxygen and sulphur—in fact, nearly the same percentage of nitrogen and sulphur in each fraction. In the extraction of coal substances by benzene under pressure, Bone's work was of great interest. He employed benzene in a special form of extractor on the Soxhlet principle at pressures between 500 and 700lb. per sq. in. and at temperature 260° to 285° C, and afterwards fractionated the extract by a suitable solvent treatment. He and his co-workers have by this means obtained four distinct benzene soluble fractions (*Proc. Roy. Soc.,* 105, Ser. A., 1924). This result is shown diagrammatically on the opposite page.

When working on a coking coal it was found that fractions 1 and 2 could be disregarded from the point of view of containing substances of a "binding" character. With regard to fraction 3, Prof. Bone said "the amount of this fraction was always very small, ranging between 0·3 and 0.8% only of the whole coal substances; so that, although it has good 'binding' properties, and therefore would be to some extent a contributary factor, it cannot be considered as the chief cause of the coking properties of the coals."

The substances contained in fraction 4 were different from the so-called "coal resins" and seemed to be rather of the "humic" type. Their chemical nature has not yet been finally established, but they constitute from 4·6 to 7·0% of the parent coal substance and have very pronounced "binding" properties, so that the rela-

Concentrated Benzene Solution of Crude Extract Poured into Light petroleum (b. p. 40°–60°)

Soluble		Insoluble	
Benzene-free light Petroleum.		Ethyl Alcohol	
Soluble	Insoluble	Soluble	Insoluble
Fraction 1.	Fraction 2.	Fraction 3.	Fraction 4.
Non-nitrogenous heavy oil.	Red brown solid, softening point about 25°.	Non-nitrogenous brittle resinous red brown solid, softening point about 60°.	Nitrogenous amorphous brown solid, softening point 180°–230°.

tive coking properties of bituminous coals run nearly parallel to their yields of this fraction. These may therefore be considered as the chief cause of the coking properties of coals.

F. Fischer, H. Broche, and J. Strauch (*Brennstoff-Chem.*, 1925) in an account of similar experiments made upon German bituminous coals some little time after the appearance of Bone's paper, divided their crude benzene extract into two fractions only, which probably explains the apparent discrepancy in interpretation of the results. The benzene extracts from a brown coal are chemically different from those yielded by sub-bituminous or bituminous coal. It would seem that the coking quality of a coal is the result of the maturing of coal and is a product of age, for in black lignite there is evidence of the incipient formation of substances closely resembling the coking constituent of the more mature coals.

(C) Recent chemical research on the character of coal includes the work of Dr. Bergius, the German chemist, during the period 1915–25. By subjecting coal to the influence of hydrogen under heat and pressure, he saturates the hydrocarbons in the coal, converting them and, it is claimed, some portion also of the fixed carbon, into saturated hydrocarbons, thus achieving the liquefaction of coal, the objective of chemists for many years. The process has not yet emerged from the laboratory stage, but should it prove a commercial possibility, the results on industry would be far-reaching indeed.

SECTION II.: THE WORLD'S COAL RESERVES; OUTPUT, CONSUMPTION AND PRODUCTION COSTS

The International Geological congress which met in Toronto, Canada, in the year 1913, made an estimate of the world's resources of coal, for which purpose they took 1ft. as the minimum workable thickness of seams, down to a depth of 4,000ft. from the surface, and 2ft. at depths of from 4,000–6,000ft.—6,000ft. being regarded by the Congress as the limit in respect of workable depth. The figures of the available resources which are given in millions of metric tons (a metric ton=2,204·6 lb.), are, in respect of continents as follows:—

World's Coal Reserves
(in millions of metric tons)

Continent	Anthracites including dry steam coals	Bituminous coal	Sub-bituminous coals, lignite or brown coals	Total in millions of metric tons
Europe	54,346	693,162	36,682	784,190
Asia	407,637	760,098	111,851	1,279,586
Africa	11,662	45,123	1,054	57,839
America	22,542	2,271,080	2,811,906	5,105,528
Oceania	659	133,481	36,270	170,410
Total	496,846	3,902,944	2,997,763	7,397,553

The great depth at which coal mining is carried on (4,000ft. below the surface in Belgium) is surpassed by the still greater depth in the mining of mineral deposits (6,726ft. in the St. John del Rey mine in Brazil). The working of coal at great depths is, however, more difficult than the extraction of ore from a metalliferous vein at like depth, for whereas in the latter case the plane of the deposit is, as it were, usually on edge reaching to the surface, in the former case it is, usually, more or less flat, the whole of the coal being derived from, approximately, the same depth, and it is very doubtful whether it will ever prove commercially possible to produce coal from a depth greater than 5,000 feet.

On the question of supply, it is not so much the duration of the world's ultimate resources of coal that matters, but how long will the better and more cheaply-got coals last. European countries are rapidly exhausting their supplies of readily available coals, and, if the present relative rates of exhaustion are continued, the period of their complete exhaustion will arrive long before that of Asia and the New World.

In available resources of coal the American continent far exceeds the rest of the world; in North America there are 5,073,431,000,000 metric tons, and in South America 32,097,000,000 tons; of all individual countries the United States of America takes first place, her resources, for example, being considerably in excess of those of the whole of the British empire. At the present rate of output the North American resources, more especially those of the United States, will outlast all other countries, and will probably suffice for 2,000 years. Great Britain's supplies at the present rate of consumption will not suffice for more than 600 years at most, and if we take into consideration the coal existing to a depth of 4,000ft. (the limit taken by the British royal commission on coal supplies of 1905) they will only last for 450 years. Germany, before the ceding to Poland after the World War of a part of her Silesian coalfield, and to France of her Saar and Lorraine fields, had resources of coal sufficient to last at the pre-War rate of output for 1,000 years, but much of her remaining coal is lignite, which is of much lower calorific value than true coal. France will have to live on imported coal much sooner than Great Britain or Belgium. The latter country has supplies sufficient for nearly 500 years. Switzerland could mine all her resources in a few years.

The most important of all classes of coal is that which is termed "bituminous," for not only does it provide the gas, coking, house and manufacturing, but many of the steam coals also. It is, too, from this class of coal that we obtain our coal derivatives, *e.g.*, tar, pitch, sulphate of ammonia, paraffin hydrocarbons, benzene, toluene, dyes and some medicines. Curiously enough, the term "bituminous" was founded on a misapprehension but is a convenient one of which the use is almost a necessity from its having an almost universal currency among coal miners. Nothing analogous to bitumen exists in coals.

In view of the importance of the bituminous coals, it is fortunate that nearly 4,000,000,000,000 tons, or more than half of the world's coal reserves, are bituminous coal.

World Production.—The following statement shows, in comparative form, the production in long tons of coal by continents for 1913 and 1926:—

World's Coal Production

Country	Production in long tons	
	1913	1926
North America	531,600,000	607,660,000
South America	1,600,000	2,000,000
Europe	730,000,000	621,200,000
Asia	55,000,000	80,000,000
Africa	8,300,000	14,000,000
Oceania	15,000,000	16,450,000
Entire world	1,341,500,000	1,341,310,000

About 90% of the world's coal is derived from the coalfields of the United States of America and Europe, the aggregate output of the British Empire and the United States being respectively about one-quarter and one-half of the world's output. The annual output from the principal countries is shown in tabular form on the next page.

	Year	Long tons
British Empire		
Great Britain:		
Anthracite	1925	6,126,399
Bituminous	1925	237,049,842
Union of South Africa	1926	12,745,497
Canada:		
Bituminous	1926	11,054,227
Sub-bituminous	1926	437,068
Lignite	1926	3,202,888
India:		
Gondnana coalfields	1925	20,447,898
Tertiary coalfields	1925	456,479
Australia:		
Bituminous coal	1925	13,626,777
Lignite	1925	876,468
New Zealand:		
Bituminous coal	1925	1,044,726
Brown coal	1925	911,425
Lignite	1925	158,844
Total (of above and smaller producers) for British Empire	..	309,470,097
Other Countries (excluding those raising less than 4,000,000 tons)		
Belgium:		
Anthracite and semi-anthracite	1926	4,768,010
Bituminous	1926	17,957,828
China (approximate)	1925	21,000,000
Czechoslovakia:		
Bituminous	1926	14,176,612
Brown coal	1926	18,314,748
France:		
Saar	1926	13,450,900
Other districts:		
Anthracite and bituminous	1926	50,581,400
Lignite	1926	1,039,200
Germany:		
Bituminous	1926	143,026,710
Brown coal	1926	137,629,377
Hungary:		
Bituminous	1926	813,618
Brown coal	1926	5,559,263
Lignite	1926	169,185
Japan:		
Semi-anthracite	1925	88,433
Bituminous	1925	30,865,385
Brown coal	1925	166,703
Netherlands:		
Bituminous	1926	8,469,225
Brown coal	1926	207,800
Poland:		
Bituminous	1926	35,064,562
Brown coal	1926	74,804
Russia:		
Bituminous:		
European	1926	20,000,000
Asiatic	1926	3,347,000
Brown coal	1926	1,000,000
Spain:		
Anthracite	1926	381,931
Bituminous	1926	5,915,539
Brown coal	1926	482,199
United States:		
Anthracite	1926	75,390,582
Bituminous, including brown coal	1926	516,330,000
World total for 1926, long tons		1,341,310,000
World total (estimated) for 1927 long tons		1,450,000,000

The following table gives for 1925–6–7 the production of (1) the British empire and (2) the rest of the world:—

World's Production of Coal: 1925–27
(Including Brown Coal)

	1925	1926	1927*
British Empire	306,000,000	193,000,000	320,000,000
Other countries	1,040,000,000	1,150,000,000	1,130,000,000
Total	1,350,000,000	1,340,000,000	1,450,000,000

*Estimated on data available.

The relative importance of the great coal-producing countries in point of coal production is illustrated diagrammatically in fig. 3. In regard to Great Britain, the average figures are taken and not those for the year 1926, as it was the year of the great national lock-out in the coal mining industry. In the case of the other countries named the figures are for the year 1926. In respect of Germany, the brown coal has been converted into terms of bituminous coal by dividing the output of brown coal by three.

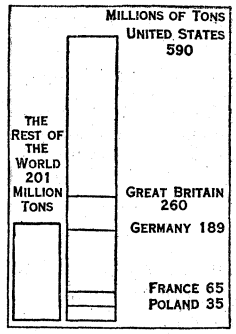


FIG. 3.—DIAGRAM SHOWING RELATIVE OUTPUT OF THE WORLD'S GREAT COAL-PRODUCING COMBINES

In fig. 4 is shown diagrammatically the "curve" of annual output from the three greatest coal-producing nations of the world and the world's output since the years 1910 to the year 1926 inclusive.

It will be seen from the curves, that, in spite of the great impetus which has been given in the last few years to the substitution of oil for coal, the hydro-electric generation of power and the introduction of economy in the use of fuel, the world's production of coal was never greater than in 1926. (The great drop in production in respect of Great Britain was due to the national lockout in the coal mining industry.) A noticeable feature in the diagram is the upward grade in Germany's coal production; although she lost some of her coalfields, she has so developed her brown coal resources and increased the output from the remaining fields of true coal as to produce the remarkable result shown in this diagram. However, the brown coal on the curve of aggregate production has not been converted into terms of true coal. Coal is widely distributed throughout Germany, the principal field is that of the lower Rhine and Westphalia which centres in the industrial region of the basin of the Ruhr, a right hand tributary of the Rhine. In Saxony, Zwickau and Lugan are other important mining centres.

Production and Costs in Great Britain.—The following figure (fig. 5) shows in diagrammatic form the rapid increase in production in Great Britain during the last 100 years, a production necessitated by and conducive to a very great extension in industry, and to an increase of population from 11,090,120 in 1811, to 40,980,311 in 1911, the output of coal being estimated by the 1871 royal commission on coal supplies to have been 10,080,300 tons, or less than the production for one fortnight at the present time.

The production from the various British coalfields stated by counties was as follows for the year 1925[1]:—

England and Wales	*Tons*
Northumberland	11,955,368
Durham	31,493,011
Cumberland and Westmorland	1,986,092
Lancashire and Cheshire	17,422,369
Yorkshire, South	30,852,862
Yorkshire, West	14,420,537
Nottinghamshire	14,022,436
Derbyshire (except South Derbyshire)	14,724,197
Derbyshire, South	1,112,240
Staffordshire, North	5,916,253
Cannock Chase	5,607,761
South Staffs and Worcestershire	1,633,626
Lincolnshire	2,896,817
Warwickshire	4,788,627
Shropshire	754,075
Forest of Dean	1,206,249
Somerset	1,002,598
Bristol	256,404
Kent	367,589
South Wales and Monmouthshire:	
Anthracite	5,566,544
Other	39,062,978
North Wales	3,099,070
	210,147,703

[1]The figures for the year 1926 though available are not given as they are abnormal, that year being the year of the national lock-out of coal miners.

Scotland	
Fife and Clackmannan	7,661,524
Lothian	4,253,079
Lanarkshire:	
Anthracite	559,845
Other	16,434,006
Ayrshire, Dumfries and Argyll	4,120,074
	33,028,528
Total for Great Britain	243,176,231

In 1913 Great Britain contributed 21·7% of the world's entire output of coal, and in the year there were 1,110,884 persons employed in about 3,000 coal mines, which were worked as about 1,500 separate undertakings. The coal properties, or royalties, as they are called in the industry, were vested in about 4,000 owners. Various estimates of the amount of capital invested in the coal mining industry have been attempted, that by Sir Josiah Stamp, £135,000,000, based on the output of five years preceding the war, being perhaps nearest the mark. It is agreed that of all the industries that contributed to the successful issue for the Allies of the World War, the coal industry was perhaps the most important.

The estimated cost of production and of profit to the coal owners in Great Britain arising from the sale of the coal prior to the war may be taken to have averaged as follows:—

	s.	d.
Wages	5	6
Stores and pit wood	1	0
General expenses, inclusive of everything, except depreciation and interest	1	3
Total	7	9
Profit	2	5
Grand Total	10	2

The average royalty rent payable to the owners of the coal averaged about 6d. per ton of coal raised.

Since the year 1923 the general tendency has been for coal in Great Britain to approach what for want of a better term may be called an economic basis of price (although it has not yet fallen to a pre-war level). This has been rendered possible by the decreased cost of production.

This is indicated by the following figures:—

Average of Four Quarters in Each Year in Shillings per Ton

Period	Wages cost (per ton)	Total cost per ton including wages	Proceeds (per ton)
	s. d.	s. d.	s. d.
1922	12 2¼	18 2¼	19 1½
1923	12 4¼	17 7½	19 9½
1924	13 3	18 7½	19 9
1925*	12 6¾	17** 11½	17 1
	11 7¾	16‡ 10¼	
1926†	12 3½	17** 3½	15 8
	9 7½	14‡ 7	

*The subvention operated over the last two quarters of 1925.

†On the first of May, 1926, the production of coal was suspended. The figures given in the tables are up to the end of April, during which period the subvention was operative.

**Subvention included.

‡Subvention excluded.

The cost of working at the end of June 1927 was 16s. 0.70d., and the average selling price of coal (proceeds of sales) 15s. 0.05d. per ton, or a loss of 1s. 0.65d. per ton. The earnings per man shift worked were 10s. 2·84d. and the output per man shift 20·47 cwt. (*See* also Section V.)

Production and Costs in the United States.—The output in the United States rose rapidly during the war years, attaining the enormous figure of 605,546,343 tons in 1918. After that it was subject to great variations, due principally to industrial unrest resulting in strikes of the miners; the production for 1925 being 522,474,999 tons. In 1926 the output amounted to 591,721,000 long tons, a number of colliers being on strike. But the productive capacity of the United States coal mines is far beyond the actual output.

In the United States coal is classified as "soft" coal (bituminous) and "hard" coal or anthracite. Great variation exists in quality in the different States and even in the same district, *e.g.*, in Central Pennsylvania there are seams of semi-smokeless coals of high steaming quality; gas coals, coking coals, and in the west, coals of high volatile content which are sold as steam coals. So great, too, is the variation in the working conditions that, as in

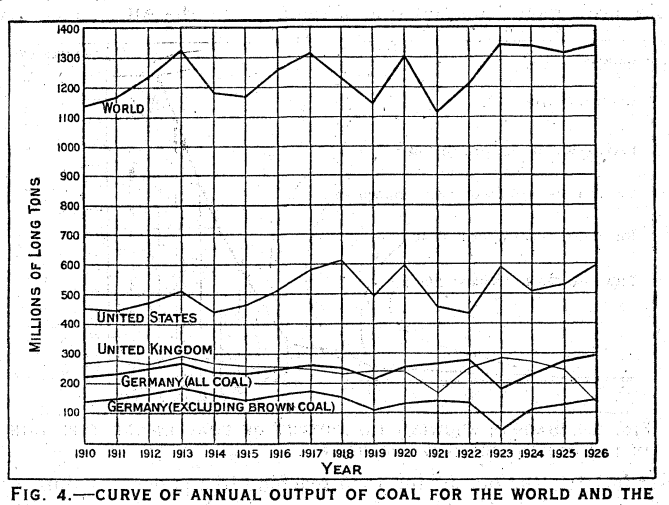


FIG. 4.—CURVE OF ANNUAL OUTPUT OF COAL FOR THE WORLD AND THE THREE GREATEST COAL-PRODUCING COUNTRIES

the case of Great Britain, the problem of making an equitable wage scale to suit the varying conditions is extremely difficult. The output per man shift in the bituminous mines is just under 4 tons (year 1922 3·82 tons, year 1923 3·99 tons) and in the anthracite mines just under 2 tons (1923 1·97 tons and 1924 1·79 tons).

It is doubtful whether there are available positive figures of the cost of working all classes of coal in the United States calculated over the whole annual production, but it was possible to compare the returns for 1922 with those for 1916 in respect of 217 colliery owners in 31 fields and 11 States. From these concerns there were produced in the aggregate 66,000,000 tons in 1916 and 52,000,000 tons (of 2,000lb. per ton) in 1922, that is to say, 13½% and 12½% respectively of the total coal output of the United States. The working costs and sale prices per ton were as follows:—

	1916 s.d.	*1922* s.d.
Cost per ton (of 2,000lb.) f.o.b.	4.8 ($1.12)	10.5½ ($2.51)
Labour cost per ton	3.5½ ($0.83)	7.7 ($1.82)
Sale price per ton	5.7½ ($1.35)	12.4½ ($2.97)
Percentage of labour to total cost	74.1	72.5

The cost of coal to a consumer in America according to one qualified authority (H. F. Hopkiss, "Economics in Coal Mining in the United States of America," *Eng. Soc.*, W. Pa. 132–141; Dixon 141) is made up as follows:—

	Per cent.
Purchase of coal, opening up mine, mining machinery, housing	8
Mine supplies	3
Labour	24
Insurance and Taxes	1
Operators' profit	3
Railway Transport	36
Retailing	25
	100

That is to say, 61% of the cost is absorbed in transport and retailing.

In America as in Great Britain, one of the great outstanding problems awaiting solution is that of distribution.

Production and Costs in Germany.—Like Great Britain, the year 1913 marked a record with 187,054,115 tons of "black" coal, or including brown coal, 272,885,210 tons, one ton of "black"

coal being equal to 2·8 tons of brown coal in point of heat value; and, when the brown coal is converted into briquettes, which is done to a considerable extent, to 1·4 tons of briquettes. Although her Saar and Lorraine coalfields passed to France in 1919, and part of her Upper Silesian field to Poland in 1922, yet Germany's output of "black" coal has suffered less than might have been expected. A heavy fall took place in 1922, due to "passive resistance" upon the occupation of the Ruhr by the Allies; recovery

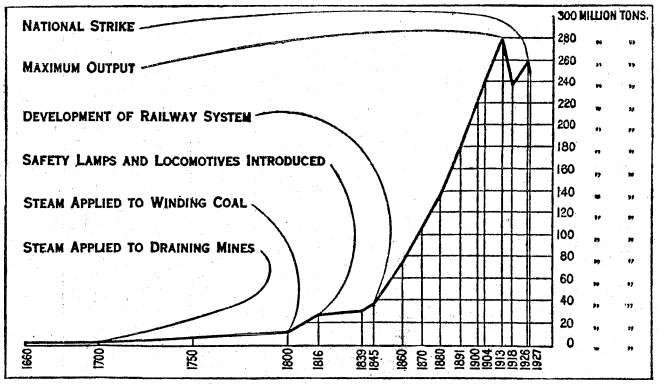


FIG. 5.—DIAGRAM SHOWING THE OUTPUT OF COAL IN GREAT BRITAIN IN THE PERIOD 1660–1927 INCLUSIVE

set in later, the output for 1926 reaching to 143,027,000 tons, or, converting brown coal into terms of "black" coal, 189,081,333 tons.

Taking the whole of Germany and comparing pre-war and post-war results, the following figures show the relative outputs exclusive of brown coal:—

Germany's Production of Coal

1913		1923		1925	
	Tons		Tons		Tons
Ruhr	112,695,000	Occupied territory	33,552,000	Lower Rhine, Westphalia	102,914,182
Upper Silesia	43,097,000	Unoccupied Ruhr Mines	7,863,000	Bavarian Palatinate	1,216
Lower Silesia	5,438,000	German Upper Silesia	8,604,000	Wealden	670,209
Saxony and Lower Saxony	5,872,000	Lower Silesia	5,223,000	Thuringia	95,216
Aix-la-Chapelle	3,212,000	Saxony	5,214,000	German Upper Silesia	14,043,311
Lorraine	3,735,000	Aix-la-Chapelle	984,000	Lower Silesia	5,473,604
Saar Area	13,005,000			Saxony	3,807,060
				Aix-la-Chapelle	3,485,900
Total	187,054,000	Total	61,440,000	Total	130,490,698

The total home consumption of coal and lignite in Germany during 1924 was as follows:—

	Tons
Coal from home sources	118,828,644
Lignite, home sources (converted ⅓)	41,453,276
	160,281,920
Plus imports	15,240,108
	175,522,028
Less exports	4,358,568
	171,163,460
Less reparations deliveries	19,680,243
Net consumption	151,483,217

Comparing the cost of working coal in *Great Britain* with the *Ruhr* district of Germany, the coal from which competes with British coal in the European and other markets, the following comparative figures were given in evidence before the 1925 royal commission on the coal mining industry (*see* evidence of Sir R. Redmayne):—

	Great Britain quarter ending Sept. 30, 1925		
	With subvention	Subvention deducted	
	s. d.	s. d.	s. d.
Cost of working per ton	17 7.57	17 11.64	15 1.50
Proceeds per ton	16 4.75	16 4.75	14 2.75
Loss per ton	.. 2.82	1 6.89	.. 10.75

Output Per Man and Hours.—The following table shows the annual average quantity of coal in long tons raised per person employed under and above ground in the countries named:—

Year	Great Britain	United States	Germany (c) (excluding brown coal)	France (d)
1910	256	618	242	192
1911	259	614	252	193
1912	243	660	282	200
1913	259	681	286	(a)
1914	(b)238	601	260	182
1915	(b)269	648	302	182
1916	(b)260	731	311	179
1917	(b)247	768	291	170
1918	(b)229	794	275	153
1919	(b)195	637	174	122
1920	(b)187	749	181	120
1921	(b)144	549	165	130
1922	217	504	184	137
1923	220	693	103	134
1924	220	654	209	143
1925	218	(a)	(a)	(a)

(a) Information not available.
(b) These figures refer to the United Kingdom.
(c) From 1912, inclusive, figures are based upon numbers of insured workers.
(d) Excluding Saar district.

The output per man per shift at the present time (year 1927) has been as follows:—Quarter ending in March, 20·66 cut; quarter ending in June, 20·47 cut; quarter ending in Sept., 19·0 cut.

The figures representing annual average quantity of coal raised per person employed have been obtained by dividing the annual output by the number of persons employed.

For comparative purposes as between countries, these figures are vitiated by the fact that the same number of days and hours may not have been worked in each country in respect of any given year; nor are the natural conditions with which the miner has to contend the same in each country. For instance, the conditions prevailing in the United States are perhaps the best in the world; on the average the seams are thick, with good roofs, and lying at shallow depths from the surface. In respect of the black coal of Germany, the conditions are somewhat more difficult than in Great Britain. Making the fairest comparison, namely, that of output per shift, calculated over all persons employed, that for Great Britain is at present about 17·85cwt. as against 19·5cwt. for the whole of the Ruhr coalfield. In the Ruhr field the rise in production per man per shift has been on the up grade. The output per shift in Germany of Lignite is very considerable, much of it being quarried "open-cast." In Great Britain the hours of work of the underground miner were in 1925 7hr., exclusive of winding time, say, on the average 7hr. 37min., but since then the length of the working shift has been extended at some collieries to 8hr. and at others to 7½ hours. In Germany (Ruhr) they are 8hr. inclusive of one winding time, so on the basis of the same length of winding time as in Great Britain the average time below ground is 8 hours. In France the working time is 8hr. inclusive of both winding times, so that miners actually work less time than in Great Britain. In the United States the time is 8hr. exclusive of both winding times, but as in the majority of the mines the

inlet is by way of adit or day-drift, the actual time below ground is probably on the average more than 8hr., though, from the report of the recent United States coal commission, the miners would appear to go into the mines and come out pretty well as they like.

SECTION III.: UTILIZATION AND CONSERVATION OF COAL; ELECTRICAL POWER USES; COAL CARBONIZATION

The use to which a coal can be most profitably put depends on two factors, its chemical composition and its physical character. A coal may have a high fixed carbon content, and as such may be

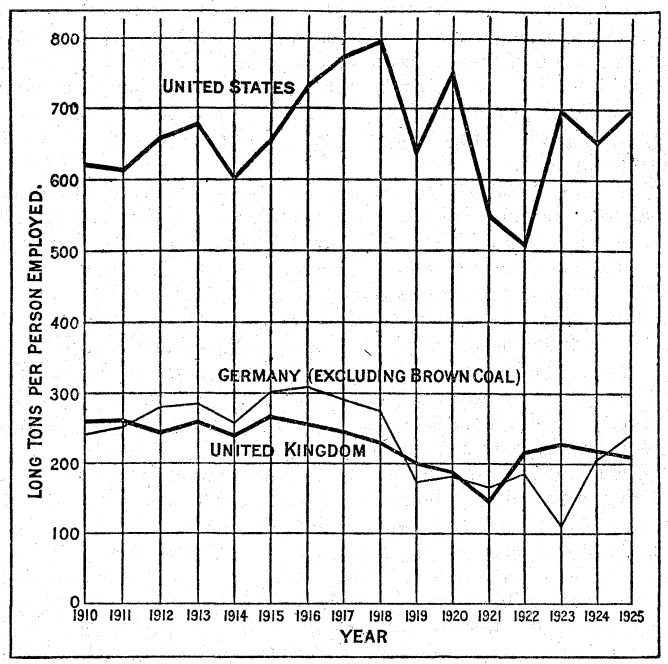


FIG. 6.—CURVE SHOWING THE ANNUAL AVERAGE QUANTITY OF COAL RAISED PER PERSON EMPLOYED UNDER AND ABOVE GROUND IN GERMANY, THE UNITED KINGDOM AND THE UNITED STATES OF AMERICA

capable of giving out great heat, but owing to its low volatile hydrocarbon content prove useless as a steam-raising coal except under forced draught. Again the ash content in an otherwise perfect steam coal may be so high as to render it a costly coal to use; or its ash may be fusible at a comparatively low temperature, and so choke the firebars with clinkers; or the sulphur content may be so high as to prove a destructive element especially in the case of a water-tubular boiler; or a coal may be excellent in point of chemical analysis, but is so friable that it breaks up in transport and cannot be burnt except in a pulverized form for raising steam, and must be used for making coke, patent fuel, or as pulverized coal. But as to making coal into coke, all coals are not possessed of the caking property, a quality which probably depends on physical as well as chemical characteristics. (*See* Section I.)

Characteristics.—The most important class of coals is that commonly known as "bituminous" from their property of softening or undergoing an apparent fusion when heated to a temperature far below that at which actual combustion takes place. This term is founded on a misapprehension of the nature of the occurrence, since, although the softening takes place at a low temperature, still it marks the point at which destructive distillation commences and hydrocarbons, both of a solid and gaseous character, are formed. That nothing analogous to bitumen exists in coals is proved by the fact that the ordinary solvents for bituminous substances, such as bisulphide of carbon and benzol, have no effect upon them, as would be the case if they contained bitumen soluble in these reagents. The term is, however, a convenient one, and one the use of which is almost a necessity, from its having an almost universal currency among those connected with coal and coal mining.

Variations in composition are attended with corresponding differences in qualities, which are distinguished by special names. Thus the semi-anthracitic coals of South Wales are known as "dry steam coals," and when still less anthracitic are known simply as "steam coals," being especially valuable for use in marine steam-boilers, as they burn more readily than anthracite and with a larger amount of flame, while giving out a great amount of heat, and practically without producing smoke. Coals richer in hydrogen, on the other hand, are more useful for burning in open fires,—smiths' forges and furnaces,—where a long flame is required.

The excess of hydrogen in a coal above the amount necessary to combine with its oxygen to form water, is known as "disposable" hydrogen, and is a measure of the fitness of the coal for use in gas-making. This excess is greatest in what is known as cannel coal, the Lancashire kennel or candle coal, so named from the bright light it gives out when burning. This, although of very small value as fuel, commands a specially high price for gas-making. Cannel is more compact and duller than ordinary coal and can be wrought in the lathe and polished. These properties are most highly developed in the substance known as jet, which is a variety of cannel found in the lower oolitic strata of Yorkshire, and is almost entirely used for ornamental purposes, the whole quantity produced near Whitby, together with a further supply from Spain, being manufactured into articles of jewellery at that town.

By the term "ash" is understood the mineral matter remaining unconsumed after the complete combustion of the carbonaceous portion of a coal. According to Couriot (*Annales de la Société geologique de Belgique,* vol. xxiii., p. 105) the stratified character of the ash may be rendered apparent in an X-ray photograph of a piece of coal about an inch thick, when it appears in thin parallel bands, the combustible portion remaining transparent. It may also be rendered visible if a smooth block of free-burning coal is allowed to burn away quickly in an open fire, when the ash remains in thin grey or yellow bands on the surface of the block. The composition of the ashes of different coals is subject to considerable variation, as will be seen by the table below:—

Composition of the Ashes of Coals

True coals	Silica	Alumina	Ferric oxide	Lime	Magnesia	Potash	Sulphuric acid	Phosphoric acid	Total
Dowlais, South Wales	39·64	39·20	11·84	1·81	2·58	..	..	3·01	98·08
Ebbw Vale	53·00	35·01	..	3·94	2·20	..	4·89	0·88	99·92
Konigsgrube, Silesia.	55·41	18·95	16·06	3·21	1·87	2·05	1·73	0·36	99·64
Ohio, U.S.A.	44·60	41·10	7·40	3·61	1·28	1·82	0·59	0·29	100·69
Lignites:									
Helmstadt, Saxony	17·27	11·57	5·57	23·67	2·58	2·64	33·83	..	97·13
Edeleney, Hungary.	36·01	23·07	5·05	15·62	3·64	2·38	12·35	..	98·12

The composition of the ash of true coal approximates to that of a fire-clay, allowance being made for lime, which may be present either as carbonate or sulphate, and for sulphuric acid. Sulphur is derived mainly from iron pyrites, which yield sulphates by combustion. An indication of the character of the ash of a coal is afforded by its colour, white ash coals generally being freer from sulphur than those containing iron pyrites, which yield a red ash. There are, however, several striking exceptions, as for instance in the anthracite from Peru, which contains more than 10% of sulphur, and yields but a very small percentage of a white ash. In this coal, as well as in the lignite of Tasmania, known as white coal or Tasmanite, the sulphur occurs in organic combination, but is so firmly held that it can only be very partially expelled, even by exposure to a very high and continued heating out of contact with the air. An anthracite occurring in connection with the old volcanic rocks of Arthur's Seat, Edinburgh, which contains a large amount of sulphur in proportion to the ash, has been found to behave in a similar manner. Under ordinary condi-

tions, from $\frac{1}{8}$ to $\frac{1}{4}$ of the whole amount of sulphur in a coal is removed during combustion, the remaining $\frac{3}{4}$ to $\frac{7}{8}$ being found in the ash.

The amount of water present in freshly raised coals varies very considerably. It is generally largest in lignites, which may sometimes contain 30% or even more, while in the coals of the Coal Measures, it does not usually exceed from 5% to 10%. The loss in weight by exposure to the atmosphere from drying may be from $\frac{1}{2}$ to $\frac{3}{4}$ of the total amount of water contained.

When coal is heated to redness out of contact with the air, the more volatile constituents, water, hydrogen, oxygen and nitrogen, are in great part expelled, a portion of the carbon being also volatilized in the form of hydrocarbons and carbonic oxide, the greater part, however, remaining behind, together with all the mineral matter or ash, in the form of coke, or, as it is also called, "fixed carbon." The proportion of this residue is greatest in the more anthracitic or drier coals, but a more valuable product is yielded by those richer in hydrogen. Very important distinctions —those of caking or non-caking—are founded on the behaviour of coals when subjected to the process of coking. The former class undergo an incipient fusion or softening when heated, so that the fragments coalesce and yield a compact coke, while the latter (also called free-burning) preserve their form, producing a coke which is only serviceable when made from large pieces of coal, the smaller pieces being incoherent and of no value. The caking property is best developed in coals low in oxygen with 25 to 30% of volatile matters. As a matter of experience, it is found that caking coals lose that property when exposed to the action of the air for a lengthened period, or by heating to about 300° C, and that the dust or slack of non-caking coal may, in some instances, be converted into a coherent coke by exposing it suddenly to a very high temperature, or compressing it strongly before charging it into the oven. From the chemical point of view it might appear that the quantity of hydrogen is a governing factor in determining the cokability of a coal, for an otherwise non-coking coal can be made to coke by adding to it a very small percentage of hydrogen. (*See* also COKE.)

Electrical Power Uses.—An important aspect of the coal question, especially for Great Britain, is not so much how long the coal reserves will last, as how long will the reserves of high-class and easily available coal last. In other words, how long will coal be available at a cost not relatively disadvantageous to her nearest competitors.

The report of the electricity sub-committee of the British coal conservation committee (1918) stated: "It is obvious that improvement in the commercial prosperity of a country—that is to say, the average purchasing power of the individual—depends on increasing the output per head. If wages be raised merely by increasing the selling price of the goods in the home market, there is no real advance, and to increase the selling price of the goods in the neutral and open markets of the world, is hardly possible in view of international competition. The only way to increase prosperity is to increase the net output per head of the workers employed."

In the United States of America the amount of power used per worker is 56% more than in the United Kingdom; and the best cure for low wages is more motive power. It has been settled conclusively of late years that the most economical means of applying power to industry is the electric motor, that is, as the means of applying the power which may have been generated by any form of prime mover (water, steam, gas or oil). In Great Britain the water power is negligible and the oil nil, so the problem resolves itself into the most economical production of electric power from coal.

It has been calculated from the data available in the British census of production, and making certain necessary adjustments, that—excluding the horse-power used at blast furnaces, gasworks, etc., since the coal consumed in these industries is excluded from the estimate of coal consumption in industry—the total capacity of engines, *i.e.*, steam reciprocating, steam turbine, internal combustion, water power, and other power, in use was 10,024,996 h.p., of which—

91·2% was in respect of steam,
6·4% " " " " internal combustion,
1·7% " " " " water power,
0·7% " " " " other power.

It has been estimated, too (*see* report of the coal conservation committee), that were a complete system of electrification inaugurated in Great Britain, on the basis of the extent to which power is used at present, a saving of 55,000,000 tons of coal per annum might be effected, resulting in a saving of £27,500,000 (valuing the coal at only 10s. per ton), while if the coal were used for extended and new industrial purposes, some 15,000,000 h.p. would be continuously available for the purpose throughout the year.

This estimate is based upon the supposition that 7lb. of coal per horse-power hour is the present average consumption of coal in production of steam power (a figure which is certainly on the low side), which corresponds with 1·54lb. per h.p.-hour delivered at consumers terminals in the case of the Newcastle Electric Supply Co., perhaps the largest electric power concern in Great Britain in 1928.

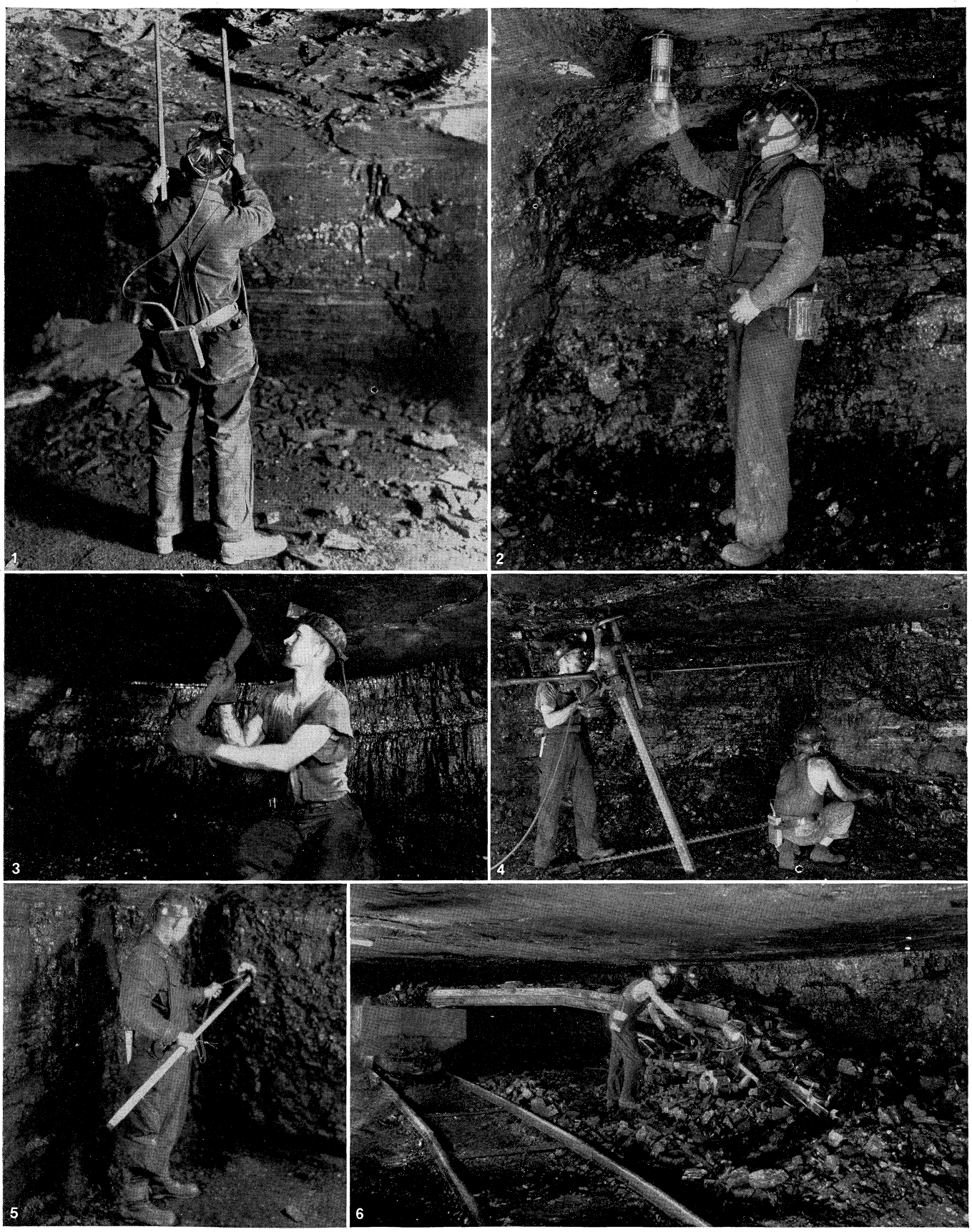
Coal Carbonization.—Under the heading carbonization of coal must be included the gas industry, the coke industry, and the new industry which is springing up, namely, the low temperature carbonization of coal. In the first named the production of what is termed town gas is only part of the activities of the gas-maker. There are a number of by-products besides the residual coke, or "poor man's coal" as it used to be termed. During the war the resources of even the largest and best equipped gasworks were strained to the utmost to secure an increased output of benzene, naphtha, creosote and fuel oil. Another important by-product is sulphate of ammonia.

Gas-making, as well as the making of metallurgical coke, is a "high temperature carbonization" process with temperatures of 1,000° C or thereabouts, whereas in "low temperature carbonization" the temperature may range from 400° to 800° C. The results of low temperature carbonization as compared with high temperature carbonization are: a lower volume of gas but a higher yield of tar of lower specific gravity; a low yield of benzene and its homologues, but a large yield of the paraffin group, light fuel oils. The yield of ammonia compounds under low-temperature carbonization is usually negligible. Whereas the coke made under high-temperature conditions is difficult to burn under domestic conditions in Great Britain, being chiefly usable for metallurgical purposes; that yielded by low-temperature carbonization is an excellent household fuel containing as it does from 6 to 12% of volatile hydrocarbons. (*See* also Section VII. and the articles GAS MANUFACTURE; COKE; and LOW TEMPERATURE CARBONIZATION.)

Looked at from the point of view of coal conservation there can be no doubt that a large field of fruitful possibilities exists. The wasteful and harmful process of coking coal in beehive ovens, and of burning coal for power purposes and in the domestic hearth, processes whereby the gas and other by-products are dissipated into the atmosphere, results annually in an enormous loss of potential wealth, as well as injury to health and destruction of buildings and vegetation.

Once the leader in the manufacture of coke, there has been a failure in Great Britain to keep abreast of development in some other parts of the world in regard to constructional materials, types of ovens, size of battery, and cost of production. Where the coke produced is to be used at blast furnaces with steel works adjacent thereto, the coke oven plant will be most economically situated in close proximity to the latter, as there is then provided a source of demand for the waste gas in the steel works. If, however, a market exists for all the gas in the neighbourhood of the colliery for lighting purposes, then the case is reversed, and cost of transport of the coal to the steel works is saved.

In the United States of America the policy is to have the coke ovens adjoining the iron and steel works, and to have them in very large units. There are great advantages in having centralized coking establishments instead of many small and scattered units. A recent writer (R. Ray, B.Sc., F.C.S., *The British Coking Industry and Some of its Products,* Institute of Fuel, Nov. 1927), taking

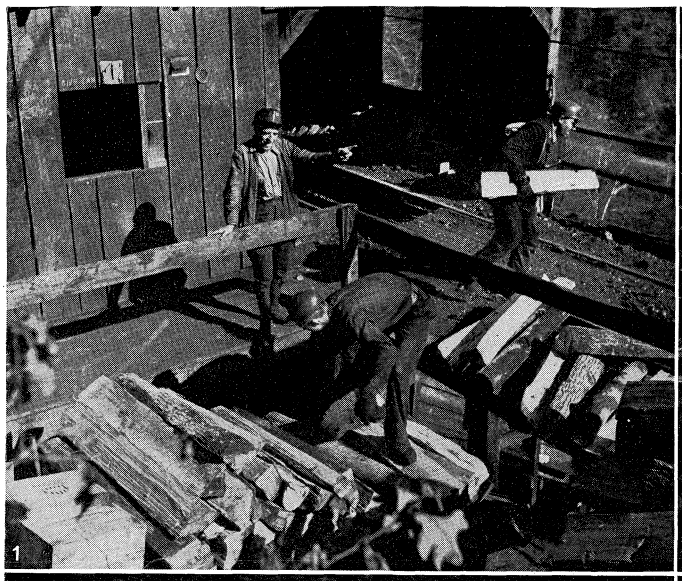


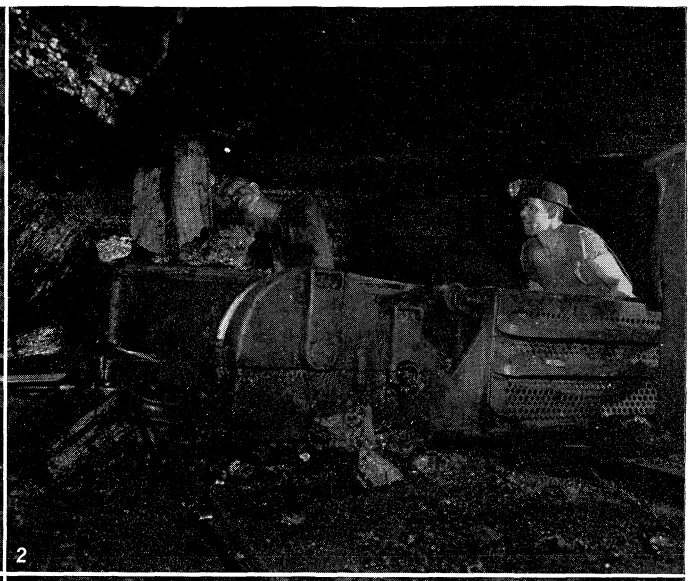
BY COURTESY OF (1, 2, 4-6) BUREAU OF MINES, U.S. DEPARTMENT OF THE INTERIOR; PHOTOGRAPH, (3) PICTORIAL PUBLISHING CO.

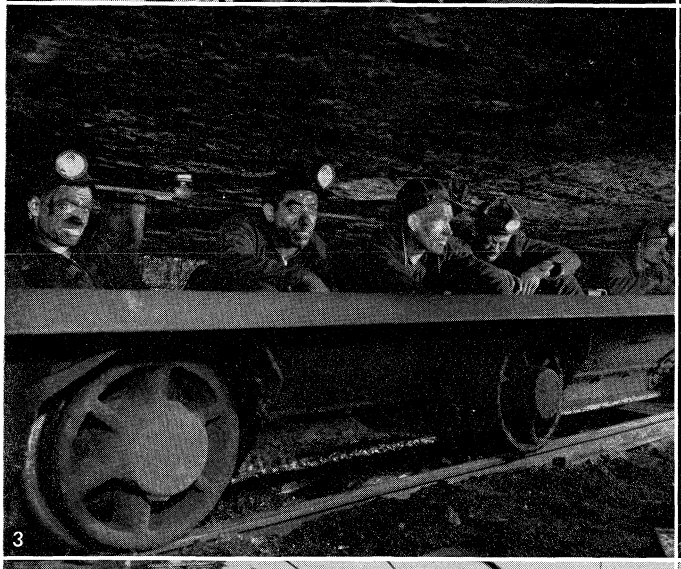
OPERATIONS IN COAL MINING

1. Workman testing the roof of a seam
2. Miner equipped with gas mask, testing for explosive gas and for oxygen deficiency
3. Working a low seam with ordinary pick
4. Electric post drill in operation
5. Charging a hole with explosive, using a wood tamping stick
6. Loading machine in operation at a mine face

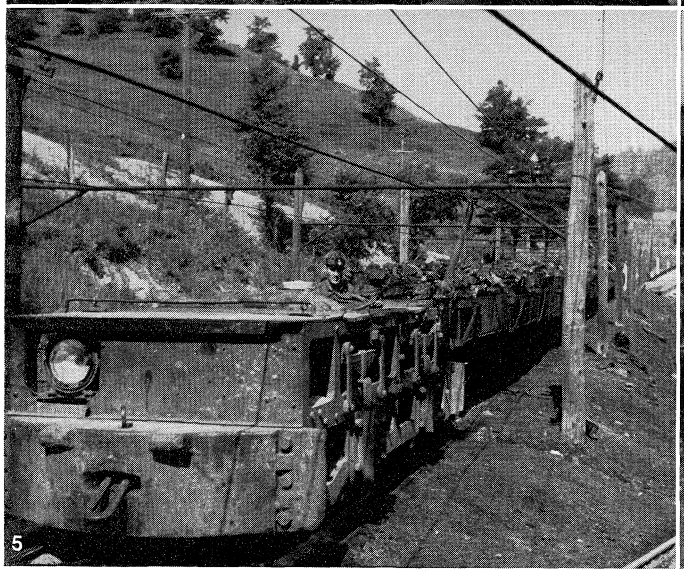
COAL AND COAL MINING

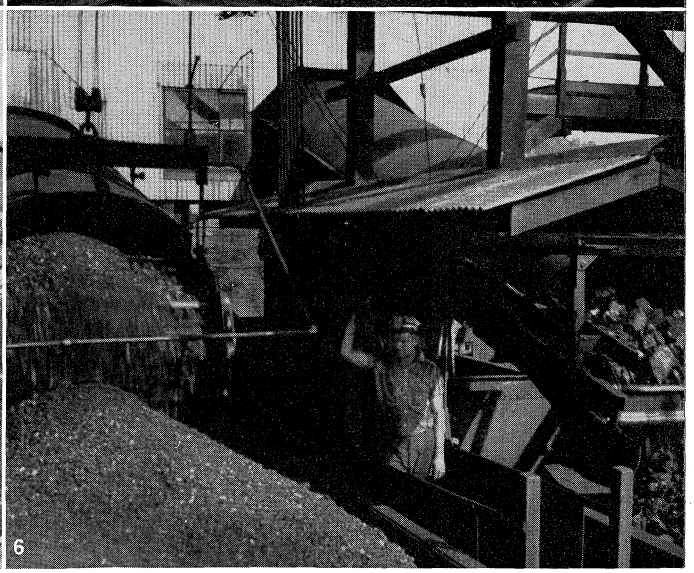












PHOTOGRAPHS, (1-4) HEYER FROM PICTORIAL PUBLISHING CO., (5, 6) HOBART FROM MONKMEYER

MINING AND TRANSPORTING COAL

1. Assembling timber posts at the tipple of a mine, for use in supporting the mine roof at regular intervals
2. Miner setting a timber post to hold up the roof while a machine cutter waits to operate a giant saw
3. Loaded "man-trip" train taking a shift of miners out of a low-seam mine
4. Motorman of a coal train emerging from a low-seam mine
5. Coal train outside the mine
6. Loading coal into railroad cars

a battery producing 270 tons a day and comparing it with one producing 1,300 tons, gives the costs per ton of the coke produced as 11s. 11.53d. and 6s. 1.27d., respectively.

The manner in which coal can be conserved in the processes of carbonization lies in the prevention of waste by recovering to the greatest extent possible the potential wealth in the coal. On the other hand, were the partially coked coal resulting from the low-temperature treatment of coal to be used for domestic heating instead of raw coal, the probability is that the consumption of coal for household purposes would be increased by one-third, on the basis that 20cwt. of raw coal will make 13cwt. of low-temperature coke.

Waste of Coal.—The other direction in which coal can be conserved is in the process of being mined, though the loss of coal in mining is not so great as is commonly supposed and not nearly as much as it was a century ago.

It used to be customary at one time—especially in some coalfields, South Wales for instance—to cast back the small coal into the goaf or waste, but very little is left underground at the present time (1928). Under 1% of the total coal gotten is left underground. The total approximate quantity of small coal cast back in the coalfields of Great Britain in the year 1917, as far as could be ascertained by the coal conservation committee, was 2,325,000 tons, of which 1,502,000 tons were attributable to South Wales. More extensive washing arrangements at collieries and in briquetting would conduce to the absorption of this loss in normal times, but at another time the difficulty may lie in marketing what coal is produced owing to the world depression in industry generally.

One source of loss—perhaps the greatest—is that in regard to the working of very thick seams lying at considerable depths from the surface. Under existing methods of working the so-called ten yard or thick coal of South Staffordshire (fully 10,000ac. of which lie at a depth of 400yd. and more from the surface, with an average thickness of 24ft., and approximately contain a quantity of available coal equal to at least 288,000,000 tons), the loss in working the seam at this depth has been estimated at 40% or 115,200,000 tons. But probably by a system of packing the wastes with spoil derived from the surface carried under hydraulic pressure, or even under compressed air pressure (the latter a process now being tried in Germany), this loss will become negligible.

Other sources of loss are those due to the spontaneous combustion of coal underground; from coal left in barriers; through coal left for support; through the drowning out of workings, and through having to leave "top" coal underground. The difficulties from spontaneous combustion are being overcome as the result of scientific enquiry. The loss through leaving top coal as being too poor in quality to work will be met by the creation of a market due to the advent of low-temperature carbonization and its use of coal in a pulverized form (*see* article on PULVERIZED FUEL).

Of the quantity of "mineral" raised at the collieries of Great Britain, it is estimated that 2·9% is refuse, but from this refuse 4·7% is recovered in the form of coal.

The figures for the year 1917 were as follows:—

	Tons	
Gross output	271,030,844	
Refuse	8,046,935,	or 2·9% of gross output.
Coal recovered from refuse	381,598,	or 4·7% of the refuse.

There would appear to be room also for the introduction of methods of saving coal in the process of cleaning.

The consumption of fuel for the production of power at mines amounted in 1917 to nearly 17,000,000 tons, or 6·2% of the output. Under a system of the generation or transmission of electrical energy "in bulk," with, consequentially, the most perfect means of fuel consumption, the probability is that the power necessary to work the collieries could be provided with a coal consumption of one-third that of the present amount, or result in a saving of about 10,000,000 tons of coal annually. It must be borne in mind, however, in this connection that the coal consumed in raising steam at collieries is frequently refuse and of such poor quality as to be difficult of disposal otherwise.

SECTION IV.: COAL MINERS: THEIR CHARACTERISTICS AND OCCUPATIONS

The coal miners of Great Britain, that is, those in employment at the mines, numbered 975,710 persons in 1927; and when the unemployed, the women and children and various surface workers are included, this figure likely exceeds 3,000,000. Differing greatly as between districts in point of disposition and dialect, they have three characteristics in common—independence, suspicion as to motive, and loyalty to their leaders. But whereas the Welsh miner is, owing to his Celtic temperament, impulsive, warm-hearted, imaginative and voluble, a good friend and a good hater, the miner of the northern coalfields is more stolid, slower to action and less easily reconcilable to altered conditions. This is instanced by the fact that, though the Welsh miner will come out on strike more readily than the northern miner, once the latter is on strike he will not so readily return to work as the Welshman. One of the qualities which coal miners share the world over is their helpfulness towards each other in times of distress.

In order to understand the miners one has to have regard to their history. Their characteristics are largely the outcome of their environment. Whereas the industries in which most other manual workers are engaged are of recent origin, coal mining is a very ancient occupation. Since—and probably before—King Henry III. granted to the goodmen of Newcastle-on-Tyne a licence to dig coals in the Castlegarth, there have been coal mines in Britain. In 1245 mention is made of the ways of persons employed in getting coal. In 1291 there is mention of the grant of a mine at Pittenerief in Fifeshire to the Abbey of Dumfermline; and coal was introduced into London in 1306.

Living in communities apart from other people, the miners have in the process of time acquired characteristics and a terminology peculiar to themselves. The nature of their work in the silence and dark of the mine conduces towards rumination. The long hours and arduous work have been preventative of leisure. Their sense of grievance has come down from the "bad old days" when women and young children—the latter of eight years and younger—were employed for 10 to 12 hrs. in degrading work below ground, and when "the colliers and salters of the North were bondmen, until 1775, when by Act 15 Geo. iii. C 28 their fetters were struck off" (Wade's *History of the Middle and Working Classes,* p. 393). "They were in a state of slavery or bondage, bound to the collieries and salt works where they worked for life, and transferable with the collieries and salt works when their original masters had no further use for them" (Wade's *British Chronology,* p. 530, 2nd ed. 1841). But all that is past and gone and is only here referred to as explanatory of much which is little understood in the coal miner of to-day.

Occupations.—In spite of the developments and improvements rendered possible in mines by the forward march of science, manual labour still plays a most important part in coal mining, and as much as from 60 to 70% of the cost of "getting" and delivering the coal into wagons is represented by workmen's wages. The number of occupations covered by the terms coal miner, collier or pitman, which are synonymous, are much greater than is commonly supposed. Thus, taking the case of a large group of collieries in South Wales, the late Mr. Hugh Bramwell, when chairman of the South Wales Coal Owners' Association, in giving evidence before the coal mining organization committee in Sept. 1915, showed the relative proportion of the different classes to be as follows:—

	Per cent.	
Underground Labour		
Colliers (*i.e.,* men and boys employed in getting and filling coal at the face)	36	
Repairers (engaged mostly in afternoons and nights)	28	
Traffic men (hauliers, engine drivers, hutchers)	18	
Officials (overmen and foremen)	2	84
Surface Labour		
Traffic and screening	6	
Enginemen and stokers	2	
Mechanics	3	
Foremen, clerks and weighers	1½	
Sundry labourers	3½	16
		100

Underground labour at collieries comprises the following occupations, viz.:—

Hewers (known also as colliers, coalgetters, pitmen, pikemen or stallmen).
Shotfirers.
Putters (known also as hauliers, trammers or hurriers).
Shifters (known also as repairers, timberers, etc.).
Stonemen (known also as brushers, drifters, ridders, caunchmen).
Wastemen (workers in the return airways).
Drivers (known also as pony drivers, horse drivers).
Inclines workers (known also as ginney workers).
Helpers-up.
Rolley waymen (known also as mechanical haulage hands, wagon way men, road corporals).
Waterleaders.
Onsetters (known also as hutchers, hitchers-on, cage loaders).
Horsekeeper (known also as farrier).
Deputies (known also as deputy overmen, firemen, chargemen).
Overmen (known also as underlookers).

The proportion of coalgetters, *i.e.*, hewers or colliers, to the total of underground workers for all districts varies between 37 and 40%, *e.g.*, 1913, 40·8%, 1918, 37·7% (*see* report of coal industry commission, 1919).

In modern England the standard of living of the miner has been continually rising for a long time, as in other classes of labour. Taking the north of England as an example, the hewers' wages at the beginning of the 18th century were 1s. to 1s. 2d. per shift; at the beginning of the 19th century they had doubled, being 2s. 3d. to 2s. d. for a shift of 8 to 12 hrs. and in 1913, the last pre-World War year, they were 7s. to 8s. a shift of 7hr., in addition to which they had free house and coal, the value of which was not less than 1s. 8d. per shift. The chief impression left by an historical review of coal mining in the United Kingdom is the enormous progress made during the last two or three generations in every respect except the return on capital.

The United States of America is frequently quoted as offering a higher standard of living to employees than any Old World country, yet we find a high American authority (Edward T. Divine, *Coal* 1925) stating that the home conditions of the anthracite miners is very indifferent, the sanitary conditions are bad, nor does the standard of living correspond to the expectation created by the earnings. Of the bituminous coal miners the same is said to be true. In the "company towns," where many of the miners have to live, the author epitomizes the situation thus: "The general result is anything but a normal American community of free citizens."

SECTION V.: COAL MINING: THE ACTUAL OPERATIONS; COLLIERY OUTPUTS

The opening and laying out of a colliery is rarely undertaken without a preliminary examination of the character of the strata by means of borings, either for the purpose of determining the number and nature of the coal seams in new ground, or the position of the particular seam or seams which it is proposed to work in extensions of known coalfields.

Determination of Depth and Dip of Coal Seams.—The principle of proving a mineral field by boring, in the case where the true dip of the measure is known, is illustrated by fig. 7, which represents a line direct from the dip to the rise of the field, the inclination of the strata being one in eight, which is about 7° or 4·5in. to the yard. No. 1 bore is commenced at the dip, and reaches a seam of coal (A) at 40 fathoms, or 240ft. At this depth it is considered proper to remove nearer to the outcrop so that lower strata may be bored into at a less depth, and a second bore is commenced. To find the position of No. 2, so as to form a continuous section, it is necessary to reckon the inclination of the strata, which is 1 in 8; and as bore No. 1 was 40 fathoms in depth, we multiply the depth by the rate of inclination, 40×8=320 fathoms, or 1,920ft., which gives the point at which the coal seam (A) should reach the surface. But there is generally a certain depth of alluvial cover which requires to be deducted, and which we call 3 fathoms, then, 40−3=37×8=296 fathoms; or, say, 296 fathoms is the distance that the second bore should be placed to the rise of the first, so as to have, for certain, the seam of coal (A) in clear connection with the seam of coal (B). In bore No. 3, where the seam (B), according to the same system, should have been found at or near the surface, another seam (C) is proved at a considerable depth, differing in character

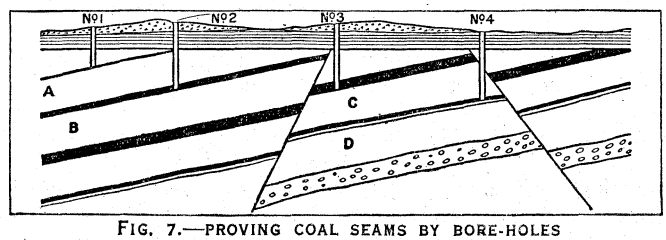


FIG. 7.—PROVING COAL SEAMS BY BORE-HOLES

and thickness from either of the preceding. This derangement being carefully noted, another bore to the outcrop on the same principle is put down for the purpose of proving the seam (C); the nature of the strata at first is found to agree with the latter part of that bored through in No. 3, but immediately on crossing the dislocation seen in the figure it is changed and the deeper seam (D) is found.

The evidence therefore of these bores (3 and 4) indicates some material derangement, which is then proved by other bores, either towards the dip or the outcrop, according to the judgment of the borer, so as to ascertain the best position for sinking pits. (*See* BORING.)

Winning the Seam.—The working of coal may be conducted either by means of levels or galleries, known as adits, driven from the outcrop in a valley, or by shafts or pits sunk from the surface. In the early days of coal mining, open working or quarrying from the outcrop of the seams was practised to a considerable extent; but there are now few, if any, places in Great Britain where this can be done. (*See* article on ADIT.) In Great Britain, every coal mine has—unless exempted under certain conditions—to be provided with two shafts or outlets, affording separate means of ingress and egress, not less than 15 yd. apart, and having between them a communication of not less than 4ft. by 4ft.

The operations by which the coal is reached and laid out for removal are known as "winning," the actual "working" or extraction of the coal being termed "getting." A seam of coal is said to be won when the shafts reach it. The process of sinking the shafts is treated under a separate article to which the reader is referred. (*See* article SHAFT SINKING.)

Opening Out the Mine.—The shafts having been sunk and equipped, and the method of working having been decided upon, it is necessary to arrange for the lay-out, namely, the formation of the shaft inset, the size of the shaft pillars, the position of the shaft sidings, the making of the stables for the horses and ponies, and the number and position of the main roads.

The laying out of a colliery after the coal has been won, by sinkings or levels, may be accomplished in various ways, according to the nature of the coal, its thickness and dip, and the extent of ground to be worked. In parts of the South Staffordshire and other coalfields, where only shallow pits are required, a pair of pits may be sunk for a very few acres, while on the other hand where sinking is deep and consequently expensive, an area of some thousands of acres may be commanded from a couple of pits. In the latter case, which represents the most approved practice, the sinking is usually placed about the centre of the ground, so that the workings may radiate in every direction from the pit bottom with the view of employing the greatest number of hands to advantage. Where a large area cannot be commanded, it is best to sink to the lowest point of the field for the convenience of drawing the coal and for drainage of water. It is necessary to maintain a thick barrier of unwrought coal between the boundary of the mine and the workings of a neighbouring colliery, especially if the latter are to the rise. If a prominent line of fault crosses the area it may usually be a convenient division of the fields into sections or districts.

The first process in laying out the workings, if the seams are only moderately inclined, consists in driving levels in the coal seam from both sides of the shaft, which, having proceeded a sufficient distance, the "shaft pillars" are formed. These consist of large pillars of coal which are left unworked as a support to the shaft until the mine is worked out, when they are then worked off. (The arrangement of these pillars and of the main roads are illustrated in the article AIRWAY, to which the reader is referred.) This pillar is known in Scotland as the "pit bottom stoop." The junction of the levels with the pit is known as the "pit eye"; it is usually of an enlarged section, and lined with masonry or brick-work, so as to afford room for handling the trams (tubs, boxes, hutches) of coal brought from the working faces. In this portion of the pit are generally placed the hauling engine and the stables.

By the British Coal Mines Act of 1911 it is required that, in all mines opened after the commencement of that act, there shall be two main intakes—there are exemptions from this provision in certain exceptional and specified cases—of such size and maintained in such condition as to afford a ready means of ingress to and egress from the workings. Only one of these roads can be used for the haulage of coal. The distance from the downcast shaft, within which the two main intakes shall not be required to be provided, is the distance between the shaft and the edge of the shaft pillars (*see* fig. 8), and in the case of an inclined shaft or level entrance not driven in the coal seam, the distance shall be the distance between the point where the shaft or entrance strikes the seam and the edge of the pillar left to support the incline or entrance. If driven in the coal seam, the distance is 200yd. from the mouth of the entrance.

When the seams sunk to are highly inclined, they are won by driving from the shafts "cross-measure" or "level stone" drifts—or "cruts," as they are called in the steep or Rearer working (*see* next section) of North Staffordshire. This is shown in fig. 9, which is a section of shaft and the roads immediate thereto at Gelsenkirchen colliery, Westphalia, illustrating an arrangement of cross-measure drifts and subsidiary drifts, connecting the workings in highly inclined seams with the shafts. Fig. 10 is a section of a subsidiary drift at the same colliery.

The Bord and Pillar System of Working.—The removal of the coal after the roads have been driven may be effected in many ways, according to the custom of the district. All these may, however, be considered as modifications of two main systems, viz., the Bord and Pillar (or "stoop and room") and the Longwall.

In the Bord and Pillar system the field is divided into strips by numerous openings or excavations called "bords" (*i.e.*, roads) driven at right angles to the main cleavage or "cleat," these openings being again divided by cutting through them at intervals with roads termed "walls" (which are parallel to the main cleavage or cleat), so as to leave a series of pillars arranged chequerwise over the entire area. The pillars are left for the support of the roof as the workings advance, so as to keep the mine open and free from waste. In the oldest form of this class of working, where the size of the pillar was about equal to the width of the "bord," from 50–70% of the whole seam was removed, the remainder being left in the pillars. Pillars are now made much larger than formerly; 22yd.×44yd., 44yd.×44yd., or even 44yd.×66yd. are frequent sizes, and the "bords" are made 5–6yd. wide, the "walls" 2 to 3 yards. (*See* BORD AND PILLAR.)

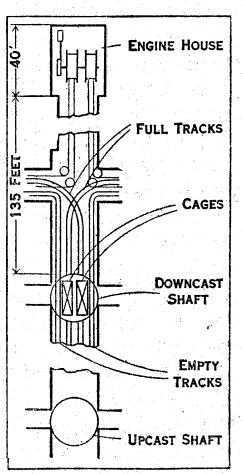
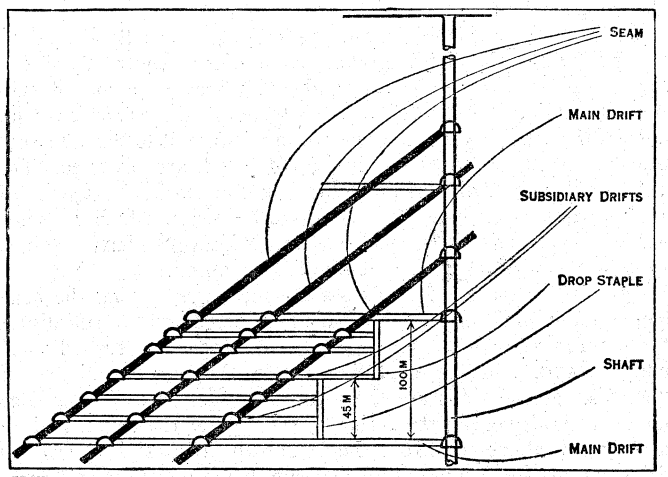


FIG. 8.—PLAN OF SHAFT SIDINGS SHOWING HAULAGE ENGINE, NAIL TRACKS, ROPES AND SHEAVES

In the formation of the pillars (the first working, or working "in the whole" as it is technically termed) a much less percentage of coal is got than in the removal of the pillars (the second or "broken" working), and the coal is usually, unless the pillars are crushed, smaller in size and the output per man less owing to blasting being generally necessary, especially if the coal seam be hard in character. If the pillars are too small or are irregularly removed, a "creep" is liable to set in, especially if the floor be soft; that is, the pillar will be forced into the floor owing to insufficiency of support offered to the superincumbent strata.

A coal seam with a soft pavement (floor, thill, spavin) and a hard roof present the conditions most favourable to "creep," the



FROM SIR R. REDMAYNE, "MODERN PRACTICE IN COAL MINING" (LONGMANS, GREEN & CO.)

FIG. 9.—SECTION OF SHAFT AND CROSS-MEASURE DRIFTS (CRUTS) AT GELSENKIRCHEN COLLIERY, WESTPHALIA, ILLUSTRATIVE OF A METHOD OF WORKING HIGHLY INCLINED SEAMS OF COAL

first indication of which is a dull hollow sound heard when treading on the pavement or floor, occasioned by some of the individual layers parting from each other as shown at (a) fig. 11; the succeeding stages of creep are shown at (b) (c) (d) (f) and (g) in the same figure; the last being the final stage, when the coal begins to sustain the pressure from the overlying strata, in common with the disturbed pavement.

"Thrusts" or "sits" are the reverse of creeps; in the one case the pavement is forced up, in the other the roof is forced or falls down for want of proper support, or tenacity in itself. This accident generally arises from an insufficient size of the pillars; some roofs, however, are so difficult to support that thrusts take place where the half of the coal is left in pillars. Fig. 12 will convey a general idea of the appearance of thrust—(k) (m) (n) showing different stages.

In the modern method of pillar working, as carried out in the Durham and Northumberland districts, the "bords" usually are from 5 to 6yd. wide, while the pillars are 22yd. broad and 30yd. long or larger, which are subsequently got out on coming back; or the "whole is followed up with the broken," that is to say, the pillars are removed contemporaneously with the projection of the "whole" workings, though well to the rear of them; a barrier of two or three ranges of pillars being left between the "working in the solid" or "whole," and the pillars which are being worked off. The space from which the entire quantity of coal has been removed is known in different districts as the "goaf," "gob" or "waste."

Modifications of the Bord and Pillar.—The modifications of Bord and Pillar working practised in Great Britain, and abroad also, are those known in Great Britain by the names of (1) Single and Double Stall, (2) Wide or Square work, and (3) Rearer workings. The first named is chiefly practised in South Wales, more particularly in the working of the anthracite seams and the "dry" steam coals, though even in the latter the Longwall method (*see* subsequent section) is adopted wherever practicable. The wide or square work is restricted to the working of the Thick or Ten Yard coal of South Staffordshire. The rearer working, which is a method of working highly inclined seams, is peculiar to North Staffordshire.

In the Stall working, or "bord and banks," as it is termed when practised in Yorkshire, where support is required to buildings, railways or reservoirs, the "stall" or "bord" is much wider, as well as

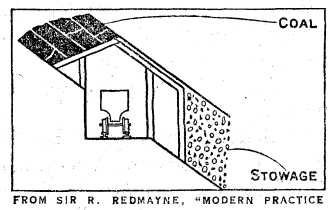
the pillars or "banks," than in South Wales. In the South Wales case the levels are driven on the strike of the seam and out of these, at intervals of 15yd., stalls 5–6yd. wide at their full width are turned away and advanced on the full rise of the seam. When the stalls have attained their limit in length, a factor which will be governed largely by the character of the floor and roof, the pillars separating the stalls will be worked off. The "double entry" method of working in the United States of America is practically the same method.

In the case of Double Stall, the stalls are usually driven 10 yards in width, the dividing pillars being of like width. A road is kept up either side of the stall and maintained by a row of supports, the middle portion of the stall being filled more or less with débris, if such is available. On attaining its full length the separating pillars, or "ribs" as they are termed, are removed. The very thick and highly inclined seam in the anthracite region of Pennsylvania known as the "Mammoth" seam, which in some districts averages 60ft. in thickness and is known to have attained to 100ft., is worked by the Double Stall method.

Level tunnels are driven across the measures cutting the coal, slopes about 28ft. wide and 15ft. high are driven on the full dip of the seam. Out of these slopes level stone roads are turned away every 100yd. and the coal worked to the rise by means of "breasts," as the stalls are there termed (figs. 13 and 14). The level (a) is driven on the strike in the top of the seam, and an airway (b) above it. From the level two "chutes" (*c*) (c) are driven across the full width of the seam, being made 9ft. wide and 6ft. high, and at such an angle as will permit of the easy contact of the broken coal. The chutes are widened out on reaching the floor of the seam, the face of the coal being cut up to the top of the seam, as shown in the figure, and the breast advanced upwards. The distance between the chutes is about 30 feet. Through the pillar separating the stalls are driven the manways (*d*) with branches (*e*) (e) right and left connecting the two manways, which are supported by timber (fig. 15).

Perhaps the Wide or Square work as practised in South Staffordshire for getting the Thick or Ten Yard seam of that field is the method of working chiefly practised on an abnormally thick seam which is flat or of moderate inclination. Though it is probably one of the most wasteful of all methods now practised, and many modifications have been tried, it still proves the most effective method of working a seam under the peculiar conditions named.

The main roads having been driven out—in the lower part of the coal—to the boundary, and the branch or district roads turned away right and left and also driven to the boundary, the coal opened out by the latter is worked by dividing it into a number of large chambers termed in South Staffordshire "sides of work" (fig. 16). A side of work when completed will be 50yd. or more square, each chamber or "side of work" being separated from an "adjoining" side by a barrier of coal 8–10yd. wide, which is locally termed a "fire rib," the only openings between the chambers being those necessary for ventilation (*see* fig. 16). In forming a side of work the roof coal is cut down bed by bed according to the partings in the seam (for the thick coal of South Staffordshire consists of a series of closely associated coal seams, varying from 8 to 12 or 13ft., divided from each other by their partings, but making together one great bed from 15 to 36 or even in some cases 40ft. in thickness), small pillars being left for the support of the roof.



FROM SIR R. REDMAYNE, "MODERN PRACTICE IN COAL MINING" (LONGMANS, GREEN & CO.)

FIG. 10.—CROSS-SECTION OF A SUBSIDIARY DRIFT AT GELSENKIRCHEN COLLIERY, WESTPHALIA

On the abandonment of a side of work the roads penetrating the barriers for the purposes of entry, ventilation and haulage, and known as "bolt holes," are dammed off so as to prevent risk of spontaneous combustion, to which this seam is very liable. Years after, when the roof has subsided and there are settled conditions of superincumbent strata, these abandoned sides of work are re-entered and the pillars recovered as far as possible. There may be even a third working for the recovery of the barriers; so that, although in the first working not more than from 40–50% of the coal be recovered, ultimately over a period of years, the loss of coal may not exceed 10%. But the coal gotten in these later workings is frequently considerably crushed.

So far the workings subsequent to the first working have been confined to the "exposed" coalfield where the coal exists at shallow depths. The problem of recovery of the ribs and pillars when working at great depths in the "hidden" coalfield, where the coal measures are overlaid by the "Red" rocks as the Permian and Triassic systems are sometimes locally designated (*e.g.*, at Baggeridge and Hamstead collieries, where, at the latter colliery, the coal lies in parts at a depth of over 700yd. from the surface), is as yet unsolved, for the crush will be very considerable.

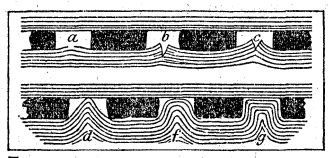


FIG. 11.—ILLUSTRATING THE STAGES OF "CREEP" IN A COAL MINE

Not only are very thick seams more dangerous to work than thin seams by reason of the difficulties in the way of effective support of roofs and sides and from liability to spontaneous combustion, but the coal is gotten at a higher cost per ton than in the case of seams of moderate thickness, as for instance 5 to 7 feet. When thin seams or seams of moderate thickness are highly inclined, they are usually worked by the Rearer method or by the Longwall system, *e.g.*, Bristol method, Scotch method or the Belgian and French methods, *tailles chassantes* or *tailles montantes*.

The Rearer method consists in laying out the mine in "panels" or districts of pillars to the rise from off the main roadways, which are driven on the "strike" or level course of the seam. The chief novelty of the system consists in the manner of working off the pillars which is commenced as soon as the panel reaches the barrier. The pillar is "entered up," that is, worked off in stages (or "shoulders," as the cuts are termed locally) in an upward direction, the angle of the workings being kept at about 45°. The coal falling into the level is drawn away and lowered down the incline, which constitutes the self-acting incline haulage road of the panel, on to the main level, along which it is hauled to the shaft. Scaffolding has to be erected to enable the miners to work and to protect them against falls, but ultimately, if the pillar being removed is below the goaf or gob, on breaking through into the goaf above it gradually fills up the excavated space and affords standing room for the coal hewer. The loss of coal in this method of working is very heavy by reason of crush and unrecoverable barriers and pillars. It has been estimated that not more than 60% of the available coal is recovered and raised to the surface.

Longwall System of Working.—The second great system of working is that known as Longwall or Long-work. This system or method of working, though it has been in operation at collieries for fully a century, and longer still in metal mines, has only within the last 50 years or so come into wide favour in coal mines. The coal is taken away either in broad faces from roads (gates, gateways or stalls), in some cases 10 to 11 but more commonly about 40–50yd. apart and parallel to each other, the essential feature being the removal of the whole of the coal at once, without first subdividing it into pillars to be taken away at a second working. The roof is temporarily supported by wooden props and by stone packs (walling) along either side of the gate roads, two or three yards in width, with intermediate pack walls in the goaf (gob or waste), if there is sufficient stone (dirt) to allow of their erection. The roof at the face is upheld by props, usually with "lids," *i.e.*, short pieces of timber flat on the side against the roof.

The general character of a long-wall working is shown in fig. 17B, which represents an area of about 500ac. of hard steam coal. The principal road extends from the shafts southward; and on both sides of it the coal has been removed from the light-shaded area by cutting it back towards the boundaries, along faces about 50yd. in length, those nearest to the shaft being kept in advance of those farther away, producing a step-shaped outline to the face of the whole coal. It will be seen that by this method the whole

of the seam, with the exception of the pillars which are sometimes left to protect the main roadways, is removed in one working. Where coal is left for the support of the main roads, it is recovered when the field has been worked to its boundaries, but more commonly the main roads are made in the goaf. The roads for drawing the coal from the working faces to the main haulage road are kept open by walling through the waste or goaf produced by the fall of the unsupported roof and are cut off at intervals by crossgates. The direction of the air current is shown by arrows, the return air passing from the face into the return airways to the up-cast shaft.

This is the method of working "Longwall forward," *i.e.*, taking the coal in advance from the pit towards the boundary, with roads kept open through the gob. Another method consists in driving towards the boundary and taking the coal backward towards the shafts, or working homeward, or "retreating Longwall," as it is technically termed, allowing the waste to close up without roads having to be kept open through it. This is of course preferable in many cases, though not always, but is only applicable where the owner of the mine can afford to expend the capital required to reach the limit of the field, in excess of that necessary when the raising of coal proceeds *pari passu* with the extension of the main roads, and where he is prepared to go a long time without receiving any return on his capital.

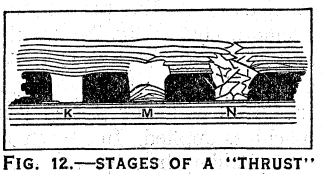


FIG. 12.—STAGES OF A "THRUST" IN A COAL MINE

The above is the method practised in working a thin seam of coal or a seam of moderate thickness, *i.e.*, from 1ft. 6in. to 7–8ft. in thickness, and that is flat or of moderate inclination. In Great Britain there are no very thick seams which are highly inclined; such thick seams as occur (*e.g.*, south Staffordshire) are practically flat. But in the coalfield of St. Etienne, there is one seam in particular which is very thick and highly inclined, the Grande Couche by name, which reaches to 80ft. in thickness, with an inclination varying from 30°–90° from the horizontal.

The method by which the seam is worked consists in driving levels along the "strike" or level course of the seam, one above the other, which are connected by inclines, and the coal between the levels is worked out by means of either horizontal or inclined slices. Cross-cuts or level holings are driven to the "hanging wall" and the "foot wall," out of which the slices or "lifts" are taken, and the coal worked off, the excavated part being tightly packed with stone. The workings of each sub-stage rest on the packing of the sub-stage below it, the sub-stages being worked in ascending order.

The coal concession is divided into "panels" or districts 130yd. wide and an inclined plane made in the middle of it, and one on either side from the bottom main level to the bottom of the first or top stage, the level in each sub-stage being turned away out of the middle incline and holed into the side or airway inclines, which secures the proper ventilation of the panel. It will be seen that the method is really a modification of the Longwall system.

The following instances of the Longwall system as applied to the working of thin seams or seams of moderate thickness where highly inclined, may be given as severally descriptive of the procedure in Scotland, Belgium and France respectively.

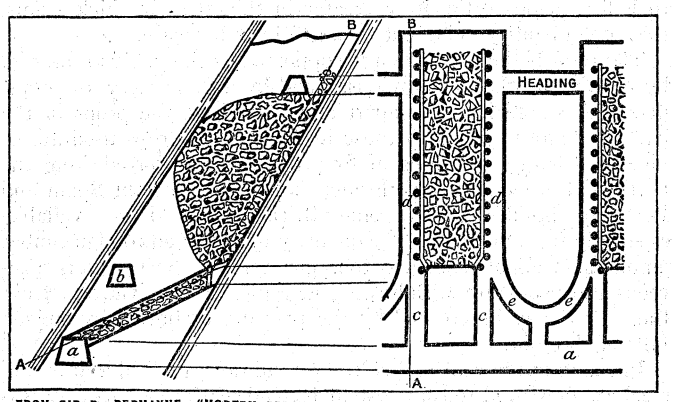
Scotland.—In the case under consideration, the seam is 2 ft. 4 in. thick, and its inclination from the horizontal 70°, the seam being won by cross-measure drifts driven out from the shafts to cut it. In the seam, levels are driven about every 30yd. and the coal worked off the side as in "overhead" stoping in the case of metalliferous mining, up to the level above, the coal falling down shoots, spaced 12yd. apart, into the level below. These shoots are about 3ft. sq. and are on the full rise of the seam and are "checked" (*see* fig. 17A) in order to break the fall of the coal. The men travel to the face by way of the shoots.

Belgium and France.—Very similar to that described above is the method of working coal on the Continent in thinnish seams when having a steep dip (*see* fig. 18). The cross-measure drifts (*étages*) which are usually driven from the shafts at distances apart of 56 to 66yd., are about 10oft. wide by 9ft. high, the levels being driven in the seam right and left, one above the other, and connected by holings for ventilation purposes. The coal faces (*maintenages*), which are worked much in the manner of overhead stoping, are stepped and the worked coal passed down coal shoots as shown. When the seams are not so steeply inclined, *e.g.*, about 35°–40°, and are very thin, *i.e.*, under say 2ft. 6in. in thickness, the system of working adopted is that termed *tailles chassantes, i.e.*, Longwall worked on the level in contradistinction to *tailles montantes*, or Longwall worked to the rise, which is practised when the inclination is moderate, *e.g.*, 10° or under, this latter system being purely ordinary Longwall with a stepped face.

The distance between each cross-measure drift or main level (*étage*) is about 60 yd. so that a width of coal to that extent is won by each main level, which is divided by three coal levels 20 yds. apart, one to each step or stall, by which the coal is conveyed to the shoot which carries it to the main level. The line of advancement is on the level course, the coal-getters being protected from falling coal by slanting boards shown in plan, fig. 19.

Subsidence and the Packing of Goaves.—The filling or packing of the excavated spaces, in order to prevent or lessen the effects of subsidence of the overlying rocks, is a matter of importance in some cases. In France and Germany the method of filling the space left by the removal of the coal with waste rock, quarried underground or sent down from the surface, which was originally used in connection with the working of thick inclined seams by the method of horizontal slices, is now largely extended to Longwall workings on thin seams, and in Westphalia is made compulsory where workings extend below surface buildings, and safety pillars of unwrought coal are found to be insufficient. With careful packing it is estimated that the surface subsidence will not exceed 40% of the thickness of the seam removed, and will usually be considerably less. The material for filling may be the waste from workings or from the spoil banks at the surface; where there are blast furnaces in the neighbourhood, granulated slag mixed with earth affords excellent packing.

In a few anthracite collieries in America the small coal or culm and other waste are washed into the exhausted workings by water, which gives a compact mass filling the excavation when the water has drained away. A modification of this system is now largely employed elsewhere, *e.g.*, France, Westphalia and Sumatra, but hardly at all in Great Britain owing to its cost. In this method

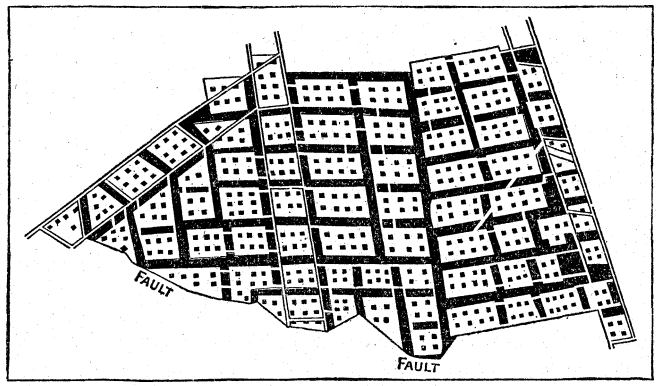


FROM SIR R. REDMAYNE, "MODERN PRACTICE IN COAL MINING" (LONGMANS, GREEN & CO.)
FIGS. 13 AND 14.—ELEVATION (LEFT) AND PLAN (RIGHT) OF THE METHOD OF WORKING A THICK AND HIGHLY INCLINED SEAM, NAMELY, THE "MAMMOTH" SEAM, PENNSYLVANIA, U.S.A.

the filling material, preferably sand, is sent down from the surface through a vertical steel pipe mixed with sufficient water to allow it to flow freely through distributing pipes in the galleries commanding the excavations to be filled; these are closed at the bottom by screens of boards or brattice cloth, sufficiently close to retain the packing material, while allowing the water to pass by a lower level to the pumping-engine, which returns it to the surface. This is known as the "hydraulic" stowage of wastes. Where water is not available for the purpose, or cannot be used for other reasons, compressed air has recently been applied as

the propelling agent in some German mines.

Cutting and Propping.—The actual cutting of the coal is to a very great extent performed by manual labour, the tool employed being a sharp-pointed double-armed pick, which is nearly straight, except when required for use in hard rock, when the arms are made with an inclination or "anchored." The terms pike, pick, mandril and slitter are applied to the collier's pick in different districts, the men being known as pikemen or hewers. The most important operation in cutting coal is that known as holing or "kirving," which consists in undercutting the coal by means of a groove 12 or 14in. wide at the face and sloping down to nothing at the far end, which is about 3–4ft. in depth. So there is left an overhanging portion of coal, which, after the supports (sprags) that hold up the undercut coal are removed, either falls of its own accord or is brought down by wedging or blasting.



FROM SIR RICHARD REDMAYNE, "MODERN PRACTICE IN COAL MINING" (LONGMANS, GREEN & CO., LTD.)

FIG. 15.—PLAN OF A PORTION OF A MINE IN SOUTH STAFFORDSHIRE, ENGLAND, WORKED ON THE "WIDE" OR SQUARE LINK SYSTEM

The process of holing in coal is one of the severest kinds of human labour. It has to be performed in a constrained position, and the miner sometimes lying on his side has to cut to a much greater height than is required to bring the coal down, in order to get room to carry the groove in to a sufficient depth, giving rise to waste in slack as compared with machine work. This is sometimes obviated by holing in a bed below, or even above, the coal, or in any portion of the seam of inferior quality, that may not be worth working, or in an interstratified band of dirt. The loss due to holing is proportionately greater in thin than in thick seams, the same quantity being cut to waste in either case.

The roof of the excavation is supported as the coal is removed, by packing up the waste material, and by a double row of props, placed at stated intervals apart along the face, the props of the back row alternating with those in front. The props used are of pinewood, large quantities of fir props being exported from the north of Europe and from France and to some extent Spain and Portugal, besides which some British pitwood is available, especially from Scotland. The quantity of imported foreign timber amounts to about 3,500,000 tons per annum. As the work proceeds the props are withdrawn and replaced in advance, except those that may be crushed by the pressure or buried by sudden falls of the roof.

In securing the roof and sides on roadways, malleable iron and steel are now used to some extent instead of timber. As a substitute for timber props at the face, pieces of steel joists, with the web cut out for a short distance on either end, with the flanges turned back to give a square bearing surface, have been introduced. In large levels steel girders are sometimes used to support the roof, but in the smaller levels complete arches made of pieces of rails fish-jointed at the crown are used occasionally. In another system, introduced by the Mannesmann Tube Co., the prop is made up of weldless steel tubes sliding telescopically one within the other, which are fixed at the right height by a screw clamp capable of carrying a load of 15–16 tons. These can be most advantageously used in thick seams 6–10ft. or upwards.

When driving the roads in "whole" working in the Bord and Pillar system, it is usually necessary to cut vertical grooves in the face at one side to determine the limit of the fall. This is known as "nicking." Where the coal is blasted down without "nicking" it is known as "shooting off the solid"; and where the coal is got without either "nicking" or "kirving," as "shooting out of the solid."

Mechanical Coal Cutters.—The substitution of mechanical contrivances for hand labour in cutting coal has been a favourite problem with inventors. As far back as 1761, one Michael Menzies of Newcastle-on-Tyne devised a machine for cutting coal which was worked by man and horse; but with the introduction of compressed air as a motive power in mines in 1855, a great impetus was given to machine cutters, and during the last 60 years great progress has been made. The writer of this article has particulars of the results obtained by a mechanical cutter at Elemore colliery in the county of Durham as far back as June and July 1865, and of Harrison and Frith's machines at Bishops Close colliery in the same county in Sept. 1865. Baird's machine, the "iron man" as it was locally termed, was one of the first machines applied. In March 1874 the cost of getting coal at Elemore Colliery by a mechanical cutter was 3s. 5d. per ton as against 3s.4d. by hand, inclusive of cutting, putting and deputies, *i.e.* the total face cost of working. The machine employed was of the disc type and it was driven by compressed air.

Messrs. Gillot and Copley's (Barnsley) machine, also of the disc type, was working as far back as 1875 and had a great vogue for many years. It had two cylinders 7in. dia. 12in. stroke, driving a main shaft at a speed of 100 revolutions per minute. This shaft was connected by gearing with the cutting wheel or disc, fitted with 20 teeth on its outer circumference, which were alternately single and double. This disc, which was 3ft. 10in. dia. was placed horizontally, projecting from the bottom of the framework of the machine, and made six revolutions per minute. The machine under cut the coal to a depth of 3ft. 4in., the height of the cut being 4 inches. The machine was pulled along the face by a wire rope, one end of which was secured to the machine, the rope being carried along the face to a block fastened to a prop at the far end of the run, and returning to the machine was slowly coiled on a drum driven by the machine which ran on rails fixed in a thin iron sleeper. It was worked by compressed air, the pressure of which at the machine was 28lb. per sq.in., and cut 70yd. of face in four hours. The machine cost £200. It will be seen that this machine, which did not differ materially from present day machines of the disc type, performed excellent work.

Mechanical coal cutters can conveniently be divided into five classes, viz., disc, bar, chain, rotary heading and percussive cutters. The extent to which these cutters are respectively used in the coal-fields of Great Britain, and the quantity of coal cut thereby, is shown in the following table:—

*Types of Mechanical Coal Cutters in Great Britain, and the Coal Cut by them (1925)**

	Disc	Bar	Chain	Percussive and other machines	Total
Number of machines	1,086	842	2,524	2,198	6,650
Tons of coal cut in the year . .	10,680,428	7,186,922	25,234,269	5,031,696	48,133,315

*Owing to 1926 being the year of the national lock-out, it is omitted from consideration.

Out of a total of 2,840 mines in Great Britain included under the Coal Mines Act (some few of which are Cleveland iron mines producing no coal), at only 915 coal mines are mechanical coal cutters used. In some coal mines they cannot be used as the coal will not stay up to be holed, and in others the nature of the roof is such as to necessitate close propping, so that there is not room for machines to move along the face. Of the machines, 3,134 are actuated by electricity and 3,516 by compressed air. About 20% of the national output of coal is got by mechanical coal cutters.

The construction of the disc type has already been described, the modern machines of this kind differing but little from the machines originally made by Gillot and Copley, but "skids" or "sledges" have largely taken the place of rails for the travel of the machine. (*See* fig. 20.) In order to keep the machine up to its work and counteract the outward thrust, when the machine is on skids, steel blades are attached to one side of the frame which cut into the floor. A disc machine cannot cut itself into the face, so it is necessary to provide a side for it to cut in from. These sides are termed "rooms" or "stables." Some of these machines cut in for a distance of five feet.

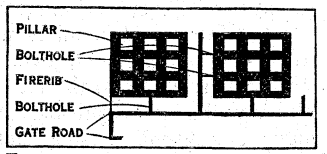


FIG. 16.—PLAN OF TWO "SIDES OF WORK" WITH GATE ROADS, BOLT HOLES, FIRE RIBS AND PILLARS

The Bar type (*see* figs. 21 and 22), consists of a bar, projecting from the frame of the machine, fitted with teeth, which is rotated by gearing. It is less powerful than the disc or the chain machine, but the bar, which is tapered to a point, makes a thicker cut and removes more material than the other two types of rotated cutters, and though a less powerful machine, it has these advantages over the other types, that it cannot be jammed by falling material; the bar is easily swung in and out of the cut; it cuts in either direction; "stables" are not required as it cuts itself into the face; "sprags" can be inserted close up to the cutting face. It is the most suitable machine for overcutting and deep cutting. (It has cut to a depth of 9 feet.) Its application is frequently well suited to cutting in a "band," if the latter is fairly thick. It has given good results in steeply inclined seams, and it is especially suited, as compared with the other rotating types, to working in a seam much dislocated by faults.

The Chain Machine (*see* fig. 23) consists mainly of a frame or "jib" 2ft. in width, projecting from the main body of the machine and carrying an endless chain having cutting teeth. It is fitted with a single bevel-gear reduction from the motor to the cutting chain driving sprocket and with a worm-reduction and ratchet-gear drive to the haulage drum. It is mounted on skids, and is carried on them by adjusting screws. The machine is about 17in. high, 2ft. $0\frac{3}{4}$in. broad and 7ft. 9in. long. The horse-power is 25–30.

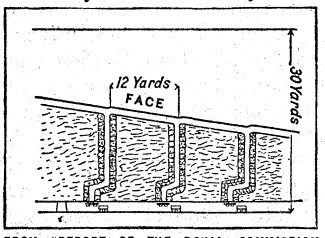
Percussive or Reciprocating Machines (*see* fig. 29) have the advantage over the types already described in being lighter, more portable and much less costly. They are used, too, not only for under or over-cutting the coal horizontally, but for cutting in a vertical plane. The "Siskol" machine, which is of this type, is used chiefly for driving headings or for making "stables" for the disc and chain type to cut from, as well as for stone work. This machine has a cylinder of $3\frac{1}{2}$in. in diameter and works with an air pressure of from 50–80lb. per sq.in., the extension rods being 20, 40, 60, 80 and 100in. long. It is used in seams from 18in. upward and is radial in its application. The machine is operated from a column by means of a sector and swings to and fro across the coalface. In the electric header the machine is rotary, whereas in the compression air machine the primary motion is percussive. Another type of percussive machine is the Ingersoll-Sergeant, which is directed and controlled almost entirely by hand.

Pneumatic Hammer Picks have come very largely into use of late years, especially abroad, many thousands being employed in the Westphalian collieries. The pick is used in Belgium also. This machine, which is only about 16–17lb. in weight and about 17in. long, with a piston $1\frac{3}{16}$in. dia. and $4\frac{1}{8}$in. stroke, is actuated by compressed air. The air is usually supplied from electrically driven compressors situated a little distance back from the coal face. A light sleeve valve placed in the axis of the small cylinder in a detachable head controls the distribution of the air, the admission ports being always closed before the opening of the exhaust ports, pressure of the air being from 60–80lb. per sq.in. The pick makes 1,200 blows per minute and automatically stops when the workman ceases pressing on it.

Mechanical Conveyors.—The most economical way of working mechanical coal cutters is in conjunction with mechanical coal conveyors along the face in the case of Longwall, where the conditions permit of these being placed and worked and in the gateways (roads) leading therefrom. There can be no doubt that the most economical way of transporting coal, from the point at which it is gotten to the shaft where the trams enter the cage, is to deliver the coal through the medium of face and gateway conveyors to the trams, and thence by means of small hauling engines actuated by electricity or compressed air (this is known as "secondary haulage"), and then to convey it to the main haulage planes along which the trams are conveyed to the shaft. Whereas in 1907 there were only 100 face conveyors in use in Great Britain, in 1926 there were 1,667.

Conveyors may be either (*a*) of the scraper continuous moving or (*b*) of the "shaker" (jigger or jerking) type. In the first-named class a series of scrapers carried by a chain pass along the surface of a steel trough, the chain being actuated by a small electric motor or compressed-air cylinder. The coal being filled into the trough is scraped along the trough to the tub (tram) in the gateway at the end of the stall or on to a gate conveyor. The conveyor being in sections is moved up as the face advances. The band conveyor is made up of solid woven cotton which passes over a drum. In the shaker conveyor the to-and-fro movement of from 6–12in. is given to the trough, carried on rollers moving in curved paths, by means of an eccentric arrangement.

Underground Haulage.—The removal of the coal broken at the working face to the main haulage level is in the case of some small mines, especially in Somersetshire, effected by hand labour, but more generally it is done by pony, horse and mechanical traction upon tramways, the "trams" or "tubs," as the pit wagons are called, being brought up to the face. In steeply inclined seams passes or shoots leading to the main level below are sometimes used, and in Belgium and parts of Westphalia, iron plates are sometimes laid in the excavated ground to form a slide for the coal down to the loading place. As has just been stated, mechanically worked face conveyors are coming into use, which deliver the coal with a reduced amount of breakage, but this application is not as yet universal. The capacity of the trams generally speaking is determined by the height of the seam. From 6–10cwt. are common capacities, but in South Wales they are larger, carrying up to one ton or more. The rails used are commonly of flat bottomed or bridge section varying in weight from 15–25lb. to the yard; they are laid upon wooden cross sleepers in a temporary manner, so that they can be easily shifted along the working faces, but are more strongly secured along main roads intended to carry traffic continuously for some time. On the main haulage roads a heavier pattern of rail also is used, carried on chairs and fish-plated. In some main roads, when the distance to the pit is not considerable, horse traction may be used, a train of 6 to 15 vehicles being drawn by one horse, the "leading" of the trains of tubs may be effected by mechanical traction. In recent years, objections to the use of animals underground have been advanced in many quarters.



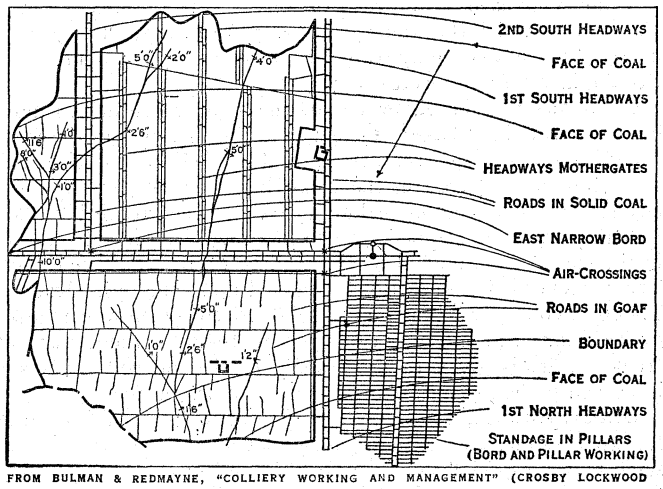
FROM "REPORT OF THE ROYAL COMMISSION ON MINES, 1909," BY PERMISSION OF THE CONTROLLER OF H.M. STATIONERY OFFICE

FIG. 17A.—METHOD OF WORKING AN INCLINED SEAM IN SCOTLAND

In a large colliery where the shafts are situated near the centre of the field, and the workings extend on all sides, both to the dip and rise, the drawing roads for the coal may be of three different kinds, namely, (1) levels driven at right angles to the dip, suitable for horse roads, (2) rise ways, known as jinny roads, jig-brows, up-brows or inclines, which, when of sufficient slope, may be used as self-acting planes, *i.e.*, the loaded trams may be made to pull back the empty ones towards the working faces, and (3) dip or down-brows, requiring engine power. A road may be used as a self-acting or gravitating incline when the gradient is about 1 in 10 or steeper. Where the load has to be hauled up a rising gradient, underground engines, driven by steam or compressed air or electric motors, are used, chiefly the latter. In some cases steam generated in boilers at the surface is carried in pipes to the engines below, but there is less loss of power when com-

pressed air is sent down in the same way and still less when electric power is employed. Underground boilers placed near the up-cast pit so that the smoke and gases help the ventilating furnace were in use to some extent in the past, but are now prohibited by section 56 (5) of the Coal Mines Act, 1911.

The principal methods in which power can be applied to underground traction are embraced in the following systems—



FROM BULMAN & REDMAYNE, "COLLIERY WORKING AND MANAGEMENT" (CROSBY LOCKWOOD & SON)

FIG. 17B.—THE LONGWALL SYSTEM OF WORKING

(1) main rope, (2) main and tail rope, (3) endless chain, (4) endless-rope system on the ground, (5) endless-rope system overhead, (6) overhead electric trolley wire, (7) electric and compressed air locomotives. Numbers 3, 4 and 5 may be considered as modifications of the same principle. In No. 1 a single line of rails is used, the empty tubs being run "in bye," by means of the force of gravity, and the loaded train or "set" of tubs is drawn up the acclivity by means of the same rope. The second method is applied where the inclination of the road is insufficient to allow of the gravitation "in bye" of the tubs, and they are drawn in by the "tail" rope being fastened to the inner end of the "set," while the loaded set is drawn out to the shaft by the "main" rope attached to the outer end of the set. In other systems, double lines with the rope travelling continuously in the same direction are the rule. When the set arrives "out-bye," the main rope will be wound up and the tail rope pass out from the drum to the end and back, *i.e.*, twice the length of the way; the set is returned "in bye" by reversing the engine. Considerable engine-power is required in order to get up the required speed, which is from 8–10m. per hour. From 8–30 tubs are usually drawn in a "set," or train, the ways being often from 2,000–3,000yd. long.

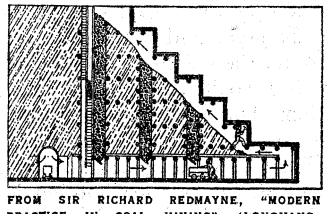
For the endless chain system, a double line of way is necessary, one line for full and the other for empty tubs. The tubs are placed on at intervals of about 20yd., the chain moving continuously at a speed of from 2–3m. per hour. This system presents great advantages in point of economy of driving power, especially where the gradients are variable, but is expensive in first cost and, though worked with branch roads, is not very well suited for curves, as a fresh set of pulleys worked by bevel gearing is required for each branch, the tubs disconnecting from the branch system and reconnecting with the main chain automatically.

In the endless-rope system the rope, which is guided upon sheaves between the rails, is taken twice round the head pulley. The tubs are placed singly on the rope or are formed into sets of from two to 12, the front one being coupled up by a short length of chain to a clamping hook formed of two jaws moulded to the curve of the rope, which are attached by the "run rider," as the driver accompanying the train is called. This system in many respects resembles the tail rope, but has the advantage of working with one-third less length of rope for the same length of way. The endless-rope system with overhead attachment is substantially similar to the endless chain.

Underground traction is performed in some cases, very largely in America and Germany, electrically by the overhead trolley wire system, but in Great Britain the flashing that accompanies it is regarded as a danger and under the Electricity in Mines Rules the use of this means is prevented. Locomotives driven by compressed air were in use to a very small extent at one time in Great Britain, but their use was discontinued as uneconomic. The use of locomotives driven by power derived from electric storage batteries are coming into use in some few mines, being the most recent development in underground haulage.

Ventilation.—One of the most important branches of colliery work is the management of the ventilation, involving as it does the supply of fresh air to the men, horses and ponies working in the pit, as well as the removal of noxious and inflammable gases that may be given off in the mine. This is effected by carrying through the workings large volumes of air which are kept continually moving, descending from the surface by a shaft known as the down-cast shaft, and leaving the mine by a return or up-cast shaft. Such a circulation or air used to be obtained by means of an underground furnace, but under the Mines Act of 1911 no fire is allowed to be used for ventilation in any coal mine or seam newly opened after the passing of that act, except in the case of a mine in which the total number of persons employed below ground does not exceed 30 and in the up-cast shaft of which there is no inflammable material. In the mines where a fire is permitted and used for ventilation, the return air has to be carried off clear of the fire by means of a dumb drift, unless the mine is one in which inflammable gas is unknown.

Most mines are ventilated by means of fans. Mechanical ventilation may be effected, either by direct exhaustion or centrifugal displacement of the air to be removed, or by compressive ventilation forcing down the air. The former is the universal practice in Great Britain, but forcing ventilation is largely practised in the Continent of Europe. An early and very successful machine of this class, the Guibal fan, is represented in fig. 25. The fan has eight arms, framed together of wrought-iron bars, with diagonal struts, so as to obtain rigidity with comparative lightness, carrying flat close-boarded blades at their extremities. It revolves with the smallest possible clearance in a chamber of masonry, one of the side walls being perforated by a large round hole, through which the air from the mine is admitted to the centre of the fan. The lower quadrant of the casing is enlarged spirally, so as to leave a narrow rectangular opening at the bottom, through which the air is discharged into a chimney, or evase, of gradually increasing section carried to a height of about 25 feet. The size of the discharge aperture can be varied by means of a flexible wooden shutter sliding in a groove in a cast-iron plate, curved to the slope of the casing. By the use of the spiral guide casing and the chimney, the velocity of the effluent air is gradually reduced up to the point of final discharge into the atmosphere, whereby a greater useful effect is realized than is the case when the air streams freely from the circumference with a velocity equal to that of the rotating fan. The power is applied by steam acting directly on a crank at the end of the axle, and the diameter of the fan may be 40 ft. or more.



FROM SIR RICHARD REDMAYNE, "MODERN PRACTICE IN COAL MINING" (LONGMANS, GREEN & CO., LTD.)

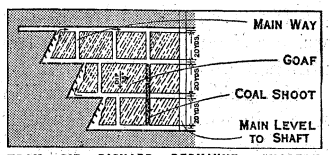
FIG. 18.—METHOD OF WORKING VERY HIGHLY INCLINED SEAMS IN BELGIUM

Other types of fan are the Waddle, the Schiele (not now much used), the Walker (largely employed in Lancashire), the Chandler, the Capell, the Ser, the Rateau, the Sirocco and the Barclay. By the adoption of more refined methods of construction, especially in the shape of the intake and discharge passages for the air and the forms of the fan blades, the efficiency of the ventilating fan has been greatly increased, so that the dimensions can be much reduced and a higher rate of speed adopted. Another type is the double inlet Sirocco. These fans are made in a variety of sizes, from 2ft. 11in. to 8ft. 4in. diameter. It is a high velocity fan, and when 8ft. 4in. diameter, with double inlet and 220 revolutions per minute and a water gauge of 3in., has drawn a volume of

air of 532,000 cu.ft. per minute through the mine.

Sir R. Redmayne applied a Parsons' turbo-ventilator to ventilate a very deep mine. It was constructed to give 250,000 cu.ft. of air per minute against a water gauge of 12in., the exhauster being driven at a speed of 2,500 revolutions per minute.

The quantity of air required for a large colliery depends upon the number of persons and the number of animals employed, and the extent to which noxious and inflammable gas is evolved; also the extent to which it is necessary to cool the mine. Even with the best arrangements a dangerous increase in the amount of gas is not infrequent from the sudden release of large volumes stored up under pressure in the coal, which, overpowering the ventilation, produce magazines of explosive material ready for ignition when brought in contact with the flame of a lamp or the blast of a shot. The management of such places, therefore, requires the most constant vigilance on the part of the mine officials and workmen, especially in the examination of the working places that may have been standing empty during the night, or at other times, in which gas may have accumulated, to see that they are properly cleared before the place is occupied or a new shift recommences work, as well as during occupancy.



FROM SIR RICHARD REDMAYNE, "MODERN PRACTICE IN COAL MINING"

FIG. 19.—SYSTEM OF WORKING, KNOWN AS TAILLES CHANSANTES, IN A COLLIERY NEAR LIEGE

The actual conveyance of the air from the intake to the working faces is effected by splitting or dividing the current at different points in its course, so that each district of any size may be supplied with fresh air and have its own separate "intake" and "return" airways (*see* article AIRWAY), the current being carried as directly as possible to the coalface. In laying out the mine it is customary to drive the levels or roads in pairs, communication being made between them at intervals by cutting through the intermediate pillar; the air then passes along one and returns by the other, the air being kept up to the face by means of bratticing of canvas or wood, or air pipes and canvas doors. As the roads advance other pillars are driven through in the same manner, the passages first made being closed by stoppings of broken rock, or built up with brick and mortar walls, or both.

When it is desired to preserve a way from one road or similar class of working to another, double doors placed at sufficient intervals apart to take in one or more trams between them when closed are used, forming a kind of lock or sluice. These are made to shut air-tight against their frames, so as to prevent the air from taking a short cut back to the up-cast, while preserving free access between the different parts without following the whole round of the airways. It often happens that currents travelling in opposite directions are brought together at one point. In these cases it is necessary to cross them. The return air is usually made to pass over the intake by a curved drift carried some distance above in the solid measures, both ways being arched in brickwork. Or the sides of the intake are walled and the walls roofed over with dove-tailed timbers which constitutes the floor of the return air way. These are known as "air crossings."

The pressure required to overcome the friction offered by the rubbing surface of the galleries varies as the square of the velocity of the current, and the difference between the ventilating pressure as between intake and return airways is measured by the water gauge. The larger and more roomy the airways, the better for the ventilation, for the pressure per square foot necessary to overcome friction varies inversely as the sectional area of the roadway, the rubbing surface and the velocity remaining constant. Thus a roadway 9ft.x8ft. has a rubbing surface of 34 lineal ft. and a sectional area of 72ft., whereas a roadway of 13ft.x4ft. has a like rubbing surface, but a cross sectional area of 52 square feet. The same pressure would be required to draw the air through the one as in the case of the other.

Lighting.—The lighting of the underground workings in collieries is closely connected with the subject of ventilation, and in so far as safety lamps are concerned, is dealt with under the article of that name. In those mines where inflammable gas is unknown, or occurs in the volume of air below the prescribed quantity, and in which no explosion of gas has occurred, open lights are frequently used, *e.g.*, the mines of the Forest of Dean and many of those in Scotland, where the lights take the form of the ordinary tallow dip candle or some kind of oil lamp—in Scotland usually carried in the hat. Usually the roads about the shaft bottom, and sometimes the way-ends of the several districts, are lit by electric lights.

Mine Gases.—The nature of the gases evolved by coal when freshly exposed to the atmosphere has been investigated by several chemists, notably by Lyon Playfair, Ernst von Meyer and Bedson. Von Meyer found the gases given off by coal from the district of Newcastle and Durham to contain carbonic acid, marsh gas (or light carburetted hydrogen, the "fire-damp" of the miner), oxygen and nitrogen (*see* article FIRE-DAMP). A later investigation by J. W. Thomas, of the gases dissolved or occluded in coals from the South Wales basin, shows them to vary considerably with the class of coal. The results given below, which are selected from a much larger series published in the *Journal of the Chemical Society*, were obtained by heating samples of the different coals *in vacuo* for several hours at the temperature of boiling water:—

Quality	Colliery	Volume per ton in cu.ft.	Composition in volumes (per cent)			
			Carbonic acid	Oxygen	Marsh gas	Nitrogen
Bituminous	Cwm Clydach	19·72	5·44	1·05	63·76	29·75
,,	Lantwit	14·34	9·43	2·25	31·95	56·34
Steam	Navigation	89·62	13·21	0·49	81·64	4·66
Anthracite	Bonville's Court	198·95	2·62	..	93·13	4·25

Coal Dust.—The danger arising from the presence of coal dust in the air of dry mines, with or without the addition of fire-damp, has, since it was first pointed out by Prof. W. Galloway, been made the subject of special enquiries in the principal European countries interested in coal mining. The conclusions arrived at by the royal commission of 1891, which were, until recent years, taken as generally representative of the views of British colliery engineers, were as follows:—

(1) The danger of explosion when gas exists in very small quantities is greatly increased by the presence of coal dust.
(2) A gas explosion in a fiery mine may be intensified or indefinitely propagated by the dust raised by the explosion itself.
(3) Coal dust alone, without any gas, may cause a dangerous explosion if ignited by a blown-out shot; but such cases are likely to be exceptional.
(4) The inflammability of coal dust varies with different coals, but none can be said to be entirely free from risk.
(5) There is no probability of a dangerous explosion being produced by the ignition of coal dust by a naked light or ordinary flame.

Since then, however, experiment and experience have shown that conclusions 3, 4 and 5 are not borne out in fact. A cloud of coal dust can be ignited by a naked light either through the medium of inflammable gas or not. The dusts of some anthracite mines would appear to be free from risk of explosion.

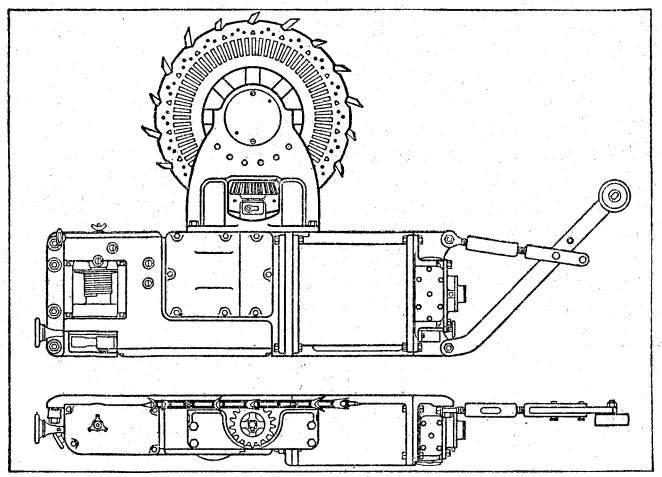
The important factors in connection with danger from coal dust would appear to be:—(*a*) the proportion of volatile hydrocarbons contained in the dust, (*b*) the purity of the dust, (*c*) fineness, (*d*) quality, (*e*) humidity.

The greater the proportion of volatile hydrocarbons the more easily ignitable is the dust, as also the freer it is from impurities such as stone dust, which exercises a deadening influence upon it. As to quantity, an explosion of coal dust has been obtained when only about 2oz. of coal dust was present over an area of 10¾ sq.ft. of surface. Humidity has a preventive or retarding effect on ignition.

It is laid down by Government regulations that in all coal mines in Great Britain, except those in which anthracite is worked, the floor, roof and sides (to within 10yd. of the coal face) of every road which is accessible, has either to be treated with incombustible dust so as to ensure that the dust on them shall always

contain not more than 50% of combustible matter, or to be treated with water so as to ensure that the dust thereon is always combined throughout with 30% by weight of water. But the percentage of incombustible dust required may be reduced by an amount equivalent to the percentage of water present in the mixture.

The incombustible dust has to be of such a character that not less than 50% of it must be capable when dry of passing through



BY COURTESY OF MAVOR AND COULSON, LTD.

FIG. 20.—SAMSON DISC COAL CUTTER DRIVEN BY DIRECT ELECTRIC CURRENT

a sieve with 200 meshes to the linear inch (40,000 to the sq.in.), unless a larger proportion of incombustible dust is used, when the percentage of fine material may be reduced to 25%.

Blasting and Explosives.—In all British coal mines when gas in dangerous quantities has appeared within three months, and in all places that are dry and dusty, blasting is prohibited, except with "permitted" explosives, whose composition and properties have been examined at the testing station at the Royal Arsenal, Woolwich. A list of those sanctioned is published by the Mines Department. They are mostly distinguished by special trade names, and are mainly of two classes—those containing ammonium nitrate and nitrobenzene or nitronaphthalene, and those containing nitroglycerin and nitrocellulose, which are essentially weak dynamites. The safety property attributed to them is due to the depression of the temperature of the flame or products of explosion to a point below that necessary to ignite fire-damp or coal dust in air from a blown-out shot. New explosives that are found to be satisfactory when tested are added to the list from time to time, the composition being stated in all cases.

Spontaneous Combustion in Coal Mines.—Underground fires are not uncommon accidents in coal mines. In the thick coal workings in South Staffordshire, the crusted coal in the sides of work is especially liable to fire from so-called spontaneous combustion, due to the rapid oxidization that is set up when finely divided coal is brought in contact with air; and not only that coal, but sometimes the solid coal also. The Bullhurst seam of North Staffordshire and some seams in Warwickshire, Lancashire and parts of Scotland are also liable to spontaneous combustion. The best remedy in such cases is to prevent the air from gaining access to the coal by building a wall round the burning portion, which can in this way be isolated from the remainder of the workings, and the fire prevented from spreading, even if it cannot be extinguished. When the coal is fired by the blast of an explosion it is often necessary to isolate the mine, or parts of the mine, completely by erecting dams, and in extreme cases by flooding with water or carbonic acid before the fire can be brought under. There have been several instances of this being done in the fiery pits in the Barnsley district, notably at the great explosion at the Oaks colliery in 1866, when 360 lives were lost.

Winding Coal in Shaft.—The drawing or winding of the coal from the pit bottom to the surface is one of the most important operations in coal mining, and probably the department in which mechanical appliances have been brought to the highest state of development.

The different elements making up the drawing arrangements of a colliery are (1) the cage, (2) the shaft or pit fittings, (3) the winding rope, (4) the engine and (5) the surface arrangements. The cage, as its name implies, consists of one or more platforms connected by an open framework of vertical bars of wrought iron or steel, with a top bar to which the drawing-rope is attached (*see* article CAGE).

The guides or conductors in the pit may be constructed of wood, in which case rectangular fir beams, about 3in. by 4in. are used. Two guides are required for each cage; they may be placed opposite to each other, either on the long or short sides, the latter being preferable. The cage is guided by shoes of wrought iron to cover the heads of the rails. Rigid guides connected with the walling of the pit are probably the best and safest, but they have the disadvantage of being liable to distortion, in case of the pit altering its form, owing to irregular movements of the ground, or other causes. Wooden guides being of considerable size, block up a certain portion of the area of the pit, and thus offer an impediment to the ventilation, especially in up-cast shafts, where the high temperature, when furnace ventilation is used, is also against their use. Wire rope guides have been introduced to a very considerable extent of recent years with a view of meeting the above objections. These are simply steel wire ropes, from $\frac{3}{4}$–$1\frac{1}{2}$in. diameter, hanging from a cross-bar connected with the pit-head framing at the surface, and attached to a similar bar at the bottom, which are kept straight by a stretching weight of from 30cwt. to 4 tons attached to the lower bar. In some cases four guides are used—two to each of the long sides of the cage; but a more general arrangement is to have three—two on one side and the third in an intermediate position on the opposite side. Many colliery managers, however, prefer to have only two opposite guides.

The cage is connected with the drawing-rope, usually by six, but sometimes by four, short lengths of chain from the corners, and in the case of six chains, from the middle of the longer side also, known as "bridle chains," gathered into a central ring to which the rope is attached, through the medium of a socket or capel made of wrought iron larger at the bottom than at the top, and with a loop at the bottom through which the shackle of the detaching hook passes. Round steel wire-ropes about 2in. diameter are now commonly used, but in very deep pits they are sometimes tapered in section to reduce the dead weight lifted. Flat ropes of steel or iron wire are used but very rarely now, the round being generally preferred. In Belgium and the north of France flat ropes of aloe fibre (Manila hemp or plantain fibre) are in high repute, being considered preferable by many colliery managers to wire, in spite of their great weight. A rope of this class for a pit 1,200 metres deep, tapered from 15·6–9in. in breadth and from 2–$1\frac{1}{8}$in. in thickness, weighed 14·3 tons, and another at Anzin, intended to lift a gross load of 15 tons from 750 metres, is $22\frac{1}{2}$in. broad and 3in. thick at the drum end, and weighs 18 tons. Tapered round ropes, although mechanically preferable, are not advantageous in practice, as the wear being greater at the cage end than on the drum it is necessary to cut off portions of the former at intervals. Ultimately also the ropes should be reversed in position, and this can only be done with a rope of uniform section.

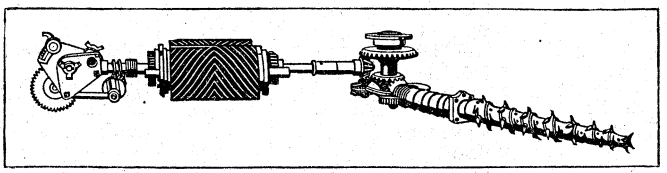
Winding Engines.—The engines used for winding or hoisting in collieries when steam driven are usually direct-acting with a pair of horizontal cylinders coupled directly to the drum shaft. Steam at high pressure exhausting into the atmosphere is still commonly used, but the great power required for raising heavy loads from deep pits at high speeds has brought the question of fuel economy into prominence, and more economical types of the two-cylinder tandem compound class with high initial steam pressure, superheating and condensing are now applied to a large extent at modern collieries. One of the earliest examples was erected at Llanbradack in South Wales in 1894, and they have been extensively used in Westphalia and the north of France, as

well as in Great Britain. In a later example at the Bargold pit of the Powell Duffryn Steam Coal company a mixed arrangement is adopted with horizontal high-pressure and vertical low-pressure cylinders. This engine draws a net load of 5½ tons of coal from a depth of 625yd. in 45sec., the gross weight of the four trams, cage and chains, and rope, with the coal, being 20 tons 12cwt.

The work of the winding engine, being essentially of an intermittent character, can only be done with condensation when a central condenser keeping a constant vacuum is used, and even with this the rush of steam during winding may be a cause of disturbance. This difficulty may be overcome by using low-pressure turbines between the engine and the condenser. The accumulator, which is similar in principle to the thermal storage system of Druitt Halpin, is a closed vessel completely filled with water, which condenses the excess of steam during the winding period, and becoming superheated maintains the supply to the turbine when the main engine is standing. The power so developed is generally utilized in the production of electricity, for which there is an abundant use about large collieries.

The drum, when round ropes are used, is a plain broad cylinder with flanged rims, encased with soft wood packing, upon which the rope is coiled; the breadth is made sufficient to take the whole length of the rope at two laps. One drum is usually fixed to the shaft, while the other is loose, with a screw link or other means of coupling, in order to be able to adjust the two ropes to exactly the same length, so that one cage may be at the surface when the other is at the bottom, without having to pay out or take up any slack rope by the engine.

For flat ropes the drum consists of a solid disk, of the width of the rope fixed upon the shaft, with numerous parallel pairs of arms or horns, arranged radially on both sides, the space between being just sufficient to allow the rope to enter and coil regularly upon the preceding lap. This method has the advantage of equalizing the work of the engine throughout the journey, for when the load is greatest, with the full cage at the bottom and the whole length of rope out, the duty required in the first revolution of the engine is measured by the length of the smallest circumference while the assistance derived from gravitating action of the descending cage in the same period is equal to the weight of the falling mass through a height corresponding to the length of the largest lap, and so on, the speed being increased as the weight diminishes, and vice versa. The same thing can be effected in a more perfect manner by the use of spiral or scroll drums. This plan, though mechanically a very good one, has certain defects, especially in the possibility of danger resulting from the rope slipping sideways, if the grooves in the bed are not perfectly true. The great size and weight of such drums are also disadvantages, as giving rather unmanageable dimensions in a very deep pit. In some cases, therefore, a combined form is adopted, the body of



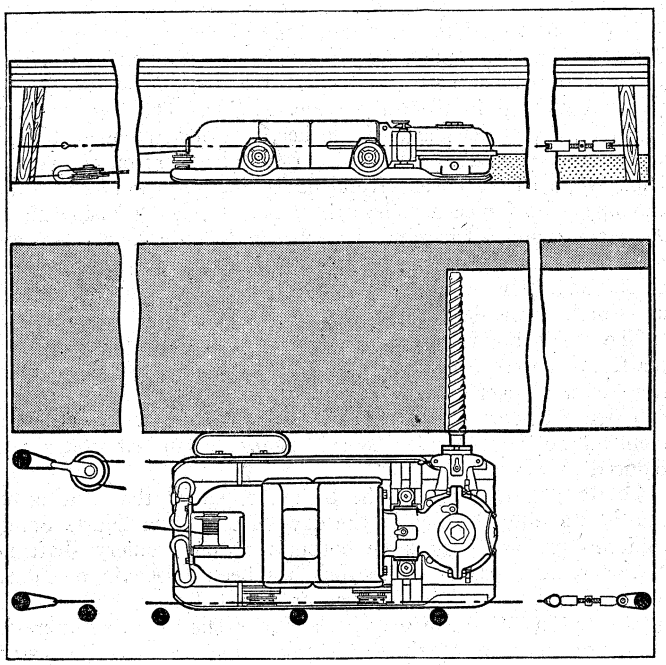
BY COURTESY OF MAVOR AND COULSON, LTD.

FIG. 21.—WORKING PARTS OF A BAR TYPE OF COAL CUTTER DRIVEN BY COMPRESSED AIR TURBINE

the drum being cylindrical, and a width equal to three or four laps conical on either side.

Counterbalance chains for the winding engines are used at some collieries. In Koepe's method the drum is replaced by a disc with a grooved rim for the rope, which passes from the top of one cage over the guide pulley, round the disk, and back over the second guide to the second cage, and a tail rope, passing round a pulley at the bottom of the shaft, connects the bottoms of the cages, so that the dead weight of cage, tubs and rope is completely counterbalanced at all positions of the cages, and the work of the engine is confined to the useful weight of coal raised. Motion is communicated to the rope by frictional contact with the drum, which is covered through about one-half of the circumference. Winding is being performed at several collieries with electricity as the motive force.

The surface arrangements of a modern deep colliery are of considerable extent and complexity, the central feature being the headgear or pit frame carrying the winding rope pulleys, usually termed the "pulley wheels," which lead the winding ropes from the axis of the pit to the drum. This is an upright frame, usually



BY COURTESY OF MAVOR AND COULSON, LTD.

FIG. 22.—FRONT ELEVATION AND PLAN OF AN ELECTRICALLY DRIVEN BAR TYPE OF COAL CUTTER, CUTTING AT THE COAL FACE

made in wrought iron or steel strutted by diagonal thrust beams against the engine-house wall or other solid abutments, the height to the bearings of the guide pulleys being from 80–100ft. or more above the ground level. This considerable height is necessary to obtain head-room for the cages, the landing platforms being usually placed at some considerable height above the natural surface, in order to provide height for the screens and wagons beneath the screening. The pulleys, which are made as large as possible up to 20ft. in diameter to diminish the effect of bending strains in the rope by change in direction, have channelled cast-iron rims with wrought iron arms, a form combining rigidity with strength, in order to keep down their weight.

To prevent accidents from over-winding (which are, unhappily, not uncommon), when, in consequence of the engine not being stopped in time, the cage may be drawn up to the head-gear pulleys, various forms of hooks have been adopted. These consist essentially of links formed of a pair of parallel plates joined by a central bolt forming a scissors joint which is connected by chain links to the cage below and the winding-rope above. The outer sides of the link are shaped with projecting lugs above. When closed by the load the width is sufficient to allow it to enter a funnel-shaped guide on a cross-bar of the frame some distance above the bank level, but on reaching the narrower portion of the guide at the top the plates are forced apart, which releases the ropes and brings the lugs into contact with the top of the cross-bar, thus securing the cage from falling.

Three principal patterns, those of King, Ormerod and Walker, are in use, and they are generally efficient supposing the speed of the cage at arrival is not excessive. To guard against this, it is now customary to use some speed-checking appliance, independent of the engine-man, which reduces or entirely cuts off the steam supply when the cage arrives at a particular point near the surface, and applies the brake if the load is travelling too quickly. Maximum speed controllers in connection with the winding indicator, which do not allow the engine to exceed a fixed rate of speed, are also used in some cases, with recording indicators.

Unloading, Sizing and Cleaning the Coal.—When the cage arrives at the surface, or rather the platform forming the working top above the mouth of the pit, it is received upon the keeps or "keps," a pair of hinged gratings which are kept in an inclined position over the pit-top by counterbalance weights, so that they are pushed aside to allow the cage to pass upwards, but fall back and receive it when the engine is reversed. The tubs are then removed by the landers or "banksmen" (the men who put the tubs into the cage at the pit bottom being termed "onsetters"). These pull them forward on to the platform, which is covered with cast-iron plates; at the same time the empty tubs are pushed in from the opposite side. The cage is then lifted by the engine clear of the keeps, which are opened by a lever worked by hand, and the empty tubs start on the return trip. When the cage has several decks, it is necessary to repeat this operation for each, unless there is a special provision made for loading and discharging the tubs at different levels. An arrangement of this kind for shifting the load from a large cage at one operation is in use at many large collieries and is known as "simultaneous decking."

The trains are received into a framework with a number of platforms corresponding to those of the cage, carried on the head of a plunger movable by hydraulic pressure in a vertical cylinder. The empty tubs are carried by a corresponding arrangement on the opposite side. By this means the time of stoppage is reduced to a minimum.

Colliery Outputs.—In the United Kingdom the drawing of coal is generally confined to the day shift of eight hours. Some collieries produce very large outputs; at one colliery shaft in Yorkshire as much as 4,000 tons has been raised in one day. There are eight colliery concerns in Great Britain each raising 2,000,000 tons of coal or over per annum. The following interesting figures are given by the royal commission on the coal industry (1925), in respect of the outputs of 613 out of a total of 1,400 separate colliery undertakings in Great Britain.

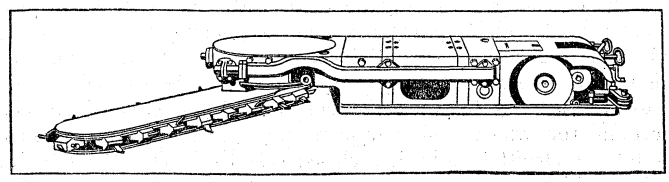
Colliery Outputs

Yearly output of undertaking in 1,000 tons	Number of undertakings	Total, in 1,000 tons	Percentage of total	Output per man per shift	Proceeds in shillings per ton	Cost: Shillings. per ton	Profit (+) or Loss (−)
				Cwt.			Per ton
Less than 5 . . .	10	32	..	12·78	23·51	32·01	−8·56
5 and under 200	307	27,360	12·7	16·22	19·02	20·23	−1·21
200 ,, ,, 400	126	36,394	16·9	17·05	18·43	19·21	−0·78
400 ,, ,, 600	72	35,118	16·3	18·34	17·90	18·01	−0·14
600 ,, ,, 800	28	19,132	8·9	18·86	17·58	17·82	−0·24
800 ,, ,, 1,000	20	17,992	8·4	18·68	17·52	17·65	−0·13
1,000 ,, ,, 2,000	42	56,280	26·2	19·66	17·77	17·49	+0·28
2,000 ,, over . .	8	22,744	10·6	19·76	17·39	17·11	+0·28
All	613	215,052	100·0	18·32	17·98	18·20	−0·25

It will be seen that the figures as to cost per ton of production per man are favourable to the large as compared with the smaller concerns. (*See* also Section II.)

Preparation of Coal for the Market.—The tub when brought to the surface is passed over a weighbridge, where it is weighed by a weigher specially appointed for the purpose by the men and the owner jointly. It is then run into a "tippler," a cage turning about a horizontal axis, which discharges the load in the first half of the rotation and brings the tub back to the original position in the second, and is then run back to the pit-bank to be loaded into the cage at the return journey.

The coal after being raised from the pit is subjected to a process of classification and cleaning before being despatched to the consumer. The nature and extent of these operations vary with the character of the coal, which if hard and free from shale partings may be finished by simple screening into large and nut sizes and smaller slack and "duff"; the large being hand picked to remove the shale. But when the coal is friable and there is much small, and it is dirty owing to intermixture of shale, more elaborate sizing, and cleaning by washing, becomes necessary. Where hand-picking is done, the larger sized coal, separated by bar screens at distances of 1½–3in. apart, is spread out on a travelling band, which may be 300ft. long and from 3–5ft. wide, and is there carried past a line of pickers who take out and remove



BY COURTESY OF MAVOR AND COULSON, LTD.

FIG. 23.—ARC WALL CHAIN CUTTER. WORKING AT 40 H.P. IT REQUIRES 750 CU.FT OF FREE AIR PER MINUTE

the waste as it passes by, leaving the clean coal on the belt. The smaller coal passing through the screen is carried by another belt to a separate sizing plant, consisting of vibrating and/or rotating screens, to be separated into several more sizes, *e.g.*, trebles, doubles or single nuts, unscreened small, peas and beans, and duff (dust), trebles being over 1⅝in. diameter, doubles over ⅞in., singles over ¾in., etc. These are cleaned by washing in either continuous current or pulsating (jigging) machines, where the lighter coal rises to the surface and is removed by a stream of water, while the heavier waste falls and is discharged at a lower level or at the bottom of the machine. The cleaned coal is carried to a bucket elevator and delivered to the storage bunkers; or both water and coal may be lifted by a centrifugal pump into a large cylindrical tank, where the water drains away, leaving the coal sufficiently dry for use. Modern screening and washing plants, especially when the small coal forms a considerable proportion of the output, are large and costly erections, requiring machinery of a capacity of 100–300 tons per hour, which absorb 350–400h.p. In this, as in many other cases, electric motors supplied from a central station are now preferred to separate steam engines.

Anthracite coal is sometimes broken between toothed rollers where the smaller sizes are desired, and is in all cases subjected to an elaborate system of screening before it is fit for sale. The following are the classes, sizes, values and percentages of make of the several classes of market brands of anthracite at a large modern Welsh anthracite mine in 1927.

	Class	Price	Per-centage	Size
		s. d.		Inches
Hand picked	Large coal	37	17	Over 7
	Cobbles	41	7	2½ to 4
	Washed cobbles	17	2½	2½ to 4 Workmen's coal
	French nuts	41	7	1½x2½
Washed . .	Stove nuts	43	12½	1⅜x1¾
	Beans	39	9	⅝x1⅛
	Peas	18 6	11	¼x⅝
	Grains	10	8½	⅛x¼
	Duff	3 6	25	⅛ and under

The number and variety of coal washers is considerable; the action of all is based upon the difference in the specific gravity of the three elements entering into consideration, namely, water with a specific gravity of 1, coal with a specific gravity of about 1·3, and shale with a specific gravity of about 2·3. In some "fine coal" washing machines a bed of felspar is provided, which having a specific gravity of 2·6 performs the function of a thick grating allowing of time for the particles of coal to be arrested and sent to the top. It gives a movable surface to the grating, so that every particle of the coal and shale is exposed to the action of the water.

Perhaps the most recent development in the cleaning of coal is that known as dry washing or dry cleaning. One such plant

used for cleaning nuts, where the use of water would cause discoloration of the coal and prove injurious to its marketing, is that made by the Meins Berrisford of Low Moor; the nut coal passes over an inclined glass plate which is kept clean by playing compressed air upon it. The coal passes over the glass but the dirt being heavier, falls down through a gap.

Depth of Working.—With the increased activity of working characteristic of modern coal mining, the depth of the mines has rapidly increased. The following list gives the depths reached in the deepest collieries in Europe in 1900, from which it will be seen that the larger number, as well as the deepest, are in Belgium:—

	Feet
La Providence, Belgium	4,000
Pendleton dip workings, Lancashire	4,000
work to a depth of 3,600ft.	
Sainte Henriette, Flenu, Belgium	3,773
Viviers Gilly, Belgium	3,750
Marcinelle No. 11. Charleroi, Belgium	3,527
Marchienne, No. 2	3,494
Agrappe, Mons.	3,478
Sacré Madame, Charleroi	3,461
Ashton Moss dip workings, Lancashire	3,360
Ronchamp No. 11 pit, France	3,330
Astley Pit, Dukinfield dip workings, Cheshire	3,150

The greatest depth attained in the Westphalian coal is at East Recklinghausen, where there are two shafts 841 metres (2,759ft.) deep.

The subject of the limiting depth of working has been very fully studied in Belgium by Prof. Simon Stassart of Mons ("Les Conditions d'exploitation à grande profondeur en Belgique," *Bulletin de la Société de l'Industrie minérale,* 3 sér., vol. xiv.) who finds that no special difficulty has been met with in workings above 1,100 metres deep from increased temperature or atmospheric pressure. The extreme temperatures in the working faces at 1,150 metres were 79° and 86° F, and the maximum in the end of a drift, 100°; and these were quite bearable on account of the energetic ventilation maintained and the dryness of the air. The yield per man on the working faces was 4·5 tons, and for the whole of the working force underground, 0·846 ton, which is not less than that realized in shallower mines. From the experience of such workings, it is considered that 1,500 metres would be a possible workable depth, the rock temperature being 132°, and those of the intake and return galleries, 92° and 108° F respectively. Under such conditions work would be practically impossible except with very energetic ventilation and dry air.

Ownership of Coal.—In the United Kingdom the ownership of coal, like that of other minerals, is normally vested in the proprietor of the soil, and passes with it, except when specially reserved in the sale. Coal lying under the sea below low-water mark belongs to the Crown, and can only be worked upon payment of royalties, even when it is approached from shafts sunk upon land in private ownership. In the Forest of Dean, which is the property of the Crown as a royal forest, there are certain curious rights held by a portion of the inhabitants known as the Free Miners of the Forest, who are entitled to mine for coal and iron ore under leases known as "gales," granted by the principal agent or gaveller representing the Crown, in tracts not otherwise occupied. This is the only instance in Great Britain of the custom of free coal mining under a Government grant or concession, which is the rule in almost every country on the Continent of Europe.

The grantee of a "gale" makes a certain payment to the Crown and the whole area of the grant is within the control of the president of the Board of Agriculture. As a matter of fact, the free miners or "galees" in the majority of cases, sell their rights to the companies who work the coal, the others receive a royalty. This is an interesting case of workmen royalty owners.

SECTION VI.: COAL MINING ACCIDENTS AND THEIR PREVENTION: THE RECORD OF CASUALTIES

The subject of health and safety in the mines of Great Britain is governed by the Coal Mines Act of 1911 and the regulations made thereunder, administered through the Mines Department of the Board of Trade. For the purpose of inspection, the country is divided into eight divisions, each under a divisional inspector of mines, with a staff of both senior and junior inspectors under him, as well as several sub-inspectors of mines, a sub-inspector of quarries, and an inspector of horses. Over the whole inspectorate is the chief inspector with a deputy-chief and an electrical inspector of mines.

While there has been steady progress in the prevention of fatal accidents in mines in Great Britain during the last 50 to 60 years, coal mining is unfortunately a dangerous occupation, the number of fatal accidents averaging over 1,000 per annum in Britain. Thus:

Decennial period or year	Death rate in Great Britain	
	Per 1,000 persons employed below and above ground	Per 1,000,000 tons of coal raised
1873–1882	2·24	7·42
1883–1892	1·81	5·65
1893–1902	1·39	4·70
1903–1912	1·33	4·76
1913–1922	1·15	4·92
1913	1·55	5·81
1917	1·34	5·27
1918	1·39	5·86
1919	0·94	4·67
1920	0·88	4·60
1921	0·87	4·49
1922	0·95	4·32
1923	1·06	4·57
1924	0·98	4·36
1925	1·02	4·53
1926	1·08	4·95

For the purpose of the official returns made in Great Britain accidents are divisible under six heads, namely: (1) explosions of fire-damp and coal dust, (2) falls of ground, (3) shaft accidents, (4) underground haulage accidents, (5) miscellaneous underground, and (6) those occurring on the surface. The number of fatalities coming under the first division varies greatly, owing to the length of the periods separating great colliery disasters; the accidents under the other heads are not subject to the same variations. The chief cause of fatalities in mines, a class of accident not so spectacular as colliery explosions, but imposing a heavy and persistent toll on the lives of the miners, is that due to falls of ground. Thus, taking the years 1922 and 1925, the figures are as follows:—

	1922		1925	
	Killed	Injured*	Killed	Injured*
Explosions	73	105	29	141
Falls of ground	551	63,035	559	60,454
Shaft accidents	39	971	37	1,255
Haulage accidents	211	46,839	260	43,771
Miscellaneous underground	125	59,254	164	58,851
	999	170,204	1,049	164,472
On surface	106	15,293	110	15,130
	1,105	185,497	1,159	179,602

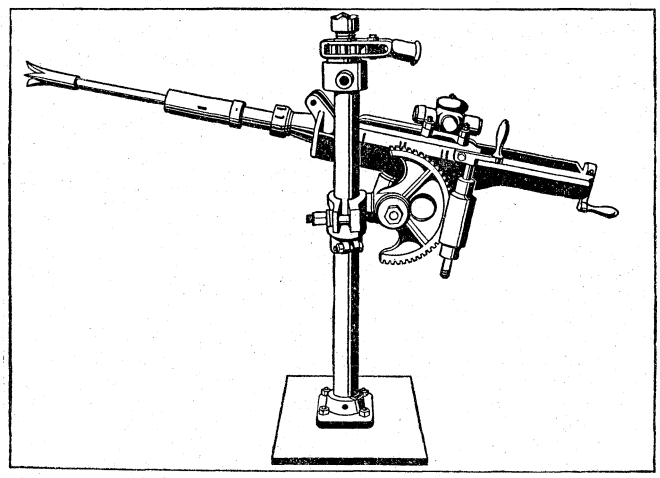
*That is accidents disabling the persons injured for more than three days.

Falls of ground account for 50–55% of the accidents at mines, and haulage, *i.e.,* accidents due to the moving tubs and ropes underground, accounts for from 20–25%; so that three quarters of the accidents at coal mines in Great Britain are due to these two causes. Regarding the former, the chief inspector of mines of Great Britain comments in his annual report for the year 1926 as follows: "Falls of roof and side continue to account for more than half of the fatal accidents in mines. Innumerable pages have been written on this subject and innumerable suggestions made, but the progress made towards a lessening of the number can only be described as disappointing and disheartening."

Avoidable Accidents.—To what extent accidents in mines are avoidable or otherwise is a moot point. In a report written a

few years ago by the then chief inspector of mines, it was stated that all accidents had been classified to show whether they were avoidable or not, and so far as falls of ground were concerned about 72% were pronounced to be unavoidable, while as regards other accidents the percentage was 45·6.

Accidents from explosions are decreasing owing to our acquirement, during the last quarter of a century, of a greater knowledge



BY COURTESY OF THE INTERNATIONAL CHANNELLING MACHINES, LTD., SHEFFIELD

FIG. 24.—THE "SISKOL" PATENT ELECTRIC HEADING MACHINE

of the part played by coal dust, and the measures which have been adopted to combat the danger, *e.g.*, prevention of accumulations, inter-mixture therewith of incombustible dusts, as well as the development of safety devices in connection with shot-firing, safety lamps, and in the application of electricity (*see* Section V.).

The question of support is now resolving itself into one of materials rather than of methods. Falls of ground on haulage roads might be reduced by the erection of steel arches to a larger extent than at present for the support of such roads. The chief inspector of mines in his annual report for the year 1926 stated: "In the South Wales Coalfield, where probably the greatest difficulties are experienced in keeping roads and faces open, steel arches for the support of roadways have been used for many years, and at present some of the collieries have over 20m. of roads so supported." Likewise, the benefits resulting from the use of steel props for the support of the working places is beginning to be realized. The first cost is greater than in the case of wooden props, but it is repaid many times over within a year or two.

But when all is said and done regarding means to be adopted for the reduction of accidents in mines, most is to be hoped from the "safety first" campaign which has been inaugurated at collieries. This is a process of intensive advertising by apt and pithy notices and illustrations of the dangers of carelessness and at some collieries the campaign is worked in conjunction with safety committees consisting of representatives of the officials and workmen, which are functioning admirably.

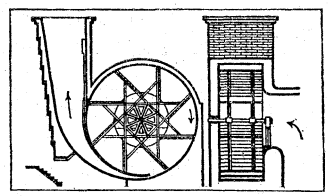


FIG. 25.—GUIBAL VENTILATING FAN

Coal miners are, on the whole, a strong and healthy body of men. The ailments to which they are most prone are chiefly nystagmus, neurasthenia, and, in the case of the older miners, respiratory diseases, such as bronchitis. Nevertheless, in spite of their dangerous occupation and liability to accidents, statistics show that miners live longer and enjoy better health than most men. (*See* also p. 198, Report of royal commission on the coal industry, 1925.)

In point of lowness of death rate from accidents in coal mines, Belgium stands best of all the great coal producing countries of the world, while the United States of America occupies the worst position. But between Great Britain, Belgium and France there is very little difference. The mean annual death rate from accidents per 1,000 persons employed at coal mines in the principal coal producing countries of the world for the periods 1903–12, 1913–1922, 1923–1925, was as follows:—

Country	Mean annual death rate per 1,000 persons employed		
	1903–12	1913–22	1923–25
Great Britain	1·3	1·2	1·0
France	1·7	1·0	0·9
Belgium	1·0	1·2	1·1
Germany:			
Prussian black coal mines	2·1	2·8	2·2
Union of South Africa	3·5	2·4	2·7
British India	1·1	1·2	1·4
Dominion of Canada	3·4	4·4	2·7
United States of America:			
Bituminous coal mines	5·1	4·3	4·9
Anthracite mines	5·2	4·4	3·7

The higher rate obtaining in the United States of America is explained in the authoritative summary, by the staff of the United States coal commission appointed in 1922 as follows: "The higher accident rate per 1,000 employees and lower rate per ton of coal, obtaining in the United States, is due to the favourable natural conditions here for mining coal, the larger use of machinery, the high speed at which the industry works, and the venturesome spirit of the men in this and other American industries." As stated in *The case of Bituminous Coal* by W. H. Hamilton and Helen R. Wright (1925) "The high death rate is not due entirely to the natural hazards of the trade, which man is powerless to prevent. The Bureau of Mines estimates very conservatively that at least half of the annual deaths could be prevented." (*See* also United States Bureau of Mines, "Coal Mine Fatalities in the United States and Europe," by W. W. Adams, April 1924.)

SECTION VII.: LIGNITE: ITS PRODUCTION AND UTILIZATION

Lignite (*see* also Sections I. and II.) is the term commonly applied to immature coals, whether brown or black, or what American geologists term sub-bituminous coal. Properly speaking it comprises those solid fuels, young geologically, which have retained their wooden structure, and have the appearance of decayed wood (Lat. *lignis,* wood). The greater mass of the brown coal deposits of Germany, for instance, though commonly spoken of as lignite, has not a woody structure, though it contains occasional deposits of true lignite. Brown coal is probably a land formation, as is shown by the considerable number of tree trunks contained therein, and the deposits following naturally the cavities of the ground beneath the coal. Owing to the action of water and movements of glaciers, the deposits are sometimes interstratified with sand and clay.

Lignite is usually of Tertiary age. There is considerable variation in respect of its chemical composition, but two characteristics are fairly general, namely high moisture and volatile hydrocarbon content.

Prof. Elwood A. Moore gives the following as the composition of brown coal compiled from analyses of those coals derived from all parts of the world:

	Variation %	Average %
Moisture	0·75 to 43·00	14·42
Volatile matter	27·00 to 53·00	40·78
Free carbon	16·20 to 51·00	36·00
Ash	2·60 to 42·20	9·32
Sulphur	0·16 to 9·00	1·14

As a matter of fact, the moisture content is higher in some instances than that given above.

The world's available supplies of lignite (brown coal or sub-bituminous coal) were estimated by the Geological Congress held at Toronto in 1913 to amount to 2,997,763 million metric tons or about $\frac{5}{12}$ of the world's resources of fossil fuel. By continents

the supplies were estimated to be:—

	Million metric tons
Europe	36,682
Asia	111,851
Africa	1,054
America	2,811,906
Oceania	36,270

In the British Isles the deposits of brown coal are negligible; small deposits occur in Bovey Tracey in Devonshire and in County Antrim, Ireland. In Canada, Australia, New Zealand and India, the resources are, however, vast. In the United States of America there are also very extensive deposits of lignite.

The output of lignite and brown coal during the year 1924, as far as ascertainable, was 161,010,000 metric tons made up as follows:—

	Metric tons
Germany	124,360,000
Czechoslovakia	20,507,000
Austria	2,777,000
Hungary	5,429,000
World's output, including small producers	161,010,000

The greatest producer of brown coal is Germany. It is customary in Germany to differentiate as between those deposits of brown coal which are rich in bitumen and those which have a low bitumen content. The "bituminous" brown coal deposits are usually from 25–65ft. thick, whereas the "lean" seams often attain to a thickness of 330 feet. The German industry is highly developed and flourishing. Many of the deposits are "stript," or worked "opencast"; that is to say, where not too deeply buried, the overlying deposits of sand, clay and gravel are removed by excavators. It is regarded as a profitable proposition to remove the "overburden" up to a thickness of three times the thickness of the underlying brown coal deposit.

The chief consumption of German brown coal is the electric power industry, and whereas in 1913 brown coal was the source of only 23% of the electric power generated, in 1922 it had risen to 41·2%, the generation of electric power in Germany having more than trebled in that period, amounting in 1922 to 7,200,000,000 kw.-hours. With the concentration of electrical production in large works built within the last ten years, a saving of from 15–20% in coal has been effected.

The number of persons employed in producing the German output of 124,360,000 tons is about 134,140. The uses to which the fuel is put besides being consumed in its raw state for domestic and industrial purposes are, (1) in conversion into briquettes, (2) the extraction of montan wax, (3) carbonization and recovery of the light oils, (4) recovery of paraffin for candle manufacture.

Briquetting.—As the coal in its raw state contains about 50–52% of moisture it is first dried in steam heated driers down to 15% moisture, and then compressed by a steam actuated press, no binder being used, into briquettes of about 7in. long by 2¼in. wide and 2in. deep with rounded ends. Formerly the use of brown coal briquettes was restricted almost entirely to domestic purposes, but latterly their use has extended to industrial and commercial undertakings. Generally speaking, the calorific value of the briquettes is double that of the raw brown coal. If the calorific value of German true coal (*steinkohle*) be taken in 7,000 calories, brown coal (*braunkohle*) at 2,500, and brown coal briquettes at 5,000 calories, then one ton of German true coal is equivalent to about 2·8 tons of brown coal or 1·4 tons of brown coal briquettes.

In 1923, 52,254,000 metric tons of raw brown coal were converted into briquettes (26,533,200 by the dry process and 3,209,000 by wet briquetting) in 239 works employing in all 35,902 workmen.

Extraction of Montan Wax.—When brown coal is treated with naphtha or benzol, "bitumen" is obtained in the form of montan wax. The commercial process consists in treating the dried coal in extracting cylinders with a mixture of hot benzol and alcohol, the extracting arrangements operating in the same way as the well known Saxhlet extractors in chemical laboratories. The benzol-alcohol is then evaporated and the montan wax recovered, the recondensed benzol and alcohol being used over again. It does not pay to extract the montan wax unless the raw coal is rich enough therein to yield 10% of the substance on treatment in the laboratory by hot benzol.

There are not many deposits of brown coal in Germany sufficiently rich in "bitumen" to allow of the extraction of that substance in the form of montan wax. This substance, which in its refined state has the appearance of bees-wax, is used in the manufacture of boot polish, cable wax, special greases, lacquers, electrical insulation, gramophone records, light polishes, and as an addition to paraffin in the manufacture of candles. The price of raw montan wax averages £22 10s. per ton, the bleached wax fetching £87 10s.

The low temperature carbonization of lignite, and recovery of light oils and paraffin, is carried out in a retort known as the Rolle oven. It consists of a column of cast-iron circular collars superimposed one above the other, the column being enclosed in a fire brick erection. The coal passes down the narrow annular space between the column of collars and the enclosing firebrick cylinder which is heated by encircling flues, the gases distilled from the coal being drawn off through the collars and condensed in the ordinary way. The following figures are taken from actual results recently obtained at some carbonization works in western Germany:—

Through-put of coal containing 50% moisture, 3–4 tons per 24 hours, per oven.
Semi-coke made per oven per day, 1–1·5 tons or 33% of the raw coal.
Tar (60% of the possible yield as determined by analysis), 4–6% of the raw fuel.
Light oil stripped from the gas in proportion to tar, 16–20%.
Light oil per retort per day, 4·4 lb.
Consumption of brown coal for firing, 2%.

In the year 1923, 14,056,000 tons of raw brown coal were subjected to distillation in 28 works employing in all 1,748 workers; 4,135,000 tons of semi-coke were obtained and 776,000 metric tons of tar.

SECTION VIII.: COAL: ITS SALE, DISTRIBUTION AND EXPORT

An attempt was made by the British Coal Mining Organization committee in the year 1915 to arrive at some close approximation of the proportional distribution of the coal output of the United Kingdom, and in doing so they made a comparison as between the year 1903 and 1913, the object aimed at being to determine how the available supply could be distributed to meet the national requirements in the best possible way during the World War. The comparison was as follows:—

Great Britain	1903	1913
	Tons	Tons
Total output	230,334,469	287,430,473
Reserved for home consumption (not including bunker coal for foreign trade)	166,529,120	189,092,369

The balances were absorbed by export and bunkers.

The average pit-head value of a ton of coal in 1913, all kinds included, was about 10s. 2d. Of the home consumption it was estimated that at least 80,000,000 tons were absorbed in the production of power, inclusive of railways. The following table shows approximately the uses to which the coal was put:—

Great Britain	1903	1913
	Tons	Tons
Railways	13,000,000	15,000,000
Coasting steamers (Bunkers)	2,000,000	2,500,000
Factories	53,000,000	60,000,000
Mines	18,000,000	19,000,000
Iron and steel industries	28,000,000	31,000,000
Other metals and minerals	1,000,000	1,250,000
Brick-works, potteries, glass-works and chemical works	5,000,000	5,750,000
Gasworks	15,000,000	18,000,000
Domestic	32,000,000	35,000,000

The figures given for 1913, which are largely in the nature of an estimate only, will be fairly applicable at the present time.

The Export Trade of Great Britain.—Great Britain is the chief coal exporting country of the world, owing this pre-eminence largely to the variety and high quality of the coal produced, the accessibility of the coal, and the proximity of her coalfields to the sea, as well as to the fact that owing to her earlier industrialization than other countries, she was mining coal on an extensive scale before they had commenced to work their resources.

Although coal has been exported from Great Britain for six centuries, it was in an insignificant quantity until the 18th century, and the first accurate return of coal shipped is in 1791, when the total amount of coal shipped from British ports totalled 335,038 tons, the coal emanating chiefly from the great northern coalfield. By 1850, the exports of coal from Great Britain amounted to 11,000,000 tons; in 1890, 29,000,000; in 1900, 44,000,000 tons; and in 1913, 73,000,000 tons; or, adding the quantity supplied as bunkers to vessels engaged in the foreign trade, the coal equivalent of the coke, and the patent fuel (briquettes) exported, more than 98,000,000 tons, or 34% of the total output, was shipped.

Great Britain still retains the advantage of owning the higher quality and greatest variety of coal as compared with any other country. Her collieries are in the great majority of cases closer to the sea than is common in other countries, and cheap freights are still available; but the production of coal in other coal-owning countries has increased enormously, and not only are their demands in respect of imported coal less than formerly, but in some cases they have become rival competitors for the available export markets.

In fig. 26 the extent of the exports of coal from the United Kingdom is shown diagrammatically in comparison with the exports from Germany and the United States, 1910 to 1926.

The table below shows the export trade in coal of the three great coal producing countries in 1913 and 1924, compiled from the coal tables (1924) issued by the British Mines Department.

World's Coal Export Trade (in millions of long tons), including coal shipped as bunkers by vessels engaged in overseas trade, and also coal equivalents of brown coal, coke and briquettes.

Country	Quantity		Per cent of total	
	1913	1924	1913	1924
Great Britain	98·3	82·0	49·8	51·2
Germany, including reparation deliveries*	47·4	25·1	24·0	15·6
United States	23·6	19·8	12·0	12·4
Total of above	169·3	126·9	85·8	79·2
The World	197·3	160·2	100·0	100·0

*Coal equivalent of brown coal briquettes delivered on reparation account is included here.

These figures show that Great Britain had improved her position in point of her percentage of the world's coal export trade, but inasmuch as the total amount of coal exported from all countries had declined, the weight of coal exported by Great Britain had also declined. The year 1925 showed a further decline of nearly 11,000,000 tons in respect of British coal exports, and, as the figures show, the exports for 1926 were very seriously affected by the lock-out, which caused the exports, including bunker coal shipped in vessels engaged in overseas trade, to be only 28,184,165 tons. Since the end of the last century, the competition of foreign coal has confined all increase in demand for British coal to markets situated, as was pointed out by the late Lord Rhondda, "within a portion of the globe limited by the Suez Canal on the east, by a line drawn from Cape Horn to the Cape of Good Hope on the south, and by a line from Cape Farewell to, say, Trinidad on the west." In 1873 one-fifth of the coal exported from Britain was shipped to regions beyond Europe and the Mediterranean; in 1913 the proportion was only one-eighth.

Taking the whole of the British Coal exports as 100, and dividing the world's markets into nine groups, the proportions of coal exported thereto in 1913 and 1924 respectively were as follows:—

Group	Year	
	1913	1924
	%	%
I. Russia, Poland and Scandinavia	21·7	17·1
II. Germany, Netherlands, Belgium, France and Switzerland	35·3	46·9
III. Spain, Portugal, Italy, Malta, Gibraltar and North Africa (except Egypt)	21·7	19·5
IV. Austria-Hungary, Balkan States, Turkey (European and Asiatic) and Egypt	7·7	4·8
V. West Coast of Africa, Azores, etc.	2·4	2·0
VI. East Coast of Africa, Union of South Africa, Madagascar, etc.	0·3	0·2
VII. Arabia, Indian Ocean and Continent, Malaya, Oceania and Further Asia	1·1	0·9
VIII. North and Central America	0·2	0·8
IX. South America and other Regions	9·6	7·8
	100.	100.

In respect of the various British ports the trade was distributed in the following percentages:—

Year	East coast			West coast			All Ports (including ports not specified)
	Scotland	North East	Humber	Bristol Channel	North West	Scotland	
1913	11·3	31·3	12·1	40·7	1·0	·3	100
1925	9·7	34·6	7·1	45·1	0·4	2·6	100

The table shows there has not been much variation as between the pre-war and post-war years.

The decrease in the export of British coals of late years is due to a variety of reasons, in addition to the reason already named, viz., the increased productivity of other nations. The high price of coal during the World War and for some time thereafter directed the attention of users of fuel to other sources of heat and power, *e.g.*, peat, oil, the generation of electricity hydro-electrically, and also intensified the practice of the more economical use of fuel. With falling prices, however, these restrictive influences will be minimized. There has been, too, on the part of some countries, a desire to erect barriers against the importation of coal; thus, the Soviet Government restricted imports to reduce payments abroad, and forced the use of native coal in north-west Russia, even though an extensive subsidy was necessary to secure this. The French Government also recently (1928) imposed restrictions as to importation of coal.

The average selling price of coal per long ton at the pit's mouth in Great Britain over the period 1905–1926 and the price of coal exported from Great Britain for the same years was as follows:—

Year	Price at the pit's mouth		Price of exported coal		Year	Price at the pit's mouth		Price of exported coal	
	s.	d.	s.	d.		s.	d.	s.	d.
1905	6	11	10	5	1919	27	4	47	3
1910	8	2	11	7	1920	34	7	79	11
1913	10	2	13	11	1921	26	2	34	10
1914	10	0	13	6	1922	17	8	22	6
1915	12	6	16	8	1923	18	10	25	1
1916	15	7	24	3	1924	18	10	23	5
1917	16	9	26	6	1925	16	4	19	10
1918	20	11	30	3	1926	19	6	18	6

It will be observed from the above table that, while the home prices did not soar unduly during the war period of control, export prices reached very high figures. The former was due to the Price of Coal (Limitation) Act then operative. (*See* Section XI.)

Sale and Distribution of British Coal.—There are 1,400 separate colliery undertakings in Great Britain, owning 2,500 mines, all engaged in the disconnected disposal of their produce through the selling agencies attached to, or disconnected from,

their concern. Thus in the great northern coalfield it is usual for the coal to be sold to merchants and others through an agent or "fitter" as he is locally termed, who is an official of the colliery company. In other cases the general manager of the colliery, the managing director or the colliery owner acts as the salesman, and

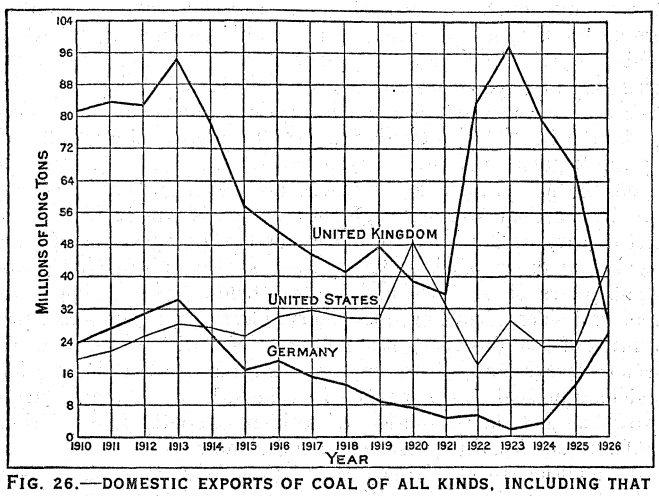


FIG. 26.—DOMESTIC EXPORTS OF COAL OF ALL KINDS, INCLUDING THAT SHIPPED AS BUNKER COAL FOR STEAMERS ENGAGED IN OVERSEAS TRADE

in others outside agents perform this function. One great object being to keep the colliery at work, long-term rather than short-term contracts are sought, the period varying from two or three to six months, or even a year; six and twelve month periods, however, are the more common in the case of large contracts. When prices are very high or very low, the tendency is towards short contracts.

Coal in Britain is seldom if ever sold on an analytical or calorific basis, but under one of the very many commercial names which may or may not—the latter is generally the case—have any reference to the seam from which it is derived. Thus "Wallsend," which originally was the coal from the High Main Seam at Wallsend Colliery on the Tyne, is now merely a name for certain high class house-fire coals. Similarly D.C.B.s (an abbreviation of Davisons, Cowper, Bothal, well known Northumbrian collieries), Derbyshire Brights, Derbyshire Hards, Best South Yorkshire Hards, Best Admiralty Smokeless, etc., have no reference to the seam of derivation, but in the trade itself do represent a certain standard of quality, and certain of the many trade names have a world-wide reputation for excellence as steam, gas, coking or domestic coals.

Few collieries engaged in the British home trade sell direct to customers, but the coal is sold at pit mouth prices to the coal merchants, who bear the cost of transportation to the distributing centre, or the wholesale merchant, sometimes termed a "factor," may dispose of his supplies to smaller merchants, and so on. The public is often at a loss to understand why there should be so great a difference between the price of the coal at the pit's mouth and that which they have to pay delivered into their cellars, even when the extent of the railway charges are known. The difference is accounted for by the many hands through which the coal has to pass from pit to cellar. The crying economic need of the day would appear to be simplicity in distribution. Coal for export also, is, to a large extent, sold through the medium of merchants, the latter undertaking the risk of transport and distribution.

United States of America.—The coal produced in the United States was estimated in 1922 to be distributed thus:—

	Per cent of the production
Domestic consumption	13
Railways	28
Public Utilities	12½
Iron and Steel Industry	15
General Manufacturing	19½
Export and Bunker Trade	12
	100

Of the total output of 591,721,000 tons in 1926, there were exported 41,997,495 tons, which was a record in export for that country, the great increase being due to the national lock-out in Great Britain. This figure includes bunker coal shipped in vessels engaged in overseas trade. About the same amount of "soft" coal is devoted to domestic consumption as anthracite. Of the production, about 43% takes place in the summer (April 1 to Oct. 1), and 57% in the winter.

In the matter of sale and distribution of coal, the machinery in the United States does not differ materially from that in Great Britain. Some 50% of the coal is marketed by the producing companies, but even they do not as a rule sell directly to the ultimate consumer. There are, according to Mr. E. T. Devine (*Coal*, by E. T. Devine), 1,500 wholesale dealers in coal, 40,000 retailers (*i.e.*, one to every 600–700 families), and 8,000–10,000 producers.

The anthracite contained within a small area of a single State, viz., Eastern Pennsylvania, has a highly concentrated ownership, 90% of the reserves being owned by the ten railway companies. The capital value of the anthracite industry is estimated at about $990,000,000. The vastness of the bituminous or "soft" coal industry is indicated by the fact that the coal areas under operation are contained in about 30 of the States, and in 1920, a year of strong demand for coal, there were 12,122 corporations, partnerships and individuals operating 14,766 coal mines.

The production of "soft" coal is on the increase, and this over-production is one of the great troubles with which the United States has to contend; mines being equipped and manned to produce twice their present output, it is not surprising that in 1923 only 179 days were worked on the average. With this capacity for over-production the necessity of the United States to find markets for her coal outside her own border is obvious, and it is interesting in this connection to compare the average export value (f.o.b.) in Great Britain and the United States of coal exported to South America—the coal market most available to the United States—together with average freights during two "spot" months, July and August, in 1925:—

Country to which exported	Great Britain			United States		
	Value per long ton	Freight	Total	Value per long ton	Freight	Total
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Argentina	24 1	16 5	40 6	18 5	16	34 5
Brazil	22 10	15 5	38 3	18 9	14 5	33 2
Chile	18 8	*	*	17 10	*	*
Uruguay	22 2	15 6	37 8	†	16	*

*Information not available.
†No coal exported.

Germany.—The German exports of coal for 1925 rose to 13,500,000 tons, and for 1926 to 28,774,070 tons. Taking the frontiers as they existed in 1925, the consumption in 1913 was 156,000,000 tons, which is not far short of the British home consumption in 1913 of 189,000,000 tons, and points to the increased industrial activity of Germany. The chief consumption of lignite was in the generation of electrical energy. In 1913 lignite was the source of 23% of the power generated in Germany, and in 1922 of 41·2%; the generation of electric power more than trebled in the 10-year period 1913–22, amounting in the latter year to 7,200,000,000 kw. hours. Increased saving in fuel consumption in large power plants and increased use of lignite in the generation of power have liberated a greater quantity of high class "black" coal for export, which competes with British coal in European and other markets.

In Germany the colliery owners must by law sell through syndicates arranged according to districts. A severe penalty is imposed on any owner selling coal outside the syndicate of the district in which his colliery is situated. The syndicates, which are not worked in order to make profit, determine the output of each colliery and fix the selling price of the coal, all coal being divided into classes, *e.g.*, gas coal, coking coal, steam coal, etc. There is one price only for any given class, except in respect of

coals grading from steam into anthracite, intermediate or "dry" steam coals; in these "border line" cases there may be more than one price.

All of these syndicates are combined into the *Reichskohlenverband* over which is a coal council composed of representatives of the coal owners, workmen and consumers' associations, termed the *Reichskohlenrat,* which has conferred upon it, by Government, power to make laws and regulations for the control of the coal mining industry, subject, however, to a power of veto vested in the Minister of Economics (*Reichswirtschaftsminister*). There are at least 100 members of the *Kohlenrat,* 25 of whom are appointed by the management, 25 by the miners and ten by the Reichstag, and the rest—of whom not more than one-third may be officials—by the president of the Reich.

More coal is now being produced in the world than in the past, and more economy is being practised in its use; that is to say, it is being put to better use than previously by improved methods of burning for steam raising and the generation of electricity, by the more extensive use of gas for heating, cooking and for driving internal combustion engines, by the use of powdered fuel, and by other means of obtaining a higher percentage of the available heat value of the fuel. But as Prof. Jevons states, "It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth."

Speaking generally, it is probable that the economy does lead to increased consumption, but it is doubtful whether it does so to the extent of the economy effected.

SECTION IX.: COAL: HISTORY OF LEGISLATION AND COMMISSIONS OF ENQUIRY

The history of ameliorative legislation in respect of the coal mines and miners of Great Britain may be said to date from the year 1778, when a law was passed which enacted that the state of life-slavery to which the miners of Scotland were subjected should come to an end, for at that time they were working under laws by which they were practically slaves. Able-bodied men were paid ten pence a day for hewing coal; their womenkind, acting as bearers in carrying the coal out from the workings and up the shafts, receiving but threepence a day. The workers forming part and parcel of the concern, passed from owner to owner with the colliery as so many chattels. The emancipation was to be gradual and it was not until 1799, when another act was passed, that complete freedom was granted to the Scottish miners. The pay and conditions of employment of mine workers in other parts of Britain were, however, at that time in advance of those of Scotland.

Repeated disasters in the coal pits led to the formation in Sunderland, in 1813, of a Society for the Prevention of Accidents in Coal Mines, and it was the members of this society who were instrumental in engaging the services of Sir Humphry Davy in the investigations which culminated in 1815 in the invention of the safety lamp.

About the middle of the last century may be regarded as the time when great advances were made in mining methods and in the conditions and social status of the mine workers, the latter being due in part to the action of the miners themselves and in part to the general advance in public conscience. Colliery bonds (yearly bonds binding the miners to work on certain terms) of 1763 show that combinations of the miners were prohibited at that time. Combinations of the coal owners in the north of England for the purpose of regulating the vend of coals, and so securing higher selling prices, had been in operation off and on for two centuries before the workmen combined among themselves (1825) with a view to restricting production and obtaining better terms for their labour. The Association of Colliers on the Rivers Tyne and Wear, consisting of 4,000 persons (*Fossil Fuel,* p. 299 note), was formed in 1826 immediately after the repeal of the Combination laws by act of parliament (5 Geo: IV. c. 95).

Committees of the House of Commons had been appointed in the year 1800 to enquire into the state of the coal trade and their reports were published in 1829, in which year, and again in 1830 and 1836, the Lords appointed a select committee "to enquire into the coal trade." Though these sumptuous volumes of evidence and reports constitute a mine of wealth as to the conditions prevalent in the industry at this time, it remained for that great protagonist in the battle for fair conditions for labour, Lord Ashley, afterwards Earl of Shaftesbury (as the outcome of the report of the commissioners for enquiring into the conditions of children employed in mines), to bring in a bill which became law in 1842. This bill prohibited the employment below ground of women and girls and of boys below the age of ten years. Social inspection also opened the way for mine inspection, which was introduced under the Coal Mines Regulation Act of 1850. This was followed by the Regulation Acts of 1855, 1860, 1872, 1887, 1894, 1905 and 1908, the Mines Accidents (Rescue and Award) Act, 1910, and, finally, the Coal Mines Act of 1911, which is still in force. The Act of 1911 deals with such matters as the qualifications of managers and other officials, ventilation, safety lamps, shafts and winding, travelling roads and haulage below ground, support of roof and sides, signalling, machinery, electricity, explosives, prevention of coal dust, inspection as to safety, withdrawal of workmen, surveys and plans, safety measures against inundation, weighing of coal and payment of workers, hours of employment, provisions as to health, notices of accidents, reports, investigations and inquests, penalties, rescue and ambulances.

In addition to the Mines Regulation Acts, there have been passed various Factory and Workshop Acts, which affect such parts of the surface arrangements at mines as, for example, coke ovens, while the Education Acts enforce certain conditions bearing on the education of children and impose penalties for employing a child in contravention of those acts. The Workmen's Compensation Acts of 1897 and 1906 render the employer liable to the workmen for injuries received whilst at work. Among these various measures may be mentioned the Elementary Education Acts of 1870, 1876, 1880, 1891; the School Attendance Acts 1893, 1899; Employment of Children Act, 1903; Employment of Women Act, 1907; Employers' Liability Act, 1880; Factory and Workshop Acts, 1878, 1883, 1888, 1891, 1895, 1901; Fatal Accidents Inquiry (Scotland), 1895; Notice of Accidents Act, 1894, 1906; Truck Act, 1831, 1887, 1896; and the Minimum Wage Act, 1911. In 1865–67, resulting from a petition to the House of Commons from the Miners' National Association urging certain reforms, a select committee was set up to enquire into the working of the law in connection with coal mines and recommended, amongst other things, certifications of competency by examination of colliery managers. Hence the act of 1872.

The Work of Commissions and Committees.—The first royal commission to be appointed in relation to coal mining was that of 1866–71 presided over by the then Duke of Argyll, the reason for its appointment being the alarm raised by the publication in 1865 of Prof. Stanley Jevons' famous book *The Coal Question,* in which he pointed out that, if the great progressive expansion in the production and consumption of coal continued, "the end of the present progressive condition of the Kingdom" would probably take place within 100 years. Various figures were given as to the duration of the coal supplies, 360 years being the lowest. No legislation resulted from the report of this commission. The next royal commission was that on accidents in mines appointed in 1879, which reported in 1886, the Coal Mines Regulation Act of 1887 being the result.

In 1886 an agitation against royalty rents by both colliery owners and workmen led to a memorial of 60 members of parliament characterizing the system as a "gross hindrance to the mining industry." In 1890 a royal commission on mining royalties was set up with Lord Northbrook as chairman. This commission reported in 1893. Amongst other conclusions come to was that "the system of royalties has not interfered with the general development of the mineral resources of the United Kingdom," and they dismissed the question of nationalization.

In the year 1901, the then chancellor of the exchequer, Sir Michael Hicks-Beach, in order to make his budget meet, put a tax of 1d. per ton on export coal, an action which raised much indignation on the part of colliery owners, miners and economists, and eventually induced the Government to set up a commission to re-

view the matters which had come before the 1871 commission. This commission, which was under the chairmanship of Lord Allerton, reported in 1905. The report is still a very valuable work of reference. Of their many conclusions two of considerable interest are worth recording. They foresaw a great development in the use of the steam turbine, powdered fuel and gas stoves. They did not believe there was any "real substitute" for coal as a source of power. They hoped for the establishment of great central electrical generating stations, and were sceptical—in this they were in error—as to the substitution of oil for coal in the Navy. They disapproved of the tax on coal, which was repealed by the Liberal Government in 1906.

In 1906 the miners' eight-hour day committee was appointed, reporting in 1907, and in 1908 an act regulating the hours of employment of miners was passed, which has come to be known as the Miners' Eight-Hour Act.

The period 1896–1911 was one of intense activity as to investigation into the health and safety of miners, for during that period there were set up and reported the explosives testing committee (1897), the first electricity in mines committee (1902), the second electricity in mines committee (1911) and the committee on bobinito (1907). In 1906 a royal commission on mines was appointed under the chairmanship of Lord Monkswell to deal with questions of health and safety and reported in 1909. The outcome of this report was the appointment of a chief inspector of mines, of which Mr. (now Sir) Richard Redmayne was the first occupant, a reorganization of the mines inspectorate, and the passing of the 1911 Mines Act, to which reference has been made already. The mines (rescue and aid) committee, set up in 1910, reported in the succeeding year on the training of rescue corps and maintenance of rescue stations, while the explosions in mines committee, sitting from 1910 to 1914, issued a series of reports giving the result of their experiments carried out at the Home Office research station at Eskmeals in Cumberland. This station is now transferred to Buxton, where it is under the safety in mines research board of the Mines Department. The short Mines Act of 1914 was passed in order to remedy a few oversights in the comprehensive act of 1911.

During the period intervening between the passage of the 1911 act and the outbreak of the World War, several departmental committees were set up to enquire into various subjects connected with coal mining, such as the committee on washing and drying accommodation in mines (1913), dealing with pit-head baths, as a result of which certain regulations were made in regard to the matters reported on; the committee on spontaneous combustion in coal mines (1912–21), which made recommendations to which effect has been given, while the report of the mines rescue apparatus research committee formed the basis of part 3 of the General Regulations of July 20, 1920. The Coal Mines (Minimum Wage) Act was passed in 1912. Though its duration was to be for three years, it is still in existence, having been maintained by Expiring Laws Continuance Acts.

During the period of the World War special legislation affecting the coal mines of Great Britain was passed, the character and object of which are dealt with under Section XI. of this article. But there were certain committees which sat during part of the war period, unconnected with war conditions, which were of far-reaching importance, such as the committee on the coal trade after the war and the coal conservation committee. This last-named committee became on the establishment of the Ministry of Reconstruction a committee of that department, and among its results were the setting up of the Fuel Research Board, and proposals as to the establishment of an electric power scheme for Great Britain, which is now in course of being carried into effect.

An important committee, too, was the acquisition and valuation of land committee, which amongst other matters dealt largely with the question of mine royalties, and as a result of whose report (1919) the Mines (Working Facilities and Support) Act was passed in 1923, giving power to the railway and canal commission to override the rights of owners of land and minerals so as to secure the effective working of coal, and dealing also with questions relating to support.

The Sankey Commission.—Since the war several important acts have been passed as the result of the findings of other commissions and committees. The most important of these was the coal industry commission which, under an act of parliament passed for the purpose, was clothed with statutory powers for enquiring into the position of, and the conditions prevailing in, the coal industry. This, perhaps the most important royal commission on coal that has sat, was presided over by an eminent judge of the high court, Sir John Sankey, G.B.E. The commission took within its purview many matters connected with the coal industry, such as health, safety, costs, profits, hours of work and conditions of employment generally. It considered alternative methods for the future conduct of the industry, as, for instance, the existing system of private ownership and control, nationalization, and, as an alternative to nationalization, a system of aggregation of colliery interests and co-partnership.

Three divergent interim reports were presented on March 20, 1919. The chairman and the three Government nominees (of the six persons selected because of their economic knowledge) recommended a "seven-hour" working day instead of the existing eight hours, "and, subject to the economic position of the industry at the end of 1920," a six-hour day; an increase of two shillings per shift in the wage of those "classes of colliery workers, employed in coal mines or at the pit-heads of coal mines, whose wages have in the past been regulated by colliery sliding scales," and, in the case of workers under 16 years of age, an advance of one shilling a day. There was included in this report a paragraph which caused much stir in mining circles. It ran,

"Even upon the evidence already given, the present system of ownership and working in the coal industry stands condemned, and some other system must be substituted for it, either nationalization or a method of unification by national purchase and/or joint control."

The report stated that it was "a matter for careful consideration whether 1d. per ton should not be at once collected on coal raised and applied to improve the housing and amenities of each particular colliery district." On the output then being procured this meant about £1,000,000 a year.

The three miners' representatives and the three nominees of the miners (of the six persons noted for their economic knowledge) signed another report which was somewhat longer than the first mentioned, and whilst advocating an advance of 30% in wages and a six-hour working day, constituted also a closely reasoned argument in favour of the complete nationalization of the coal mining industry.

The three colliery owners' representatives, on the other hand, in a somewhat brief report, took up the attitude that they had not to decide the question as to "what amount we would desire colliery workers to receive to enable them to attain a higher standard of living, but the amount to which their existing wages ought to be increased, regard being had to a reasonable standard of living amongst the colliery workers and the effect of any increase of their wages on the development of the coal industry and the economic life of the country." They also opposed any decrease in the working hours. As regarded nationalization or unification of ownership of collieries, they stated that "such evidence as has been placed before us is insufficient to enable us to pronounce any judgment."

The Government accepted the majority (the chairman's) interim or first stage report "in the letter and the spirit," as a result of which the Seven Hours Act and the Mining Industry Act of 1920 were passed.

On June 20 of the same year the commissioners made four divergent final reports, one by the chairman, another by Sir Arthur Duckham (one of the six gentlemen eminent in economic knowledge), another by the miners' representatives and their three nominees (of the six "economic" members of the commission) and a fourth by the colliery owners' representatives and two of the Government's nominees of the six economic members.

The chairman reported in favour of acquiring the coal royalties and mines by purchase for the State. Sir A. Duckham advocated,

amongst other things, State ownership of the minerals (royalties) by purchase, a system of unification in areas under private enterprise, the setting up of pit committees, and the multiple shift system. The miners' representatives advocated State organization and ownership (*see* subsequent Section X.). The fourth report of the colliery owners and two of the economic members stated, amongst much other matter, "that the evidence submitted to the commission afforded no ground for belief that nationalization would have the effect of reducing the price of coal, in fact it pointed the other way, and that they believed in any form it would be detrimental to the development of the industry and the economic life of the country; nor would it lead to peace." They favoured purchase by the Government of the coal royalties and recommended the setting up of pit committees and district and national councils.

The Government practically accepted none of the reports in their entirety and brought in a bill for setting up pit committees, district and national councils, but the leaders of the miners declined to accept it as a settlement. A national stoppage of the miners was, however, averted.

The coal trade remained in a very disturbed state, and in 1924 a court of enquiry under Lord Buckmaster was set up, and another in 1925 under the well-known Counsel Mr. MacMillan, dealing with certain aspects of the industry. In 1925 the Mining Industry (Welfare Fund) Act was passed prolonging the Welfare Fund for another five years. There was a state of world-wide depression in the coal mining industry, production being in excess of demand. In July 1925 the British Government decided to make to the coal industry a financial subvention as from Aug. 1 of that year to April 30, 1926, by which wages would continue to be paid at the current rate. By March 31, 1926, this subsidy had reached £19,000,000.

The Samuel Commission, 1925.—In Aug. 1925 a royal commission was appointed under the chairmanship of the Rt. Hon. Sir Herbert Samuel, G.B.E., "to report upon the economic position of the coal industry and conditions affecting it, and to make any recommendations for the improvement thereof." The commission, consisting of four persons unconnected with the industry, issued on March 6, 1926, one of the most exhaustive and masterly documents ever produced in connection with the coal industry of Great Britain.

The commission, besides hearing fresh evidence, made a close study of the evidence which had been given before the Sankey commission. The following is a very brief and condensed summary of the findings and recommendations of the commission:—

They condemned the principle of a subsidy. They could not agree with the view of the coal owners that little can be done to improve the organization of the industry, and that the only practicable course was to lengthen hours and lower wages. They considered the problem as divisible under two heads—the permanent and the temporary aspect. The immediate problem to be faced included the fact that, excluding the subsidy, 73% of the coal was produced at a loss and the commission arrived at the opinion that, "If the present hours are to be retained, we think a revision of the 'minimum percentage addition to standard rates of wages' fixed in 1924 at a time of temporary prosperity, is indispensable." They hoped that no increase in hours would be necessary. They deemed it essential that there should be, as heretofore, considerable variation as between districts in the rates of wages, but at the same time advocated the continuance of national "wage agreements" and recommended that the representatives of the employers and employed should meet together, first nationally and then in districts, in order to arrive at a settlement. The revision of the minimum percentage would save the industry from immediate collapse, but it was inevitable that a number of collieries would have to be closed; consequently it might be necessary to arrange for the transference of labour on a considerable scale, in which case the Government should provide funds for the purpose.

With regard to the permanent aspect of the problem, the commission advocated the acquirement by purchase by the State of the royalties; the amalgamation of the collieries into larger groups which the State, as owner of the minerals, would be able to promote; the promotion of a closer connection of mining with the allied industries, *e.g.*, "the development of electrical supply under the new proposals of the Government should be closely co-ordinated with the generation of electricity at the mines." They suggested the setting up of a national fuel and power committee with advisory powers. They regarded research into the methods of both winning and using coal as being backward. The State should give financial support to the further experiments on a commercial scale which are necessary in the case of low-temperature carbonization. The matter of distribution of coal left much to be desired; large financial advantages might be gained by the formation of co-operative selling agencies—they were especially needed in the export trade. The Government should consider the establishment of an official system for the sampling and analysis of coal so as to encourage selling on a specification and guarantee. Local authorities should be empowered to engage in the retail coal trade. Larger mineral wagons should be used and a greater concentration of ownership thereof effected, and a standing joint committee of the Ministry of Transport and the Mines Department be formed to promote these measures. Whilst the standard length of the working day, which averaged $7\frac{1}{2}$ hr. underground, should remain unaltered, "the optional re-distribution of hours within the present weekly total, over a week of five days instead of six, should be considered," and the multiple shift system should be extended. Joint pit committees should be established generally. Payment of men should be on such a basis, where possible, as to give them a direct interest in output. They advocated a family allowance system and profit sharing. For all new collieries a proper provision of houses for the workers should be a condition of the lease. The general establishment of pit-head baths was necessary and when prosperity returns to the industry they considered that annual holidays with pay should be established. The industry should be continued under private enterprise.

Although the owners, under pressure, accepted the report in principle, it was rejected by the miners, and on Saturday, April 29, 1926, the men ceased work. To support them a general strike was ordered (*see* GENERAL STRIKE), but in a few days this was abandoned. The miners, however, remained idle throughout May and June and the attempts made by the prime minister and others to bring about a settlement of the dispute were unavailing. In June the Government introduced legislation into parliament to carry out the recommendations of the Samuel commission, and (1) the Coal Mines Act 1926, which permitted of increasing the time below ground of workmen by one hour, and (2) the Mining Industry Act, 1926, which gave effect with two important exceptions to the recommendations of the Samuel commission, were passed.

Space does not permit of a description of the very important provisions contained in the latter act, *e.g.*, those for facilitating amalgamations of collieries, the extending of the Mines (Working Facilities and Support) Act, levy on royalties for purposes of erecting pit head baths, limitation of recruitment of labour in the industry for facilitating profit-sharing schemes, pit committees, etc. A number of committees were also set up as the outcome of the report of the Samuel commission to deal with matters referred to therein, *e.g.*, the fuel and power council, the mineral transport committee, the committee of co-operative selling in the coal mining industry; the latter has reported already.

During the last 60 years there have been in connection with the British coal mining industry nine royal commissions, over 30 committees of enquiry, and 26 acts of parliament. Perhaps no branch of industry has been subjected to so much and such stringent state regulation as that of coal mining in Great Britain, with a view, in a great measure, to the protection of the miners. Socially, morally and financially the status of the workers has greatly advanced since 1850, and coal mining has developed into a branch of engineering requiring the most skilled engineers. This high degree of skill is essential because the richer and more accessible coal deposits were largely worked out in the earlier periods of coal mining in England.

SECTION X.: COAL: THE QUESTION OF NATIONALIZATION

A policy which of late years has been espoused by the Miners' Federation of Great Britain is that of the nationalization or socialization of the coal mining industry. Whatever form it takes, whether ownership by the State, with State control, or some form of guild socialization—as, for instance, ownership by the workers in the industry for their benefit—it implies the elimination of the individual employer and the destruction of private enterprise.

The miners, however, did not welcome Government control of the coal mines when it was first mooted in Dec. 1916, being suspicious of what was entailed thereby. On Dec. 20, 1916, the executive of the Miners' Federation adopted a resolution, "That the executive views with the utmost concern the declaration of the prime minister that the Government contemplate taking control of the whole of the mines of the country, and before any definite action is taken, we ask the prime minister to grant an interview to the executive committee at the earliest possible date." Eventually, that view has completely changed.

At the beginning of 1919, when the miners put forward a series of demands, there was included a demand for the "nationalization" of the collieries. And again, upon the issue of the four separate and diverse reports of the Sankey commission (*see* SECTION IX.), the report of the miners' representatives advocated State organization and ownership. The report of the chairman (Mr. Justice Sankey) recommended the immediate acquirement of the coal royalties for the State, which was to pay just compensation to the owners thereof. He also recommended a scheme for the local administration of the collieries, and that legislation be passed for acquiring them for the State, after the scheme had been worked for three years from the date of the report; during that time the coal control, then in existence, was to be continued. The reasons for nationalization of minerals and collieries which animated the miners' representatives and the chairman of the commission may be epitomized as follows:—

(*a*) Coal being a principal national asset of the United Kingdom, and a wasting asset, it is in the State's interest that it should be worked and used to the best advantage.

(*b*) The ownership of coal is vested in about 4,000 owners, among whom, though many are reasonable, there are some who are a hindrance to the development of the industry.

(*c*) Under a system of corporate ownership, boundaries of undertakings are arbitrary and irregular, making it difficult to work the mines, while the coal at present left between the separate mines is lost.

(*d*) Drainage and pumping of the mines could be more effectively carried on under a system of nationalization than under individual ownership.

(*e*) Competition between coal owners for the export trade frequently prevents the industry from getting the full value of the coal.

(*f*) The system of inland distribution of coal being in the hands of many private individuals, the consumer is unable to obtain the coal as cheaply as he should. It is estimated that there are 28,000 retail distributors of coal in the United Kingdom.

(*g*) There are about 3,000 pits owned by about 1,500 companies or individuals in the United Kingdom. Were these combined under State ownership, standardization of materials and appliances would be possible, with the resulting economies.

(*h*) Though all the above economies and improvements could be effected under a system of unification without nationalization—by a system of "rationalization," as it has come to be called—it is, or was, agreed that, as the workers think under private ownership they are working for the capitalist, and when a strike takes place a contest between labour and capital is set up which is much less likely to apply with the State as owner.

The miners' representatives were opposed to any compensation whatever being paid to the owners of the coal (royalty owners). Sir Arthur Duckham, a Government nominee on the commission, reported in favour of unification under private ownership. The colliery owners' representatives and two of the Government nominees on the commission reported in favour of the State purchase of the coal but against nationalization of the collieries. They stated that "the evidence submitted to the Commission affords no ground for belief that nationalization would have the effect of reducing the price of coal," and that "without co-operation, nationalization, even if otherwise advisable, would in no way secure increase of output or continuity of production. The evidence has clearly shown that strikes are not prevented by State ownership and management," and were emphatic that nationalization "in any form would be detrimental to the development of the industry and to the economic life of the country." The Government of the day rejected nationalization, and after the great strike of 1920 the objective for the time being of the miners' representatives had got narrowed down to a national pool of wages and profits. But nationalization of minerals and mines is the avowed policy of the Labour Party in Great Britain.

As a remedy for such defects as unscientific use of coal, costly getting of coal, imperfect selling and transportation arrangements, etc., the Samuel commission (reported March 6, 1926) did not recommend the adoption of the policy of nationalization. They remained unsatisfied that such a system was workable or that it offered a clear social gain. "We perceive in it" they said (p. 233 of the report) "grave economic dangers, and we find no advantages that cannot be obtained as readily or more readily in other ways." They were of the opinion (p. 237) that, "The way to prosperity for the mining industry lies along three chief lines of advance: through greater application of science to the winning and using of coal, through larger units for production and distribution, through fuller partnership between employers and employed. In all these respects progress must come mainly from within the industry."

The author of *Coal Mining Industry during the War* in the concluding chapters of his work, refers thus to nationalization:—

"The economies of administration and working attainable under a system of aggregation must be patent to every broad-minded and enquiring student of the mining industry. Keen competition between rival coal owners allows the foreigner in normal times to exploit the coal output of the country. Great economies could be achieved, too, by a centralized system of purchasing of stores, and important far-reaching economies could be secured by centralization of pumping and to some extent winding plants, and further, underground haulage would be simplified and cheapened by the abolition of eccentric boundaries. . . . The gains or drawbacks of nationalization, on the other hand, hinge upon definite principles of human action and experience. Whatever results may accrue from such a policy, from the record of observation I find great difficulty in believing that it would make for efficiency. During the period of control the representatives of the State did their best, and they were often unfairly criticized, but it is certain that no experienced head amongst them would care to put forward the claim that public management has a genius for either efficiency or economy. It was imperative at the time to impose unified action in important matters, where there was no existing machinery within the industry capable of doing so. But the virtue was in the co-ordination and not in the head directing it, and there can be no doubt that joint action from within, had it been available at the moment it was required, would have produced a more effective and economical mechanism. A prominent instance of this was the system of voluntary district coal distribution which was carried on by a committee of the coal owners. Even if nationalized control were not vetoed by the inherent physical difficulties of the case, it would still have the disadvantage of removing from the industry the great energizing forces of personal responsibility and initiative."

In Great Britain and America there are no State-owned mines. The German State formerly owned a large number of collieries. The Prussian State owned and managed three large coal mines in Upper Silesia, now in Polish territory, three lignite mines and eight bituminous coal mines in the Ruhr, together producing about 9,500,000 tons per annum. Prussia also had control of the Hibernia coal mines, which, however, were run on the lines of a private company. In 1924 all these mines were denationalized, though the State continued to hold all the shares and other capital, the only difference being that, though the directors are appointed by the State, the officials and control generally of the mines are not under the State.

Russia. All the collieries in Russia, once privately owned, are under the Soviet. Figures based on returns by the Soviet—the conditions being those of gradual recovery from war-effects—present (1928) a poor comparison with pre-war conditions. A considerably reduced output has been obtained and that output only with the aid of important State subsidies. In the fiscal year ending Sept. 1924 the coal mining industry received subventions in cash amounting to 24,800,000 chervonetz (1 ch.=£1 1s) and a credit of 50,000,000 ch. in addition. The industry is greatly in arrears with payment of taxes. The position of the miner is far worse than before the war; in the Donetz basin he received, in March 1924,

15 gold roubles compared with 36·8 gold roubles in 1914 calculated upon the index cost of living. The output in 1913, exclusive of the area assigned to Poland, was 28,990,000 tons, whereas in 1924 it was only 14,580,000 tons; the country cannot even absorb this greatly diminished output. In 1913 the output per man per annum was 149·4 tons; in 1924 it was only 86·8 tons.

Holland. Holland has some State coal mines, the production from which in 1924 exceeded that from the privately owned mines for the first time. The State-owned mines produced 2,912,899 tons out of a total for the country of 5,787,020 tons. The gross working profit from all the State mines in 1924 was 7,320,000 florins as compared with 8,340,000 florins in 1923.

British Empire. In the British Empire there are several cases of State ownership of collieries on a very small scale, *e.g.*, the Udi mine in Nigeria, the Mount Mulligan mine in Queensland and the James and Liverpool collieries in New Zealand.

SECTION XI.: COAL: CONTROL METHODS IN THE WORLD WAR

In times of war and national emergency, when industry is paralysed for lack of motive power, the overwhelming importance of coal is emphasized. Coal is not only the prime factor in the manufacture of nearly all war materials, and in the mobilization of shipping, but in the case of Britain, it is a prime article of exchange for the foodstuffs that are imported. The cost of living is further very largely affected by the price of coal. During certain periods of the war the trading value of coal became very pronounced, for a free exchange in coal did not exist. Certain Governments, notably the British and German, held the delivery of coal under control. For instance, Britain supplied coal to Norway and Sweden, at a price subject to those countries giving in exchange return cargoes of pit timber and certain classes of high grade iron ore and steel billets. To Sweden also at one time bituminous coal and anthracite were supplied subject to the release for transport to Russia of certain medical stores of which the latter country was in great need. Similarly, Switzerland relied almost entirely on German coal for industrial purposes, and Germany used this weapon as a means to press for "compensatory goods," and also obtained iron ore in like manner from Sweden.

By a systematic development of the policy of granting supplies of coal for bunkering purposes only upon condition that those receiving such supplies would render certain services to the British empire and her Allies, or would abstain from giving certain facilities to their enemies, the firms who controlled the marketing of British coal were gradually able to exert a degree of pressure upon neutral shipowners and manufacturers which formed a valuable contribution towards the economic measures directed against the enemy. But, the immediate effect of the war on the coal trade of Great Britain was also to close several important foreign markets against her. Transport facilities, by reason of the diversion of rolling stock and shipping to military purposes, was also impeded. The result was a temporary glut of coal at the collieries for home consumption.

The Allies, especially France and Italy, became largely dependent on Britain for their supplies of coal, the latter country entirely, while France's demands were soon double that of the normal importation. The great expansion in the manufacture of the munitions of war at home greatly augmented the fuel requirements of the iron and steel works, and on top of all this the war requirements made a constant drain on the number of miners. Up to the end of March 1916, no fewer than 282,000 men from the coal mines had voluntarily enlisted in the fighting forces. So that, although the decline in exports of coal and coke during the year 1915 amounted to about 14 million tons, this was more than balanced by decreased output, amounting to nearly 12,500,000 tons, and increased demands for home consumption. The average pithead price of coal rose from 9s. 11.21d. in 1914 to 12s. 4.8d. per ton in 1915.

The Coal Mining Organization Committee.—This body consisting of representatives of the colliery owners and miners, presided over by the chief inspector of mines, was set up by the Government in Feb. 1915 to organize the industry to the best advantage to meet the exigencies created by the war. It had no plenary powers; it could only investigate, report and arbitrate. It continued in almost constant session until complete financial control of the industry by the State was instituted in 1917, and but for the very strained relations between the colliery owners and workmen in South Wales, which culminated in a complete impasse at the close of 1916, it is probable that the committee could have functioned successfully throughout the war. Two other committees dealing with coal problems were established on the advice of this committee, namely, the coal exports committee, under whose control was placed the whole of the export trade of the country in coal, and the coal and coke distribution committee, which dealt with the inland distribution of supplies.

In 1916 the output of coal showed an increase of over 3,000,000 tons on the previous year, and the average pit-head price had risen to 15s. 2.57d. per ton. Exports still further decreased, but this was occasioned by the unavoidable restriction which had to be imposed to meet home requirements, due to the starting of munition factories and the extensions of works. On the advice of the coal mining organization committee, the Government instituted the Price of Coal Limitation Act, which became law as from July 29, 1915, and remained in being until the end of March 1921, being repealed when Government control ceased.

The coal trade had reached a purely artificial state which continued throughout the war, the natural laws governing supply and demand being largely disturbed by Government control of prices and of export. The limitation of the price of coal, which was in the nature of a self-denying ordinance on the part of colliery owners and the miners, constituted one of the chief events in the history of the coal mining industry of Great Britain. It was almost the first attempt at a statutory limitation of the price of an essential commodity and, on the whole, it achieved a remarkable success. By the act, certain maximum pit-head prices for the sale of coal for inland consumption were fixed, the coal owners being left free to obtain the best possible price for coal for export, with the exception of a limitation in the case of coal sold to the Allies. Thus at one time the price of the same coal was for home consumption 16s. 6d. per ton and for export 60s., 62s.6d. and 65s., and after the Armistice actually reached 140s. a ton for export.

Government Control.—Owing to the wage disputes in South Wales terminating in an impasse, the Government took possession of the coal mines in Wales and Monmouthshire as from Dec. 1, 1916, with the object of eliminating war profits, avoiding industrial disputes and securing the best results from labour in the mines during the war. In February of the year following it was succeeded by a more stringent control which was extended to include all coal mines, the three advisory committees mentioned above being merged in the control. An agreement arrived at between the controller and the coal owners as to the compensation to be paid to the latter under the control was confirmed by act of parliament on Feb. 6, 1918.

The management of the collieries remained with the owners, and a profit standard was fixed in respect of each colliery undertaking based on any one of the three years preceding the war which the owner chose to select, such profit being guaranteed to him during the period of control, provided he worked up to a standard output. Eighty per cent of all the profit over and above the guaranteed profit was paid to the inland revenue, as in the case of the excess profits of other concerns. Of the remaining 20% the Government coal controller took 15%, which went to form a pool from which he met deficiencies that arose in respect of the guaranteed profits of any of the undertakings, the colliery owners receiving the remaining 5%.

Perhaps the two most important actions taken by the controller of coal mines were those in respect of the transport and rationing of coal. On Sept. 8, 1917, the Transport of Coal Order was issued, under which Great Britain was divided into 20 areas to which coal produced in each of the production areas might be forwarded by public railway for inland consumption, (1) for steam and manufacturing purposes, (2) for gas and cooking purposes, and (3) for domestic purposes. It was estimated that, on the basis of the year 1917, the scheme would effect a saving in transport of rail-

borne coal of 700,000,000 ton-m. per annum; though it is doubtful whether the saving effected actually reached this figure. The rationing of domestic coal first applied to London under the Household Coal Distribution Order of Aug. 10, 1917.

The Distribution Order, 1917.—Three principal objects were aimed at by this order: the establishment of minimum stocks of coal to be held in reserve throughout the winter; a priority in distribution of any available stocks of coal, in case of shortage, to be conferred on consumers requiring or taking supplies in quantities not exceeding 2 cwt. per week, and restriction in the consumption of coal where it was in excess of the normal average requirements of houses of different sizes. In July 1918 compulsory rationing in respect of domestic coal was made applicable to the whole of England and Wales, and in Oct. 1918 to Scotland also.

End of War Time Control.—The financial control of the coal mines was terminated by the passage, on March 31, of the Coal Mines (Emergency) Act, 1920, which specified that it should be deemed to have ceased as from April 1, 1919.

The financial decontrol of the mines took place on March 31, 1921. As the temporary scheme was drawing to a conclusion the representatives of the owners and workmen met in order to work out a permanent settlement. Their efforts failed, and on April 1, 1921, another national strike took place; it lasted until July 4, when a settlement was arrived at embodying for the first time the idea of profit-sharing.

BIBLIOGRAPHY.—W. Stanley Jevons, *The Coal Question* (1865); E. Hull, M.A., F.R.S., *The Coal Fields of Great Britain;* E. S. Moore, *Coal, its properties, analyses, classification, geology, extraction and distribution* (1922); Sir R. A. S. Redmayne, K.C.B., *Modern Practice in Coal Mining: The British Coal Mining Industry during the War* (1923); H. H. Hughes, *Text Book on Coal Mining;* H. F. Bulman and Sir R. A. S. Redmayne, K.C.B., *Colliery Working and Management;* R. L. Galloway, *Annals of Coal Mining and the Coal Trade* (2 vols.); Imperial Mineral Resources Bureau, *The Mineral Industry of the British Empire and Foreign Countries—Coal, Coke and By-Products, 1913–1919;* Department of Overseas Trade, *Reports on the Economic and Financial Conditions of Germany* (1924–25); *Reports of the Royal Commission on the Coal Industry* (1919 and 1926); The Rhenish Westphalian Coal Syndicate, *Special Report for U.S.A. Federal States Commission, Berlin* (Nov. 1915); *Report of the United States Coal Commission* (1922–23); *Reports of German Economic Council* (Oct. 1920); W. A. Bone, F.R.S., *The Constitution of Coal* (Soc. of Chem. Ind. vol. xliv., 1925); E. Jungst, *The Wages Position in the Ruhr Mining Industry* (Essener Allgemeine Zeitung, Oct. 28, 1925); *Coal Trade Reports of the Houses of Lords and Commons; Report of the Royal Commission on Mining Royalties* (1893); *Report of the Royal Commission on Coal Supplies* (1905).

(R. R.).

SECTION XII: COAL INDUSTRY: UNITED STATES

According to recent estimates, those of the International Geological Congress, the United States has about 52% of the coal supply of the world, but in view of the fact that the geological resources are probably almost as closely estimated in the United States as in any part of the globe and that large areas of the earth's surface have been only roughly surveyed and some not at all, this figure may be subject to some reduction. Twenty-eight States, as well as the Territory of Alaska and the Philippine islands, have bountiful supplies of coal, 8 States have only a small quantity in each and 12 States, with the Hawaiian islands, are absolutely without this fuel. Table I. shows the separate production of 25 states and Alaska in 1926 with the combined tonnage of Arizona, California, Idaho, Nebraska, Nevada and Oregon.

Some of the figures in the last column of the table—"average tons per man per day"—may be too high in some States because men in those regions frequently go into the mines to shoot coal and load cars on days when the tipples or mines as a whole are not in operation. The figures relate only to active mines of commercial size that produced bituminous coal in 1937. The number of such mines in the United States was 6,548 in 1937, 6,057 in 1929 and 9,331 in 1923. There were 212 mines in Class 1A (producing 500,000 tons or over in the course of the year). These mined 37.6% of the entire tonnage. There were 449 in Class 1B (with a tonnage between 200,000 and 500,000). These produced 31.2% of the tonnage. Class 2 (100,000 to 200,000 tons) numbered 469 and produced 15.3%; Class 3 (50,000 to 100,000 tons) numbered 448 and produced 7.4%; Class 4 (10,000 to 50,000 tons) numbered 1,117 and produced 5.9% and Class 5 (less than 10,000 tons) numbered 3,853 and produced 2.6%. Two important trends disclosed by Table I are a marked reduction in the amounts of fuel used by the mines, and a heavy increase in shipments by truck. The general development of truck transportation has resulted in truck shipments over a considerable area, instead of only for purely local sales.

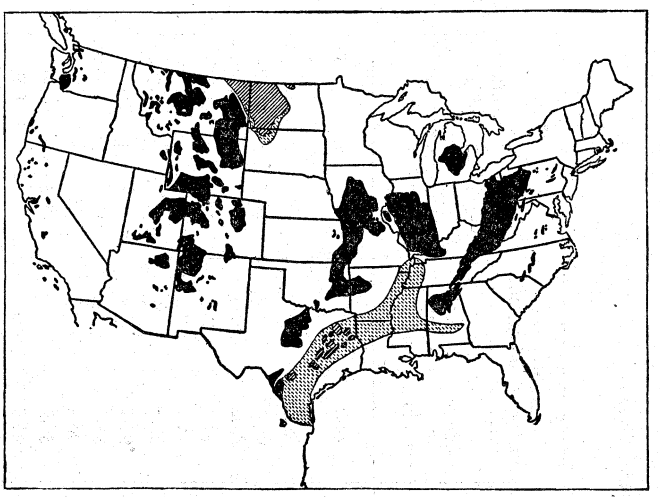


FIG. 27.—COAL WHETHER SUB-BITUMINOUS, BITUMINOUS, SEMI-BITUMINOUS, SEMI-ANTHRACITE OR SUPERANTHRACITE IS DESIGNATED BY THE SOLID BLACK AREAS. LIGNITE OF DOUBTFUL OR UNDETERMINED VALUE IS DESIGNATED BY BROKEN HATCHING; DARKER HATCHING SHOWS LIGNITE FIELDS OF KNOWN COMMERCIAL VALUE

Table II. shows the coal analyses in more important districts.

Pennsylvania Anthracite.—The anthracite region of Pennsylvania until and including 1869 (except in 1865) produced more coal than all the rest of the United States. In that year the output of Pennsylvania anthracite was 17,083,134 tons. Since that time the tonnage of the anthracite field has increased, but the production of bituminous coal and lignite has augmented so much more rapidly that in 1938 the anthracite tonnage was only 11.8% of the total. (*See* ANTHRACITE.)

Methods of Mining.—Most of the coal produced in the United States is mined by room-and-pillar methods which are equivalent to the bord-and-pillar, or post-and-stall, methods of Great Britain. The width of the room varies from 10 to 80 ft. depending on the strength of the part of the roof immediately over the coal, the depth of the seam from the surface, whether it is the purpose to withdraw the pillar and whether an attempt is made not to disturb the surface. Where, as in the Connellsville region of Pennsylvania, the cover is deep and the pillar coal friable, the room width may be only 12 ft. wide, especially, if, as is usual, the extraction of the pillar or "second mining" is to be attempted later. In that case pillars of as much as 80 ft. width have been provided. In many parts of West Virginia, in central and southern Illinois, and in the south-western coal region generally where pillars are not removed, the percentage of recovery may be less than 50. In the Connellsville, Fairmont and Pocahontas regions complete extraction is attempted and 90% is frequently attained. In these regions the pillars are withdrawn retreating and in a long break line extending over two or three entries which is adhered to rigidly in order that no pillar may form a salient angle in the line of goaf, and thus receive more than its due load. No coal is left standing. If it cannot be loaded it must, at least, be shot down so as to permit the roof to break and fall, relieving the stress on the coal face. In such instances the roof is frequently observed to be torn on the surface, as in longwall workings, some hundreds of feet back of the break line over the still standing coal. The underground breaks of the roof within the area that has been totally excavated doubtless do not connect with these surface breaks. The fractures in the workings appear to project into the goaf, or excavated area, from a line near the break line at an angle to the horizontal of 70 degrees, leaving a corbel of rock along the break line.

TABLE I.—*Salient Statistics of the Coal Industry in the United States in 1937*
(Exclusive of mines producing less than 1,000 tons)

	Thousands of net tons						Percentage of total output from		Percentage of underground output		Percentage of total output mechanically cleaned[a]	Average number of employees	Average number of days worked	Average tons per man per day
	Rail and water shipments	Truck deliveries and local sales	Used by mine employees	Used at mines for fuel	Made into coke at mines	Total tonnage produced	Underground	Strip workings	Undercut by machine[a]	Loaded by machine[a]				
Alabama	11,760	500	87	112	..	12,440	99.7	0.3	72.8	14.3	81.1	2,613	200	2.74
Alaska	129	..	[d]	3	..	132	100.0	..	[e]	[h]	[h]	123	207	5.16
Arkansas	65	33	2	9	..	511	98.1	1.9	81.2	33.3	[h]	4,253	136	2.61
Colorado	5,338	1,556	50	145	115	7,187	[e]	[e]	68.6	8.2	10.5	9,432	181	4.21
Illinois	42,825	7,611	203	758	..	51,602	77.8	22.2	88.4	62.4	11.0	42,449	168	7.25
Indiana	15,546	1,986	28	195	..	17,765	53.4	46.6	90.3	70.5	12.3	11,238	174	9.10
Iowa	1,731	1,833	45	26	..	3,637	88.5	11.5	35.7	[h]	[h]	8,720	146	2.87
Kansas	2,520	351	6	16	..	2,893	32.0	68.0	28.3	[h]	[i]	3,574	173	4.68
Kentucky	45,217	1,304	252	204	..	47,086	[e]	[e]	93.7	1.4	1.1	55,596	192	4.41
Maryland	1,283	272	7	9	..	1,549	100.0	..	35.6	[h]	[h]	2,525	189	3.25
Michigan	181	343	9	24	..	562	100.0	..	98.3	[h]	[j]	1,343	145	2.88
Missouri	950	1,088	15	27	..	4,091	35.1	64.9	58.6	..	[i]25.5	6,436	152	4.18
Montana	768	204	8	4	..	2,965	[f]65.5	[f]34.5	[f]64.9	83.2	[h]	1,503	186	10.62
New Mexico	1,553	87	11	7	..	1,715	100.0	..	25.8	[h]	[h]	2,608	208	3.17
N. Dakota	577	664	..	10	..	2,250	40.1	59.9	68.0	[h]	[h]	1,475	181	8.41
Ohio	20,792	4,184	44	129	..	25,178	90.2	9.8	94.6	9.5	[i]5.4	30,294	185	4.49
Oklahoma	1,412	169	5	15	..	1,600	70.9	29.1	78.4	[h]	[h]	3,147	142	3.58
Pennsylvania (bit.)	96,758	9,400	409	624	3,787	111,002	99.2	0.8	76.9	8.3	19.6	133,897	199	4.16
S. Dakota	26	21	..	..	..	47	10.4	89.6	[e]	[h]	[h]	47	165	6.05
Tennessee	4,813	289	36	47	27	5,212	100.0	..	70.0	5.7	5.1	8,465	195	3.17
Texas	862	40	[d]	9	..	910	[f]	[f]	[f]	[h]	[h]	1,819	199	5.59
Utah	3,500	286	19	6	12	3,809	100.0	..	87.4	41.8	[h]	3,417	189	5.88
Virginia	13,017	246	80	39	412	13,795	100.0	..	90.2	6.7	4.1	16,494	200	4.18
Washington	1,445	471	18	21	..	2,001	100.0	..	35.9	33.6	66.4	2,822	204	3.40
W. Virginia	114,228	2,531	687	418	531	118,646	[e]	[e]	92.0	7.4	13.0	113,643	209	5.00
Wyoming	5,530	223	36	126	..	5,918	97.2	2.8	94.5	92.0	[h]	4,743	204	6.11
Other States	11	13	..	[d]	..	24	99.9	0.1	20.6	[h]	[h]	128	165	1.15
Total bituminous	399,238	35,706	2,057	3,052	4,884	445,531	92.9	7.1	84.8	16.3	13.9	491,864	193	4.69
Pennsylvania (anthr.)	46,203	[b]2,981	[c]	2,672	..	51,856	[g]82.2	[g]11.0	3.8	20.6	[h]	99,085	189	2.77
Grand total, 1937	445,441	38,687	5,038	5,724	4,884	497,388	91.8	7.5	76.3	16.7	[h]	590,949	192	4.39
Bituminous, 1929	497,934	[b]23,262	[c]	4,663	9,129	534,989	96.2	3.8	75.4	7.0	6.9	502,993	219	4.85
Anthracite, 1929	65,295	[b]3,233	[c]	5,301	..	73,828	97.3	2.7	1.6	[h]	[h]	151,501	225	2.17
Grand total, 1929	563,229	[b]26,496	[c]	9,964	9,129	608,817	96.3	3.7	68.2	[h]	[h]	654,494	221	4.21

[a]Data for 1936; 1937 figures not available. [b]Includes coal used by mine employees. [c]Included with local sales. [d]Less than 500 tons. [e]Included with Other States. [f]Texas included with Montana. [g]Current mine production is supplemented by recoveries from culm banks and by river dredging; the former supplied 5.3% and the latter 1.5% of the total output. [h]Not reported. [i]Kansas included with Missouri. [j]Michigan included with Ohio.

Plans (fig. 28) are shown of a standard practice of mining in the Pocahontas region from an article by Audley H. Stow in *Coal Age*, vol. 3, pp. 594–600.

Another (fig. 30) of the methods of operation of the U.S. Coal and Coke Co. is from an article by Edward O'Toole on the Pocahontas Coal Field, *Trans. A.I.M.E.*, vol. lxxii., pp. 874–897. The

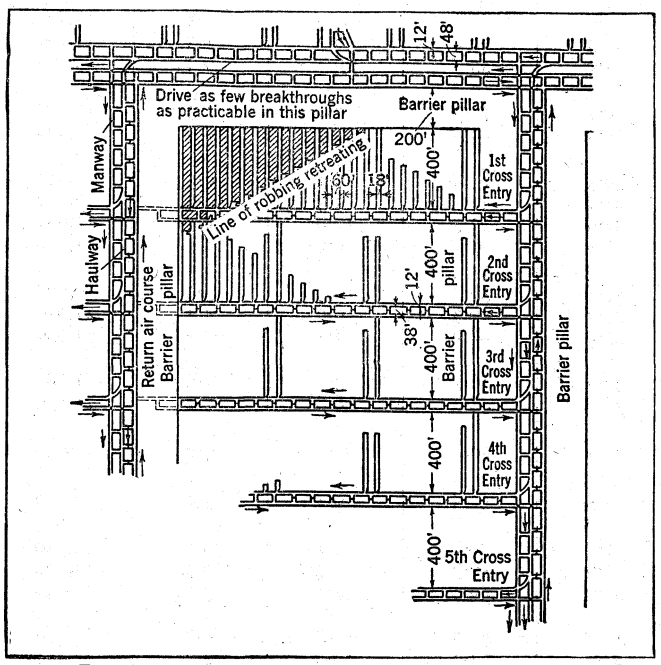


FIG. 28.—TYPICAL POCAHONTAS COAL MINING LAYOUT

plan of concentrated mining of the H. C. Frick Coke Co. and others (fig. 29) is derived from *Trans. A.I.M.E.* vol. lxxiv. pp. 523–536.

Longwall of the circular advancing type has been in operation for many years in northern Illinois, northern Iowa and northern Missouri, also in parts of Arkansas. In general it was adopted only where, as the coal was thin, packwall material was available. Only in quite recent years with the advent of conveyors has longwall been adopted where the coal is of such thickness that rooms can be driven without lifting bottom or shooting top rock and even then but seldom. Room-and-pillar is still standard and almost universal practice where the coal thickness exceeds 4 feet.

Mine Gradients.—In southern Illinois the coal is as level as the prairie land above it, and in much of the United States it is on gradients running from zero to 5%. As the great Appalachian uplift is reached on the east and the Cascades are approached on the west the grades increase. The gentle folds of western Pennsylvania give way to steeper folds in the central Pennsylvania area, grades of 10% being not uncommon. In the anthracite region the coal may pitch at 90 degrees and even turn over so that the rock that was laid down as the roof of the coal becomes what metal miners term the footwall. In the Cahaba and Coosa regions of Alabama, similar conditions exist and in the Cascades also.

There are between the Appalachians and the Cascades some heavy gradients. In Wyoming at Hanna, Gebo, Cumberland, Kemmerer and Rock Springs they have given much trouble. At first it was customary to drive the rooms up the pitch and let the loads pull the empties up to the face of the room, a rope passing over a pulley connecting the two. Friction in some cases had to be used to steady the loads down the grade, and, wood rails being used, speed of travel was further reduced. This method resulted in many accidents to cars and to men. Derailments were frequent, so the method was discontinued at Hanna, Gebo and Rock Springs. In Alabama this system is still being used. In Wyoming it became the custom to drive engine planes down the dip and lay out the rooms on the strike. The loaded cars are drawn by mules to the room mouth and there a rope is attached, the cars being pulled one by one by this rope around the switch or room parting up the engine plane to the level heading above. There the cars from the various rooms are assembled and pulled by electric locomotives to the main hoist. The mining machines are also lowered or raised on the same engine plane to the rooms which are to be cut. This involves four haulage units—mule, small hoist, locomotive and main hoist—and this does not make for efficiency but the plan seems to be better than the old method. More recently, with the advent of conveyors and scrapers, it has become general practice once again to drive rooms and, sometimes, long faces directly up the pitch, bringing the coal down to level gangways, from which it is hauled by electric locomotives to engine planes, on which it is hoisted to the surface.

Steep grades are also found in Colorado, and in northern Illinois is an extremely steep inclination in a coal bed near La Salle, but this coal is not being mined where the pitch occurs.

Steep Gradient Methods.—Where the pitches are heavy indeed but still light enough for the purpose, it has been customary in the anthracite region to use what is known as a "buggy breast" (fig. 31). The breast or room, is driven up the pitch, and rock is piled in the roadway near the mouth of the room to a considerable depth and to a gradually decreasing depth toward the face so as to reduce the gradient. On the new inclination thus formed a small car or "buggy" is run. This is dumped at the end of the grade into a short chute which carries the coal to a point near the entry where it can be loaded into a standard mine car. The system is used on gradients from 10 to 18 degrees. On lesser gradients the room is frequently turned enough off the pitch to make it possible to place the standard car at the face by mule power or electric motor.

Where the pitch runs from 18 to 30 degrees, sheet iron is used. Where the coal will not run it has to be pushed or "bucked" with a shovel at great expenditure of human energy. When the coal runs too freely the sheet iron can be omitted and boards laid or the coal may be allowed to run on the coal floor. But with heavier grades the full-battery system is used (figs. 32 and 33). A heavy battery or barricade is erected somewhere, either at the mouth of the room or further in. A chute with a gate at the barricade leads to the car. The coal as it is dislodged is directed to the centre of the room, where it is held by two lines of posts and timber on either side of the centre. It is allowed to fill this space.

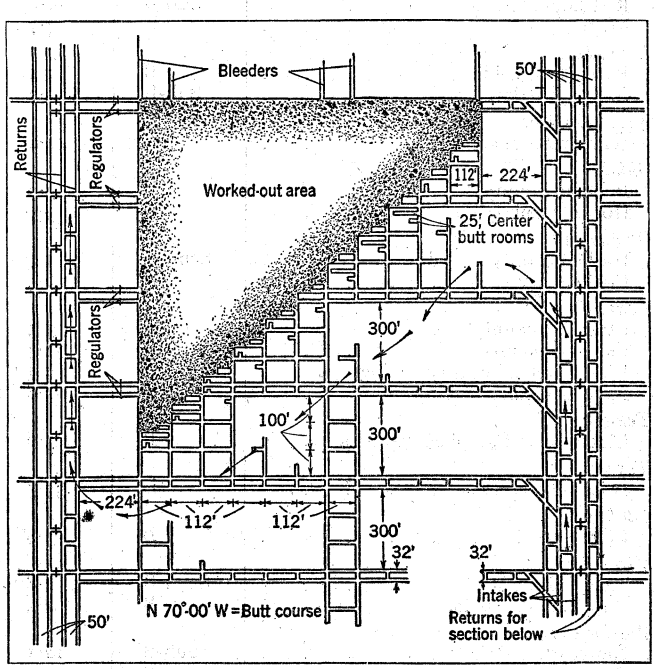


FIG. 29.—CONCENTRATED MINING

On either side is a manway which is kept open. Any excess of coal over that needed to fill the battery is let out through the gate and loaded into cars on the gangway by gravity. The rest of the coal is not loaded till the room or "chute" is driven its full distance up the pitch.

In early days pillars were not drawn. To-day long holes are

TABLE II.—*Analyses of Coal as Mined*

(From M. R. Campbell's Address at the International Conference on Bituminous Coal, Proc., pp. 49–59, greatly condensed)
(B, bituminous; Semi-B, semi-bituminous; Sub-B, sub-bituminous; L, lignite.)

Location	Rank of coal	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	B.T.U.
Alabama:							
Birmingham district coking	B	2·4	25·9	66·8	4·9	1·5	14,490
Birmingham district	B	1·7	31·3	60·8	6·2	1·5	14,290
Cahaba field	B	3·1	35·0	55·8	6·1	0·4	13,560
Arkansas:							
Huntington district	Semi-B	3·5	16·7	72·0	7·8	1·3	14,020
Camden district	L	39·4	26·5	24·4	9·7	0·5	6,360
Colorado:							
Denver field	Sub-B	18·8	30·5	44·5	6·2	0·3	9,650
Denver field	Sub-B	25·6	28·0	41·1	5·3	0·4	9,180
Trinidad coking	B	2·1	32·6	52·5	12·8	0·7	12,960
Trinidad noncoking	B	7·8	38·5	44·8	8·9	0·5	11,540
Illinois:							
LaSalle county	B	13·9	37·3	38·5	10·3	3·4	10,990
Sangamon county	B	14·3	37·2	40·3	8·2	4·4	11,010
Franklin county	B	9·2	33·8	48·6	8·4	0·9	11,930
Indiana:							
Clay county, block	B	15·4	32·6	46·1	5·9	2·0	11,680
Sullivan county	B	13·6	35·0	44·6	6·8	1·1	11,550
Iowa:							
Appanoose county	B	17·1	35·4	40·4	7·1	4·0	10,930
Kansas:							
Crawford county	B	4·9	33·5	52·5	9·1	5·0	12,940
Kentucky:							
Perry county	B	3·9	37·2	54·8	4·1	0·8	13,730
Harlan county	B	4·4	35·0	56·9	3·7	0·7	13,920
Hopkins county	B	8·5	38·0	46·4	7·1	3·5	12,340
Maryland:							
Georges Creek basin	Semi-B	2·3	16·3	70·6	10·8	0·8	13,510
Upper Potomac basin	Semi-B	4·3	21·3	64·4	10·0	2·5	13,270
Michigan:							
Saginaw district	B	11·9	31·5	49·8	6·8	1·2	11,780
Missouri:							
Adair county	B	15·4	34·8	38·8	11·0	3·6	10,460
Montana:							
Bridger district	B	9·8	27·6	46·2	16·4	0·6	10,240
Red Lodge district	Sub-B	11·7	36·1	40·2	12·0	1·1	9,790
Missoula field	L	24·7	29·3	26·1	19·9	0·9	6,730
New Mexico:							
Raton field coking	B	2·1	36·1	50·2	11·6	0·6	12,970
Gallup district	Sub-B	12·7	36·5	43·3	7·5	0·7	11,230
North Dakota:							
Williams county	L	41·1	27·2	26·3	5·4	0·7	6,490
Ohio:							
Belmont county	B	3·9	43·1	43·9	9·1	4·4	12,840
Hocking county	B	9·7	32·5	53·4	4·4	0·5	12,250
Oklahoma:							
Haskell county	Semi-B	2·7	21·1	69·9	6·3	0·8	14,100
Coal county	B	6·5	39·0	45·2	9·3	3·7	11,840
Pennsylvania:							
Clearfield county	Semi-B	3·3	19·9	69·0	7·8	2·0	14,020
Cambria county	Semi-B	3·3	12·5	77·9	6·3	1·0	14,340
Westmoreland county coking	B	2·7	30·4	57·8	9·1	1·3	13,610
Fayette county coking	B	2·8	30·0	59·8	7·4	1·2	13,990
Tennessee:							
Claiborne & Campbell counties	B	3·6	37·3	55·5	3·6	1·1	13,980
Texas:							
Houston county	L	33·5	39·5	16·2	10·8	0·6	7,140
Utah:							
Castlegate	B	2·9	40·0	51·7	5·4	0·3	13,350
Virginia:							
Tazewell county	Semi-B	3·8	15·5	77·8	2·9	0·6	14,860
Wise county coking	B	2·5	31·7	60·3	5·5	0·5	14,250
Washington:							
Newcastle district	Sub-B	12·1	36·8	40·7	10·4	0·3	10,410
Burnett district	B	3·2	35·0	49·3	12·5	0·4	12,720
West Virginia:							
Fairmont district	B	2·9	34·5	56·9	5·7	0·7	14,040
New River district, high rank	Semi-B	4·0	14·1	73·7	8·2	0·8	13,850
Logan district	B	3·3	33·3	58·4	5·0	0·7	14,050
Pocahontas field Welch district	Semi-B	2·8	15·0	76·5	5·7	0·9	14,330
Wyoming:							
Rock Springs field	B	9·8	34·3	52·5	3·4	1·0	12,260
Sheridan district	Sub-B	22·6	32·5	40·4	4·5	0·3	9,220

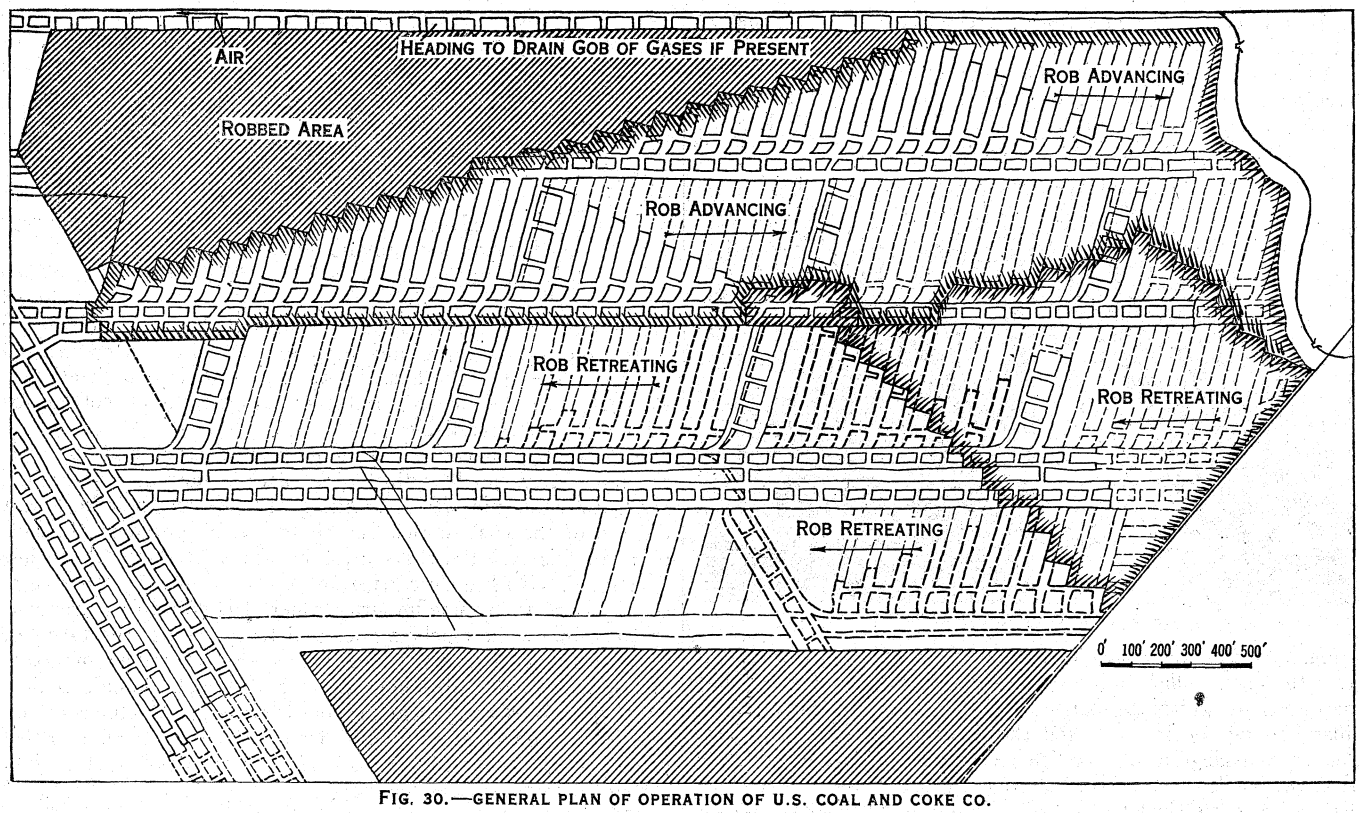


FIG. 30.—GENERAL PLAN OF OPERATION OF U.S. COAL AND COKE CO.

drilled in the pillar and the coal shot down or the coal removed in some other way. Sometimes on steep pitches with soft coal, such as the Primrose, the coal will run out of the bed and a steady flow can be taken out at the gate till the roof falls and rock ap-

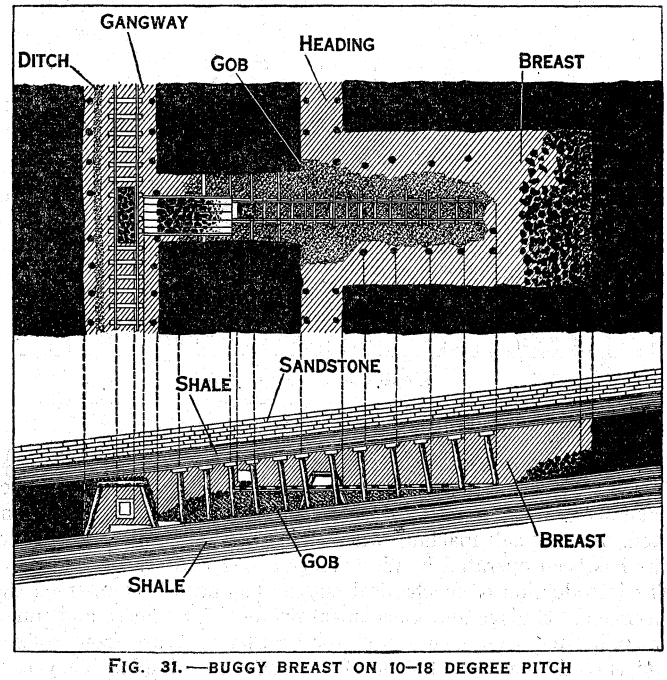


FIG. 31.—BUGGY BREAST ON 10–18 DEGREE PITCH

pears. The objection to the full-battery system lies in the "degradation," or breaking, of the coal to small sizes and the delay in getting the benefit of a large part of the coal won. In consequence new systems are being put in operation in the anthracite region, notably the slant chute system (fig. 34) used first on a heavy pitch in No. 1 tunnel of the Lehigh Coal & Navigation Co., which, as will be seen, shortens the distance the coal has to travel on the full pitch, arranges for the removal of all the coal and provides that the coal will travel the greater part of the distance on a slope much less than that of the full pitch (*Trans. A.I.M.E.* vol. 72, pp. 730–734).

The pillars between breasts, whether level or pitching steeply, are often "skipped" (that is, reduced in size by taking off a part up one side) or split by a roadway where the coal pitches slightly or by what is known as a "chute" if the coal pitches heavily. After this the pillar is brought back, but in any event driving these narrow places is expensive, so wherever the pitch is steep the pillar is often entirely removed by the full-battery method, reliance being placed on the coal in the battery to support the roof till the pillar is extracted. This manner of working has been developed into another system, known after the Wanamie Colliery of the Lehigh & Wilkes Barre Coal Co. where it was first used. In the illustrations (figs. 35 and 36) it will be noted that "breasts" are driven with timber and manways on either side.

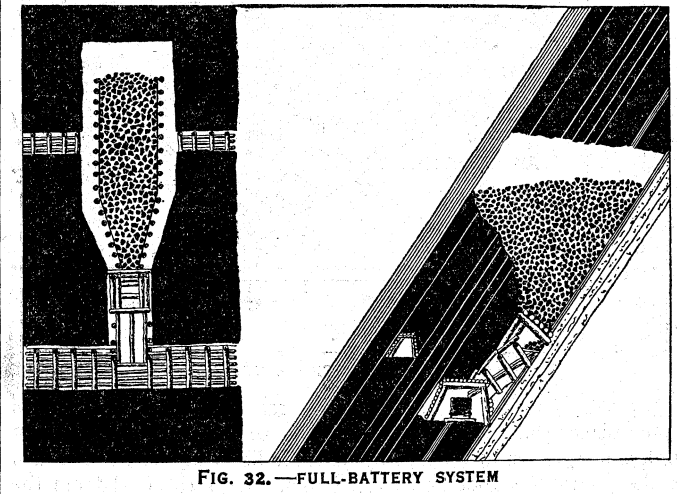


FIG. 32.—FULL-BATTERY SYSTEM

The Carbon Hill Coal Co. is using what is practically "tailles chassantes," or a stepped longwall face travelling along the pitch in a level direction, the upper end trailing behind the lower, *see* fig. 39 Each miner has his own step, below which is set a wood planking termed a "wing" which protects the miner below and

directs the coal to a chute which carries the coal to a gangway below.

Where in this state badly split seams have to be worked on a steep pitch even more elaborate methods are used. For further details of the methods described and others *see* Simon H. Ash in the *Trans. A.I.M.E.*, vol. lxxii., pp. 833–873.

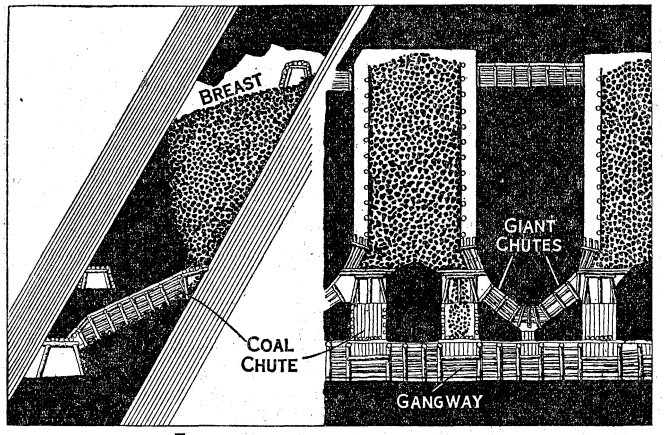


FIG. 33.—DOUBLE CHUTE BREASTS

Fig. 35 shows the Wanamie method of removing pillars upward from the chain pillar by use of the full battery. Fig. 36 exhibits the means by which the uprise is constructed through the chain pillar. In fig. 37 is illustrated the manner in which, in Pierce County, Washington, narrow "chutes," or rooms, are extended to be drawn back as shown in fig. 38. A longwall method used by the Carbon Hill Coal Co. in Washington is outlined in fig. 39. In many anthracite mines, where pillars have been left in one seam and another seam below it is worked later, rockholes are driven vertically or at a steep angle up to the pillar of the first seam, in which a narrow place is driven till another narrow place is reached from another rockhole. Thus ventilation is provided and the pillar is removed, the coal being dropped or chuted down the rockhole. Much coal in the Mammoth is thus being recovered through the Skidmore bed and the Big Ross through the Little Ross.

Cutters.—Only a few industries in the United States have made equal progress with coal mining in the present century.

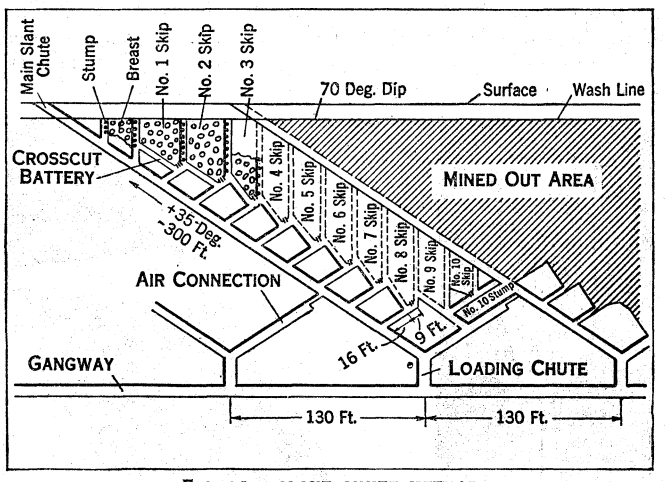


FIG. 34.—SLANT CHUTE METHOD

Very little coal is now undercut by hand despite statistics. In some places the law requires the miner to undercut the coal, but unless it is undercut for him by machine he rarely does more than make a cut of a foot or two and then shoots the coal from the solid. The punching machine, whether operated by air directly, or by air compressed at the machine electrically, has almost entirely disappeared. It cut the coal with a wedge-shaped kerf causing it to fall heavily and roll over so that it was easy to load. All other machines make a uniform kerf and the undercut coal may fall when shot with scarcely any change in condition. In consequence "snubbing," or converting the uniform kerf into one of wedge shape, is a quite general practice. This work has been done mechanically but not in many mines.

The breast machine, which makes a series of forward cuts under the coal, about the width of the machine and has to be retreated and moved each time a cut is made, still continues to be used, not because anyone prefers it but because such equipment is on hand or can be bought second-hand cheaply and because the wage scale for cutting makes usually no distinctions.

The shortwall cutting machine is provided with chains which enable it to sump its cutter bar into the coal. When it has arrived at the required depth it can be caused to travel across the face cutting the kerf as it goes and stopping only when it has traversed the room or entry. The longwall machine can also cut itself into the coal, but is best suited to places where continuous cutting for a long distance is available.

Some cutting machines are mounted on a truck and cut from the rail. They can be adjusted to place a kerf at any desired level. In some mines with fragile roof they cut their kerf near the top of the coal so that the shots can be put near the bottom. In this case the shots must be heavy or they will be less effective than with undercutting and top shooting. In other cases the cut is made in some impurity which it is desirable to remove. In some mines the machine is caused to cut across the face two or more times to remove completely a thick "binder" or "parting" which it is desirable to keep out of the coal. Some machines cut a square kerf and others one that is circular. Machines of this type are made which cut both horizontally and vertically, so that having cut the coal with a level kerf they can cut it vertically or "shear" it as the expression runs.

This increases the percentage of "cuttings," or "bug dust," but is said on good authority to so greatly lessen the use of powder that less fine coal results.

Longwall machines are made of heights as low as 12 inches. So far no coal is being worked in the United States too low for the operation of a shortwall machine. The track-mounted, or turret,

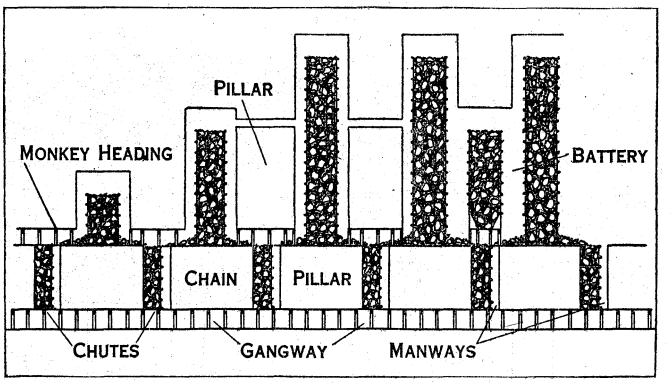


FIG. 35.—WANAMIE SYSTEM FOR STEEPLY PITCHING COAL

machines require greater height and there are fewer of them in use. Disc machines like those so common in Great Britain are unknown in the United States. Post punchers, however, have been used. A shortwall machine with a rotary bar armed with cutter bits has been operated in West Virginia for cutting across faces. The introduction of mechanical cutting has been accompanied by mechanical haulage and mechanical drilling. The horse and mule are units of power well suited for "gathering" cars from rooms and entries where the height of the seam is suitable. They can work in gas without hazard. They can go up one room pulling a car, pass through a crosscut to another room and bring out a loaded car, and they often can go through a crosscut from one entry to another and so work conveniently in both. This "flexibility" is absent with electrical equipment which, however, has the advantage of being able to bring more and heavier cars to the parting, requires no food when idle, and is not so readily stalled by adverse gradients.

Haulage.—In 1924 (H. O. Rogers, U.S. Bureau of Mines, in

Coal Age, vol. 32, pp. 84–88) no less than 36,352 animals were still used for underground haulage in bituminous mines. There were also 649 rope haulages, excluding those on main slopes; 779 storage-battery locomotives that could be run with or without trolley current; 1,515 storage-battery locomotives without trolley; 11,986 electric trolley locomotives, 85 compressed-air locomotives, 226 gasolene locomotives, 132 steam locomotives, a total of 14,723

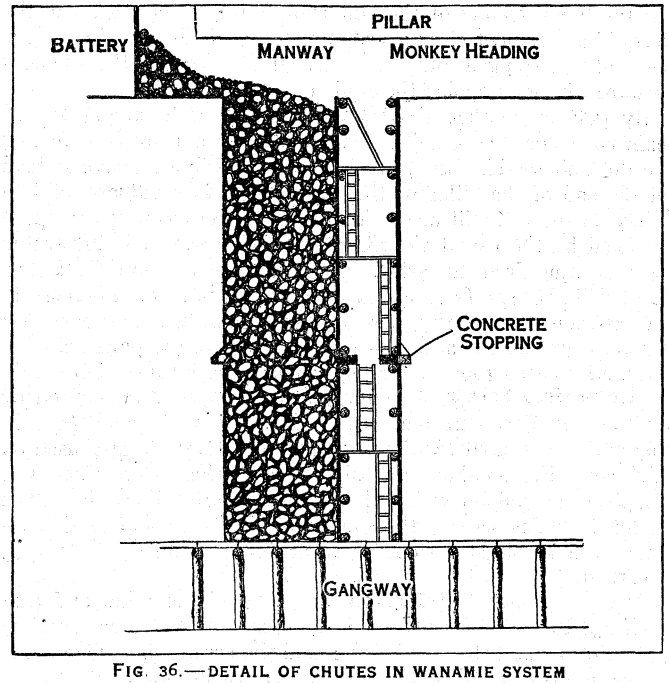


FIG. 36.—DETAIL OF CHUTES IN WANAMIE SYSTEM

locomotives of all kinds. The percentage of coal hauled by animals only in bituminous mines was 10·1; by rope only 0·1; by locomotive only 32·8; by animal and rope 1·9; by animals and locomotives 50·0; by rope and locomotives 1·3; and by animals, rope and locomotive 3·8. This does not include strip-pit coal; 85·6% came from mines using one or more locomotives.

Mine cars are increasing in size, due to the fact that being loaded by machinery the labour of lifting coal to a high car need

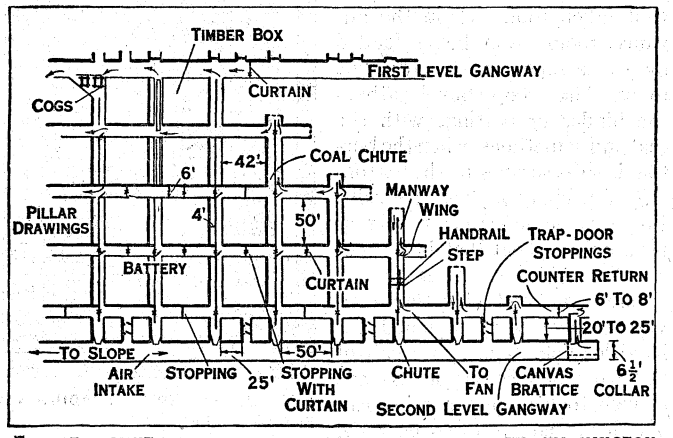


FIG. 37.—CHUTE AND PILLAR SYSTEM. PIERCE COUNTY, WASHINGTON

not be considered, that where large loading machines are provided to get maximum results large receiving units are necessary, that in thin coal a large car can be loaded as readily as a small one, for the loading is done in a high entry, that the haulage units are adequate to handle the biggest cars and that improvements—spring-draft rigging, automatic couplings and bearings—are relatively more economical in weight and cost with a large car. In order to get capacity the body of the car is made wider than the track (which sometimes has as much as 4 ft. 8½ in. gauge). Cars are made as large as 12 ft. long over bumpers, 10 ft. inside length and 6 ft. inside width. With such wide cars the sides are flared at a low angle or the bottoms are wider than the gauge and the tops of the wheels run in a housing provided in the flared sides or in the bottom.

Coal is often hauled in mines a distance of 5 miles. The H. C. Frick Coke Co. at one point had three shaft mines which were about 4 m. from the Monongahela river, on which lay their Clairton by-product plant. The three mines were combined underground; two rotary dumps were installed each capable of overturning forty 2·1-ton mine cars at one time with a feeding device for delivering that quantity of coal to a 60-in. fabric belt and a series of 18 rubber belts, 48 in. wide, aggregating with the fabric belts 4 m. and 1,810 ft. The coal is dumped from a cross belt into hoppers over the river, and then into barges.

Another belt line was also built by the same company of a similar character but a little less than 3 m. long with a single 30-wagon underground rotary dump, which delivers the coal that comes from two mines, and a single 2-wagon underground rotary dump which delivers the coal from a third mine. This equipment has a capacity of 12,800 tons per 8-hour day.

For the haulage of large trains big electric locomotives are provided or units are put in tandem. One large electric locomotive weighs 38 tons and develops 399 h.p. from three 500-volt motors. Storage-battery locomotives, locomotives with a cable reel and crab locomotives with a wire cable which serves as a portable hoist are used for gathering. The first two are those most gener-

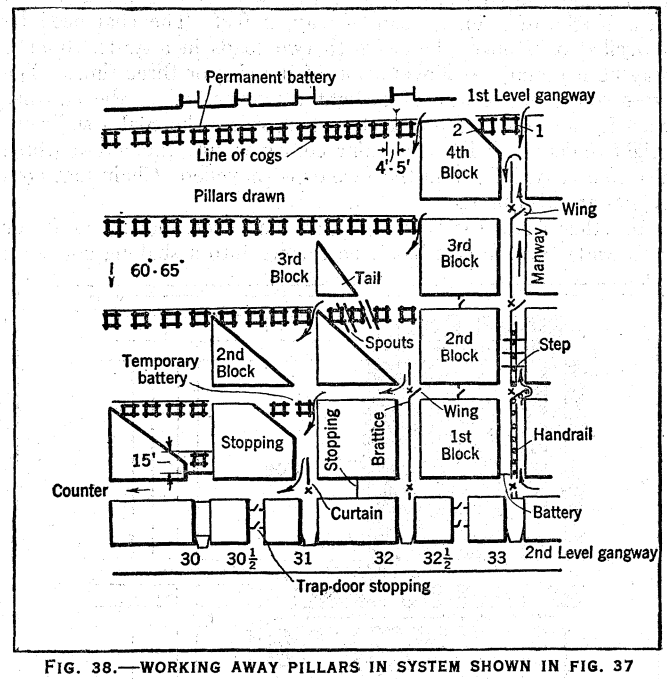


FIG. 38.—WORKING AWAY PILLARS IN SYSTEM SHOWN IN FIG. 37

ally used. For gathering on down gradients room hoists are often provided.

Mechanical Loading.—Last of all improvements is mechanical loading, which in the United States has been liberally interpreted to include both hand-loading into conveyors and loading by machinery into mine cars. Strange to say, the United States had the first conveyor longwall working, namely the Vintondale mine of the Lackawanna Coal Co., in Cambria county, Pennsylvania. The first installation was made by C. R. Claghorn in 1901. After a change in management the longwall face caved, destroying some hundreds of feet of conveyor, and the plan was abandoned, but meantime a large coal area had been worked by this means. Col. Blackett introduced the system into England, and it returned to the United States as a European practice owing to its many years of estrangement. Conveyors are being used in many ways. In some instances they are being operated in rooms 30 to 40 ft. wide. The coal is cut by a machine which is kept in the room and used by the loaders whenever they are ready to prepare the face for shooting. When the coal is shot down part

of it—perhaps a third—falls on a cross conveyor which carries it to the main conveyor, in this instance, a shaking pan, which transports it from the face to the entry, where it is discharged into a mine car. Another third of the coal perhaps is pulled down onto the cross conveyor and yet another third has to be shovelled. This shovelling is easily performed because the conveyor is every-

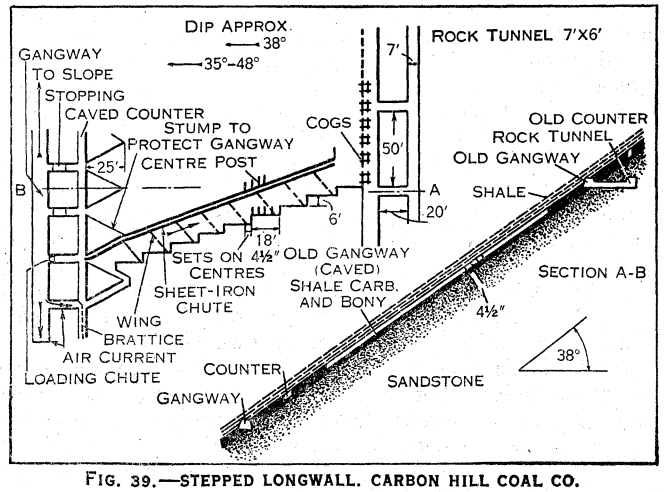


FIG. 39.—STEPPED LONGWALL. CARBON HILL COAL CO.

where near the coal and because the coal need be lifted only a clear height of 4 in. instead of, say, 2 feet. The coal need be shovelled only once whereas with two roads in a 40-ft. room it may be necessary to shovel some of it twice or three times. The cross conveyor consists of a flight conveyor and at the end has what is known as a "gooseneck" which raises the coal a sufficient height to deposit it in the shaking conveyor, into the end of which also some coal falls from the face or is shovelled. Chain-mat conveyors are also used.

In other cases the working place has been made 100 ft. or more wide and the coal has been thrown into a shaking conveyor

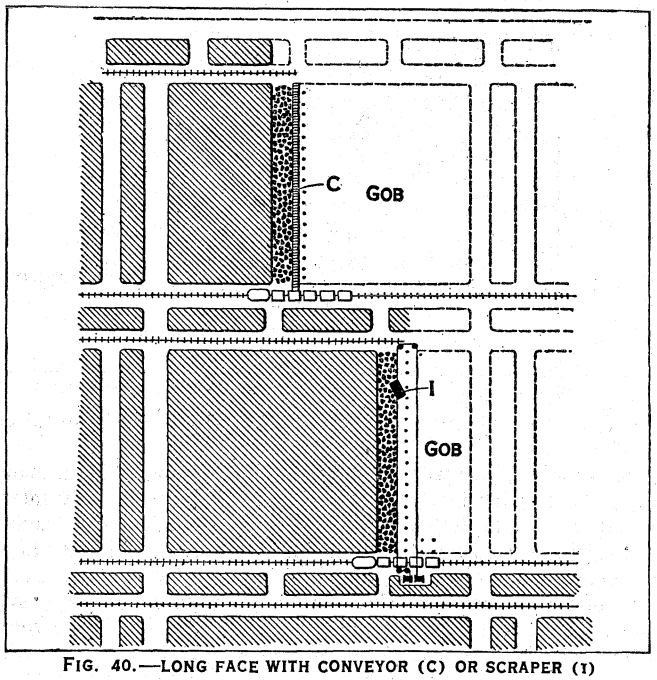


FIG. 40.—LONG FACE WITH CONVEYOR (C) OR SCRAPER (I)

running parallel with the face. This dumps into another shaking conveyor, both conveyors being driven by a common unit, the face conveyor being actuated by the main conveyor through a bell-crank attachment. However, frequently the conveyor is situated in front of a long face which may be level or possibly on a pitch (*see* fig. 40). Where coal is left along the entry, conveyors may be used to receive the coal near the entry pillar and to convey it to the opening through the pillar. Another conveyor then lifts it into the car. Another provision is the duckbill loader which can be used even where the place being driven is narrow. The differential movement of the shaking conveyor that pitches the coal forward as does a shovel in the hands of a miner is used to enable the duckbill attachment at the end of the shaking conveyor to dig into the coal. As the duckbill has a flaring mouth and wedged teeth it gets under the pile. As soon as the coal is in the shovel-like duckbill it is carried back toward the room mouth. By arranging for the swiveling of the conveyor it is possible to make the duckbill attachment clear a wide area of coal. Little trimming is necessary. Arrangements are provided for feeding the duckbill forward without stopping the equipment.

By putting another shaking conveyor at right angles to the main conveyor with a bell-crank attachment and by transferring the duckbill to this face conveyor, it is possible to have it load off the end of the pillar of the room. This is a valuable aid to safety as the duckbill needs for its manoeuvring only the space occupied by the cut at the pillar end. The system is illustrated by a drawing from an article by Oscar Cartlidge in *Coal Age*, vol. xxxiii., p. 473 (*see* fig. 41). In the West the conveyors in several rooms have been connected with one drive and that also has been done in the anthracite region. Where the pans transmit the motion, each room, perhaps, should have its own drive unit.

Mechanical Scrapers.—Mechanical scrapers were devised by Cadwallader Evans in Jan. 1914. They are well suited to thin coal and are so used for the most part but they are also used on thick coal. Fig. 42 shows an Illinois application (from *Coal Age*, vol. xxxi., p. 428, in which the scraper is used advancing. The loading chute is seen at the mouth of the room and in this instance can be skidded sidewise so as to be available for use in two rooms.

The scoop shovels travel on the floor of the mine and pull from 250 lb. to 5 tons of coal in one load. Where, however, the larger size is used the coal is thick and the scraper is hauled along a face 200 or 300 ft. in length. The retreating method (*see* fig. 43) is quite generally used. A narrow place is driven up the centre of what will later be the room and when this has reached its boundary the scoop shovel is caused by diagonal cuts to widen the working place to the required width. As the work is retreating, no pillar or only a foot or so has to be left, this being to prevent fallen roof rock in the advance room from being loaded by the scraper in the adjacent room. The scoop shovel gathers the binder or partings with the coal and sometimes, when the bottom is soft, scrapes up the bottom clay, especially if there are rolls. For this reason the scraper is used only in coal that is reasonably free of irregularities.

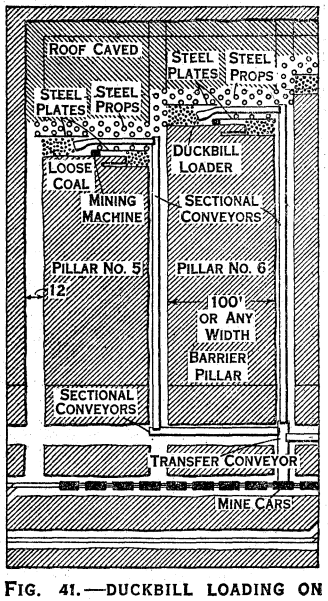


FIG. 41.—DUCKBILL LOADING ON END OF PILLAR

Short inclined elevating conveyors have been designed for hand loading. The upper end of these inclined conveyors is high enough to load into a mine car. The lower end rests so near the floor as to make loading easy. This type of conveyor can be moved around either on a track or on the floor. In some instances it has a self-propelling truck and power-driven capstans for handling the mine car back of the loader.

A large number of conveyor loaders has been designed and used that pick up their own coal and pass it by a conveyor to another swiveling conveyor that discharges the coal into a car. The main difference between them is in the means by which the coal is lifted from the bottom. One well-known machine has gathering arms which pull the coal onto an inclined conveyor. Most types rely on the conveyor itself to do its own gathering.

The conveyor in one type has a chain, working on sprockets with vertical axes, which sweeps the coal onto and up an inclined trough. Others have vertical sprockets and the flights being buried in the loose coal lift it onto the conveyors. One such conveyor has loaded an average of 466 tons from room and entry faces in eight hours over a period of a month. Another shortwall machine combines cutting and loading. It cuts the coal, which is then

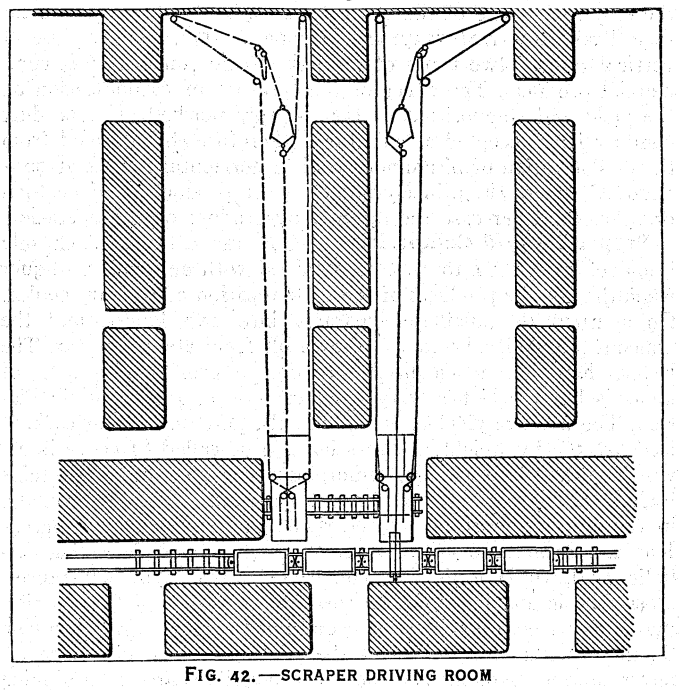


FIG. 42.—SCRAPER DRIVING ROOM

shot down. The machine is sumped again into the loose coal and fed as for undercutting, but for this part of the service two other bars like the cutting bar but shorter are provided. They, with the cutter bar, drag out the coal and force it onto the flights of a conveyor.

Another quite recent machine is only 26 in. high. It has only one conveyor chain working on sprockets with vertical axes. This conveyor not only lifts the coal from the floor but places the coal in the mine car or a room conveyor, the conveyor itself being so arranged that one end can be swiveled. The intention, however, is not to bring the mine car to the loading machine but to have the loader dump into a portable shaking conveyor running on the room rails with the loading mechanism of this conveyor serving (1) as a flight conveyor to lift the coal from the conveyor to car height, (2) as a car feeder to spot a line of cars in front of the loading chute at the entry as desired and (3) as a locomotive to haul the conveyor from room to room.

Another type of loader is a power shovel that is forced under the coal and lifted. The shovel has no back and consequently the coal falls off the rear of the shovel onto a conveyor, by which it is conveyed to the swiveling conveyor which drops it into the mine car. This has been modified so that where the first conveyor can be loaded by the advance of the loader without a movement of the shovel the equipment can be used in this manner. Another type of shovel loader has an hydraulic pillar which bears against the roof and around which as a trunnion the whole equipment turns a full circle of 360 degrees if necessary. The shovel is forced under the coal pile and withdrawn. It is then lifted and swung over the mine car, whereupon it is emptied by an ejector plate.

For heading-driving, one machine is provided with an undercutting bar and two shearing cutters with a number of picks which break the coal down, which then falls and is removed by an inclined conveyor. Another machine has two revolving cutters that cut two interlapping tunnels in the coal with a chain that cuts the top and bottom. It makes an entry 11 ft. wide and about 6 ft. high with flat roof and floor line but with sides which are segments of circles.

Stripping Methods.—Open-cut mining is the term applied to the working of mineral deposits which either outcrop at the surface of the ground or are covered by a shallow overburden or capping, which must be removed before the ore can be mined. In coal mining work mining by this means is generally termed stripping. Since the cost of removing the overburden is charged to the cost of mining a point is reached, as the cover increases in thickness, beyond which open-cut mining does not pay and some method of underground mining must be used.

One of the most distinctive features of open-cut methods in American coal mining, one that probably cannot be found in any other country or in any other type of mining in the United States or elsewhere is the method of stripping by casting. There are many strippings in the United States where the overburden is loaded by shovels or drag line excavators into cars, hauled to a distance and dumped. This is the most usual way of uncovering mineral in Europe and in America. Large machinery is sometimes used, as at Yallourn in Australia, where one 370-ton shovel, one 200-ton shovel and one 150-ton shovel with respective bucket capacities of 9, $3\frac{1}{2}$ and $2\frac{1}{2}$ cu.yd. are installed, and Hazleton, Pa., where a 6-cu.yd. shovel weighing 230 tons is being used. Here the maximum cover to be removed is 165 feet.

In Yallourn, conveyors are used instead of cars but the usual American method is entirely different. If the coal outcrops, the cover is lifted off the coal in a long swath 100 or more feet wide by a steam or electric shovel or drag line excavator and dumped down the hill. If the coal does not outcrop, the cover is similarly lifted from the coal and deposited along the property line. A smaller steam or electric shovel follows the stripper and lifts the coal into mine cars which carry it to the tipple. Where the coal occurs in a knob or small hill the two shovels chase each other round the hill, the stripper uncovering the coal and depositing the spoil where the coal has been removed by the coal shovel. In this manner none of the overburden is moved more than 100 to 125 ft., and it is all done without the use of cars or conveyors. The cars are used solely for transporting coal. As much overburden as

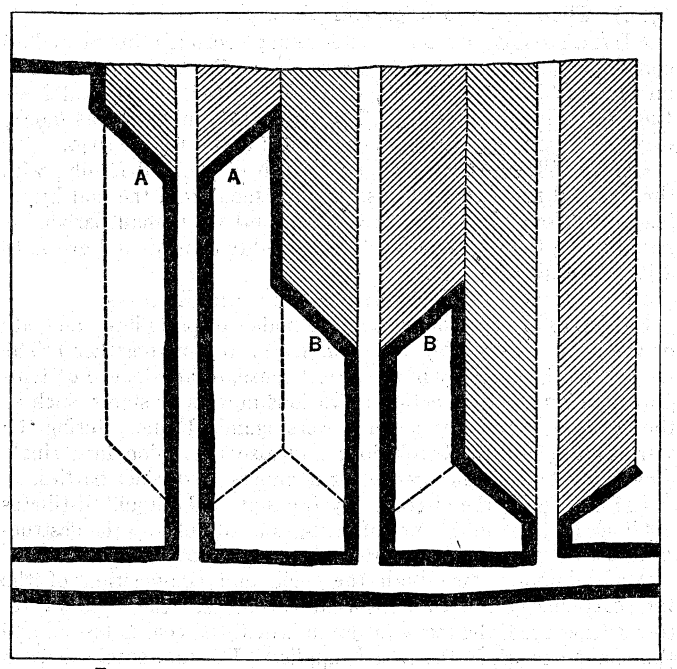


FIG. 43.—LAYOUT FOR SCRAPER RETREATING SYSTEM

10 or 12 times the thickness of the seam being worked has been removed. In rare instances as much cover as 70 ft. has been taken but the difficulty of finding space for the spoil and the disadvantages in making such big cuts limit the overburden taken even with thick coal. The Binkley Mining Co., at Seelyville, Ind., uses a Bucyrus-Erie shovel with a 30-cu.yd. dipper on a 105-ft. boom and a 72-ft. dipper stick, with a dumping range of 113 ft. and a dumping height of 74 ft. for stripping coal. A still larger shovel, with a 32-cu.yd. dipper has been built by the Marion Steam Shovel Company.

Regulation and Inspection.—Owing to the many States in which mining is pursued and in part to the varied conditions in each State and to the differences in their accident records, the laws vary greatly and, as some think, unduly. The anthracite and bituminous mines in Pennsylvania have entirely separate laws. Each State has its own inspectors and some have both State and county inspection. The U.S. Bureau of Mines is almost solely a research body. It had at one time regulatory power over properties in the segregated Indian lands and in the areas mined under lease from the U.S. Government. The authority has been transferred to a division of the General Land Office, Dept. of the Interior.

The bureau has examined and approved several explosives and several types of mining equipment which it has declared "permissible," the word "permitted" not being used as in Britain, because the bureau has no power to admit or exclude explosives or equipment under the U.S. Constitution. The bureau has established mine rescue stations and equipped cars for the same purpose, and these are used most effectively for the saving of life in the larger mine disasters.

Safety.—Safety conditions in coal mines have been greatly improved in recent years. The total fatalities in coal mines in the United States in 1938 numbered 1,128, of which 1,073 were underground, 11 in the shaft, and 44 on the surface. This compares with a total of 2,176 fatalities in 1928, and 2,580 in 1918.

(R. D. H.; X.)

COALBROOKDALE, a village and ecclesiastical parish of Shropshire, England, on the G.W.R., 5 mi. S. of Wellington. Pop. (1931) 1,417. The "dale" is the valley of a stream rising near the Wrekin and following southeast for about 8 mi. to the Severn. Its ironworks, founded in 1709 by Abraham Darby with Dutch workmen, were the pioneer attempt to use pit-coal for smelting iron. The third Abraham Darby built the famous Coalbrookdale iron bridge (a cast-iron arch of 200-ft. span) over the Severn, which gives name to the neighbouring town of Ironbridge, which with a portion of Coalbrookdale is in the parish of Madeley (*q.v.*). There are also brick and tile works.

COALDALE, an anthracite-mining borough of Schuylkill county, Pennsylvania, U.S.A., 45 mi. S. by W. of Scranton. It is on federal highway 209, and is served by the Lehigh and New England railroad for freight. The population in 1930 was 6,921, of whom 1,703 were foreign-born white; and 6,163 in 1940.

COAL-FISH (*Gadus virens*), a fish of the cod family, with three dorsal and two anal fins, distinguished from the cod by its blackish colour, prominent lower jaw, and very small barbel. It ranges from the Arctic ocean to the Mediterranean, and grows to a length of about 4 feet.

COALING STATIONS: *see* FUELLING STATIONS.

COALITION, a combination of bodies or parts into one body or whole. (Lat. *coalitio,* from *coalescere,* to grow together.) The word is used, especially in a political sense, of an alliance or temporary union for joint action of various powers or states, such as the coalition of the European powers against France, during the wars of the French Revolution; and also the union in a single Government of distinct parties or members of distinct parties.

COAL TAR, the viscous, oily fraction of the liquid distillates obtained in the manufacture of coal-gas or of coke by the destructive distillation of bituminous coal at 900–1200° C.

Many factors affect both the yield and composition of the tar, particularly the class of coal carbonized, the type of retort setting used, the temperature at which the coal is heated and the manner in which the heat is applied. The tars obtained when coal is distilled in horizontal retorts for the production of either gas or coke are sufficiently similar to be classed under the heading of coal tar.

In the manufacture of gas, the coal is often mixed with boghead shale, bituminous lignite, etc., the gas being thereby enriched. The tar is, however, of less value, being mixed with paraffins, which make the purification of tar products much more difficult. Also, by the substitution of vertical for horizontal retort settings, a tar is obtained which differs in some respects from ordinary coal tar. This new tar is thinner owing to the presence of paraffinoid substances, contains a higher percentage of tar acids, and on distillation yields much less pitch (40–55%) than tars from horizontal retorts. The yield of tar from vertical retorts is slightly higher, and the amount of "free carbon" (*i.e.,* residue insoluble in benzene) is much smaller. These variations from "normal" tar are due to the fact that many of the products of distillation are removed from the reaction chamber before the coal has reached its final high temperature. Vertical retort tar, therefore, has some of the characteristics of low-temperature tar (*see* TARS, LOW-TEMPERATURE). Owing to the increasing use of vertical retorts, two types of tar have to be considered as commercial products. The effect of temperature of carbonization on the yield and composition of tars is very marked. The product commercially accepted as coal tar is therefore that derived from the carbonization of bituminous coal in horizontal retorts at 900–1200° C, where the primary object is the production of coal-gas or coke. In either case the tar is a by-product of the operation.

Properties and Composition.—Coal tar, a thick, black, oily liquid of sp. gr. 1·1 to 1·25, is obtained with ammoniacal liquor when the volatile products of the carbonization of coal are cooled. On settling, the distillate separates into two layers, and the aqueous ammoniacal liquor is drawn off from above the tar. The latter, however, mechanically retains approximately 4% of aqueous liquor which is very troublesome in subsequent distillation. The average yield of tar is 10 gals. per ton of coal carbonized, or 5% by weight. All tars contain so-called "free carbon," which, although resembling amorphous carbon, always contains hydrogen. The constituents of coal tar are almost wholly aromatic in character, comprising hydrocarbons of the benzene, naphthalene and anthracene series, oxygenated compounds including carbolic acid, the cresols and cumarone, nitrogenous substances, mostly basic and belonging to the pyridine and quinoline series, and in lesser degree compounds containing sulphur, *e.g.,* thiophen. Small amounts of members of the aliphatic series are, however, never absent, paraffins, acetone, acetonitrile, carbon disulphide and other representatives of the "fatty" series being usually identifiable. Several hundred entities have been identified in tar, less than 200 have been estimated, and not more than 100 have been isolated; commercially, it is profitable to isolate in the pure state only a few of these.

The most general characteristic of tar is the occurrence in it of naphthalene, which may represent as much as 10% of the crude tar and is the predominant constituent. Other constituents are benzene, anthracene, phenanthrene, carbazole, acenaphthene, fluorene, carbolic acid, cresols, pyridine, quinoline, isoquinoline and cumarone; the amount of any one of these substances rarely exceeds 1%. Valuable as these pure compounds are, from an industrial and commercial point of view, as distinct from that of the organic chemical industry itself, the various crude products obtained from tar are of equal if not greater importance. These coal tar "crudes," including the benzols, toluols, solvent naphtha, heavy naphtha, cresylic acid, creosote, heavy bases, anthracene oil and pitch, form the various "fractions," or can be easily prepared from these fractions, when the tar is distilled.

Distillation.—Whether crude or refined products are required, straight distillation is the industrial method of dealing with the crude tar. It is very seldom, however, that all the above fractions are collected in any one distillation, the crude products required being dependent on fluctuating demands or on the particular purpose for which the tar is distilled. Thus if tar for road making is the object, the anthracene oil fraction is not collected but left in the still with the pitch. Again the crude benzols boiling up to 110° are sometimes collected separately instead of being run with the light oil up to 180–200° C. In a preliminary distillation of tar the following fractions are usually collected:—

(1) Crude naphtha (first runnings), boiling point up to 110° C.
(2) Light oil, b.p. 110° to 180–200° C.
(3) Crude carbolic oil or light creosote, b.p. 180–200° to 240–250° C.
(4) Heavy creosote, b.p. 240–250° to 270–280° C.
(5) Anthracene oil, b.p. 270–280° to 340–350° C.
(6) Pitch.

These fractions are more or less standard, but rearrangements in the cutting points are to be expected as research develops new applications for substances such as acenaphthene, fluorene, acridine,

etc. The value of cumarone and indene as resin-forming constituents is a case in point. To obtain a fraction rich in these two substances, a distillate b.p. 160–180° C is isolated.

Dehydration of Tar.—The presence of aqueous liquor leads to many difficulties in the distillation of tar, especially "frothing" and "bumping." Although many efforts have been made to dehydrate the tar before distilling it, prolonged, gentle heating is the only method which has been found satisfactory. For this purpose steam is supplied through a series of closed coils immersed just below the surface of the liquid. By regulating the supply and controlling the level of the tar, the process is made continuous, and dry, heated tar overflows for use in any distillation apparatus.

In cases where no special preliminary dehydration of the tar is carried out, special mechanical and heating devices are used during the distillation of the light oils and water. A typical tar distillation plant is the Woodall–Duckham still (*see* DISTILLATION).

The tar, separated from excess of aqueous liquor by long settling, is charged into the still and heat applied either by means of coal or (as in coke-oven installations) of surplus gas, which permits of very delicate heat control. In all distillations, unless the tar has been previously dehydrated, the first runnings consist of a very light oil and water which separate on standing, the oils forming the upper layer. When no more water distils—a point usually coinciding with the rise of the specific gravity of the oils to 1·0—the crude carbolic oil is collected, and at this stage the condensing apparatus must be maintained at 40° C to avoid deposition of naphthalene in the coils. The end point of the carbolic acid fraction is denoted by the appearance of the distillate, which runs more freely as the naphthalene content decreases. The anthracene oil fraction is collected when the distillate assumes a green colour or when "green grease" makes its appearance, the condensers at this point being maintained at about 100° C. The pitch is run out of the still whilst hot. Towards the end of tar distillations much trouble is often caused by "coking." To prevent this, and also to help in the distillation of the higher-boiling fractions, use is often made of direct superheated steam and of reduced pressures. These modified methods also improve the yield and quality of the distillates, particularly of anthracene. The temperatures of fractionation are seldom controlled by thermometers, but use is made of the specific gravity, appearance, or volume of the distillates. The end point of the operation is determined, not by temperatures, but by the class of pitch required or the total volume of distillate obtained.

Working Up of the Fractions.—Fraction I. (first runnings), representing 1·5–2% of the crude tar, after separation from the aqueous liquor which has accompanied it in the distillation, consists of a mobile oil of sp.gr. 0·89 and is composed mainly of benzene and toluene with small amounts of phenols and bases. The products of commercial importance isolated from this fraction are pure benzene and toluene and the crude distillates, "90% benzol" and "50% benzol." The first step in the purification of the oils consists in washing them thoroughly with caustic soda solution (10%) whereby the acidic (phenolic) constituents are extracted as sodium salts soluble in the aqueous solution. A similar extraction with dilute sulphuric acid removes the bases as soluble sulphates. If the ultimate aim is the production of pure constituents, the oils at this stage are agitated with concentrated sulphuric acid, impurities such as olefines and nitriles being destroyed. Successive treatments with alkali and water render the oils neutral. The alkaline and acid washings from this fraction are added to the similar extracts from the light oil and the carbolic oil. The neutral oils, before treatment with concentrated sulphuric acid, consist almost entirely of benzene and toluene, although small quantities of olefines, paraffins, nitriles, carbon disulphide and thiophen are usually present. A further stage in the purification of the oils consists in fractional distillation with or without the aid of direct steam. By careful fractionation and the use of efficient rectifying columns, almost pure benzene (*q.v.*) and toluene (*q.v.*) can be obtained. The yields of these hydrocarbons from this and the next higher fraction are approximately 0·4 to 0·6% and 0·2 to 0·4% respectively calculated on the crude tar. In many cases the pure hydrocarbons are not isolated, fractions designated as "90% benzol" and "50% benzol" being collected. (The expression "per cent." in this case signifies that 90%, or 50%, distils below 100°.) Commercial 90% benzol contains about 70% benzene, 24% toluene, traces of xylenes and 4–6% carbon disulphide, light paraffins, etc.; 50% benzol is chiefly toluene and xylene with a small proportion of benzene.

Fraction II. (light oil), consisting of hydrocarbons, mostly homologues of benzene, together with phenol and pyridine, amounts to 7–8% of the tar. By application of the treatment described in the case of fraction I, this fraction may be made to yield the pure hydrocarbons, toluene, *o*-, *m*- and *p*-xylene (0·2 to 0·5%), pseudocumene, and mesitylene, or alternatively the crude fractions 50% benzol, 30% benzol, solvent naphtha and heavy or burning naphtha. Solvent naphtha, consisting of xylene and higher homologues, with naphthalene and paraffin in small quantity, is that fraction of the neutral oils distilling between 120° and 160° C, whilst heavy naphtha, containing mostly pseudocumene, mesitylene, naphthalene, with smaller amounts of cumarone and indene, distils between 160° and 190° C.

The acid extracts from fractions I. and II. are worked up for basic compounds. The bases obtained from these low tar distillates are principally of the pyridine series, contaminated with a small quantity of aniline and resinous products. The two latter are removed from the solution of the sulphates of the bases by fractional precipitation by ammonia and the bases subsequently liberated by the addition of aqueous caustic soda or ammonia. The crude bases separating as a black oil are collected and distilled over solid caustic soda in iron stills. Pyridine to the extent of 0·1% of the tar forms the major part of these bases, but methylated derivatives of this constituent are also present.

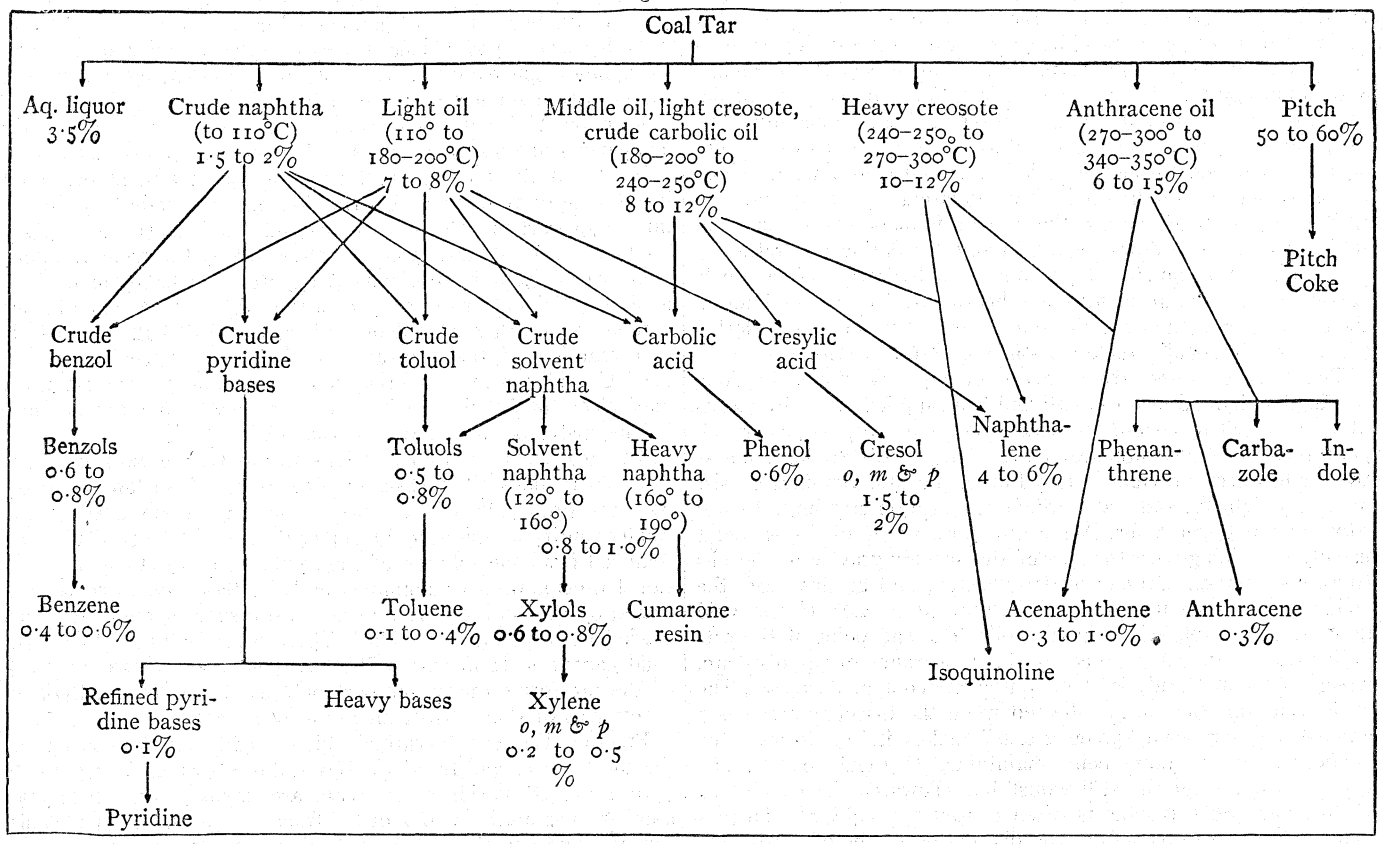
Fraction III. (crude carbolic oil or light creosote) is one of the most important fractions of the tar of which it represents 8 to 12%. Its major constituents are naphthalene, which may amount to as much as 40% of the fraction, and the lower phenols, carbolic acid and the cresols. At ordinary temperatures it is solid or semi-solid with a specific gravity of 1·2, but at 45° C is wholly liquid. The oils are chilled and the naphthalene, of which about four-fifths crystallizes out, is isolated by filtration or by exuding the oil under hydraulic pressure. Further purification of this hydrocarbon consists in treating the melted product with concentrated sulphuric acid and caustic soda, followed by distillation or sublimation. The content of naphthalene, by far the largest single constituent of the tar, varies from 6 to 10%.

The oily filtrate from the crude naphthalene, containing phenols, cresols, xylenols, pyridine bases and dissolved naphthalene, is called crude carbolic acid. It contains 25–35% of phenols and 5% of bases. The former are extracted in the manner described in the purification of fraction I., and the alkaline solution with the corresponding extracts from fractions I. and II. are steamed to remove neutral substances and then decomposed by means of mineral acids or carbon dioxide. The phenols, which separate as an oil, are collected, washed with water and distilled, when crude carbolic acid, b.p. about 180° C, is separated from the cresols (*q.v.*), xylenols and higher phenols, the mixture of which is termed liquid carbolic acid or cresylic acid. Repeated fractionation of crude carbolic acid finally yields a pure white product which crystallizes on cooling after distillation.

The oils left after extraction of the phenols can be worked up for pyridine bases, naphthalene and heavy solvent naphtha in the following manner. Agitation with sulphuric acid extracts the bases, which can be recovered as described above, whilst the remaining neutral oils are chilled and filtered, a second yield of naphthalene being thus obtained.

Fraction IV. (heavy creosote), a greenish-yellow, fluorescent oil amounting to 10–12% of the tar, contains carbolic acid, cresol, naphthalene, anthracene and other hydrocarbons, and is employed in the crude state as creosote oil. The naphthalene content in this fraction may be as high as 20% and the hydrocarbon often crystallizes out on standing. It is removed by distillation, being found in the first runnings of the distillate, from which it crystallizes in a pure condition. The crude oily residue of the oils containing nearly 30% of high phenols is employed in commerce without

Crude Coal Tar Distillates as obtained in practice and the Refined and Pure Products Derived therefrom
Yields are average values on the crude tar



further purification. The "creosote oil" contains several constituents which are of increasing importance.

Isoquinoline (*see* QUINOLINE) is obtained from the mixture of crude quinoline bases which are extracted from the creosote oil by sulphuric acid. Its purification, a matter of some difficulty, consists in fractional precipitation of the crude bases with ammonia, and the conversion of the most basic components into sulphates, followed by crystallization of the sulphate most insoluble in alcohol until the m.p. rises to 206° C. Decomposition of this sulphate liberates the pure base, b.p. 242° C.

Indole (*q.v.*), extracted as its potassium salt when the neutral oils of the creosote fraction are heated with solid caustic potash, is liberated when the potassium salt is treated with water, and purified by distillation under reduced pressure.

Acenaphthene (*q.v.*) appears in the creosote fraction distilling at 260–270° C. On cooling, this fraction yields a solid product moderately rich in hydrocarbon. Further purification is carried out by crystallization from alcohol.

Fraction V. (anthracene oil or green oil), which represents on an average 12% of the tar, is wholly liquid at 60° C, but on cooling to ordinary temperatures it becomes semi-solid, yielding a crystalline deposit of crude anthracene amounting to 6–10% of the fraction. This crude product is freed from oils by centrifugal plant or by hydraulic or filter presses. After pressing, first cold then hot, a crude anthracene cake containing 30 to 40% of anthracene is obtained. Other hydrocarbons present in this crude product include methylanthracene, phenanthrene, acenaphthene, diphenyl and pyrene, whilst nitrogen compounds such as carbazole and acridine are also present. As a general rule phenanthrene and carbazole (*q.v.*) are the chief constituents together with anthracene in the crude filtered product. These three substances can be separated by treatment first with naphtha, which dissolves the phenanthrene, and then with pyridine, in which carbazole is much more soluble than anthracene (*q.v.*). The latter is then purified by sublimation.

From the anthracene oil fraction, by treatment at 280° C with solid caustic potash, the hydrocarbon fluorene (*q.v.*) can be isolated through its potassium salt, which is freed from oils and other hydrocarbons, and decomposed by means of water. The accompanying chart (Bunbury and Davidson) illustrates the preliminary distillation of tar and the nature and average yield of the commercial products.

APPLICATIONS

Refined Products.—The constituents of tar isolated in the pure state and used as such in chemical industry, usually as starting points for the manufacture of other chemical compounds, are benzene, toluene, naphthalene, phenol and anthracene; in lesser degree, the xylenes, cresols, pyridine, acenaphthene, phenanthrene and carbazole; and to a smaller extent still, indole and isoquinoline. These substances together only amount to some 10% of the tar, and of this naphthalene forms the major portion. Synthetic methods of manufacture are reducing the demand for even these few tar products. Thus the synthesis of anthraquinone (*q.v.*) has rendered unremunerative the extraction of anthracene from the tar. Synthetic phenol, being superior in quality to that derived from crude carbolic oil, will gradually reduce the demand for the latter, provided a sufficient supply of benzene is available. The tendency, therefore, is to find some utilization for those constituents of the tar which can be isolated without undue difficulty.

Although the number of pure products isolated commercially is small, their value can hardly be assessed. Many industries are largely dependent on these few substances either directly or indirectly. In fact, the majority of the industrially important organic chemicals are prepared from the five first-mentioned constituents of tar. Naphthalene is one of the main starting points in the manufacture of intermediates for the important dyestuff industry, whilst from anthracene springs the whole of the anthraquinone series of vat colours and also the mordant dyes of the alizarin group.

The pharmaceutical use of coal-tar products takes its place in the front rank, not so much because of the amount of material used, which is comparatively small, but on account of its importance in the prevention and suppression of disease. As antiseptics, antipyretics, hypnotics, anaesthetics, etc., the derivatives of benzene, toluene and phenol particularly have received wide and

successful application. Further, the growth of synthetic organic chemistry from coal-tar products has enabled the medical profession to fight a winning battle against bacteria and trypanosomes. The value of these specialized applications of tar products lies not in finance or in economics but in their significance in human affairs.

Toluene and phenol are respectively the starting points for two well-known explosives, T.N.T. and picric acid, whilst the World War led to the manufacture of lachrymators ("tear gas"), such as diphenylchloroarsine, designed to produce disablement. In the manufacture of these, large quantities of benzene, toluene and phenol are used.

Another important industrial development is the manufacture of synthetic resins (*q.v.*), wherein large quantities of phenols and cresols are used in one type of resin and cumarone and indene in another.

Derivatives of tar products have had successful application as rubber accelerators, particularly nitrosophenol, aniline and nitrosodimethylaniline.

The manufacture of perfumes, the photographic industry, and the synthetic organic chemical industry employ large quantities of the pure constituents of coal tar. An interesting development is the manufacture of hydrogenated naphthalenes and phenols which are powerful solvents, especially for fatty oils, waxes, gums, resins, etc. One of the most important properties of hydrogenated phenols is their power of dissolving or dispersing in aqueous soap solutions, yielding a colloidal solution with powerful detergent and emulsifying powers. They are used in soaps, pastes and polishes, and in certain varnishes and lacquers.

Crude Products.—In addition to the value of the pure constituents isolated from the tar, there are products obtained by distillation which have far-reaching technical and industrial uses, and which are consumed in quantities many times greater than all the pure products combined. The coal-tar industry is indeed dependent on the commercial usefulness of the "crudes," *i.e.*, the distilled fractions and the residue, which together amount to 90% of the tar. The following are some of the most important applications of tar and its crude distillates.

(1) *Crude Tar.*—Commercial application of crude tar is somewhat restricted, as in most processes the presence of water is detrimental. In the crude state, however, tar is used as an anti-corrosive paint in the protection of iron, wood, brick and stone work against atmospheric conditions. This application is particularly useful in large manufacturing works where iron-work is exposed to an acid atmosphere. As a preservative, the crude product is used in the tarring of ropes and other accessories in ships. By the application of the Bergius process of hydrogenation (*q.v.*) tar, when heated with hydrogen at 430° C under 100 atmospheres pressure, is converted into a product resembling petroleum, 60% of which distils below 250° C and from which fuel oils and spirits can be obtained by distillation.

(2) *Prepared Tars.*—By far the widest application of tar is in the surfacing of roads and binding of macadam, granite chips or wood blocks. For this purpose the crude tar is "prepared" by distillation up to the point when the creosote oil begins to distil. The residue in the still, consisting of pitch dissolved in the heavier oils of the tar, constitutes road tars. Prepared tars, or tars from which the water and more volatile oils have been removed, can be regarded as soft pitch. These may be diluted further with distilled creosote and are often mixed with asphalt, mineral pitch or bitumen to improve the binding power. In tarring stones about 10 gal. of tar are used per ton of stone, and in surfacing 1 gal. covers about 6 square yards. Prepared tars are also used in the manufacture of steel linings for converters of the Bessemer type, and in the manufacture of roofing felt, when the woollen fabric is impregnated with the hot material and covered with a layer of sand on both sides.

(3) *Pitch.*—In the distillation of tar the residue in the still is pitch, constituting from 50 to 60% of the original tar. Until the modern demand for road tar developed, this pitch formed the most valuable fraction of the tar commercially. It is used chiefly as a binder for small coal in the preparation of briquettes, the proportions used being approximately 90% of coal and 10% pitch. Some of the more important specifications for pitch for briquettes are: softening point not to be below 60° C, amount of "free carbon" not to exceed 30% and absence of excessive amounts of volatile matter. In the preparation of briquettes, the coal slack is "wetted" with molten pitch and compressed into uniformly shaped blocks which are resistant to ordinary handling and transport. Mixtures of coal and pitch or the coke formed by the carbonization of the pitch have been used as domestic fuel. These products are attractive by reason of their low ash content and the high radiant heat obtained on combustion.

Pitch is often used as one of the components in protective paints and varnishes. For this purpose it is dissolved in heavy naphtha, other ingredients such as creosote being added as desired. A special bituminous paint is made by heating pitch to 160° to 200° C and adding cumarone resin as a solvent; a waterproof paint consists of a mixture of 1 part of pitch, 1 part of hot tar, and a suspension of 1 part clay in 1 part of water.

Other minor applications of pitch are the production, by further carbonization, of a coke suitable for the manufacture of electrodes, and as a filling material for resins in the manufacture of cold moulded articles.

(4) *Crude Benzols.*—The neutral oils of tar distillate up to 110° C constitute the commercial "crude benzol." For employment as a motor fuel it is further purified by redistillation and careful fractionation, eliminating the carbon disulphide which distils in the first runnings. If a high-grade fuel is required, the thiophen, which cannot be separated from the benzene by distillation, is removed by treatment with concentrated sulphuric acid. Motor benzol gives a ton-mileage per gallon 25% higher than petrol and has other advantages, such as less tendency to knock, whilst allowing a higher compression ratio to be used. It is also used in admixture with petrol, the fuel being known as "benzole mixture." Motor benzol has the following properties. Its sp.gr. is 0·87–0·885, and on distillation not more than 75% should pass over below 100° C and 90% below 120° C, whilst at 125° C there should be no residue. The sulphur content does not exceed 0·4% and the product is water-white in colour and free from water. It is free from acids, bases and sulphuretted hydrogen, does not freeze above −14° C, and when shaken with 90% sulphuric acid for 5 minutes does not give more than a light brown colour in the acid layer.

As a solvent, the crude benzol is used extensively in the paint and varnish trade, and for dry cleaning. Mixed with acetone it dissolves nitrocellulose, and with anthracene oil it is used as a solvent for resins. Purified benzol is one of the most important solvents used in fine organic chemical work. It is also used as a fuel in heating lamps and blow-lamps.

(5) *Solvent Naphtha,* as its name implies, is almost wholly used as a solvent. It also dissolves paints and varnishes and is used extensively in the composition of grease and oil removers.

(6) *Heavy Naphtha.*—High boiling, heavy or burning naphtha contains two substances, cumarone and indene, which when treated with suitable reagents polymerise to form valuable resinous products. In the manufacture of the resins (*q.v.*) the pure compounds are not isolated, the crude naphtha, b.p. 160–180° C after purification, being used. This crude distillate is also employed as a fuel for burning in illuminating lamps of the Lecigen type for use out of doors.

(7) *Anthracene Oil.*—After removal of the crystalline deposit of anthracene, the green oil is used, like creosote, as a fuel in Diesel engines and as an absorbent in gas washing. It is also employed as a lubricant for clay moulds in brick making, and as a component in grease for lubricating wire ropes such as are used in mines, ships, etc.

(8) *Light Creosote.*—Large quantities of light creosote, generally in the form of cresylic acid, are used in the preparation of general disinfectants, sheep dips and timber preservatives. It is usually profitable to extract the carbolic acid from the light creosote by using insufficient alkali to neutralize all the phenols in the fraction. The "sharp oil" or cresylic acid which remains is the basis of many common disinfectants. Saponified by emul-

sifying agents it is found in commerce under the trade names of "Lysol," "Creolin," etc. When dispersed in water, these products are powerful disinfectants and are used for general purposes.

(9) *Creosote Oil* or heavy creosotes have provided excellent fuels for oil-burning engines of the Diesel and semi-Diesel type. These oils have a high ignition temperature, approximately 450–500° C, and difficulties are met in starting the engine from the cold. Two methods have been used to overcome this difficulty—either starting the engine on a low fuel such as petrol and changing over to the higher fuel when the engine is sufficiently hot, or using a mixture of 10% petrol and 90% creosote as fuel. Creosote for this purpose must be thoroughly freed from solids such as naphthalene, inorganic salts and tarry impurities. It also forms a good fuel for oil-burning furnaces such as are employed in glass works and in heating rivets and small metal work. Like naphtha it is burned in lamps for out-door use.

Heavy creosote is also used as an absorbent in the recovery of light hydrocarbons from coal gas. In this process, called "gas washing" or "gas stripping," the gas is made to ascend towers down which the heavy oil is sprayed.

The absorbed light oils, consisting chiefly of benzene, toluene and xylene, are recovered by subsequent distillation and amount to 1 to 3 gal. per ton of coal.

Creosote finds its largest application in the preservation of wood, especially railway sleepers, piles, telegraph posts and paving blocks, being frequently applied under pressure, sometimes after subjecting the timber to a vacuum. The oil may also be used at a temperature sufficient to boil the sap out of the wood. The advantages of treating wood with creosote are the closing of pores, thus rendering the material a non-absorbent of water, the inhibition of germ life, and the coagulation of albumen by the tar acids. It is estimated that the life of railway sleepers is increased fivefold by creosoting.

Heavy creosote, after elimination of deposited naphthalene, is frequently converted into general disinfectants by admixture with about four times its volume of slaked lime, when "disinfectant powder" is obtained. This is used for railway cars, farm buildings, etc. When saponified by soaps, these oils form disinfecting emulsions with water and are used as sheep dips. Being less caustic than carbolic acid, the tar acids of the heavy creosote are less harmful to animals (*see* TARS, LOW-TEMPERATURE, for wood-tar creosote).

Creosote has been suggested as a soil sterilizer. A direct conversion of creosote oils into permanent gas has been evolved, but high temperatures are necessary. A ton of oil is capable of yielding 13,000 cu.ft. of gas of 14 candle power. Sulphonation products of light and heavy creosotes, either alone or on further condensation with formaldehyde, have been used as tanning agents.

(10) *Crude Tar Acids, i.e.,* the phenolic substances found in the higher fractions of the tar distillates have been applied as froth-producing agents in the "froth flotation" process, which mechanically and economically separates associated solids such as coal and stone, ore and earth, etc.

(11) *Pyridine Bases,* and more particularly crude pyridine, are used as denaturants to make alcohol non-potable. They are also employed as solvents, notably in the purification of anthracene.

(12) *Crude Solid Aromatic Hydrocarbons.*—The sulphonated products of crude phenanthrene, fluorene and carbazole have been applied as tanning agents. More extensive use has been made of crude naphthalene. It is claimed that a solution of naphthalene in petrol functions as an anti-detonating fuel from which greater efficiency can be obtained than from petrol. Motor cars, omnibuses and motor boats have been successfully run on naphthalene itself as a fuel, although the use of this product necessitated special adaptations in the engine for feeding and carburetting. It is claimed that 1 lb. of naphthalene is equivalent to 0·3 gal. of petrol. As a fuel, however, naphthalene finds its widest application in the manufacture of fire lighters which consist of wood waste impregnated and consolidated by immersion in the molten hydrocarbon.

BIBLIOGRAPHY.—G. Lunge, *Coal Tar and Ammonia* (5th ed., 1916); A. R. Warnes, *Coal Tar Distillation* (3rd ed., 1923); F. E. Dodge, "Coal Tar and its Distillation Products," in Rogers' *Manual of Industrial Chemistry* (4th ed., 1925); H. M. Bunbury and A. Davidson, *Industrial Applications of Coal Tar Products* (1925). (D. D. P.)

COAL-TAR DYESTUFFS: *see* DYES, SYNTHETIC.

COALVILLE, a town in north-west Leicestershire, England, 112 mi. N.N.W. from London by the L.M.S.R. Pop. of urban district (est. 1938) 24,150. Area 10 sq.mi. This is a town of modern growth, a centre of the coal-mining district of south Leicestershire. There are also elastic web factories, iron foundries and brickworks. A mile north of Coalville is Whitwick, with remains of a Norman castle, while to the north again are remains of the nunnery of Gracedieu, founded in 1240.

COAST, the edge of the land in contact with the sea. The term (from Lat. *costa,* a rib, side) is sometimes applied to the bank of a lake or wide river, and sometimes to a coastal zone (*cf.* Gold Coast, Coromandel Coast). If the coast-line runs parallel to a mountain range, such as near the Central Andes, it has usually a more regular form than when, as in the *rias* coast of south-west Ireland, it enters between the crustal folds. A recently elevated coast is usually regular, while a recently depressed coast shows the irregularities which were present upon the surface before submergence. Waves and sea-currents are the chief agents in coast sculpture. A coast of homogeneous rock exposed to steady erosion will present a regular outline, but if exposed to differential action it will be most embayed where the action is greatest. A coast consisting of rocks of unequal hardness will be marked, when the wave and current action remains similar throughout, by headlands, "stacks" and "needles" of hard rocks, and bays or gulfs of softer or more loosely aggregated rocks, *e.g.,* the southern shore-lines of the Isle of Wight and of south-western Wales. Subsequently the coast becomes "mature" and its outline undergoes little change as it gains on the land, for the hard rock being now more exposed is worn away faster than the softer rock which lies protected in the bays and re-entrants.

COASTAL HIGHWAY: *see* ATLANTIC COASTAL HIGHWAY.

COASTAL MOTOR BOAT: *see* FLEET AUXILIARY VESSELS.

COAST DEFENCE. The military policy of every great power in the world includes, as one of its integral parts, provision for defence of that nation's coast line. It is generally accepted that the broad objective of coast defence is: first, to prevent a hostile landing by enemy sea-borne forces; second, if such a landing is made to expel the enemy before he can gain a foothold from which further military operations are possible; and third, to provide secure protection behind which the nation's own fleet can safely retire for rest, refitting or repair.

The most efficient method of accomplishing these objectives is obviously to prevent the enemy from carrying out the organization, assembly and equipment of expeditionary forces; in other words, to prevent the creation of a force competent to attempt an overseas operation. Here an ounce of prevention is worth, not the traditional pound of cure, but rather some tons of it. It is equally obvious that operations to this end cannot be performed except by forces equipped to seek out the enemy's strongholds and attack him there. Just as in either land, sea or air operations, or in any sort of battle, the best defence is a strong offence, so in coast defence the best procedure is to prevent an approach to one's own shores. This means the use of naval and air forces in offensive warfare and a discussion of this subject is beyond the scope of this article; but it is curious that military history is replete with examples of the fact that rulers, governments and peoples have often failed to realize that the real defence of a nation's coast line against attack from the sea must come from naval forces and, in modern warfare, air forces, which are free to carry the attack to the enemy.

When the Athenians were preparing to move against Syracuse, Hermocrates, a Syracusan, told his fellow countrymen: "They will soon be here, and you must consider how, with your present resources, you can make the most successful defence. You should not let them take you by surprise because you despise them, or neglect the whole matter because you do not believe they are coming at all.

"I have a plan, which, in my judgment is the best suited to

the emergency, although it is the last which you in your habitual indolence will readily embrace. Let me tell you what it is. If all the Sicilian Greeks, or at least if we and as many as will join us, taking two months' provisions, would put out to sea with all available ships and prepare to meet the Athenians at Tarentum and the promontory of Iapygia, thereby proving to them that before they fight for Sicily, they must fight for the passage of the Ionian sea, we should strike a panic into them. They would then reflect that at Tarentum (which receives us) we, the advanced guard of Sicily, are among friends, and go forth from a friendly country, and that the sea is a large place not easy to traverse with so great an armament as theirs. They would know that, after a long voyage, their ships will be unable to keep in line, and coming up slowly and few at a time will be at our mercy. On the other hand, if they lighten their vessels and meet us in a compact body with the swiftest part of their fleet, they may have to use oars, and then we shall attack them when they are exhausted. Or if we prefer not to fight, we can retire again to Tarentum. Having come over with slender supplies and prepared for a naval engagement, they will not know what to do on those desolate coasts. If they remain they will find themselves blockaded; if they attempt to sail onward, they will cut themselves off from the rest of their fleet, and will be discouraged; or they will be far from certain whether the cities of Italy and Sicily will receive them. In my opinion the anticipation of these difficulties will hamper them to such a degree that they will never leave Corcyra."

Unfortunately the Sicilians would not adopt this logical plan and consequently had to fight a long campaign around their own city.

In the latter part of the 16th century, the strategical blunder of England's rulers in refusing to permit concentration of her naval forces and their offensive employment against the Spanish Armada was retrieved only by superior battle action by the English captains and crews. The United States of America, in the Spanish-American War, attempted to use her navy defensively, in order to still distressing internal clamour, and it was not until the noted American naval strategist, Admiral Alfred T. Mahan, had published his *Influence of Sea Power upon History* and his *Lessons of the War with Spain,* that the principles he enunciated were universally accepted. This is the more difficult to understand when one remembers the "Wooden Wall" of the Delphian oracle and the part which the British fleet played in the frustration of Napoleon's dream of domination of Britain. However, the strategical employment of the British fleet during the World War of 1914–18 leaves little doubt that the lesson has been thoroughly learned by the modern world.

Organization.—It is not feasible to fortify the entire coast line of any country so heavily as to prohibit landing somewhere by an enemy who controls the sea. The expense of such an installation both in men and money would be prohibitive. But certain localities are so important that they must be permanently fortified, and these are selected on the basis of providing secure, well-protected harbours for naval and military bases, the commercial and industrial importance of the locality, or the value of the locality to possible enemies. In essence, these fortified places provide strong-points upon which the entire system of coastal defence rests, and with which the defence of the open coast must be integrated.

These considerations have led, in the case of most of the great nations, to a division of responsibility for coast defence between their military and naval forces. In those countries where air forces are not integral parts of army and navy, responsibility is still further divided between land, sea and air elements. Such a situation requires very thorough co-ordination and exact definition of responsibilities and authority, especially in cases where joint operations on the part of two or more elements are concerned.

United States of America.—In 1793, George Washington, the originator of so many other matters vital to the U.S., advised Congress that the vulnerable portion of the U.S. coast line should be fortified. His advice went unheeded for a year but in 1794, General Henry Knox, who had been Washington's chief of artillery, drew up plans for harbour defence works for which a small amount of money had been provided. These works never got much beyond the planning stage, due to lack of funds, until after the War of 1812 when the reverses suffered at the hands of a small force of regular British troops convinced the American people of the necessity for some permanent opposition to hostile landings. In 1816 construction of defensive works was begun and during the next 45 years most of the important harbours on the Atlantic and Gulf coasts were protected by a series of closed masonry forts. During the American Civil War many of these forts gave excellent accounts of themselves and capitulated only to greatly superior forces after extensive siege operations.

Subsequent to the Civil War coast defence languished for 20 years, but in 1886 the subject received renewed impetus and the succeeding two decades witnessed the construction, at all important harbours in the continental United States, of defensive works designed solely to repulse attack by naval gun-fire. These works were very vulnerable to assault from the land side and this fact, coupled with the implication inherent in the existence of long stretches of undefended coast between the fortifications, led students of national defence to consider, apparently for the first time in half a century, coast defence as distinguished from purely harbour defence. The result of this consideration was the adoption of a system of defence which was largely negative and which placed upon coast artillery troops not only the responsibility for serving their guns but also that of acting as infantry in their own support in the event that enemy troops succeeded in effecting a landing in the vicinity of the batteries. Lack of sufficient mobile troops to provide the supporting elements was responsible for this makeshift arrangement, which prevailed for nearly 10 years, in fact until the entry of the United States into the World War in 1917.

At that time the U.S. harbour defences mounted both guns and mortars of large, medium and small calibre, together with ammunition and fire control necessary for their effective tactical employment against naval vessels. In addition, a thoroughly efficient system of submarine mines had been developed and was ready for installation. Harbours in the Panama Canal Zone, Hawaiian Territory and the Philippine islands, as well as those in the continental United States, were provided with their quota of permanent fortifications. Calibres of weapons ranged from three up to and including 16 inches—sufficient in power and range to combat effectively any naval armament afloat. Weapons were more or less dispersed with connecting control and supply lines concealed and protected. Prior to the use of aeroplanes for reconnaissance and fire direction many U.S. guns were mounted on disappearing carriages located behind parapets, so that the guns and their accessories were invisible from the sea. Modern emplacement, however, relies on camouflage and dispersion for protection and also on mobility which is secured by mounting cannon on railway carriages which enable the guns to change position at frequent intervals.

Subsequent to the war of 1914–18, two schools of thought grew up on the subject of the proper type of weapon for harbour defence. One maintained that fixed defences were obsolete, or at least obsolescent, and that all future defensive installations should be railway guns which could be moved from point to point to meet naval threats. Their opponents, while agreeing that railway artillery had many advantages, particularly in specific localities such as the Panama Canal Zone, maintained that it was not the whole answer to the problem of fortification of harbours. They reasoned that naval forces could move more rapidly than heavy railway artillery and that it was necessary to have heavy artillery available and ready to function at strategic points before the arrival of a hostile fleet. A compromise view eventually prevailed. Both types of weapons are used by the United States.

The European conflict also taught the U.S. that a proper solution of the problem of coast defence required more than mere resistance by harbour defence artillery to naval bombardment. Coast defence concerns all arms and demands employment of all branches of the army, organized and trained to function as a team. This conception, which still prevails, led to the adoption of what is known as a "Positive System of Coast Defence" in which not only all branches of the army participate but also se-

lected elements of the navy.

TYPES OF ATTACK

Coast defences may be attacked from the land, sea or air and such attacks may be separate or co-ordinate. The likelihood of separate sea or land attack against coast defences, in the future, is remote unless the attacker has control of local sea areas. But separate air attacks, combinations of land and air attacks or sea and air attacks are certain, just as the combination of all three basic forms is inevitable. Coast defences will have to provide resistance to all of these.

Fleets cannot be relied upon for defensive missions; they should never be tied to the defence of any harbour or section of coast line no matter how important; their proper function is always the offensive, to seek out and destroy the enemy on the sea or in his home bases. The same logic applies to air forces. Therefore, the burden of coast defence must be borne by land forces, which, however, must have both naval and air support.

Defence Against a Major Attack from Sea and Air.—A major attack would be undertaken by capital ships, that is, battleships, and would be for the purpose of supporting a landing of a large body of troops bent upon invasion. The allied operation at the Dardanelles in 1915 is an example of a major attack.

In that operation the naval forces of France and England consisted of a large number of second line battleships with one new battle cruiser ("Inflexible") and one new battleship ("Queen Elizabeth") for long range bombardment. These capital ships were supported by destroyers, submarines and other subsidiary craft. Attacks by this naval force on the fortifications continued from mid-February until mid-March during which period no less than six capital ships were sunk or put out of action by the Turkish defences which, although they mounted artillery generally considered to be of obsolete design and inadequately supplied with ammunition, nevertheless severely repulsed the allied fleet by a combination of artillery fire and mines.

Adequate defence against capital ships requires that shore-based artillery be able to bring effective volumes of heavy armour-piercing or deck-piercing fire to bear upon the ships during brief intervals of time. Since battleships are well-armoured and carry guns up to 16-in. calibre, coast artillery must mount guns of 12-in. calibre and upward. These weapons must be located so that they can bring mutually supporting fire to bear on all areas from which hostile fire may be expected. This consideration has led to mounting seacoast guns so that they can deliver all-around fire, that is, through a horizontal angle of 360°. The range of naval guns has increased to about 40,000 yd., hence it is desirable to advance the shore guns as far forward as possible from the harbour or base to be defended, with the purpose of keeping the ships beyond the bombarding range of the object of defence. The necessity for coast guns to be able to fire both with precision and rapidity is occasioned by the fact that naval targets do not long remain within range of coast artillery because of the great risk they run while so exposed. While the taking of such risk is justifiable in purely naval action, the instances in which a ship may properly indulge in combat with shore batteries and mine fields are exceptional. The relative value of a battery afloat to a battery ashore is not to be measured alone by the fire of gun against gun. The gun afloat has limitations of protection, ammunition supply, fire control and stability from which a gun ashore is free. Moreover, the risk which the naval gun takes is accentuated by the vulnerability of the ship to mines and torpedoes as well as shot and shell, and sailors must always remember that if the ship is sunk, all the guns it carries together with the mobility which makes them valuable are destroyed.

Emplacement.—Coast defence cannon are ordinarily emplaced in pairs, especially those of 12-in. or larger calibre, although in some instances they may be mounted singly or in groups of from four to eight. Each pair or group, together with the necessary fire control and fire direction facilities, ammunition supply installation and other accessories, is usually referred to as a "battery." This same term is used to designate the men who operate the guns. Thus, "Battery A" of a particular regiment will mean the officers and men who man "Battery Blank" which may consist of two 12-in. rifles or four 3-in. rifles or 8 12-in. mortars or some other combination of weapons. The ammunition storage, fire control stations and battery commanders' stations are ordinarily located so as to take advantage of such natural protection as the ground near the battery affords, consistent with the ability to perform their battle functions efficiently. Usually electric power is provided for working the guns, handling heavy ammunition and, of course, for communications.

Fire Control.—In order to deliver accurate and rapid fire at a moving target such as a battleship the shore battery determines firing data by a method of finding the various positions of the target at stated intervals of a time sequence, say every minute for a period of five minutes, then predicting from this known data where the ship will be at the end of another interval of time, say the end of the sixth minute. Thus, being able to predict the probable future course of the target, and its probable location at a selected future instant, it is possible to relate such prediction to the position of the gun, point the gun ahead of the ship and fire the gun so that the ship and projectile will arrive at the same point simultaneously. This procedure is known as position-finding, and the most common development of it is the horizontal base system which requires two observation posts located at the end of a carefully measured line some thousands of yards in length, called a base line. These stations are equipped with powerful optical instruments with which simultaneous observations are made on the target. The data thus obtained are telephoned to a central station called a plotting-room, where they are processed, either graphically or automatically, so as to result in determination of the distance and direction of the target from the guns. These results are then set on appropriate scales on the guns or carriages, the guns are pointed accordingly and are fired, usually electrically, at the proper instant.

Obviously this system and its variations, such as the vertical base system in which the height of one observing instrument above sea level replaces the horizontal base of the parent system, depend upon ability to see the target from shore. In the case of long range fire, where the target is invisible from shore, the shooting must be directed from aircraft. Such fire will naturally be less accurate than that directed by shore stations and will involve wireless communication between aeroplane and shore stations. Conversely, ships' fire under similar conditions of range will be directed by aircraft. It is evident that control of the air is indispensable to the delivery of accurate fire by either side under these circumstances.

The necessity for control of the air will certainly lead to extensive air activity precedent to naval action against coast defence works. In fact, it may be doubted if such actions will be attempted unless air superiority can be gained. Hence, the closest co-operation and mutual support between coast defence forces and defensive air forces becomes of paramount importance. Also the provision of anti-aircraft defence in and about fortified harbours becomes essential. While air supremacy is a prerequisite of a successful attack on fortified harbours, it is equally essential when a landing is to be attempted on open beaches against well-organized resistance. In such operations the attacker will be under the necessity of disembarking his troops from transports into small boats at a great distance from shore and these troops will need the support of well-directed naval gun-fire from the time of such debarkation until they have established themselves on shore. During this time they are most vulnerable to fire of all descriptions —infantry, artillery and aircraft.

All these considerations have given rise to the typical coastal defence conception which comprises the following elements given in the order of their appearance from front to rear:

First, distant naval and air reconnaissance to detect enemy preparation for an overseas movement.

Second, naval and air action to counter such efforts before they get under way.

Third, naval and air action to meet such an effort at sea and defeat it there if the enemy succeeds in launching it.

Fourth, naval and air off-shore patrolling and scouting to

give early warning of the approach of hostile forces.

Fifth, naval and air in-shore patrolling to cover naval mine fields or other obstructions.

Sixth, army controlled mines and accessories and fixed underwater obstacles and listening devices.

Seventh, coast defence artillery, fixed and mobile, in combination with anti-aircraft guns; with both fire control and searchlights supplemented by aircraft support, warning service and beach defence.

Eighth, mobile army forces of all arms strategically located and capable of rapid movement and co-ordinated action.

This set-up when composed of troops well-organized, well-trained, well-equipped, well-supplied and competently led can make a hostile landing effort so expensive to the attacker as to deter him from the attempt except as a last resort or unless he has such overwhelming superiority in one or more elements of combat as to convince him that his effort will succeed.

Defence Against a Minor Attack from Sea and Air.—Such an attack would be undertaken by cruisers or lighter craft and would consist of raids on shipping, bases, or port facilities, usually for destructive purposes. The principles underlying coastal defence against such attacks do not differ from those mentioned above and the installations necessary to repel such attacks differ from those listed only in degree. Shore installations must furnish the same amount of protection to the object defended as in the case of major attacks and must have the power and capacity to do this.

Localities which are thought to be subject only to minor attacks might have their defences less far advanced than those which can expect major attacks, and heavy concentrations of fire might be provided to cover interior channels or water areas. Also, lighter guns might be considered sufficiently powerful to cope with such naval units as are likely to be brought into action by a raiding force of cruisers or lighter craft. Wherever possible full advantage should be taken of high ground for battery sites in order to reap the benefits of plunging fire on ships' decks which are less well protected than their sides.

Defence Against a Close-in Attack from Sea and Air.—An attempt to bring the attack to close quarters may accompany either a major or minor hostile effort. Such an attempt might have as its objective the blocking of a channel, as in the British attack on Zeebrugge on the night of April 22–23, 1918, which resulted in temporarily blocking the canal to Bruges, an important German submarine base; the destruction of ships within a harbour or a protective anchorage, as in the torpedoing of the Turkish ship "Stamboul" in the harbour of Constantinople (Istanbul) by the British submarine "E–11" in daylight, or the sinking of the British battleship "Royal Oak" inside Scapa Flow by the German submarine commander, Lieut.-Commander Gunther Prien in Oct. 1939; the destruction of docks, port facilities, shipping and goods as in the destructive raids made by the English on the Dutch coast after their defeat of De Ruyter off North Foreland in July 1666; or, finally, landing raids such as that planned and executed by Admiral Sir Reginald Bacon of the Dover Patrol against Ostend in 1917. Such attacks are most likely to be made with light craft, destroyers, fast motor boats or submarines, and will be characterized by speed. Admiral Bacon's memorandum to the Admiralty advocating a landing on the Belgian coast said: "Speed of landing is the great element of success. It is in fact the whole underlying principle of the scheme to get men in numbers ashore before the enemy has time to appreciate the landing points. . . ."

The best chance of success for close-in attacks lies in night operations. The most effective defence against such attack is furnished by rapid-fire batteries of medium and small calibre, searchlights, mines and obstacles such as booms and nets. The rapid-fire batteries should be amply supplied with ammunition and a liberal number of searchlights should be provided. These may be either fixed or mobile but should be of a size and power sufficient to illuminate vessels at ranges of several thousand yards under favourable conditions of visibility. Searchlights are known by different names according to their tactical employment, for example, observation lights, searching lights and illuminating lights.

Both anti-aircraft artillery and aircraft may be used effectively against close-in attacks. Naval vessels are extremely vulnerable to attacks by aircraft of the dive bomber type and the fire-power of newer types of anti-aircraft guns makes them especially effective against light craft. Raiding attacks may expect to encounter concentrations of fire from all defensive weapons.

Miscellaneous Coast Defence Provisions.—The necessity for providing defence against gas attacks which might be delivered by means of gas shells fired from ships' guns or gas bombs dropped from aircraft led to the gas-proofing of fire control stations, command posts and ammunition shelters. Masks and protective clothing are provided for those men whose duties require them to remain in the open air.

Beach defence, involving the construction of field works such as trenches, machine gun emplacements and wire obstacles is organized for important localities; a complete system of communications connecting all defensive elements is established; warning services are placed in operation and preparations are made by mobile troops to launch strong counter-attacks against the enemy, should he succeed in effecting a landing at any point.

Defence Against a Major Attack by Land and Air.—Attacks of this sort must be visualized as an ever-present possibility especially by those nations separated from powerful, unfriendly neighbours only by land frontiers. Against these, harbour defence fortifications are not particularly effective, principally because heavy coast artillery guns are special weapons designed and built to fire armour-piercing shot and shell which are not well adapted for use against land or air forces. Also, many coastal batteries were formerly so emplaced that they could fire only seaward. Again, submarine mines, nets and other obstacles are useless against land forces. However, the modern practice of emplacing coastal guns so that they can deliver all-around fire and possible developments of large calibre high explosive ammunition have given harbour defence fortifications some additional value against hostile land forces operating within range of the big guns. Anti-aircraft defences, both fixed and mobile, may be expected to acquit themselves as creditably against land-based enemy aviation as against fleet-based aircraft.

Defence against a major land and air attack is primarily the responsibility of the mobile forces but coast fortification troops must be prepared to afford such support as their capacities permit.

Defence Against Minor Attack by Land and Air.—Observations contained in the previous paragraph apply equally well to attacks of this sort.

Defence Against Major or Minor Attacks by Land, Sea and Air.—The employment of coastal defence weapons and forces against attacks by combinations of land, sea and air forces will obviously follow the principles and methods outlined for use against sea and air attacks. The addition of land forces by the attacker must be counteracted by the mobile forces of the army.

AIR ATTACKS

The scope of air attacks against coast defence installations will vary according to whether or not the enemy aircraft can operate from land bases or from aircraft carriers and also with the strategical situation. In any case, both anti-aircraft artillery and defensive aircraft must be provided to resist whatever effort the enemy may make. In cases where a landing is intended, it may be taken as certain that intense air attacks will be delivered against coast defence fortifications in the area, for the purpose of destroying or at least neutralizing their actual or potential fire-power.

Command.—In situations requiring an intensive effort to defend a coastal region both army and navy forces will be involved. When air forces are separate entities, they too will be involved as such. Then questions concerning the responsibilities and authority of each element of the defending forces will arise. As has been said, the closest co-operation between all elements is essential to a successful defence, and experience has shown that, in general, the only way by which this co-ordination can be assured is through unity of command. This simply means that one individual officer from army, navy or air force is placed in command of all forces engaged in the defensive effort. His orders must be obeyed by all. His authority over troops from those forces to which he does not belong usually extends only to combat operations. In other words, the commander's authority does not cover interference with the administration or discipline of troops from other services, but only their employment in battle.

Harbour defences, being strongly fortified elements within the de-

fensive organization of coastal areas, their commanders function under the commanders of the coastal areas, as part of the tactical chain of command.

Planning.—The co-operative effort which successful coast defence entails makes mandatory careful advance planning. Defensive projects covering in great detail the location, organization and extent of defensive fortifications are prepared in time of peace. These projects, usually the work of officers representing all the defence forces who are familiar with local geographic and hydrographic conditions, form the basis upon which the defensive effort will be built in case of hostile attack. These projects are furthered by detailed plans for the utilization of available troops, and these plans, too, are prepared in time of peace. Plans emanating from the headquarters of large units of coastal defence organizations carry instructions for subordinate units. Plans of the subordinate units are so constructed as to support the plans of higher headquarters.

Conclusion.—It may fairly be concluded that the problem of coastal defence is both intricate and extensive. Modern opinion inclines to the view that successful coastal defence operations demand unified, co-ordinated team play on the part of all elements of the defensive forces, naval and military alike.

BIBLIOGRAPHY.—Alfred T. Mahan, *The Influence of Sea Power upon History* (1928 ed.) and *Lessons of the War with Spain* (1899); Sir Reginald H. S. Bacon, *The Dover Patrol* (1919); Charles Lee Lewis, *Famous Old World Sea Fighters* (1929); Various issues of *The Journal, U.S. Artillery* (1921–40). (C. H. TY.)

COAST GUARD, a force usually naval in character, maintained in some countries for the suppression of smuggling or affording assistance to vessels in distress or wrecked and for other duties incidental to a seaboard, *e.g.*, signalling, etc.

To cope with the intensive smuggling which followed on the conclusion of the Napoleonic wars a special British preventive service was formed, officered by half-pay naval lieutenants, to work in conjunction with the revenue cutters and riding officers to whom hitherto the duty of the protection of the revenue had been entrusted. Until 1831 the control of this service was vested in the customs, but in that year the service was reorganized and came, for purposes of administration, under the Admiralty, taking the name of Coastguard, but it was not until 1845 that it assumed a naval character. In 1856 the Coastguard Act was passed and the service transferred entirely to the control of the Admiralty. By the provisions of this act the Coastguard were, in time of war, to be used for the defence of the coast and as a reserve for the navy. The protection of the revenue remained, however, the primary function in time of peace.

From the establishment of the Coastguard—both prior to and since its transfer from the board of customs to the Admiralty—certain services connected with wrecks, casualties at sea, and life-saving generally were undertaken gradually by the force.

The main work of the Coastguard in time of peace, therefore, was on behalf of government departments other than the Admiralty, the board of trade and board of customs, the former being the government department responsible by Act of Parliament for the establishment and maintenance of rocket and other life-saving stations on the coast of Great Britain. The personnel were, however, trained regularly in their naval duties, at first by periodical cruises in Coastguard vessels stationed at various ports on the coast and subsequently by embarkation in the fleet during the annual manoeuvres. A certain portion, however, were organized and trained as a signal section for the purpose of manning signal stations around the coast in the event of war. This system prevailed at the outbreak of the World War.

On the conclusion of peace the Coastguard was reorganized, the personnel being composed of naval pensioners in place of active service ratings. The force, however, continued to be officered by officers on the active list and its duties remained substantially the same as in pre-war days.

In 1922 as the result of the recommendations of the Geddes Committee an inter-departmental committee was appointed to enquire what establishment was necessary for carrying out the civil duties discharged by the Coastguard, what arrangements should be made for a divisional responsibility and cost between the departments concerned and what economies consistent with the maintenance of the necessary national services could be effected. The committee reported in effect that the responsibility for revenue protection should be assumed by the board of customs and excise and that the responsibility for the other non-naval services should be assumed by the board of trade. These recommendations were accepted by the Government and the service was reorganized on the lines recommended as from April 1, 1923.

The Coastguard Act of 1856 was repealed by the Coastguard bill of 1925 whereby it was enacted that H.M. Coastguard shall consist of such numbers of officers and men as the board of trade may, with the consent of the Treasury, from time to time think fit, and shall be raised, maintained, equipped and employed as a coast watching force for the performance of the duties hitherto performed by the Coastguard on behalf of the board.

As a result the Coastguard is now, although very much reduced in numbers, primarily a life-saving service, to which end the organization is directed. The personnel is composed entirely of retired naval officers and pensioners from the royal navy.

In France, although there is no coast guard service in the sense of that maintained by Great Britain and the United States, a number of semaphore stations are established on the coast, manned by long-service men from the navy, called "Guetteurs Sémaphorique." Their duties are primarily concerned with signalling, but the work is also of a life-saving character as a look-out is kept for vessels in danger or distress, while the personnel have charge of and assist to work the rocket life-saving apparatus, should there be one in the vicinity of the station. The service is under the control of the minister of marine, stations being under the command of the maritime prefect of the district.

BIBLIOGRAPHY.—The rise and early history of the Coastguard in Great Britain are told in *Smuggling Days and Smuggling Ways* by the Hon. Henry N. Shaw, R.N. (1892). Information of this nature can be found also in *The King's Customs* by Hatton and Holland. Later history must be traced in the *Queen's (and King's) Regulations and Admiralty Instructions* of successive years. The reports of the Inter-Departmental Conference on the Coastguard held in 1907 (Cmd. 4,091) and of the Inter-Departmental Committee on the civil duties of the Coastguard held in 1922 (Cmd. 1,753) contain much useful information as to the history and the duties of the Coastguard.

(H. J. M. R.)

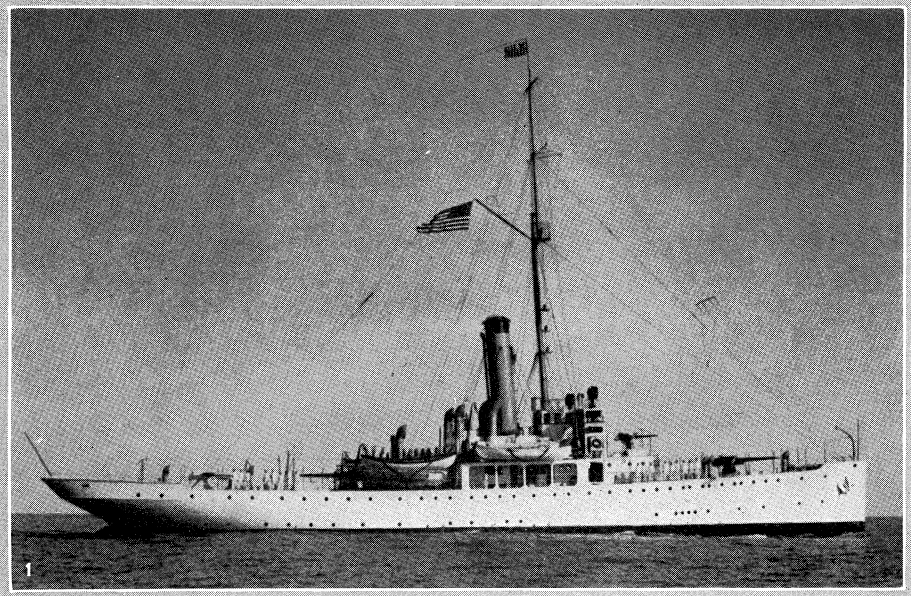
UNITED STATES

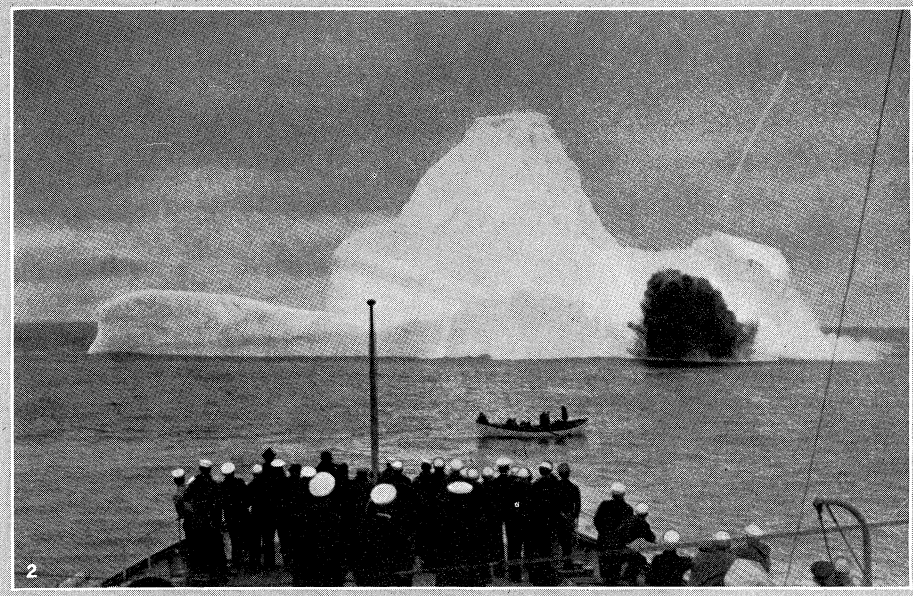
The United States Coast Guard was originally created by an act of Congress approved on Jan. 28, 1915, which combined therein the existing U.S. revenue cutter service and U.S. life-saving service. The act expressly provides that the Coast Guard "shall constitute a part of the military forces of the United States, and shall operate under the Treasury department in time of peace, and operate as a part of the navy, subject to the orders of the secretary of the Navy, in time of war or when the President shall so direct." On July 1, 1939, the Lighthouse Service of the Department of Commerce was also consolidated with the Coast Guard, in accordance with President Roosevelt's Reorganization Plan No. 2.

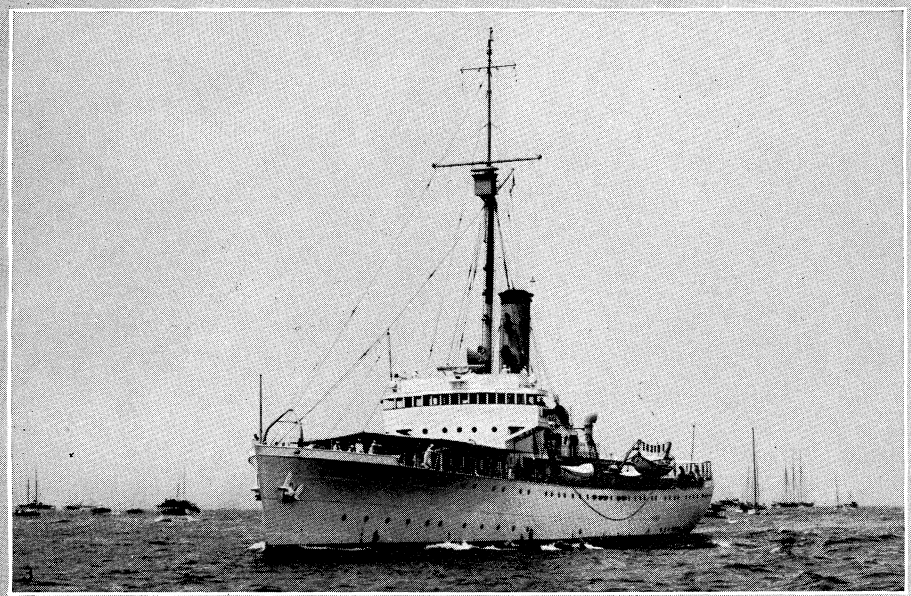
The Coast Guard, through its antecedents, the revenue cutter service and the lighthouse service is one of the oldest organizations under the Federal Government. After the Revolutionary War, the continental navy was disbanded. There was no sea force available for the protection of the coasts and the maritime interest of the newly constituted United States until the organization of the revenue cutter service by an act of the first Congress, approved by President Washington on Aug. 4, 1790. The vessels of the revenue cutter service formed the only armed force afloat belonging to the young republic until the navy was organized a few years later. The revenue cutter service was from the first, and the Coast Guard still is, charged with the protection of the customs, that is, with preventing smuggling from the sea.

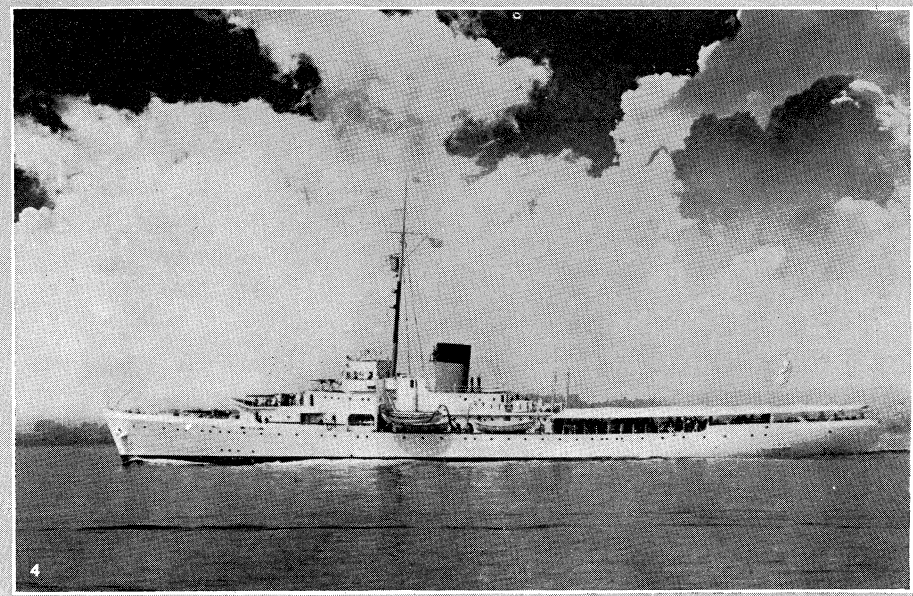
The former lighthouse service had its beginning in the act of Congress of Aug. 7, 1789, one year prior to the establishment of the revenue cutter service, which provided that lighthouses and other aids to navigation should be maintained at the expense of the Federal Government, and which resulted in the U.S. taking over 12 lighthouses originally built by the colonies or the States.

The Coast Guard has played a distinguished part in every war in which the United States has been engaged, with the exception only of the war with Tripoli. The records show that of the 22 prizes captured by the United States during the difficulties with France in 1798 and 1799 the Coast Guard cutters captured 18, un-







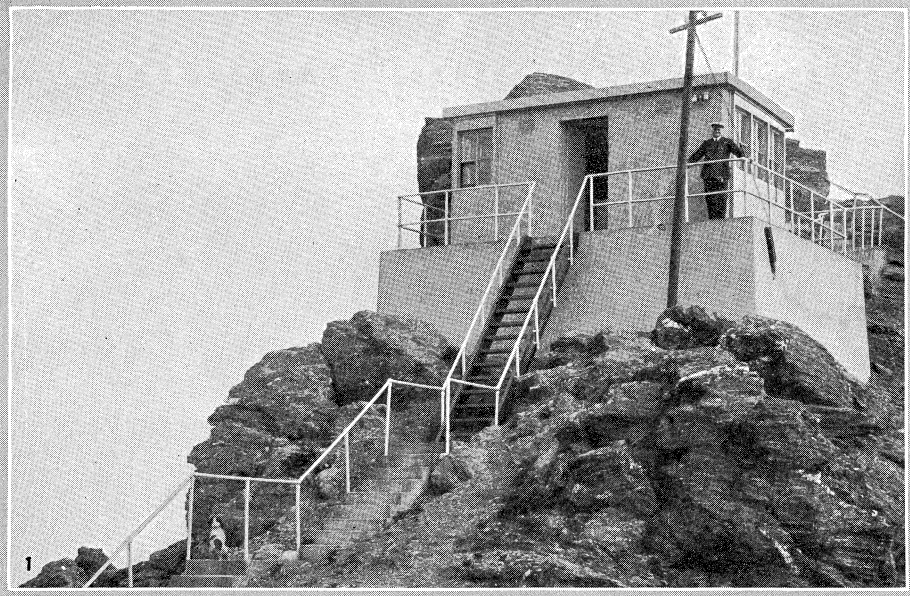


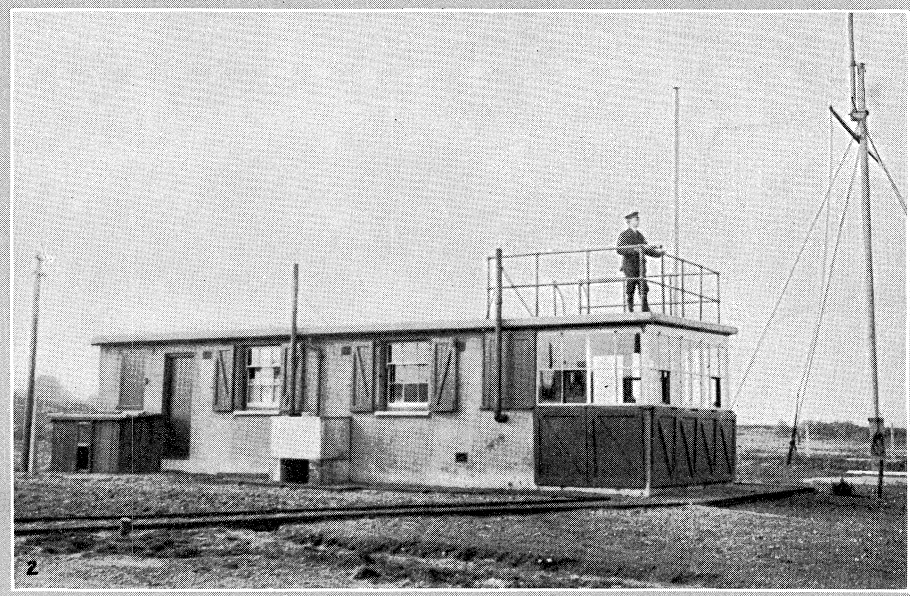
BY COURTESY OF THE U.S. COAST GUARD

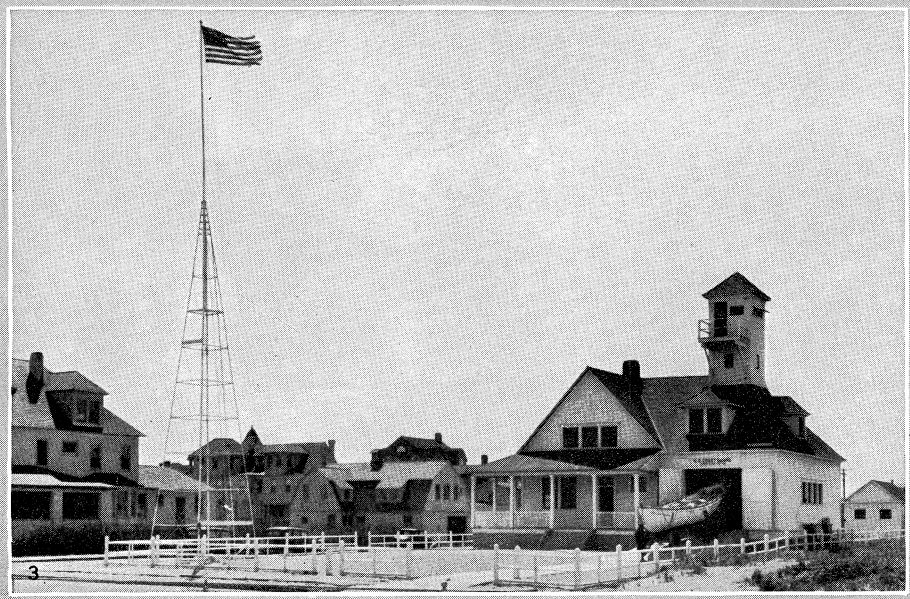
UNITED STATES COAST GUARD CUTTERS

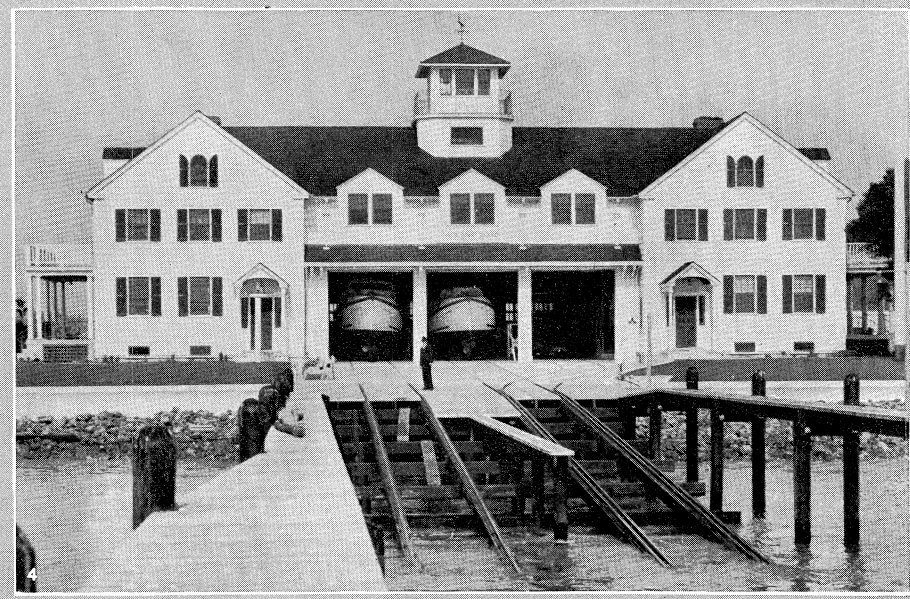
1. Cruising cutter "Mojave," especially designed (as to length, displacement, speed, equipment, etc.) for coast guard duty
2. Coast guard cutter on international ice patrol in the North Atlantic experimenting with the use of TNT for the destruction of icebergs
3. Cutter "Pontchartrain" on International Yacht Race Patrol
4. The 328-ft. cutter "Bibb"

COAST GUARD









BY COURTESY OF (3, 4) THE UNITED STATES COAST GUARD

BRITISH AND AMERICAN COAST GUARD STATIONS

1. Coast guard lookout hut, Bolt Head, Devon. Lookout hut for vessels in distress, placed on a commanding headland
2. The Lookout, Cromer, Norfolk. This station is equipped with wireless telephone for communication with lightships off the Norfolk coast
3. United States Coast Guard station, Shark River, New Jersey
4. United States Coast Guard station, Humboldt Bay, California

aided, and assisted in the capture of two others. A Coast Guard vessel made the first capture afloat in the War of 1812. The suppression of the piracy which prevailed during the first quarter of the 19th century in the Gulf of Mexico was due chiefly to the Coast Guard. The cutters waged a relentless war upon the pirates, pursued them to their every resort and rendezvous, and attacked and dispersed them wherever found. Vessels of the Coast Guard service participated actively in the Seminole Indian War, in the Mexican War and in the Civil War. The cutter "Harriet Lane" was attached to the squadron of naval vessels that was sent to Paraguay in 1858. The Coast Guard cutters fought alongside vessels of the navy in the Spanish War. The cutter "Hudson" was actively engaged at the battle of Cárdenas and the cutter "McCulloch" was with Admiral Dewey's fleet at the battle of Manila bay. When the United States entered the World War, the entire Coast Guard, in accordance with law, passed into the naval establishment. Coast Guard vessels fought submarines and performed escort and patrol duty in the European war zone, and officers and men served with distinction in practically every phase of naval activity. The sinking of the Coast Guard cutter "Tampa," after she had safely escorted her convoy to an English port, by an enemy submarine, Sept. 26, 1918, when every soul on board, 115 in all, was lost, constituted, with the sole exception of the loss of the navy collier "Cyclops," the largest individual loss sustained by U.S. naval forces during the war.

In time of peace the Coast Guard maintains a constant readiness for war and is prepared to pass into the naval establishment on 24 hours' notice. It is a real and valuable part of the national defence. In addition, it is charged with a large number of important peace-time duties, most of which are essentially humanitarian in their character. Its most important function, in time of peace, is that of saving life and property at sea. Its ships cruise actively along the coasts at all times, and particularly in the most dangerous weather, to render aid to vessels in trouble. In addition to the ships and supplementing their work in rescuing human life, a cordon of about 200 Coast Guard stations (formerly known as life-saving stations) protects the shores.

The Coast Guard clears away derelicts and other floating obstructions to navigation that constitute a very real danger to ships at sea. It maintains the international ice patrol along the trans-Atlantic steamer lanes, a service that was instituted following the sinking of the steamer "Titanic" April 14, 1912. Since the Coast Guard took charge of this patrol there has not been a single life lost by collision with icebergs or ice-fields in the North Atlantic. The cutters protect the seal herds and other fisheries in Alaskan waters and visit the remote parts of the Alaskan coast, carrying medical aid and the benefits of law and civilization to the whites and natives in those far northern regions. The Coast Guard enforces the regulations governing anchorage of vessels in navigable waters; it aids in the enforcement of the navigation laws governing merchant vessels and motor boats; it suppresses mutinies on merchant vessels; it protects human life and maintains order at regattas and large marine parades. During the great Mississippi flood in the spring of 1927, the Coast Guard service sent 674 officers and men and 128 vessels and boats into the inundated regions. It removed 43,853 persons from perilous positions to places of safety and saved 11,313 head of live stock. During the fiscal year ended June 30, 1940, the number of lives saved or persons rescued from peril by the Coast Guard was 14,070. The number of derelicts and other obstructions to navigation removed or destroyed was 83. The number of persons on board vessels assisted was 32,084. The value of vessels assisted, including their cargoes, was $88,016,268. The number of vessels boarded and their papers examined was 39,450.

On June 30, 1940, the Coast Guard fleet consisted of 34 cruising cutters, 52 harbour cutters and launches, 110 patrol boats, and 86 small picket boats. The personnel consisted of 600 commissioned officers, 291 cadets, 759 chief warrant and warrant officers, and 13,267 enlisted men.

There are about 200 Coast Guard (life-saving) stations. The equipment of Coast Guard stations consists of the beach apparatus—line-projecting guns, hawsers, breeches-buoys, etc.—flag and pyrotechnic signals, life-cars and life-boats, surf-boats and other types of boats, all intended to rescue persons in peril at sea. The maintenance of aids to marine navigation, which is now a function of the Coast Guard, as a result of the consolidation with it of the former light-house service, consists of marking about 40,000 mi. of coast line with lighthouses, lightships, radiobeacons, fog signals, buoys and beacons. These aids, of which there are 30,000, are widely distributed over the Atlantic and Pacific coasts of continental United States, the United States waters of the Great Lakes, and the waters of Alaska, the Hawaiian islands and Puerto Rico, and the Mississippi river and its navigable tributaries. There are about 500 lighthouses having resident keepers in attendance; lightships are maintained on 30 stations; and a fleet of about 60 tenders is used in the maintenance of the buoyage system and other duties. About 145 radiobeacons are in operation at strategic points, and there is a total of about 1,500 fog signals. Publications of the Coast Guard dealing with the navigational aids include the *Light Lists* (5 volumes), a weekly notice to mariners for the coasts, a weekly notice to mariners for the Great Lakes, radiobeacon charts, and miscellaneous pamphlets dealing with the significance and use of navigational aids. The historic motto of the Coast Guard is *Semper Paratus* ("Always Prepared"). (R. R. W.)

COASTING, usually called tobogganing (*q.v.*) in Europe, the sport of sliding down snow or ice-covered hills or artificial inclines upon hand-sleds, or sledges, provided with runners shod with iron or steel. It is uncertain whether the first American sleds were copied from the Indian toboggans, but no sled without runners was known in the United States before 1870, except to the woodsmen of the Canadian border. American laws have greatly restricted and in most places prohibited the practice, once common, of coasting on the highways, and the sport is mainly confined to open hills and artificial inclines or chutes. Two forms of hand-sled are usual in America, the original "clipper" type, built low, with long, pointed sides, formerly shod with iron but since 1850 with round steel rods for runners; and the light, short "girls' sled," with high skeleton sides, usually flat shod. There is also the "double-runner," or "bob-sled," formed of two clipper sleds joined by a board and steered by ropes, a wheel or cross-bar, and seating from four to ten persons.

In the U.S., coasting enjoyed considerable popularity into the early decades of the 20th century. After 1932 it ceased to be rated an important winter-sport at resorts in the Adirondacks of upper New York state and New England, where the emphasis is all on skiing. In the eastern cities of Canada, however, coasting is still a popular pastime. The chute at Mt. Royal, Montreal, consists of five tracks side by side, separated by ice. Dufferin Terrace, Quebec, has a three-track chute.

In Scandinavia several kinds of sled are common, but that of the fishermen, by means of which they transport their catch over the frozen fjords, is the one used in coasting, a sport especially popular in the neighbourhood of Oslo, where there are courses nearly 3 mi. in length. This sled is from 4 to 6 ft. long, with skeleton sides about 7 in. high, and generally holds three persons. It is steered by two long sticks trailing behind. On the ice the fisherman propels his sled by means of two short picks. The general Norwegian name for sledge is *skijälker,* the primitive form being a kind of toboggan provided with broad wooden runners resembling the ski (*q.v.*). In northern Sweden and Finland the commonest form of single sleds is the *Sparkstottinger,* built high at the back, the coaster standing up and steering by means of two handles projecting from the sides.

Coasting in its highest development may be seen in Switzerland, at the fashionable winter resorts of the Engadine, where it is called tobogganing. The first regular races there were organized by John Addington Symonds, who instituted an annual contest for a challenge cup, open to all comers, over the steep post-road from Davos to Klosters, the finest natural coast in Switzerland, the sled used being the primitive native *Schlittli* or *Handschlitten,* a miniature copy of the ancient horse-sledge.

The construction of great artificial runs followed, the most famous being the "Cresta" at St. Moritz, begun in 1884, which is about 1,320 yd. in length, its dangerous curves banked up. The famous run has an electrical timing apparatus. The record time for the descent is 53.7 sec. made in 1911, an average speed of 47 mi. per hour. The total drop from start to finish is 514 ft., the average gradient 1 in 7.7. On this the annual "Grand National" championship is contested, the winner's time being the shortest aggregate of three heats. In 1885 and the following year the native *Schlittli* remained in use, the rider sitting upright facing the goal, and steering either with the heels or with short picks. In 1887 the first American clipper sled was introduced by L. P.

Child, who easily won the championship for that year on it. The sled used by the contestants is a development of the American type, built of steel and skeleton in form. With it a speed of over 70 mi. an hour has been attained. The coaster lies flat upon it and steers with his feet, shod with spiked shoes, to render braking easier, and helped with the gloved hands. This is called the *ventre-à-terre* position. The "double-runner" has also been introduced into Switzerland under the name of "bob-sleigh."

Both bob-sleigh and skeleton-tobogganing are controlled by the International Federation of Bobsleigh and Tobogganing, and both races are included in the winter sports of the Olympic games. Each nation may enter three sleds in each event but only two may compete. There are races for the 4-man and the 2-man sleds (boblets). Races are run on four descents of the track, two on each day—the results being determined by the totals of the times. Electric timing devices are used.

Bob-sled racing first figured in the Olympic games at Chamonix in Feb. 1924, when Switzerland won, Great Britain was second and Belgium third.

As late as 1945 the only bob-run in the U.S. built to Olympic requirements was that on Mt. Van Hoevenberg in the Adirondacks outside the village of Lake Placid, N.Y. This run is 2,350 metres or approximately 1½ mi. long. The average drop is 10%, the maximum 15%. There are a total of 28 curves, some of which are 22 ft. high. There in Feb. 1932 the United States won first and second places in the 4-man bob-sled race of the third Olympic winter games. Germany was third, Switzerland fourth. The 2-man or boblet event was also won by the United States, with Switzerland second, the United States third, Roumania fourth. In the fourth Olympic winter games at Garmisch-Partenkirchen, Germany, Feb. 1936, the 4-man bob-sled competition was won by Switzerland, but the United States again won the event for the 2-man sleds.

The 4-man bob-sleds of latest design weigh close to 500 lb., and speeds of 70 m.p.h. have been attained.

See T. A. Cook, *Tobogganing at St. Moritz* (1896), and *Ice Sports*, in the Isthmian Library, London (1901); W. Duston White, *The Book of Winter Sports* (1925).

COAST PROTECTION AND LAND RECLAMATION. The boundaries between sea and land are perennially changing. In many sheltered bays and estuaries the sea is receding, while along other portions of the sea coast it is continuously encroaching. The same causes operate to produce both results: the rivers carry down detritus and sediment from the higher ground; the sea, aided by wind and tide, is always eroding exposed portions of the seaboard; and rain and frost assist in disintegrating cliffs composed of softer strata.

RECLAMATION

The main objects of reclaiming land from the sea are: (a) to increase the area of ground available for cultivation; (b) to gain land of high potential value for some industrial purpose or for municipal expansion. Examples of the first are the fen-land reclamations, the embanking and reclaiming of Sunk Island in the river Humber, and the great Zuider Zee reclamation which was begun in 1920. The reclaiming of nearly 300ac. of foreshore by the construction of a costly sea embankment at Hodbarrow in Cumberland, for the purpose of mining iron-ore under the foreshore and sea bed, and many instances of reclamation of sites for dock works, such as that begun at Southampton in 1926, are examples of reclamation for industrial purposes. The reclaiming of the foreshore at Back Bay on the west side of the Colaba peninsula at Bombay, begun after the World War, is a notable undertaking connected with city expansion. The high cost of labour and materials compared with the value of agricultural land in recent times has, particularly since the war, rendered works of reclamation, solely with the object of cultivation, in Great Britain at any rate, usually unremunerative.

Reclamation in Estuaries.—Accretion is the increase of land areas brought about by natural forces; *e.g.*, the deposit of silt in estuaries. Land which has been raised by accretion nearly to high-water level can be shut off from the sea by works of a simple nature and the fresh alluvial soil thus obtained is generally very fertile. Accretion in estuaries is a slow process under ordinary conditions. Directly, however, a fixed channel is secured by longitudinal embankments or training walls, accretion progresses rapidly by the deposit of sediment in the slack-water behind the embankments. Ultimately the time arrives when the water may be altogether excluded by the construction of enclosing embankments; these must be raised above the level of the highest tide, and should have a flat slope on the exposed side, protected, in proportion to exposure and depth of water, with clay, sods, fascines or stone pitching.

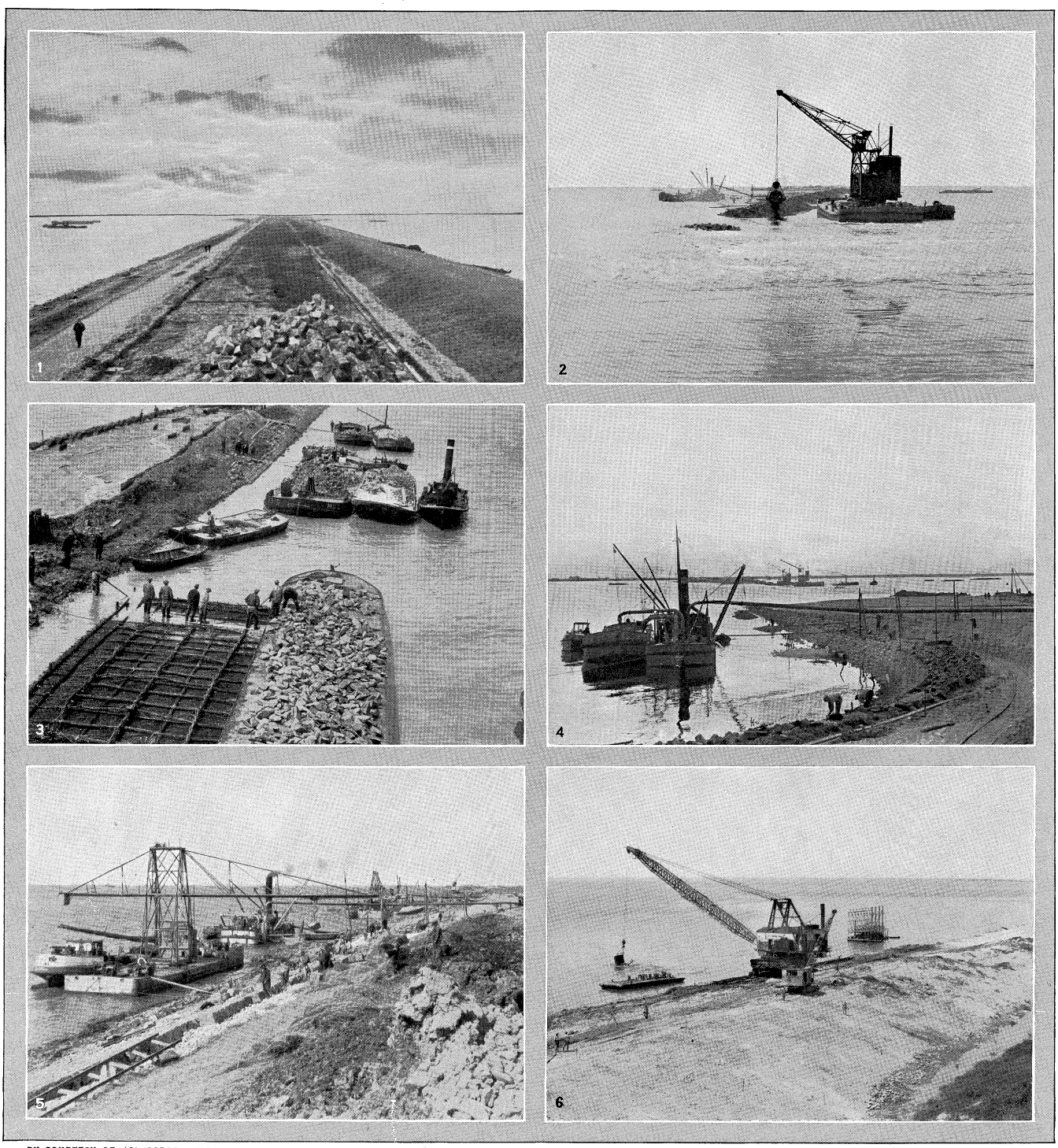
In the intermediate stages of the process outlined above much may be done to promote the growth of accretion, or warping as it is termed, and to ensure the fertility of the reclaimed land. The deposit of warp is accelerated by anything which tends to reduce the flow and consequent scour of the ebb-tide over the foreshore: thus considerable advantage will accrue from placing rows of faggots or sods across the lines of flow. The light, fertilizing alluvium only deposits in shallow water at high tide and where there are no tidal currents. The final enclosure, therefore, in the case of land intended for cultivation, should not be effected until this deposit has taken place. A final and rapid deposit can sometimes be effected by making sluices in the banks: the turbid water is admitted near high tide, and retained until the whole of its silt has been deposited, the clear water being allowed to escape slowly towards low tide. Premature enclosure must be guarded against; it is more difficult, the cost greater, the reclaimed land is less fertile and, being lower, less easy to drain.

The practice of reclaiming land in British estuaries is a very ancient one. The Romans effected reclamations in the Fen districts, in Romney Marsh and near Winchelsea; the enclosing of Sunk Island in the Humber was begun in the 17th century, and now produces an annual revenue of something like £10,000; large reclamations in the Dee estuary took place in the 18th century; and, in recent times, works have been carried out in the estuaries of the Ribble, Tees and other rivers. The bulk of the recent work has been with the object of industrial development. For instance, in the Tees estuary large areas of foreshore have been, and are being, reclaimed for factory sites and other industrial purposes by forming banks of iron-slag obtained from the iron-works of the Middlesbrough district. Slag constitutes an excellent material for the construction of reclamation banks in localities where it can be obtained at a low cost near the site of the works. The deposit of alluvial material, during and after embanking, is not an important factor in reclamation for industrial purposes and where the levels of land have to be raised it is usual in such cases to effect this by the artificial deposit of filling material.

Sea-coast Reclamation.—In the reclamation of land adjoining the open coast, sites where accretion is taking place are obviously the most suitable. Marsh lands adjoining the sea, and more or less subject to inundation at high tides, can be permanently reclaimed by embankments; but these, unless there is protection by sand dunes or a shingle beach, are required to be stronger and higher, with a less steeply inclined and better protected slope than is required in estuaries. Waves overtopping the bank will quickly cause a breach, and produce disastrous results; the height of the bank must, therefore, be calculated to meet the case of the severest on-shore gale coinciding with the highest spring tide. Undermining, caused by the recoil of waves on the beach, is liable to occur in exposed sites; this may be prevented by a line of sheet-piling along the outer toe of the bank.

Sea-coast embankments should not generally be constructed farther down the foreshore than half-tide level, as the cost of construction and maintenance would increase out of all proportion to the additional area obtained. It is, as a rule, more economical to reclaim a large area at one time, instead of enclosing it gradually in sections, as the cost varies with the length of embankment; it is, however, more difficult to effect the final closing of a bank, where a large area is thus reclaimed, on account of the greater volume of tidal water flowing in and out of the contracted opening. The final closing of a reclamation embankment is best accomplished by leaving a fairly wide aperture, and by gradually raising a level bank across its entire

COAST PROTECTION AND LAND RECLAMATION



BY COURTESY OF (6) CORPS OF ENGINEERS, U.S. ARMY; PHOTOGRAPH, (5) EWING GALLOWAY

CONSTRUCTION OF DIKES

1. Zuider Zee reclamation, in Holland: main dike dividing sea and land
2. Building main sea dike, showing grab-dredger unloading boulder clay
3. Laying fascine mattress in secondary dike, sunk by stone from barges
4. Pumping sand from barges to form the hearting of dike at Wieringen
5. Electric crane and hydraulic pump delivering sand and stone to dike
6. Dragline building a levee on east shore of Lake Okeechobee, Florida

length. The embankments in Holland are closed by sinking long fascine mattresses across the opening; these are weighted with clay and stone, and effectually withstand the scour through the gap; the two terminal slopes of the finished sections are similarly protected.

There are many examples of sea-coast reclamation: Romney marsh was enclosed long ago by the Dymchurch wall, where the method of protection adopted in late years more nearly resembles

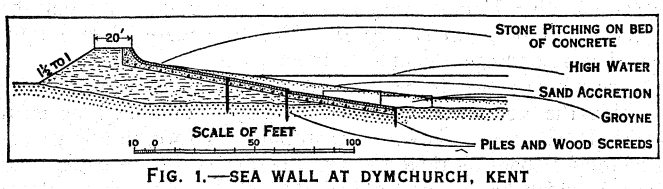


FIG. 1.—SEA WALL AT DYMCHURCH, KENT

the Dutch system than any other work in Great Britain (fig. 1), and a large portion of Holland has been reclaimed from the sea by embankments (fig. 2); the reclamation bank for the Hodbarrow iron-mines illustrates the use of puddled clay to prevent infiltration. The outer portion of this embankment for a length of over 3,000ft. was protected on its sea face by concrete blocks, each weighing 25 tons, deposited "pell-mell" (fig. 3). The sea embankment of the Back Bay reclamation at Bombay (*q.v.*) is an example of modern construction on a rocky foreshore. When completed the length of the wall will be 4 miles.

Breaches in Embankments.—The repair of a breach effected in a completed reclamation embankment is a more difficult task than that of closing the final gap during construction; this is owing to the channel or gully scoured out upon the opening of the breach. When a breach occurs which cannot be closed in a single tide, the formation of an over-deep gully may to some extent be prevented by enlarging the opening. Breaches in embankments have been closed by sinking barges across the gap, by piling and planking up, by lowering sliding panels between frames erected to receive them, and by making an inset wall or bank round the breach.

The gradual drying of reclaimed land lowers the surface some two or three feet; the land therefore becomes more liable to inundation after reclamation than before. Accordingly, it is most important to prevent breaching of the bank by promptly repairing any damage caused by storms; and if a breach should occur, it must be closed at the earliest possible opportunity.

Reclamation by Dredging.—Mention should be made of the method of reclamation by dredging material from the bed of the sea or a river and depositing it on shore or behind an embankment for the purpose of raising the level of existing

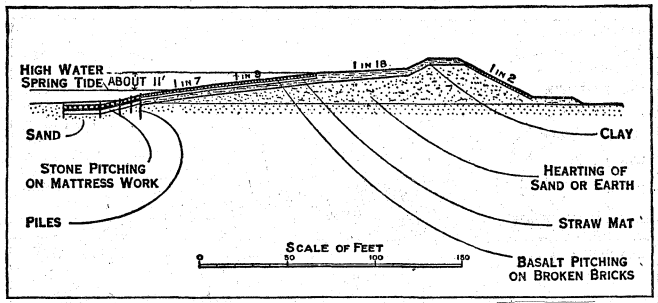


FIG. 2.—CHARACTERISTIC CROSS-SECTION OF DUTCH SEA EMBANKMENT OR DIKE

land or converting foreshore or sea-bed into dry land. The method was first used on a large scale in Holland towards the end of the 19th century and has since been extensively employed in many parts of the world (*see* DREDGERS AND DREDGING). The material, whether sand, silt, clay or gravel, is dredged from the sea or river-bed by a bucket dredger or a suction dredger. If the former is employed the dredged material is usually delivered into barges and conveyed to a "pump-ashore" station, where admixture with water takes place, and a pump forces the mixture through a line of pipes on to the land to be reclaimed. If suction dredgers are used for gaining the material it can be pumped ashore direct through floating pipe lines, if the distance is not too great, or transported by barges from which it is pumped ashore by means of a fixed or floating reclamation pump. In some instances an intermediate pumping station in a long line of delivery pipes has been used to "boost" (*i.e.*, to speed up or relay the flow through the pipes) the mixture of water and dredgings delivered to it from the main dredger.

COAST EROSION AND PROTECTION

There is a difference of opinion about the value of much of the works for coast protection, and some consider that money expended thereon does not give an adequate return. Even in Holland, whose existence depends on the maintenance of its sea walls and defences, authorities are divided on important questions both of principle and practice. Since the close of the 19th century there has been remarkably little development in the means adopted to combat coast erosion; and, generally

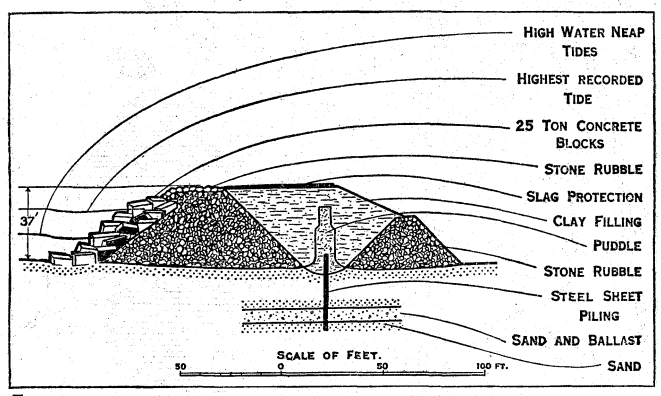


FIG. 3.—RECLAMATION BANK FOR THE HODBARROW IRON MINES, 1904

speaking, the methods of construction which still find favour, not only in Great Britain but also abroad, are the same in principle as those which have been used for generations previously. The royal commission on coast erosion, appointed in 1906, whose final report was issued in 1911, collected and placed on record much useful information on the subject of coast erosion, protection and reclamation, not only relating to the United Kingdom but also in reference to foreign countries and Holland and Belgium in particular.

The recommendations of the commission regarding the control of the foreshores of the United Kingdom and the constitution of a central sea defence authority have not yet been given effect to by legislative enactment. The report, however, has served to dispel certain erroneous ideas, particularly as to the extent of the loss of land due to erosion in the United Kingdom, and proves conclusively that the expense of protecting purely agricultural land is out of all proportion to the value of the land thereby saved from destruction.

Causes of Sea Encroachment.—Encroachment of the sea on the coasts is due to erosion of cliffs and shore material. Of the detritus derived from such erosion a portion is carried along shore by the combined action of wind, waves and tides. It remains in a state of more or less constant movement until it is finally deposited to swell an accreting sand or shingle bank, or is driven against some natural or artificial barrier, where it lies and is perhaps buried under subsequent deposits. The travelling shingle and sand or littoral drift is the principal source of the beach materials which form, and make good the wastage from, the foreshores of the coast. But in the course of this lateral travel the particles, large and small, forming the detritus are still further disintegrated. The lighter material is carried off in suspension by the sea and ultimately finds a resting-place on the ocean bed at a level below the influence of wave action or tidal scour.

The remaining portion of the solid materials derived from the destruction of the cliff or shore is more or less immediately transported into deep water, the finer particles being rapidly swept

away by the current until finally deposited on the sea bed, and a certain proportion of the larger material, too heavy to be carried in suspension for any considerable distance, is drawn down the foreshore and the bed of the sea by the under-tow of the waves and ultimately makes its way by gravitation into deep water where it finds a resting place.

Deep Sea Erosion.—The process of erosion and littoral drift is not confined to the foreshore and beach above low-water mark.

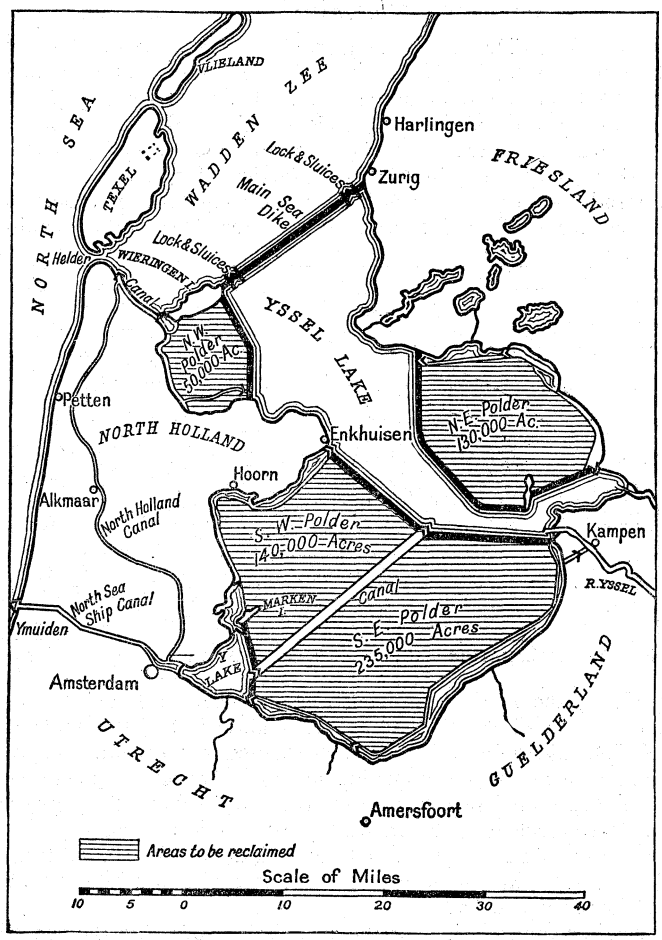


FIG. 4.—SKETCH PLAN FOR THE RECLAMATION OF THE ZUIDER ZEE

Such changes are continuously in progress below low-water where wave action or tidal scour is capable of affecting the sea bottom. These agencies and the gravitating tendency of the particles continue at work until the opposing forces reach a condition of equilibrium. Under certain conditions material lying on the sea bed below low water and in shallow depths is driven back on to the foreshore, but this is merely a temporary phase in the progress of littoral drift. With change of wind or tide the conditions may be reversed.

Conditions Affecting Littoral Drift.—The direction of the prevailing littoral drift is in general governed by the direction of the flood-tide, the prevailing winds and the shape of the coast. Opinions differ as to the relative effect of tide and wind, and although the direction of drift is at times varied by the wind direction, and the consequent wind waves, most competent authorities agree that, in the case of Britain at any rate, the prevailing drift coincides with the set of the flood-tide. In fact, on the British coasts the direction of the flood-tide does generally coincide with the direction of the prevailing winds. On the east coast the drift is from north to south and on the south coast from west to east, in both cases in the direction of the flood-tide and prevailing wind.

Where a coast-line is broken up by deep bays and indentations no continuous drift can take place, each bay retaining its own characteristic material which is prevented from leaving it by the projecting headlands extending to low water or beyond and forming natural groynes. Numerous examples of these conditions are found on the south coast of Devon and Dorset. The direction of the flood-tide is also in many cases altered locally by the configuration of a bay; *e.g.*, the deflection of the tide along the shores of the bay in a direction opposite to that of the normal coastal current. In cases where a coast-line is broken up by estuaries or rivers the results are variable, depending upon the continual struggle which takes place between the opposing forces affecting littoral drift and the tidal inflow and outflow of the river, the latter sometimes aided to a material extent by the addition of large volumes of fresh water.

During strong winds in a direction contrary to the set of the tide the normal travel of drift may be nullified or even reversed. The accumulation of material on a foreshore is generally brought about by tidal and wave action in calm weather, and a beach which has been depleted during a long spell of heavy weather usually makes up again, at any rate to a partial extent, on the occurrence of calm sea and the cessation of wind. This replenishing is due to the return of a portion of the material previously drawn down into shallow water below low-water mark. Generally speaking, on-shore gales result in the drawing down of the beach material and its gravitation towards the deep sea. Off-shore winds, on the other hand, frequently lead to the accumulation of material on a foreshore.

In order to increase the extent of a foreshore or to maintain it even in its existing condition, the natural and incessant losses must be made good by accretion or the trapping of material derived from other parts of the coast. This may be done in favourable circumstances by the construction of groynes or other works similar in effect, but the accretion through their agency is in every case accomplished to the detriment of neighbouring foreshores. Thus the large groynes at Brighton trap for the time being the greater part of the shingle travelling from west to east, and very little passes on to the foreshore to the east of Brighton, which has consequently become denuded.

Effect of Artificial Projections on Adjoining Coast.—The construction of solid piers or other similar obstructions at an angle with the general shore line and projecting into the sea is, when occurring on a coast-line subjected to erosion, almost inevitably followed by serious depletion of the foreshore to leeward. The solid projection, which in many cases is carried sufficiently far in a seaward direction to reach comparatively deep water, effectively hinders the passage of littoral drift from its windward to its leeward side. (The terms "windward" and "leeward" are used in the sense understood by engineers engaged in coast protection work; viz., "windward"—the direction whence the prevailing littoral drift proceeds; and "leeward"—the direction towards which such drift takes place.) Thus the

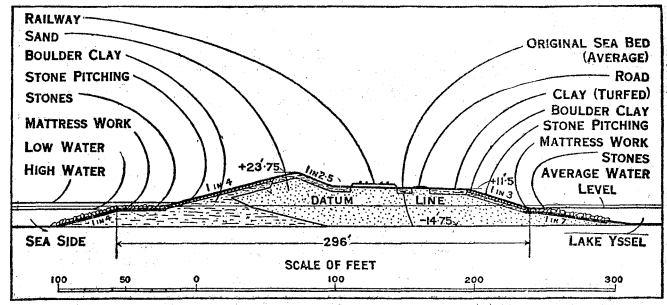


FIG. 5.—CHARACTERISTIC CROSS-SECTION OF THE MAIN SEA DIKE IN THE RECLAMATION OF THE ZUIDER ZEE

erosion of the lee shore is accelerated by the loss of the travelling material which under natural conditions makes good to a partial extent the ravages of the sea. Instances of such stoppage are numerous on the English coast. The Folkestone harbour pier has arrested the travel of the beach from the westward, and led to the accumulation of a large bank on that side and the denudation of the foreshore to the east of the harbour and towards Dover. The construction of the harbour works at Dover has stopped the eastward drift at that point and accelerated the destruction of the cliffs in St. Margaret's Bay. At

Lowestoft the construction and subsequent extensions of the harbour pier and other works which project at right angles to the coast-line at the sea outlet of Oulton Broad have resulted in the accumulation of a bank of shingle to the northward and serious encroachments on the town frontage to the south of the harbour.

Sea Walls.—The conditions affecting the design of a sea wall differ so materially that every case must be considered on its merits and provided for accordingly. Sea walls may be divided roughly into two classes, sloping and upright, each class having its advocates among engineers. Generally speaking, walls having a sloping face are used in Holland and Belgium, whilst a vertical or nearly vertical face is more common in Great Britain. The immediate effect of the construction of a wall is detrimental to the beach in front of it, although affording protection to the cliff or banks behind. Thus the construction of a sea wall on a sand or shingle foreshore is in itself calculated to bring about the denudation of the beach and the wall may become before long the agent of its own destruction. Whilst the wall will prevent erosion by the sea of the cliffs in rear of it, the beach in front of the wall must be protected and conserved by the construction of groynes. Many walls have failed through the displacement of the filling behind them by wave action; the provision of a substantial and wave resisting surface or paving behind the wall is, therefore, of great importance, and has been too often neglected. Suitable provision for the drainage of the cliffs, where they exist at the back of sea walls, is also a matter of high importance which also has often been neglected with disastrous results. Much can undoubtedly be done by draining, sloping and planting, to preserve and protect cliff faces, and these works ought to proceed simultaneously with the carrying out of sea-defence undertakings, when the cost of the latter is justified, to protect the foot of the cliff.

Sea walls subjected to abrasion by shingle are, if faced with concrete, very liable to progressive and serious damage. In such positions a concrete wall is frequently protected by a facing, at any rate over that portion subjected to abrasion, of hard stone or flints. For this reason also reinforced concrete is unsuitable for use in the face work of walls on a shingle beach, as the wearing away of the concrete soon results in exposure and deterioration of the steel reinforcement.

Upright sea walls, with some batter on the face, have been constructed along the frontage of many sea-side towns, with the double purpose of making a promenade or road, and of affording protection. A very sloping and also a curved batter reduces the effective stroke of the wave by facilitating its rising up the face of the wall, but the force of the recoil is correspondingly augmented. A vertical face offers more direct opposition to the wave, minimizes the tendency to rise and, consequently, the recoil; while a stepped face tends to break up the wave both on ascending and recoil, but there is a corresponding liability to displacement of the face blocks of the wall. The sea walls shown in figs. 6, 7 and 8 exhibit straight, stepped and curved forms of batter. The building of the Scarborough wall (1887) was followed by erosion of the shale bed on which it was founded, and further protective works, including aprons and groynes, had to be added subsequently. A sea wall at Bridlington, constructed in 1888, and, like the walls at Hove and Scarborough, protected by groynes, is shown in fig. 9. At Blackpool walls of the Dutch type but with somewhat steeper aprons have been built on an extensive front (fig. 10).

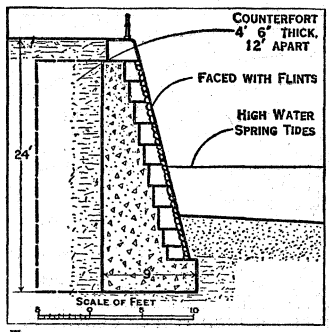


FIG. 6.—SEA WALL AT HOVE, SUSSEX

Groynes.—However effective they may be in collecting travelling material, groynes will not in all cases prevent the waves reaching the top of a cliff or bank and eroding it to a greater or less extent. A combination of the two forms of protection—groynes and wall—is frequently desirable, but groynes alone have on many low-lying foreshores, particularly where there are no cliffs, proved successful and efficient without the construction of sea walls or protected banks, as for instance on the four m. of shore between Worthing and Shoreham. In some cases protection of the crest of a beach above high water has been secured with success by the construction of a timber barrier or wave screen, formed of piles spaced apart and driven parallel to the line of shore.

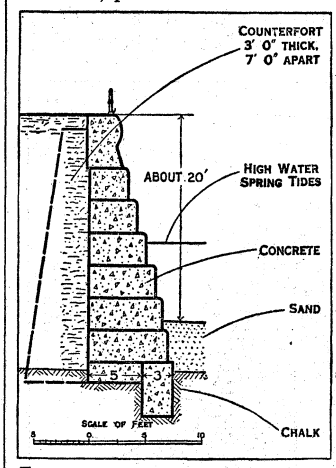


FIG. 7.—SEA WALL AT MARGATE, KENT

Groynes may be divided into two main classes: (1) high and substantially built structures of timber or other material; (2) low groynes of inexpensive and light construction usually placed at short intervals apart. In general low, light groynes are suitable on flat, sandy foreshores which are not exposed to sudden and extensive changes of level. In any case it is undesirable to build up the planking of a groyne to a considerable height above the foreshore level existing at the time of construction, and it is preferable to raise the groyne by the addition of planking to keep pace with the accretion of beach material. The use of reinforced concrete for the construction of groynes has frequently been advocated, but is unsuitable on shingle beaches on account of the rapid abrasion of the thin concrete covering of the steel reinforcement.

Groynes although, in Britain, usually constructed of timber are sometimes built of concrete or masonry; examples are the high groynes at Brighton and Hastings (fig. 11), which are faced with flints to protect the concrete from abrasion by shingle. A typical high timber groyne at Eastbourne is shown in fig. 12 and a low groyne of lighter construction in fig. 13.

Groynes, speaking generally, to be of maximum efficiency should be at distances apart about equal to, or little more than, their length. They should extend continuously from the shore or work to be protected to the vicinity of low water of spring tides. There is much diversity of opinion and practice with regard to the direction in which groynes should point. Some authorities advocate their direction at right angles to the shore line, others pointing slightly to windward and some prefer a leeward direction. No general rule can be laid down and a plan suitable for one locality may prove a failure in another. The opinion of the majority of authorities, however, appears to favour a direction pointing slightly to windward.

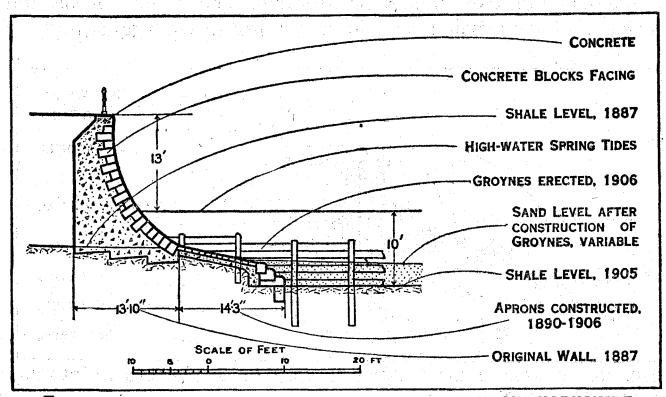


FIG. 8.—SEA WALL (NORTH CLIFF) AT SCARBOROUGH, YORKSHIRE

Relative Extent of Loss and Gain of Land.—The evidence as regards the total superficial area gained and lost in recent years on the coasts and in the tidal rivers of Great Britain shows

that far larger areas have been gained by accretion and artificial reclamation, taken together, than have been lost by erosion. Evidence laid before the royal commission by the Ordnance Survey Department in 1907 showed that within a period, on the average, of about 35 years, about 6,640ac. had been lost to the United Kingdom, while 48,000ac. had been gained. Most of the gain has been in tidal estuaries, while the loss has been chiefly

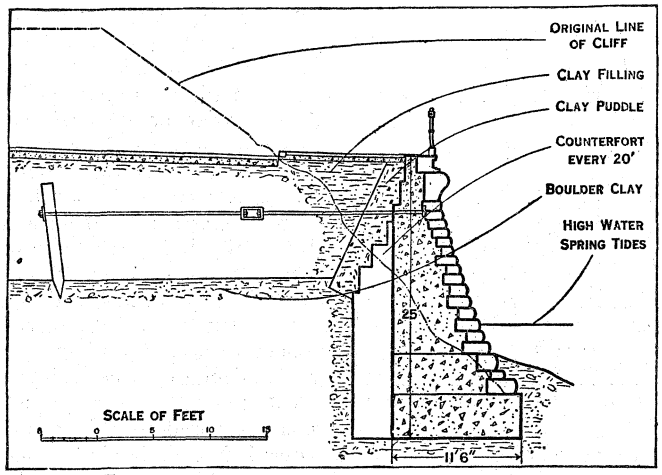


FIG. 9.—SEA WALL AT BRIDLINGTON, YORKSHIRE

on the open coast. Moreover, the gain has been due in the main to the deposition of sediment brought down by rivers and to artificial reclamation. It is, however, probable that the land lost has been more than compensated for by land naturally accreted. The report of the royal commission contains the following statement:—

"The erosion . . . would have been far more serious if extensive works of defence had not been constructed by local authorities, railway companies and others, at a great cost, though, on the other hand, such works in many places have been responsible for erosion of the neighbouring coasts by interfering with the normal travel of the beach material. On the whole we think, however, that while some localities have suffered seriously from the encroachment of the sea, from a national point of view the extent of erosion need not be considered alarming."

Removal of Shingle.—Beach material is too often limited in quantity and the question arises whether its removal for commercial purposes should be allowed. The results of natural erosion and denudation are, in many instances, aggravated by

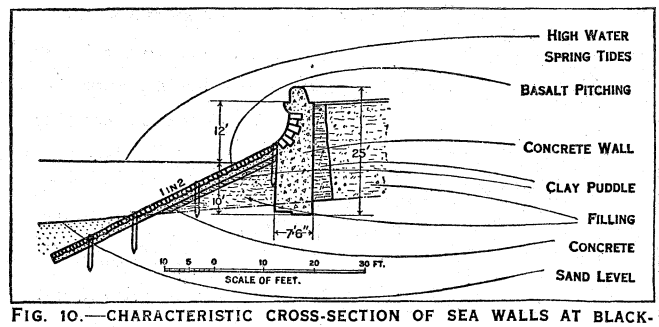


FIG. 10.—CHARACTERISTIC CROSS-SECTION OF SEA WALLS AT BLACKPOOL, LANCASHIRE

this practice. The powers possessed by the Board of Trade provide for the issue of prohibitory orders and, in certain circumstances, where the removal of beach or sand can be shown to be injurious, such orders have been frequently made.

Cost of Coast Protection.—The cost of construction of groynes varies very considerably with the design and local conditions. Before the World War light low groynes might be constructed at a cost of from 10s. to £1 per foot lineal, and groynes of more substantial construction from £1 to £3 per lineal foot, while some of the large concrete and masonry groynes, of the type frequently constructed at Brighton and Hastings, cost as much as £7 or £8 per lineal foot. The initial capital cost of protection per mile of shore was seldom less than £4,000, even when no sea wall was constructed. Under present conditions these figures should be nearly doubled. The annual charge for repairs, interest on capital, and replacement may be put at not less than 10% of the original capital cost.

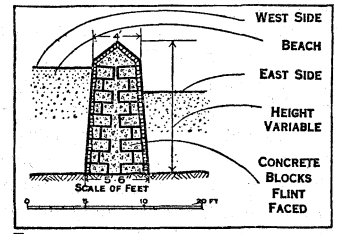


FIG. 11.—CROSS-SECTION OF CONCRETE GROYNE AT HASTINGS, SUSSEX

The cost of protecting purely agricultural land which is subject to erosion must of necessity, under the conditions which usually prevail, be considerably in excess of the value of such land. Protection under such conditions is only justified when agricultural land is in the vicinity of towns, and erosion, if not stopped, is likely to lead to those towns being outflanked by the sea and in situations where the works have as their object the preservation from inundation of areas of low-lying land of considerable extent. It is not desirable, even if it were practicable, to prevent erosion of all parts of the coast, as the waste of the cliffs provides the greater part of the beach material which acts as the most valuable agent of protection.

The expenditure incurred in the construction of sea defences by many of the coastal towns of Britain in recent years has been very considerable and in some cases has imposed a heavy burden on the inhabitants. As an instance the case of Sidmouth, a seaside town on the south coast of Devon, having a population of about 6,000, may be referred to. As a result of exceptional gales the sea defences of the town over a frontage of under half a mile were seriously damaged and undermined between the years 1917 and 1925 and the construction of new sea walls and groynes, completed in 1926, entailed an expenditure of over £100,000.

Sand Dunes and Alluvial Flats.—The preservation of sand dunes is most important along certain parts of the coast where they afford protection to low-lying areas behind them, and they should in these cases be maintained and fostered by the encouragement of the growth upon them of marrum and other grasses, which help to bind the sand together. Where drifting of blown sand occurs much may be done to check it by the fostering of

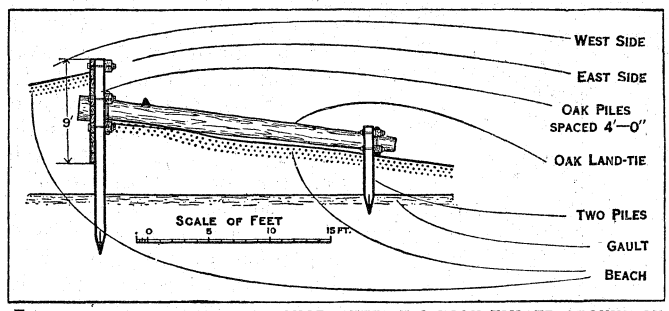


FIG. 12.—CROSS-SECTION OF CHARACTERISTIC HIGH TIMBER GROYNE AT EASTBOURNE, SUSSEX

such grasses. The process of natural accretion on alluvial flats has been hastened in many cases by the planting of suitable vegetation such as rice grass (*spartina*), and in this way land may in time be reclaimed by entirely natural means.

CONDITIONS IN HOLLAND AND BELGIUM

A large part of Holland and some portions of Belgium are below the normal sea level and are protected from inundation by artificial embankments (dikes) or by narrow belts of sand dunes. The foreshore works on the coast of Holland and Belgium, although of great interest and attended with considerable success, do not afford examples to be followed as affecting the sea defences of Great Britain and other countries exhibiting physical characteristics similar to those of the latter. The protection works

in such cases as Blankenberghe, Heyst, Scheveningen, Kallantsoog and Petten are of great magnitude and the engineers responsible for these works, particularly in Holland, have at their command the accumulated experience of centuries of sea-defence work. The local conditions with which these works have to conform—viz., low flat foreshores consisting entirely of sand—are wholly different to those generally associated with sea-defence works in England. The large expenditure involved is justified by the necessity of securing the safety, not only of the sea-board, but of large tracts of the countries themselves. Investigations in Holland are said to indicate a continuous subsidence of the land of that country relative to the sea level, amounting to about 15cm. per century.

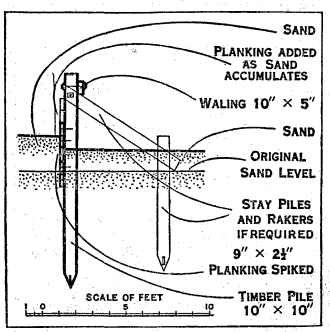


FIG. 13.—CROSS-SECTION OF CHARACTERISTIC LIGHT TIMBER GROYNE

The North sea foreshores of Holland and Belgium consist for the most part of fine sand; similar deposits border the lower portions of the numerous river estuaries which penetrate far inland, but in the higher parts of these the foreshores are generally composed of fine sand covered with clay or mud. The foreshores of the North sea between high and low water have an average gradient of about 1 in 45 and the shores above high water normally slope at about 1 in 25. Submerged sandbanks more or less parallel to the shore are a characteristic feature of the North sea and estuary coast-lines of Holland and Belgium. These, where they exist, afford considerable protection to the sandy shores during on-shore gales. In calm weather and with off-shore winds sand accumulates on the foreshores.

SEA DEFENCE WORKS

The most important forms of sea defence works in common use in Holland are: (a) groynes, (b) sea walls or "dikes" and (c) fascine mattresses with stone ballasting for the protection of submerged banks.

Groynes.—Groynes are usually constructed at right angles to the shore line and are maintained as a rule at a small height above the average foreshore level. On those portions of the North sea coast which are most exposed, groynes are placed about 250

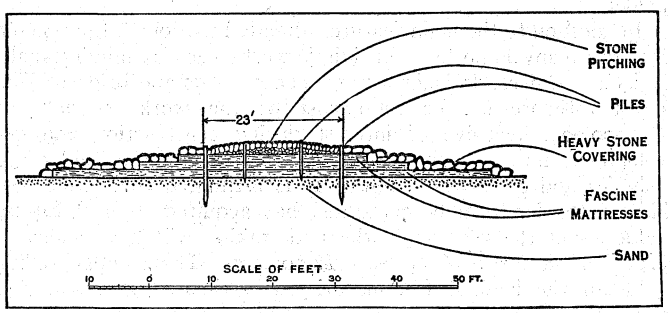


FIG. 14.—CHARACTERISTIC CROSS-SECTION OF MATTRESS GROYNES ON THE COAST OF NORTH HOLLAND

metres apart and are extended out beyond the low-water line. Many of the groynes on the Dutch coast are constructed of layers of fascine mattresses covered by heavy stone, having their crests almost flat or turtle-backed with side slopes of 1 in 2, or flatter. The fascine or brushwood mattresses are held together and pinned down by rows of piles. Wide brushwood aprons, with heavy stone covering forming flat slopes, are constructed on either side of the groyne in order to protect the flanks against scour (fig. 14). The groynes are carried up above the line of high water to meet the base of the sand dunes or the protecting dikes. These groynes, inclusive of the side aprons, are often of considerable width, sometimes as much as 30 metres at their deepest and widest parts. The cost of groynes recently built in Holland has varied from £4,000 to £11,000 each.

On the coast of Belgium at Blankenberghe and in its vicinity the shore is groyned on an extensive scale. The groynes on the average are about 820ft. long and 680ft. apart; they resemble the typical Dutch groyne in form and are constructed with a foundation of mattress work or concrete, faced with brickwork or stone pitching (figs. 15 and 16).

Dikes.—On much of the North sea coast-line of Holland and Belgium, where the beach is protected from erosion by groynes,

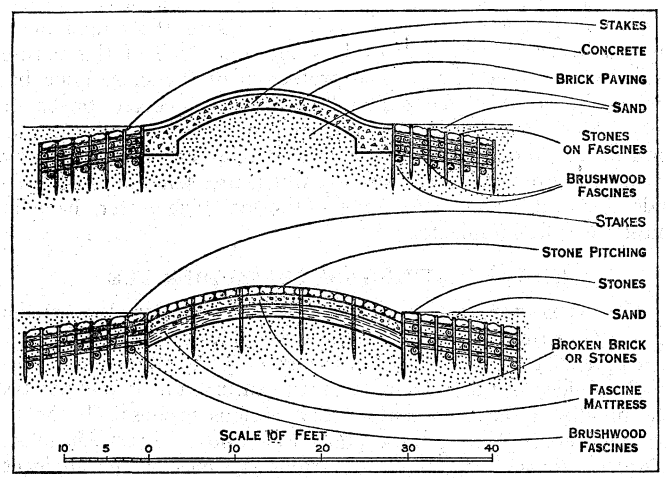


FIG. 15.—CHARACTERISTIC CROSS-SECTIONS OF GROYNES AT OSTEND AND BLANKENBERGHE, BELGIUM

the sand dunes or the coastal embankments (dikes) are frequently protected by a flat slope of brickwork, or basalt or other stone pitching, or concrete slabs laid on beds of clay, rubble and mattress work (fig. 2). In situations, such as Scheveningen and Ostend, where a promenade has been formed on the sea embankment, a curved faced wall is sometimes substituted for the upper part of the normal slope of the paving thus reducing the width of the protecting works (figs. 17 and 18); but over large stretches of coast, particularly in Holland, a simple flat paved slope is the common practice.

Protection of Submerged Banks.—The underwater banks of some of the estuary channels and sea inlets on the Dutch coast often stand at a steep slope with deep water alongside. Under these conditions there is serious liability to erosion and it is usual to protect the banks both above and below water by artificial means. For many years fascine mattresses have been used for this purpose. These are made up on a convenient sandy foreshore, covered at high tide, and, when completed, are towed to the place where they are to be used and sunk on the sea bottom by ballasting with stone. They consist of two layers or grids of brushwood each

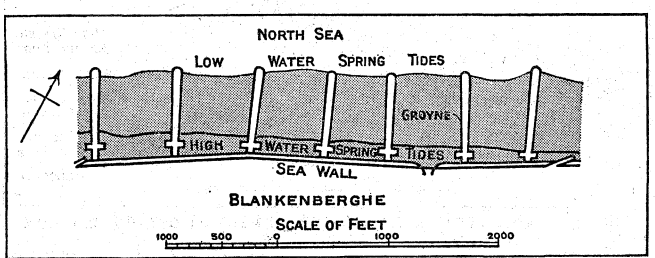


FIG. 16.—PLAN OF GROYNES ON NORTH SEA COAST AT BLANKENBERGHE, BELGIUM

built up of crossed rows of parallel brushwood ropes, 0·4 metre circumference, and spaced 0·9 metre apart centre to centre, bound tightly together with a filling of brushwood in three layers between them. On the top of the upper brushwood grid, openwork partitions are formed for the reception of stone ballast. Formerly, clay mixed with a little stone was used for ballasting, but in modern practice stone alone is employed, the mattresses being weighted to the extent of 1,000kg. per sq. metre. The cost of continuous protection of the steep banks of the estuary channels, where the depth of water alongside is sometimes as much as 100ft., is very

considerable, amounting in some cases to as much as £100 per metre run of bank. In some localities the cost has been reduced by the construction of intermittent mattress work, leaving short unprotected stretches of bank between projecting spurs which serve to deflect the main current away from the unprotected embayments. In cases where the sea bed of the deep channels consists of clay, erosion is not so uniform as that of sandy bottoms and the side slope is sometimes very steep, exceeding 1 to 1 in certain cases. In such situations rubble stone ballasting or surfacing of the bank is preferred to the employment of mattresses. (In Great Britain stone protection of this nature is known as "revetting.") The protection of the shore lying between the steep submerged and partially submerged banks of the channels and the base of the dike or wall which forms the immediate protection of the land behind, is usually effected by means of groynes. These shores, which are sometimes of considerable width above the level of normal high water, have in most cases flat gradients.

THE RECLAIMING OF THE ZUIDER ZEE

The partial reclamation of the Zuider Zee, undertaken by the Dutch Government in 1918, is the greatest work of its kind ever attempted. The earliest plans for regaining the submerged lands of the Zuider Zee date from the 17th century, but it was not till the middle of the 19th century that serious proposals began to be considered. Among these plans were those of van Diggelen, 1849, Leemans, 1877, and the various schemes of the engineer C. Lely, subsequently Minister of Public Works, which appeared between 1887 and 1891; the last of which is substantially that on which work was actually commenced in 1920. The finally approved scheme as shown in the plan fig. 4 includes: (1) a sea dike about 1½m. long between the mainland of north Holland and the island of Wieringen, completed in 1926; (2) a drainage and navigation canal for small vessels, also finished in 1926, extending from the western end of the Wieringen dike near van Ewijcksluis along the coast of North Holland to Helder. This canal will maintain the access from the Texel channel to the old North Holland canal at de Kooi by a lock at that place, and connect with canals to be formed along the eastern coastline of North Holland up to Amsterdam; (3) the main sea dike, about 18½m. long, from the eastern end of the island of Wieringen to the Frisian coast near Zurig (figs. 4, 5 and Plate). Two sets of

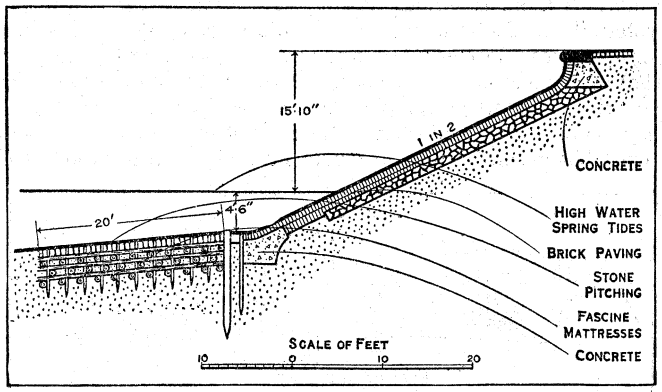


FIG. 17.—CROSS-SECTION OF SEA EMBANKMENT AT OSTEND, BELGIUM

sluices will be provided, one set near each end of the dike, the total width of the sluice openings being about 1,000ft. Navigation locks for vessels up to about 2,000 tons in capacity are also to be built near the ends of the dike. This part of the work was commenced in 1926 and is expected to be completed in 1934. A large part of the section of the sea dikes is formed of boulder clay dredged from the Zuider Zee, brought to the depositing sites in barges and unloaded by grab dredgers. The sand filling of the dikes is pumped; (4) the reclamation of four areas (polders), by the construction of secondary dikes inside the sea dikes, aggregating about 553,000ac. thus increasing the total land area of Holland by about 7% and the arable land alone by 10%; (5) The formation, inside the main sea dike, of an inland freshwater lake of about 247,000ac. called the Yssel lake, to provide for the disposal of the flood waters of the river of that name, and a canal, about ⅔m. wide, connecting this lake with a smaller one (Y lake) to the east of Amsterdam. This canal will separate the south-west polder from the south-east polder and will have a regulating lock and sluices at its entrance from Lake Yssel.

The draining of the reclaimed land will be accompanied by a shrinkage, the amount of which, it is expected, will vary between

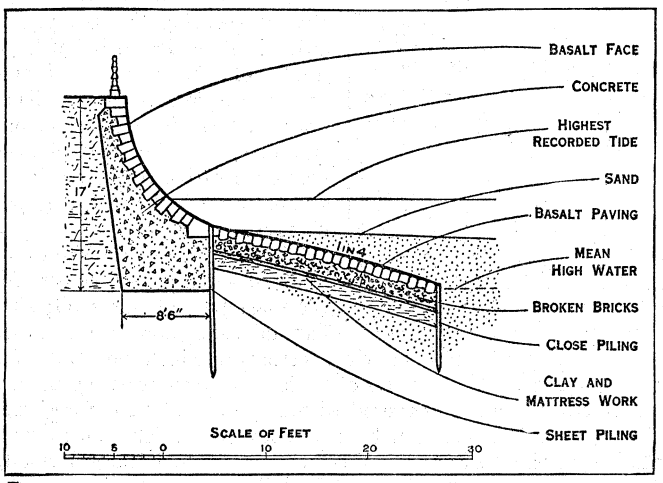


FIG. 18.—CROSS-SECTION OF SEA WALL AT SCHEVENINGEN, HOLLAND

one and three feet. All the polders will be at levels considerably below sea level, and the lowest drainage channels will be as much as 22ft. below the Yssel lake level. Pumps will be installed at points on the borders of the polders to provide for the drainage of the land. They will lift land water up to the level of the lake and discharge it over the secondary dikes.

The reclaiming of the north-west polder (Wieringen) was commenced in 1927; and it is proposed to begin the work on the three remaining polders as soon as the main sea dike is completed, probably in 1934. The north-west polder will be finished about 1932, but cultivation will not be possible till three or four years later. It is calculated that the lands will not have become so free from salt as to reach their full capital value until the 14th or 15th year from this commencement of the reclamation of a polder.

In addition to the main features already mentioned, the scheme includes many important subsidiary works such as minor canals, locks and sluices, drainage arrangements, roads and bridges. The latest estimate of the total cost of the work amounts to £45,000,000, inclusive of interest during construction and development, but not including the compensation of the Zuider Zee fisheries and some other items. It is estimated that, when the last of the lands to be reclaimed has acquired its full capital value about the year 1959, the undertaking will have shown a profit to the State of at least £8,000,000. The average selling value of the land at full maturity is estimated at about £90 per acre.

BIBLIOGRAPHY.—The *Reports and Evidence: Royal Commission on Coast Erosion and Reclamation of Tidal Lands,* particularly the final report, Cd. 5,708 (1911), should be consulted both for Coast Erosion and Reclamation. Vol. i., part 2, i. Cd. 3,684 (1907), contains a useful bibliography by W. Whitaker, F.R.S., up to 1906. The Bibliographic lists issued by the International Association of Navigation Congresses, Brussels (since 1908) are very complete. Another good bibliography of works in English was issued by the Engineer School Library, Washington, D.C., in 1926. The best comprehensive account of coast protection for general readers is W. H. Wheeler's *The Sea Coast* (1902). *See* also A. E. Carey and F. W. Oliver, *Tidal Lands* (1918); and D. W. Johnson, *Shore Processes and Shore Line Development* (1919). The latter and the periodical reports of The Board of Commerce and Navigation, New Jersey, on *Erosion and Protection* should be consulted for conditions in the United States. For Holland *see* papers by A. T. de Groot in *De Ingenieur,* No. 35 (1911), and R. P. J. Tutein in *Die Gids,* Nos. 3 and 5 (1913). Samuel Smile's *Lives of the Engineers* contains good accounts of early reclamation works. *See* also E. M. Ward, *English Coastal Evolution* (1922); W. H. Wheeler, *History of*

the Fens (1897) (contains a bibliography of Fenland literature); and *Proceedings Inst. C. E. (passim).* (N. G. G.)

COATBRIDGE, a large burgh, having the privileges of a royal burgh, Lanarkshire, Scotland. Pop. (est. 1938) 45,045. It is situated on the Monkland canal, 8 mi. E. of Glasgow, with stations on the L.M.S.R. and L.N.E.R. Until about 1825 it was only a village, but since then coal and iron mining have been developed, and it is now a centre of the iron trade of Scotland. Its prosperity was largely due to the ironmaster James Baird (*q.v.*). The industries of Coatbridge produce malleable iron and steel boilers, tubes, wire, tinplates and railway wagons, tiles, fire-bricks and fire-clay goods. The town, which became a municipal burgh in 1885, forms with Airdrie one of the parliamentary divisions of Lanarkshire. About 4 m. west by south lies the coalmining town of Baillieston.

COATES, ALBERT (1882–), English conductor and composer, was born at St. Petersburg (Leningrad), April 23, 1882, and was sent home to England to be educated at Buckhurst Hill school, Essex, and then at Liverpool university. Later he studied at Leipzig Conservatoire and had his first experience of conducting as *repétiteur* at the opera there under Nikisch. He was then conductor at Elberfeld (1906), and joint conductor with Schuch at Dresden. From Germany he went to Russia as conductor of the Imperial Opera at St. Petersburg, a post which he held for five years. He appeared in England from time to time, but it was not until 1919 that he made London his permanent headquarters and established himself in the favour of the British public as one of the leading English conductors. He has also conducted in Paris, in New York and in other American cities, and for two years (1923–25) was director of the Philharmonic orchestra at Rochester, N.Y.

COATES, JOSEPH GORDON (1878–1943), New Zealand statesman, was born at Matakohe, the son of a farmer. He was elected M.P. for Kaipara in 1911, and impressed his leader, Mr. W. F. Massey, with his solid ability. From 1917 to 1919 he served in France with the New Zealand forces, in which he attained the rank of major and gained the military cross. Shortly after his return home, he joined the cabinet, and, as head of the Public Works, Railways and other departments proved himself a capable administrator. In 1925 he succeeded Massey as prime minister, and he worked toward consolidating and developing the dominion's industries. He was minister of public works and finance in the cabinets of 1931–33, and 1933–35. He was a member of the New Zealand War cabinet, and was made minister of armed forces and war coordination on July 1, 1942. He died in Wellington, New Zealand, May 27, 1943.

COATESVILLE, a city of Chester county, Pennsylvania, U.S.A., on the west branch of Brandywine creek, 38m. W. of Philadelphia. The Lincoln Highway is its main street, and it is served by the Pennsylvania and the Reading railways. The population in 1930 was 14,582, and in 1940 was 14,006 by the federal census. It has two important steel plants, in addition to numerous other manufacturing industries. The total factory output is valued at about $32,000,000 a year. Coatesville was founded about 1800, and was named after Jesse Coates, one of the early settlers. It was chartered as a city in 1915.

COATI, or COATI-MUNDI, the name of the members of the South and Central American genus *Nasua,* of the mammalian family Procyonidae. They are recognized by their long body and tail, and elongated, upturned snout. The tail is often prominently banded. Coatis are gregarious and arboreal in habit, and feed on birds, eggs, lizards, and insects. They are often tamed as pets. (*See* CARNIVORA.)

COATS, J. & P., Limited. This now world famous thread concern was founded in Paisley in 1830 by James and Peter Coats to carry on the business established in 1826 by their father James Coats (1774–1857). The small factory built in 1826 still forms a diminutive part of the vast works at Ferguslie, Paisley. There was keen and at times bitter rivalry between J. & P. Coats and another local manufacturer—Clark & Co.—, which continued until 1896 when the two firms amalgamated in the name of the former.

At the same time control was acquired of the two leading manufacturers in England—James Chadwick & Brother and Jonas Brook & Brothers—and The Central Agency, Ltd., was formed to take over the marketing of the product.

The combine made rapid progress, particularly in building up a large export trade, and with a subscribed capital of £20¼ millions in 1939 owned or was associated with the ownership of manufacturing units in some 43 countries, and had selling agencies in every country in the world. Sewing cotton for domestic and commercial use remained the main product of the company, but a large number of fancy threads for embroidery purposes and to a lesser extent silk and rayon threads were introduced.

It is of interest to note that although there have been many improvements made in the machines used in the manufacture of cotton thread, there have been no revolutionary changes in the method of manufacture, and the process in the 4th decade of the 20th century is substantially the same now as it was at the beginning of the 19th century.

COB, something round, stout, tufted or like a head (possibly from Ger. *Kopf,* head). The principal uses of "cob" are for a stocky, strongly-built horse, from 13 to 14 hands high, a small round loaf, a round lump of coal, in which sense "cobble" is also used, the central part of the fruiting spike of the maize plant, and a large nut of the hazel type, commonly known as the cob-nut. The fruiting spike of Indian corn is called corn on the cob.

COBALT, a mining town on Cobalt lake, Timiskaming, northern Ontario, Canada, 330m. N. of Toronto, on the Temiskaming and Northern Ontario railways. Unknown till 1903, it is now the centre of one of the richest silver districts in the world. The region also produces cobalt, arsenic and nickel in large quantities. Pop. (1942) 2,376.

COBALT, a metallic chemical element closely allied to iron and nickel (symbol Co, atomic number 27, atomic weight 58·97). Though the atomic weight of cobalt is slightly greater than that of nickel, the properties of cobalt indicate it should precede nickel in the periodic classification, a conclusion confirmed by the fact that 28 is the atomic number of nickel (*q.v.,* also ATOMIC NUMBER). The term cobalt is met with in the writings of the alchemists, and was used to designate in general substances which resembled metallic ores but yielded no metal on smelting. The term was particularly applied to two ores, cobaltite and smaltite, both of which contain cobalt combined with arsenic. These ores closely resemble metals and were termed "kobold" (goblin, compare Greek, *κόβαλος*), by the Saxony miners, because they gave off poisonous arsenical fumes on smelting and yielded no silver, despite their silver-white appearance.

Occurrence.—The metal was first prepared in an impure condition by G. Brandt in 1733, who found it to be magnetic and very infusible. It is found free in nature, though only in small quantities, chiefly in meteorites and its presence has been detected in the sun and many stars. In combination cobalt is fairly widely distributed, but it occurs seldom except in association with other metals, such as iron, nickel, copper, manganese, antimony and bismuth. It is remarkable that practically all the ores of cobalt are arsenical and consist of arsenides, arseno-sulphides or arsenates. But it has been found as monoxide, CoO, along with manganese in wad, as sulphide, CoS, in jaipurite, and as hydrated sulphate or vitriol, $CoSO_4,7H_2O$, in bieberite. The crimson hydrated arsenate, erythrite, $Co_3(AsO_4)_2,8H_2O$, is probably a hydrolytic oxidation product of the arsenide, as the sulphate is of the sulphide. The chief source of the ores smelted in Great Britain is Queensland, Australia, where smaltite, $CoAs_2$, occurs associated with erythrite. The cobalt speiss, resulting from the roasting of the ore to form oxide and arsenate, contains from 40 to 60% of cobalt with only very small amounts of nickel, iron and traces of other metals. Smaltite is also found at Cobalt, Ontario, Canada, but contains only about 10 to 20% of cobalt in the roasted speiss, together with larger amounts of nickel, and varying amounts of copper, silver and the platinum metals, chiefly palladium, platinum and rhodium. Considerable quantities of cobaltiferous residues result from the production of nickel and copper in Ontario, and are either worked up for cobalt or smelted without purification for alloy purposes.

Production and Properties.—The process used for extraction of cobalt from speiss is essentially the same whatever the origin of the ore. A good speiss should contain enough cobalt sesquioxide to yield sufficient chlorine with hydrochloric acid to oxidize all the arsenic to arsenate, and sufficient iron to combine with all the arsenic to form ferric arsenate, which is precipitated with milk of lime. Lead, bismuth and copper, if present, are removed as sulphides by saturation with sulphuretted hydrogen. The resulting solution is oxidized and fractionally precipitated with bleaching-powder liquor, cobalt being precipitated first as sesquioxide, leaving nickel chloride in solution. The nickel may then be removed as dioxide by further addition of bleach liquor, or as carbonate by addition of washing soda solution. The black cobalt sesquioxide, thus obtained, is dried and extracted with dilute hydrochloric acid to remove traces of nickel, again dried, mixed to a stiff paste with starch and roasted in thin layers. The reduction to metal is effected partly by carbon from the starch and partly by carbon monoxide from the furnace gases.

Cobalt, a silver-white metal, slightly harder than iron or nickel, is magnetic at all temperatures up to 1,150° C, and then becomes non-magnetic. The melting point is 1,480° and the boiling point 2,415°, both temperatures being intermediate between the corresponding temperatures for nickel and iron. The density of the metal varies from about 8·7 to about 8·9. Cobalt in a finely divided condition occludes up to about 200 times its volume of hydrogen, which is readily given up again on heating to 200° in vacuo.

Polished cobalt is not appreciably affected by exposure to air or water, and is only superficially oxidized at a red heat. It dissolves in nearly all dilute acids evolving hydrogen, but is scarcely attacked by moderately concentrated nitric acid. It is not attacked by alkaline solutions or fused alkalis. Heated in chlorine, bromine or iodine vapour, the metal forms the blue dichloride, green dibromide or black di-iodide, respectively. At 500° in ammonia a nitride, Co_2N, is formed which decomposes into cobalt and nitrogen at 600°. The metal is obtained in a pyrophoric condition (spontaneously inflammable) by reduction of its oxides at 250°. The cold pyrophoric metal decomposes acetylene with incandescence, forming carbon, hydrogen and benzene. Finely divided cobalt, even when not pyrophoric, decomposes carbon monoxide above 350°, forming carbon and oxygen. At 150° under a pressure of upwards of 40 atmospheres, the reduced metal combines with carbon monoxide yielding the tetracarbonyl, $Co(CO)_4$, in orange crystals, which decompose at 60° at atmospheric pressure by loss of one-quarter of their carbon monoxide to form the black tricarbonyl, $Co(CO)_3$. At red heat the metal decomposes steam, and at 150° burns in nitric oxide to form cobaltous oxide, CoO.

Oxides.—Cobalt is known in three conditions of oxidation, represented by the oxides, CoO, Co_2O_3 and CoO_2. A fourth oxide is also known, which crystallizes in black octahedra, Co_3O_4, or CoO, Co_2O_3 or $Co(CoO_2)_2$, and resembles the spinels in form and composition. The ordinary salts of commerce are cobaltous salts derived from the monoxide. A few simple and many complex salts are known derived from the sesquioxide. The dioxide gives rise to a few complex salts, and has slight acidic properties, combining with bases to form cobaltites, such as $MgCoO_3$. Cobalt thus possesses at least four valency electrons, of which two are relatively feebly bound and give rise to cobaltous salts. In the bivalent condition cobalt has slight basic properties, the salts having an acidic reaction and being slightly hydrolysed by water. This accords with its position as a transition element of the 4th period. (*See* PERIODIC LAW.)

Salts.—The metal is occasionally found native and is never found combined in nature with a higher valency than two. Cobaltous salts of nearly all the known acids have been prepared, of which the chloride, nitrate, sulphate, carbonate, acetate and linoleate are in fairly extensive commercial use. Nearly all soluble cobaltous salts are red in the hydrated condition, while the insoluble salts are usually pink. On dehydration many of the red salts assume an intense blue colour, and this fact is made use of in the preparation of "sympathetic" inks. The hydrated sulphate, cobalt vitriol, is a noteworthy exception, the anhydrous salt being pink. Most cobaltous salts combine with ammonia forming hexammines, for example $[Co(NH_3)_6]Cl_2$, though pentammines and tetrammines are also known. Similar complex compounds are formed with many organic bases. A very large number of cobaltous double salts are known, such as double sulphates, double nitrates, double carbonates and double cyanides. Potassium cobaltous sulphate belongs to the series $R''SO_4,R'_2SO_4,6H_2O$, where R″ may be Co, Fe, Mn or Cr. Double nitrates of the form $Co_3R_2(NO_3)_{12},24H_2O$ have been used in the separation of the trivalent "rare earth" elements. Potassium cobalto-carbonate, $K_2Co(CO_3)_2,4H_2O$, forms a pink solution in water, which becomes blue on heating, the pink colour returning on cooling. Potassium cobaltocyanide, $K_4[Co(CN)_6]$, decomposes water on boiling with liberation of hydrogen and formation of caustic potash and cobalticyanide, $K_3[Co(CN)_6]$. On rapid oxidation by air, the cobalticyanide yields hydrogen peroxide, caustic potash and the cobalticyanide, but on slow oxidation no hydrogen peroxide results, any hydrogen peroxide formed being utilized to oxidize the cobaltocyanide.

Almost the only simple cobaltic salt that is known is the fluoride, CoF_3, a green powder, decomposed by water to form brown cobaltic hydroxide. Cobaltic double and complex salts are, however very numerous. The alums, as $K_2SO_4CO_2(SO_4)_3,24H_2O$, form blue octahedra, which are unstable in solution and yield cobaltous and alkali sulphates and oxygen. The cobaltinitrites of the stronger bases only are known. The sodium salt is freely soluble in water, whereas the potassium, ammonium and barium salts are insoluble. Sodium cobaltinitrite is used as a test for potassium, yielding with potassium salts very insoluble yellow precipitates of the disodium potassium salt, $Na_2K[Co(NO_2)_6]$, or the sodium dipotassium salt, $NaK_2[Co(NO_2)_6]$. The tripotassium salt cannot be obtained in the presence of sodium salts. The cobalticyanides are much more stable than the cobaltocyanides, or even the ferro- and ferricyanides. On treatment with concentrated acids, the cobalticyanides are not decomposed but yield the complex acid, hydrogen cobalticyanide, $H_3[Co(CN)_6]H_2O$, which is colourless and becomes anhydrous at 100° C. Cobalticyanides of nearly all the metallic bases have been prepared, including those of the "rare earth" metals. Yttrium may be separated from erbium owing to the fact that the yttrium salt is about thrice as soluble as the erbium salt.

On treatment of cobaltous salts with an oxidizing agent in the presence of ammonia, complex cobaltic ammines are formed. Cobaltous chloride, for example, dissolved in excess of ammonia solution, is oxidized by hydrogen peroxide in the presence of ammonium chloride to form a mixture of cobaltammines, in which the number of ammonia molecules per atom of cobalt varies from four to six, pentammines predominating. If much ammonia is present, the two tetrammines, $[CoCl(H_2O)(NH_3)_4]Cl_2$ and $[Co(H_2O)_2(NH_3)_4]Cl_3$, are converted, on warming, into pentammines. The main product consists of the three pentammines, purpureo-cobalt chloride, $[CoCl(NH_3)_5]Cl_2$, roseo-cobalt chloride, $[CoH_2O(NH_3)_5]Cl_3$, and hydroxo-purpureo-cobalt chloride, $[CoOH(NH_3)_5]Cl_2$. The roseo and hydroxo salts are both converted into the purpureo salt if much ammonium chloride be present and the liquid be boiled. The hexammine, $[Co(NH_3)_6]Cl_3$, luteo-cobalt chloride, is invariably present to the extent of 2 or 3% and becomes the chief product if the reaction takes place under a pressure of a few atmospheres. In the foregoing series of ammines, the ammonia may be replaced by equivalents of ethylenediamine and other organic bases and the chlorine by other acid radicals. Cobaltic diammines and triammines are also known, particularly in combination with the nitrite radical, for example, ammonium diamminocobaltinitrite (Erdmann's salt), $NH_4[Co(NH_3)_2(NO_2)_4]$, and triamminocobaltic nitrite, $Co(NH_3)_3(NO_2)_3$, which does not give rise to any ions on solution.

In all complex cobaltic compounds six non-ionizing groups can be discerned attached or co-ordinated to the cobalt atom, which is accordingly said to possess the co-ordination number six. (*See* AMMINES.) Some of these co-ordinated compounds have been shown to be capable of existing in optically-active, isomeric

forms, proving, as in the case of carbon, that the valency directions are not planar but spatial. In the case of carbon, the attached atoms or groups are disposed tetrahedrally about the carbon atom, and give rise to optically active isomerides according to the laws of symmetry. In the case of cobalt, the disposition of groups about the cobalt atom is octahedral, and as many as five isomeric forms have been proved to exist for certain co-ordinative groupings. (*See* also STEREOCHEMISTRY.)

Detection and Estimation.—Cobalt can be detected, even in very minute amounts, by the formation of an intensely blue borate on heating a cobalt salt in a borax bead. In solution, cobaltous salts can be detected by the green colour resulting on treatment with sodium bicarbonate and hydrogen peroxide, and by the red colour or precipitate resulting on treatment with an acetic acid solution of α-nitroso-β-naphthol. In group analysis, cobalt is precipitated as sulphide by means of ammonium sulphide. It may be separated from nickel owing to the fact that cobalticyanides are stable to hypobromites, whereas nickelocyanides are decomposed by hypobromites to form nickel dioxide. The intense blue colour and solubility of cobaltous thiocyanate in organic solvents may be used as a test for cobalt. The solubility of sodium cobaltinitrite and the insolubility of the potassium salt may be used as a test for either potassium or cobalt. After separation from other metals, cobalt may be precipitated as oxide by persulphates or hypobromites, as sulphide by ammonium sulphide, or as carbonate. When estimated by the α-nitroso-β-naphthol method, the precipitate may be dried and weighed, but in the other cases it is usual to ignite to sulphate with sulphuric acid, or to ignite and reduce to metal with pure hydrogen. The anhydrous sulphate method when available (in the absence of non-volatile metals and non-volatile acids) is rapid and accurate. Cobalt may also be estimated after electro-deposition from an acid solution of the double ammonium sulphate. The thiocyanate test has been adapted for the colorimetric estimation of small amounts of cobalt.

Uses.—Metallic cobalt is used industrially in the manufacture of ferrous and non-ferrous alloys. In some cases cobalt speiss is smelted directly to yield a ferro-nickel-cobalt alloy, which is used in the manufacture of special steels. Steels containing much cobalt and tungsten are used in the manufacture of permanent magnets for telephony and other purposes. Non-ferrous alloys, containing over 50% of cobalt with varying amounts of tungsten, chromium and occasionally molybdenum, are used in the production of high-speed cutting tools, which retain their hardness at a red heat. The high-speed tool alloy, stellite, has a composition approximating to cobalt 55, tungsten 15 to 25, chromium 15 to 25, and molybdenum 5%. Cochrome is a ferrous alloy containing cobalt 60, chromium 14 to 16, iron 14 to 16%, similar to nichrome in composition and properties but with cobalt instead of nickel. It is used for electrical heating elements. Cobalt compounds are used to an increasing extent in industry, the linoleates, oleates, resinates and acetates being used as "driers" in the paint and varnish industry. Smalt is a complex potash aluminium cobalt silicate or glass, made by roasting impure cobalt oxide with quartz and potassium carbonate. It is a valuable and very permanent pigment of an intense blue colour. Potassium cobaltinitrite has long been used as an artists' pigment of great stability under the name of cobalt yellow. This pigment has also been used in the ceramic industry for producing a pure blue colour on porcelain after baking. Cobalt oxide, alone and in conjunction with other oxides, is in common use in the production of blues, purples, yellows and reds in the china trade. Cobalt ultramarine consists of the oxides of cobalt, aluminium and zinc; cobalt green of cobalt and zinc oxides; turquoise green of cobalt, zinc and chromium oxides; and cobalt red of cobalt and magnesium oxides.

Cobalt compounds have no therapeutic value and are non-toxic, the toxicity even of the complex cobaltamines being no greater than that of the ammonia they contain.

See J. N. Friend, *Text-book of Inorganic Chemistry*, vol. ix., part 1 (1926). (J. D. M. S.)

COBALTITE, a mineral with the composition CoAsS, cobalt sulpharsenide. It is found as granular to compact masses, and frequently as beautifully developed crystals, which have the same symmetry as the isomorphous mineral pyrite, being cubic with parallel hemihedrism. The usual form is a pentagonal-dodecahedron with faces of the cube and octahedron. The colour is silver-white with a reddish tinge, and the lustre brilliant and metallic, hence the old name cobalt-glance. The brilliant crystals from Tunaberg in Sodermanland, Sweden, and from Skutterud near Drammen in Norway are well known in mineral collections. Crystals have also been found at Khetri in Rajputana, and under the name *sehta* the mineral is used by Indian jewellers for producing a blue enamel on gold and silver ornaments.

COBÁN, a city of Guatemala, Central America, capital of the department of Alta Verapaz and the northern centre of the coffee trade. Population (1940) 8,001. Cobán is 105 mi. north of Guatemala City, although overland connections (motor to El Rancho, thence by rail) are rather poor. Principal commercial outlet of the district is via the Polochic river, Lake Izabal and the Río Dulce to the Caribbean port of Livingston. Besides being a rich area in the production of coffee, there are numerous plantations of tea, cacao, vanilla, etc., surrounding the city.

COBB, HOWELL (1815–1868), American political leader, was born at Cherry Hill, Ga., on Sept. 7, 1815. He graduated from Franklin college (University of Georgia) in 1834, and in 1836 was admitted to the bar. From 1837 to 1840 he was solicitor-general for the western circuit of his State. In 1843–51 and in 1855–57 he was a member of the national House of Representatives, becoming Democratic leader in that body in 1847, and serving as speaker in 1849–51. From 1851 to 1853 he was governor of his State; and from 1857 to 1860 he was secretary of the Treasury in President Buchanan's cabinet. In 1861 he was appointed colonel of a regiment and two years later was made a major-general in the Confederate army. He sided with President Jackson on the question of nullification; was an efficient supporter of President Polk's administration during the Mexican War; and was an ardent advocate of slavery extension into the Territories, but when the Compromise of 1850 had been agreed upon he became its staunch supporter as a Union Democrat, and on that issue was elected governor of Georgia by a large majority. In 1860, however, he ceased to be a Unionist, and became a leader of the secession movement. He died in New York city on Oct. 9, 1868.

See W. B. Phelps (ed.), "The Correspondence of Robert Toombs, Alexander H. Stephens and Howell Cobb," *Am. Hist. Assoc., Annual Report*, vol. ii. (1911).

COBBE, FRANCES POWER (1822–1904), British social writer and author, was born in Dublin on Dec. 4, 1822, of a family many of whose members had held high positions in the Church. She was educated privately, and her first book, *The Theory of Intuitive Morals*, was published anonymously. In 1858 she began social work among the girls and boys of Bristol. She spent much time abroad, and began to contribute to the newspapers and reviews, carrying out various special investigations on vivisection, of which she was all her life a violent opponent, on destitution, and on separation orders and divorce. She was a strong suffragist. From time to time she conducted services in Unitarian chapels. She published about 30 separate works, among which may be mentioned: *The Duties of Women* (1881; new ed., edit. Blanche Atkinson, 1905), and her own *Life* (2 vols., 1894; new ed., edit. Blanche Atkinson, 1904).

COBBETT, WILLIAM (1763–1835), English author, journalist and Radical, is one of the most representative figures in English literature, and his life and writings embody the history of the common people between the revolutions of the eighteenth century and the dawn of the Victorian era. He was born at Farnham, Surrey, on March 9, 1763 (not 1766, as he himself wrongly stated). His father was a small farmer; and his grandfather had been a day-labourer. As a boy, he worked in the fields, but, at 14, began his adventures by running away from home and getting work in Kew Gardens. He returned home after a while; but, at 19, after an unsuccessful attempt to join the Navy during a visit to Portsmouth, again left Farnham and, going to London on a sudden impulse, found employment as a solicitor's clerk.

Soon sickening of this occupation, he went down to Chatham, meaning to enlist in the Marines, but found himself in a line regiment instead. After a year at the depot, during which he read hard and discursively and taught himself grammar and writing, he was drafted, as corporal, to Nova Scotia, where his regiment was stationed. Soon, however, he was shifted to Fredericton, New Brunswick, where he remained till 1791, rising rapidly to the position of regimental sergeant-major. This position made him conscious of the systematic fraud and peculation which went on in the regiment—as indeed throughout the service—and he set to work to collect evidence against the principal offenders. At length, in 1791, his regiment was ordered home; and he at once procured his discharge, with excellent testimonials. Having done this, he immediately set about bringing the defaulters to book, and demanded a court-martial of the officers against whom he had collected evidence. This was at length granted; but Cobbett was unable to secure the discharge of his essential witness, or to get the regimental books impounded for safekeeping. In despair of getting the case fairly heard, he failed to appear at the court-martial, and fled to France in March 1792. He had married Ann Reid, to whom he had become engaged some years before in New Brunswick, while he was awaiting the court-martial proceedings; and she joined him in France. He remained there until the late summer of 1792 when, seeing the outbreak of war to be imminent, he took ship for America. There, first at Wilmington and later at Philadelphia, he supported himself by teaching English to the French *émigrés,* who were reaching the United States in large numbers.

So far Cobbett had written little. In the army, he had composed a grammar for the use of private soldiers; but this was not published. He had also almost certainly a hand in a pamphlet exposing army abuses, published in 1793 under the title of *The Soldier's Friend.* But in 1794 occurred an incident which really embarked him on his long career as a political writer. Joseph Priestley, the great Unitarian Radical, came in that year to settle in the United States, and numerous addresses of welcome were presented to him by American Radical societies. These aroused Cobbett's strong pugnacious instincts; and he entered the lists as a pamphleteer with his *Observations on Dr. Priestley's Emigration* (1794). From that date until his return to England in 1800, he was the most vehement and violent writer on the British side in the United States, producing a series of tirades against the French Revolution and all its works, and against all Americans who ventured to give it, or any sort of Radicalism, even the mildest support. *A Bone to Gnaw for the Democrats, A Kick for a Bite, The Scare-Crow, The Cannibal's Progress* (an account of the horror of the French Revolution), and a scurrilous *Life of Tom Paine,* are among these early pamphlets. They are all unmeasured in violence, and often outrageous, but always lively, readable and written in really virile and forthright English. Cobbett's style was almost as good in his first unpracticed writings as in the best of his more famous later work. Pre-eminent among these early pamphlets is his autobiographical *Life and Adventures* of Peter Porcupine (the highly apposite name under which he had chosen to write) in which he defended himself against those who abused him by an account of his upbringing and early career. This pamphlet is one of the best of all his writings. He also supplemented his pamphleteering with a regular newspaper, *Porcupine's Gazette.*

Cobbett was soon in trouble with the law. He libelled Dr. Rush, doctor and well-known Democratic politician, accusing him of killing George Washington with his special "bleeding treatment." This brought a heavy fine, and he then wrote scurrilous pamphlets about McKean, the judge who had tried the case, and was Rush's political ally. Before long he made the United States too hot to hold him, and in 1800 he gave up the contest and returned to England, where his writings, regularly republished, had already made him well known. He was greeted with enthusiasm as a powerful recruit to jingo journalism. He met Pitt at dinner, and was offered the editorship and ownership of one of the leading Government newspapers. He refused the offer, as he had already refused Government payment for his services in America, and attempted instead to start a daily newspaper of his own, *The Porcupine.* This speedily failed; but in 1802, with help from Dr. Laurence and William Windham, who was for some years his chief political supporter, he started the weekly *Political Register,* which he thereafter edited, and for the most part wrote, regularly until his death in 1835.

The *Political Register,* with which Cobbett's name was always from 1802 chiefly associated, began its career as an extreme anti-Jacobin journal. It strongly opposed Addington and the Peace of Amiens, and called loudly for a renewal of the war with France. But after Pitt's return to power and the renewal of the war, Cobbett slipped gradually into opposition, and found himself in alliance with Windham and with Fox, the latter of whom he had hitherto vehemently denounced. In 1806, in the Ministry of All the Talents, his friends came to power; but Cobbett soon fell into opposition to them also. He was by this time denouncing the "Pitt system" as the root of all evil, and attacking in particular the methods of pursuing the war, the multiplication of pensions and sinecures, and the dangerous growth of the National Debt. When the Ministry of All the Talents broke up in 1807, he was already definitely a Radical, at war equally with Whig and Tory, and beginning to cry out for peace and parliamentary reform as well as for "economical reform."

So far, Cobbett was merely an outstanding political journalist, whose writings, however trenchant, had given little indication of his peculiar quality as a democratic leader. But from about 1805 a new tone begins to appear in his work. From 1800 to 1805 he had lived in London; but in the latter year he bought a substantial farm at Botley, near Southampton, and spent most of his time in the country. The change opened his eyes to the great contrast between the countryside as he remembered it in his boyhood and as it had become under stress of war-time prices and enclosure. He realized for the first time the misery of the labouring classes, the effects of the Speenhamland system of poor relief, of the enclosure movement, of the great revolution in agrarian conditions that was then at its height. It roused his indignation —the indignation of one who was himself by nature and nurture a yeoman. It completed his conversion to Radicalism, which he expressed as the cause of the dispossessed and suffering labourers of rural England.

Cobbett, the one articulate voice among the suffering people of the countryside, brought a new note into Radical agitation. At once, he became a power. But his power brought penalties. In 1809 there was a minor mutiny among the soldiers at Ely, over unfair deductions from pay. The mutiny was suppressed, and the ringleaders were flogged under the eyes of German mercenaries. Cobbett wrote, denouncing the floggings, and was prosecuted for sedition. A fine of £1,000, two years in Newgate gaol, bail in £3,000 and the finding of two sureties at £1,000 each, were his punishment.

From Newgate, under the lax prison discipline of the time, Cobbett continued to edit the *Register,* and wrote his famous *Paper against Gold,* in which he denounced the war-time inflation of the currency, and the financial policy of Pitt and his successors. His imprisonment, however, brought him financial ruin. He went bankrupt. His farm at Botley was sold; and most of his valuable properties passed out of his hands. The *Register* he barely saved. Three great publishing enterprises on which he was engaged had to be sold—the *State Trials* (known as Howell's, from the editor whom Cobbett employed), the *Parliamentary History of England,* and the *Parliamentary Debates,* which were bought by his printer, Hansard, and thereafter bore the latter's name. All these were originated by Cobbett, though the actual editorship, under his control, had been mainly left to others.

When Cobbett emerged from prison in 1812, he appeared to be ruined. But he had still the *Register,* and the ending of the war, in 1815, brought him his chance. Prices fell, indeed; but the cessation of war demand and the prostration of Europe after the long struggle led to widespread unemployment and distress. In the industrial districts, unrest grew; and the farmers, pressed down by high taxation, were also in a condition of active discontent. The Government had no plans for dealing with the crisis;

and Cobbett with his demands for parliamentary reform and a reduction of the heavy interest on the National Debt, became the central figure in a nation-wide agitation. In 1816, he began the issue of a cheap unstamped *Register* (denounced as Cobbett's "two-penny trash") addressed particularly to the journeymen and labourers of the Northern and Midland counties. He became suddenly the most influential leader of the working classes. But by this time the Government, alarmed at hunger-riots and movements of despair and discontent, was embarking on a campaign of repression which recalled Pitt's measures in the years following the French Revolution. In 1817 Lord Sidmouth, the Home Secretary, passed his "Gagging Bills" and procured the suspension of the Habeas Corpus Act. Widespread arrests of Radical leaders followed; and Cobbett, in order to avoid arrest, fled to the United States, where he remained until 1819.

Settling down on a hired farm at North Hempstead, Long Island, Cobbett set himself to write. He sent the copy regularly for the *Political Register,* which continued to be published by his agents in England. But he also embarked on other literary work. To the respite which exile gave him from daily political preoccupations we owe the beginning of his great literary period. Hitherto he had written much excellent journalism, but no important book. But between 1817 and 1819 he produced not only his *Journal of a Year's Residence in the United States of America,* but also his famous *Grammar of the English Language,* which, despite its faults of scholarship, is still probably the best introduction to correct virile English for the working-class student. In America, too, he projected certain others of the important books which he produced, from this time onwards, with profuse mental vigour.

Although the repression was by no means over—indeed, the "Six Acts" were not passed until after his return—Cobbett came back to England late in 1819, and assumed his place as the outstanding leader of working-class radical agitation. From 1819 to 1832 his history is, in one aspect, the history of the agitation for parliamentary reform. But he found scope for other activities as well, above all for his well-known *Rural Rides* through the southern half of England. His accounts of these appeared in the *Register* between 1820 and 1830, in which year they were first published in book form.

Rural Rides, certainly Cobbett's best widely read book except the *Grammar,* are difficult to describe. They are, in part, a plain account of what he saw in the English countryside—of good farming and of bad, of rotten boroughs and the country houses of bankers, stock-jobbers and successful army contractors, and above all of the misery and starvation of the common people. But they are far more than this. They abound in digressions, in racy snatches of autobiography, in topical political tirades, and everywhere in abundant outflowings of Cobbett's own forceful and appealing personality. Though they were composed in haste and sent off to the *Register* without chance of revision, they were astonishingly well written. *Rural Rides* are Cobbett at his best, showing more sides of the man than appeared in any other of his works.

But *Rural Rides,* and the ceaseless "rustic harangues" which accompanied them, did not, even with the added burden of conducting the *Register* and actively guiding a large section of the reform movement, at all exhaust Cobbett's energies. Books, and mostly good books, flowed from him—*Cottage Economy* and the *Sermons* in 1822, *The History of the Protestant Reformation in England* (questionable history this, but vigorous writing) in 1824–26, *The Woodlands* in 1825, *Advice to Young Men* (next to *Rural Rides* his best book) and *The English Gardener* in 1829, and a host of others. Moreover, in 1820–21 he whole-heartedly espoused the cause of Queen Caroline against the king, acted as one of her regular advisers before the famous trial, and wrote ceaselessly on her behalf. He even composed a number of her own letters and messages concerned with the case. And in his hands the defence of the Queen became also a means of rallying the forces of the Reformers.

Meanwhile, in 1820, he had rid himself by bankruptcy of some of his financial worries, and had settled down to rebuild his shattered fortunes by means of his pen. Botley had been given up, and for awhile he had no land. But soon he developed a flourishing seed-farm in Kensington, and began to deal also in American trees, and in a variety of imported seeds and plants. Especially he urged the cultivation of maize ("Cobbett's corn"), of the locust tree, and of Swedish turnips, as well as the introduction of the straw-plait manufacture from home-grown grasses. His seed-farm and his agricultural writings brought him a large following among the farming classes.

In 1830, with the fall of Wellington and the end of the long period of Tory ascendancy, the reform agitation came to a head. The Whigs, under Lord Gray, assumed office, and reform became the one political question of the day. Immediately upon this change followed the hunger movement of the rural labourers in the southern and eastern counties, known as "the last labourer's revolt." The opponents of the movement sought to trace these troubles to Cobbett's influence, and the Whig Government, anxious to prove its respect for property and to reassure the propertied classes as the subject of reform, prosecuted him. Refusing to employ counsel, Cobbett defended himself in a masterly speech, which thoroughly turned the tables on his opponents. The jury disagreed, and no further attempt was made to molest him. The revolt, however, was savagely repressed.

At length, in 1832, the Reform Act became law. Cobbett, though he had no love for the Whigs, had urged the workers to support it, on the ground that no more liberal measure stood any chance of immediate success. At the election which followed he was elected M.P. for Oldham, as the colleague of John Fielden, the Radical manufacturer. He had stood at Manchester also, but withdrew on learning of his success at Oldham.

This was not Cobbett's first parliamentary contest. He had stood unsuccessfully for Coventry in 1820 and for Preston in 1826. Indeed, for many years he had been seeking to force his way into parliament. At sixty-eight years of age, he found himself a member, as strongly in opposition to the reformed parliament of 1832 as he could have been to the unreformed parliaments of earlier years. His two and a half years of parliamentary life he passed as the leader of a tiny group of extreme radicals, supported sometimes by O'Connell and his Irish, but always fighting for forlorn hopes. Especially, he put up an unavailing struggle against the "new poor law" of 1834, and his last weeks of life were spent in the endeavour to run a campaign against the act when it had been passed into law.

It is usually said that Cobbett was not a success as a parliamentarian. He could hardly have been so, for he accepted none of the rules of the game. He remained to the end the leader of an essentially extra-parliamentary crusade. But already his health was failing. He had been always an indefatigable worker, rising very early and doing a good part of a day's labour before other men were astir. Now severe colds and coughs began to trouble him; but he insisted on adding assiduous attention to his parliamentary duties to his other multifarious activities. In 1835 his health gave way under the strain, and, on June 18, he died of an attack of influenza. His sons attempted for a few months to carry on the *Register;* but it was nothing without his vigorous editorials, and was speedily discontinued.

Cobbett was survived by his wife and by seven children. Anne, the eldest (1795–1877), wrote *The English Housekeeper* and other works. Both she and the two other daughters, Eleanor and Susan, remained unmarried. The three eldest sons all went to the bar. William (1798–1878) wrote *The Law of Turnpikes* and other legal works, and edited the *Register* for a while after his father's death. John Morgan (1800–1877) wrote several books, stood unsuccessfully for Oldham in 1835, and successfully, as an Independent, in 1852. He held the seat till 1865, and again, as a Conservative, from 1872 to 1877. He married John Fielden's daughter in 1851. James Paul (1803–1881) wrote *A Ride in France, Journal of a Tour in Italy,* etc., and stood for Bury as a Radical in 1837. Richard Baverstock Brown, the youngest son (1814–1875) became a solicitor in Manchester, and was active there in the Chartist movement.

Cobbett's character has been variously estimated. He was

always extremely pugnacious, and made many enemies. But he made also many firm friends. His pugnacity, which led him to quarrel, almost as much with allies as opponents, was purely political. Carlyle called him "the pattern John Bull of his century"; his fellow M. P., Buckingham, said that he had "a ruddy countenance, a small laughing eye, and the figure of a respectable English farmer." Hazlitt, who liked his books, also said he looked like a farmer. Cobbett was, indeed, despite his appeal to the workers of the factory districts, always at heart a countryman, with an unconquerable instinct for the land and the men of the land. He was intensely English, and, in his way, intensely patriotic; and it was this patriotism that roused him to the defence of his fellow-countrymen, trodden under by the oppressions of war and the twin revolutions in agriculture and industry whose devastating social effects he watched from phase to phase. He was that rarest of literary portents—an articulate peasant. His prose is astonishingly quick in its movement, and yet solid as a lump of earth. His clods of abuse and denunciation stick to-day. He had a marvellous facility for nicknames, and for the ridicule that hurts. But above all his prose depends for its success on the personal quality that pervades it. It is spoken rather than written down; and in it the man lives. *Rural Rides* and *Advice to Young Men* will be read as long as English is read at all. Cobbett has often been called an egoist, and he was; but his egoism—his capacity to make himself express the aspirations of a whole suffering class—is at the very root of his appeal.

BIBLIOGRAPHY.—Most of Cobbett's important writings have been mentioned above. Besides a host of pamphlets, his other books include *Porcupine's Works* (selections from his early American writings, in 12 vols., 1801); *A Collection of Facts and Observations relative to the Peace with Bonaparte* (1801); *Letters to Addington, in the Fatal Effects of the Peace with Bonaparte* (1802); *Letters to Lord Hawkesbury, on the Peace* (1802); *The Political Proteus* (an attack on R. B. Sheridan, 1804); *Letters on the Late War between the United States and Great Britain* (1815); *The Pride of Britannia Humbled* (New York, 1815); *Paper against Gold* (1815); *The American Gardener* (1821); *Collective Commentaries* (1822); *French Grammar* (1824); *The Poor Man's Friend* (1826); *A Treatise on Cobbett's Corn* (1828); *The Emigrants' Guide* (1829); *History of the Regency and Reign of George IV.* (1830); *Lectures on the French and Belgian Revolutions* (1830); *Spelling Book* (1831); *Tour in Scotland* (continuing *Rural Rides,* 1832); *Manchester Lectures* (1832); *Geographical Dictionary* (1832); *French and English Dictionary* (1833); *Four Letters to the Hon. John Stuart Wortley* (1834); *Life of Andrew Jackson* (1834); *Lectures on the Political State of Ireland* (1834); *Legacy to Labourers* (1835); *Legacy to Parsons* (1835); *Legacy to Peel,* (1836). Six volumes of selections from the *Register,* under the title, *Cobbett's Political Works,* were published in 1835–36.

Of the lives, the most recent is by G. D. H. Cole (1924). There are other lives by Huish (1836), E. Smith (1878), E. I. Carlyle (1904), and Lewis Melville (1913). (G. D. H. C.)

COBBOLD, THOMAS SPENCER (1828–1886), English man of science, was born at Ipswich in 1828, a son of the Rev. Richard Cobbold (1797–1877), the author of the *History of Margaret Catchpole.* From 1868 he acted as Swiney lecturer on geology at the British Museum until 1873, when he became professor of botany at the Royal Veterinary college, afterwards filling a chair of helminthology which was specially created for him at that institution. He died in London on March 20, 1886. His special subject was helminthology, particularly the worms parasitic in man and animals. His numerous writings include *Entozoa* (1864); *Tapeworms* (1866); *Parasites* (1879); *Human Parasites* (1882); and *Parasites of Meat and Prepared Flesh Food* (1884).

COBDEN, RICHARD (1804–1865), English statesman and economist, was born at Dunford Farm, near Midhurst, Sussex, the son of a small farmer, who died when Richard was a child. There were 11 children, who were befriended by relatives. Richard was sent to one of the bad private boarding schools of those days, in Yorkshire, and in 1819 became a clerk in his uncle's warehouse in Old Change, London. After serving in the warehouse he began to travel for the firm. In 1828 he joined with two friends in setting up business as calico merchants. Three years later the firm acquired a factory at Sabden, Lancs., and began to do their own calico-printing. This was the beginning of a business career which brought Cobden an independent fortune and permitted him in later years to devote himself, untrammelled by financial difficulties, to his life work for greater freedom of trade. He remedied his lack of education by a course of serious study and by travel in the United States (June–Aug. 1835) and in the Near East (1836–37), in Germany (1838) and elsewhere, making full use of his opportunities of studying the economic and financial systems of the countries he visited. At this time he published two pamphlets which show that the broad lines of his ideas on foreign policy were already matured. These are *England, Ireland and America* (1835), by "a Manchester Merchant," in which he maintained that England had no interest in defending Turkey against Russia; and *Russia* (1836), in which he attacks the doctrine of the balance of power.

In October 1838 a group of seven Manchester merchants met to form an association to promote a movement for the abolition of the corn laws (*q.v.*). This became the nucleus of a national association, the Anti-Corn-Law league. From the beginning Cobden was the moving spirit in the league. Though other great names were associated with it, Cobden's was the directing mind. He had already met John Bright in connection with a campaign for providing education for the mass of the people, and had drawn him into politics. Bright's eloquence moved thousands in the meetings organized by the league, but Cobden's counsels carried more weight among statesmen. Throughout the whole of this campaign Cobden linked up the question of free trade with that of peace and disarmament; he regarded liberty of commerce as a key to international solidarity. He entered the House of Commons for Stockport at the general election of 1841. Parliament met in August, and Sir Robert Peel moved a vote of censure on the Whig Government, which was carried on Aug. 28. The new administration proposed a modification of the corn law which altered the sliding scale of 1828 and reduced the duty. Villiers' annual motion for repeal was defeated. Cobden presented his case against the corn law in his first speech in the House during the debate on the address. His sincerity and his precise knowledge of the question in hand made a strong impression. He proved a redoubtable opponent of Peel's financial policy, and persistently opposed the reintroduction of income tax.

Cobden desired the minimum of interference in trade and industry. When Graham's Factory Bill was brought forward in 1844 he accepted the regulation of child labour but he protested against any "interference with the freedom of adult labour." He was less extreme than Bright in his individualism, but had no use for the early reformers of the terrible factory system of the day, because he would not accept the principle of Government intervention. On the other hand he ardently supported measures for the improvement of education, and supported Peel's proposal to augment the grant to the Irish Roman Catholic college at Maynooth, on the ground that the priests were the instructors of the people and should themselves be thoroughly educated.

Meanwhile Cobden worked incessantly for the Anti-Corn-Law league, speaking all over the country, and, with increasing force in the House of Commons itself. His most powerful speech was perhaps that made in the House on March 13, 1845, when Peel, who was expected to reply, is said to have crumpled up his paper and notes and said to Sidney Herbert, "You may answer this, for I cannot." Some members of the Peel Government had realized at the time of Peel's first budget that the next change in the corn laws must be their total repeal. The prospect of famine in Ireland at the end of the year made the change inevitable. On Dec. 5 Peel resigned. Lord John Russell, invited to form a cabinet, asked Cobden to take office, but he declined on the ground that his mission lay outside the House on the public platform. On the 20th Peel resumed office. For the course of the events in the session of 1846 *see* PEEL, SIR ROBERT. It is sufficient here to say that Peel's famous resolutions included a modified sliding scale of duties for three years, and that after Feb. 1, 1849, oats, barley and wheat should be admitted at a nominal duty of a shilling. The bill embodying this resolution was passed by the House of Lords on June 25, 1846. Four days later Peel resigned, not without a tribute to Cobden. "The name," he said, "which ought to be, and will be, associated with the success of these measures, is not mine, or that of the noble lord (Russell), but the name of one who,

acting I believe from pure and disinterested motives, has, with untiring energy, made appeals to our reason, and has enforced those appeals with an eloquence the more to be admired because it was unaffected and unadorned: the name which ought to be associated with the success of these measures is the name of Richard Cobden."

The seven years' struggle for repeal left Cobden a ruined man, for he had been compelled to neglect his own business. A subscription was raised for him to enable him to meet his obligations. With part of the amount provided he bought his birthplace, the farmhouse of Dunford, which was thenceforward his home. He spent 14 months abroad (Aug. 1846–Oct. 1847), visiting the chief countries of Europe and urging on the many public men by whom he was received the necessity of greater freedom of trade. He returned more than ever opposed to a policy of intervention in any shape or form in the political situation of Europe. He now turned to work for the promotion of peace and the reduction of armaments, the logical complement of free trade, and became a formidable opponent of Palmerston's general foreign policy. In the Parliament elected in 1847 he sat for the West Riding of Yorkshire. In that parliament he brought forward two important motions: one in favour of international arbitration (June 12, 1849), the other the mutual reduction of armaments (1851). He associated himself with the peace movement, at that time derided, and helped to organize a series of international congresses for the promotion of peace at Brussels, Paris, Frankfurt, London, Manchester and Edinburgh between 1848 and 1851. The panic which took possession of a large section of Englishmen in 1851 on the foundation of the Second Empire in France put his principles to the test. By his resolute campaign against the scaremongers this pamphlet, *1792 and 1853, in Three Letters* (1853), Cobden sacrificed the popularity he had won as the man who gave cheap food to the people. With Bright he withstood the torrent of popular sentiment in favour of war against Russia during the period before the Crimean War. He maintained strongly that the future of the Turkish provinces in Europe lay with the Christian populations and that England should be on their side and not on the side of the Turk. On Feb. 26, 1857, over the "Arrow" incident (Oct. 1856) in China, when Canton was bombarded on the ground that the Chinese had unlawfully boarded a ship of that name, Cobden brought in a motion condemning the action of Sir John Bowring in this matter, which was carried and led Palmerston to dissolve parliament. Cobden's peace policy had destroyed his electoral prospects. He was defeated at Huddersfield, and retired to his house in Sussex for the time, and then made a second visit to America.

On his return (June 29, 1859) he found he had been returned unopposed by Rochdale to the new parliament, and that the Whigs were once more united under Palmerston, who asked him to join his cabinet as president of the Board of Trade. This offer, generous from a man of whose policy he had been the stoutest opponent, was declined on the ground that consistency forbade it. Nevertheless Cobden was the organizer of one important achievement of the new ministry, the conclusion of the commercial treaty with France of 1860. He first discussed the feasibility of such a proposal with Gladstone, and then with Palmerston and Russell; from the two latter he received tepid encouragement, but was offered the assistance of the Paris embassy. He proposed to go to France to interview Napoleon III., and in fact, spent a year (Oct. 1859–Nov. 1860) in laborious and at first unofficial negotiations (he only received definite official powers in Jan. 1860) for a mutual reduction of tariffs in the interest of increased trade between France and England. His work for the conclusion of this commercial treaty is proof, if any were needed, that Cobden was not a merely negative advocate of a laissez-faire policy, but a practical and constructive statesman.

The last of the greater issues of policy in which Cobden was involved was the American Civil War. He had been a regular correspondent of Charles Sumner's since 1851, and though his hatred of war made him say frankly that he would not have gone to war for emancipation, he did, after some hesitation, declare for the North, and J. A. Hobson, writing of this correspondence, asserts that he "did more than any other Englishman, save Bright, to correct the mistakes of fact and judgment which confused the issue in this country (Great Britain) at the outset, and to give sound counsel upon the sharp concrete cases which more than once brought us near to the breaking-point with the Federal Government."

Cobden died on April 2, 1865, in London of a chill contracted on a journey which he had insisted on taking in order to be present at a discussion on a scheme of Canadian fortification.

His distrust of Government at home and his limited belief in democracy were coupled with a firm belief in the good sense and worth of the middle classes. Starting from the belief that it was impossible to regulate wages by national considerations alone in industries competing in a world market he regarded trade unionism as an unjustifiable use of monopoly. He was a child of the industrial revolution, and he believed that the removal of restrictions on the free play of self-interest would bring to everyone his due share of the profits of industry. He opposed factory legislation for this reason, except in the case of children, for whom he realized that freedom of contract was in fact freedom of coercion. Nevertheless in his later years his confidence in the beneficial results of middle class domination began to be shaken, and the man who had written in 1842 (in a letter to F. W. Cobden) that trade unions were "founded upon principles of brutal tyranny and monopoly," wrote to William Hargreave in 1861, "Have they (the working people) no Spartacus among them to lead a revolt of the slave class against their political tormentors? . . . It is certain that so long as five millions of men are silent under their disabilities it is quite impossible for a few middle class members of parliament to give them liberty." But he was still thinking of the political rather than the industrial machine.

Cobdenism and what is called the Manchester School have fallen into some disrepute for various reasons, and in the criticisms launched on the school there is some danger of losing sight of the great services that Cobden rendered. His views on domestic and foreign policy were closely linked together. His experience convinced him that Government intervention in the affairs of foreign countries was nearly always bad; he believed in the minimum of Government at home and the minimum of intervention abroad. The subsequent controversy, still unsettled, was whether a too "spirited," or a too "passive" foreign policy would lead to the worse results. In the matter of international freedom of trade he was too optimistic. He believed that other countries would follow the English logic. He did not foresee the almost universal strength of economic nationalism, the enormous change in the whole structure of the economic world since brought about by gigantic foreign investments, with the development of new countries by the wealthier nations; he did not foresee the international operation of capital. But in his advocacy of arbitration, disarmament and peace he was far in advance of his time, and his ideals, apart from questions of practical application in circumstances as then existing, are justified by enlightened opinion to-day.

See his *Speeches*, edit. John Bright and J. E. Thorold Rogers (1870); *Political Writings of Richard Cobden*, with introduction by Sir L. Mallet (1878); W. Bagehot, *Biographical Studies* (1881); John Morley, *Life of Richard Cobden* (1882); J. A. Hobson, *Richard Cobden* (1918), which contains Cobden's letters to Sumner, taken from the Sumner-Cobden correspondence preserved at Harvard.

COBET, CAREL GABRIEL (1813–1889), Dutch classical scholar, was born at Paris on Nov. 28, 1813. After travelling in Italy to study Greek mss., he was professor at Leyden (1846–1884). He died on Oct. 26, 1889. Cobet's special weapon as a critic was his consummate knowledge of palaeography, combined with rare acumen and wide knowledge of classical literature.

His works include:—*Prosopographia Xenophontea* (1836); *Observationes criticae in Platonis comici reliquias* (1840); *De Arte interpretandi Grammatices et Critices Fundamentis innixa* (1846), his inaugural address at Leyden; *Commentationes Philologicae* (1850–51); *Variae Lectiones* (1854); *Novae Lectiones* (1858); *Miscellanea Critica* (1876); *Collectanea Critica* (1878); observations of Dionysius of Halicarnassus (1877); professorial discourses (1852–60). Editions of *Diogenes Laertius* (1850); Philostratus *περὶ γυμναστικῆς* (1859); speeches of Hypereides (1858–77) and Lysias (1863). He was the editor of *Mnemosyne*.

See an appreciative obituary notice by W. G. Rutherford in the

Classical Review, Dec. 1889; Sandys *Hist. Class. Schol.* (1908) iii. 282.

COBH, a seaport, watering place, and naval station of Co. Cork, Eire, on the south side of Great Island, on a hill above Cork harbour; formerly called Queenstown. Pop. (1936) 6,178. Until the end of the 18th century, Cove of Cork was a small fishing village. Its prominence is due to the fact that it became a military and naval centre and port of embarkation for troops. The quays are exposed to the south and south-east winds. The depth at the harbour entrance is 41 ft. (low-water) while in the river it is 29 ft. at high tides and 26 ft. at low tides. Vessels of 27 ft. draught have discharged at Cork deep-water quays lying afloat at all states of the tide. There is a large dockyard and victualling station at Haulbowline.

COBHAM, a village of Kent, England, 4 mi. W. of Rochester. Pop. of civil parish (1931) 933. The church (Early English and later restored) is rich in ancient brasses (1320–1529), commemorating thirteen members of the Brooke and Cobham families. Cobham college, containing 20 almshouses, after the dissolution took the place of a college for priests, founded by Sir John de Cobham in the 14th century. Cobham hall is mainly Elizabethan. The Cobham family was established here before the reign of King John. In 1313 Henry de Cobham was created Baron Cobham. In 1603 Henry Brooke, Lord Cobham, was attainted for participation in the Raleigh conspiracy, and died in prison in 1618. The attainder was reversed in 1916 and Dr. Gervase Alexander was summoned to parliament as Lord Cobham. There are, however, two Lords Cobham, for during the attainder of the barony Sir Richard Temple was created Baron and Viscount Cobham in 1718. Cobham hall was granted to Lodowick Stewart, duke of Lennox, and came by descent and marriage to the earls of Darnley.

COBIA or **CRAB-EATER** (*Rachycentron canadus*), a very voracious game-fish, cosmopolitan in warm seas, the only genus of the family Rachycentridae which, according to G. A. Boulenger, is allied with the mackerel-like fishes. The fish is slender and somewhat pike-like, reaching a length of five feet. The head is flattened and the lower jaw projecting. The tail is strong and forked, the upper lobe slightly the longer. The soft dorsal fin is long and low; in advance of it about eight low, isolated spines constitute the spinous dorsal. The anal is almost as long as the dorsal. This fish is dark olive green above, shading into lighter brownish-green and silvery. On the sides two distinct dark stripes parallel each other, one from tip of upper jaw to tail; the other starting at the origin of the pectoral fin. (*See* FISH.)

COBLENZ or **KOBLENZ,** a city and fortress of Germany, capital of the Prussian Rhine province, 57 mi. S.E. from Cologne by rail, situated on the left bank of the Rhine at its confluence with the Moselle, whence its ancient name *Confluentes,* of which Coblenz is a corruption. Pop. (1939) 91,908.

The town was one of the military posts established by Drusus about 9 B.C. Later it was frequently the residence of the Frankish kings, and in 860 and 922 was the scene of ecclesiastical synods. In 1018 the city, after receiving a charter, was given by the emperor Henry II. to the archbishop of Trier (Trèves), and it remained in the possession of the archbishop-electors till the close of the 18th century. In 1249–54 it was surrounded with new walls and it was partly to overawe the turbulent townsmen that successive archbishops built and strengthened the fortress of Ehrenbreitstein (*q.v.*) that dominates the city. As a member of the league of the Rhenish cities which took its rise in the 13th century, Coblenz attained to great prosperity. In 1344 the Moselle was spanned by a Gothic freestone bridge of 14 arches. The town suffered greatly, however, in the wars of the 17th, 18th and 19th centuries. In 1688 the French bombarded the Altstadt, destroying the old merchants' hall (*Kaufhaus*), which was restored in 1725. In 1786 the elector of Trier, Clement Wenceslaus of Saxony, took up his residence in the town, and a few years later it became one of the principal rendezvous of the French *émigrés.* In 1794 Coblenz was taken by the Revolutionary army and, after the peace of Lunéville, it was made the chief town of the Rhine and Moselle department (1798). In 1814 it was occupied by the Russians; by the congress of Vienna it was assigned to Prussia, and in 1822 it was made the seat of government of the Rhine province.

The city, down to 1890, consisted of the Altstadt (old city) and the Neustadt (new city), or Klemenstadt. The old city was triangular in shape, two sides being bounded by the Rhine and Moselle and the third by a line of fortifications. Here is the church of St. Castor, originally founded in 836 by Louis the Pious: the present Romanesque building was completed in 1208, the Gothic vaulted roof dating from 1498. In the old quarter, too, are the Liebfrauenkirche, a fine church (nave 1250, choir 1404–31) with late Romanesque towers; the castle of the electors of Trier, erected in 1280, which now contains the municipal picture gallery; and the family house of the Metternichs, where Prince Metternich, the Austrian statesman, was born in 1773. In the modern part of the town, the palace (Residenzschloss), built in 1778–1786 by Clement Wenceslaus, the last elector of Trier, contains some fine Gobelin tapestries. Coblenz is a principal seat of the Moselle and Rhenish wine trade. Its manufactures include pianos, paper, machinery, boats and barges, sugar, dyes and chemicals. It is an important transit centre for the Rhine railways and for the Rhine navigation. Immediately outside the former walls lies the central railway station, in which is effected a junction of the Cologne-Mainz railway with the strategical line Metz-Berlin.

Coblenz was bombed by the Allies in 1917 and 1918. After the Armistice the town and bridgehead were occupied by Allied troops under the Treaty of Versailles, the town forming the second zone to be evacuated after 10 years. (*See* RHINELAND.)

Coblenz was the seat of the Rhineland High Commission, and was occupied first by American troops and from 1923 to 1926 by French troops. In October 1923 Separatists proclaimed a Rhineland republic but in Feb. 1924 this movement collapsed.

Because of its importance as a railway centre, Coblenz was bombed by the British in World War II.

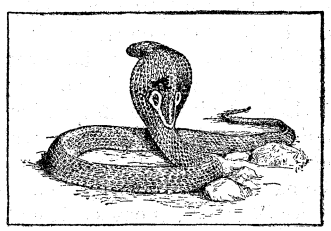
COBOURG, the capital of Northumberland county, Ontario, Canada, on Lake Ontario and the Canadian National and Canadian Pacific railways, 70 mi. E.N.E. of Toronto. Pop. (1941) 5,973. It has a large, safe harbour, and steamboat communication with St. Lawrence and Lake Ontario ports, and is connected by ferry with Charlotte, New York. It contains car-works, foundries, and carpet and woollen factories, and is a summer resort, especially for Americans. Victoria university, formerly situated here, was removed to Toronto in 1890.

COBRA, the name applied to the poisonous elapid snakes of the genera *Naja, Hemachates,* and *Ophiophagus,* which have the power of dilating the neck laterally to form a broad disc or "hood." The dilatation is brought about by the raising and pushing forward of the long anterior ribs, the elastic skin being stretched taut over this framework. This type of hood is in marked contrast to the vertical expansion of the neck of many snakes (*e.g.,* boomslang and mamba), which is caused by the inflation of the windpipe. In all species, however, erection of the hood only occurs when the animal is annoyed or disturbed.

The genus *Naja,* the cobras proper, containing about ten species, ranges from the Cape throughout Africa, Arabia and India to southern China, the Philippine Islands and the Malay archipelago; *Hemachates,* the spy slang of the Boers, with a single species, is confined to South Africa; *Ophiophagus,* the king cobra, ranges from Burma through the East Indies. These snakes are proteroglyphous, *i.e.,* with fixed poison fangs on the front of the upper jaw, and the bite of all the species is extremely dangerous. Accurate statistics of snake-bite mortality cannot be obtained, but it seems fairly certain that the common Indian cobra (*Naja naja*) is responsible for several thousand deaths annually.

As in all proteroglyphous snakes, the venom acts directly on the nervous system and so is much more rapid in its action than that of the viperine and opisthoglyphous snakes, the toxicity of which is chiefly because of the power of destroying the blood corpuscles. In the past, despite a multitude of so-called cures and a widespread belief in the efficacy of "snake stones," no really effective treatment was available except immediate excision of the site of the bite; now efficient "antivenines" are produced from the blood sera of animals that have been immunized by regulated

doses of venom. These antivenines, however, must be administered hypodermically. The dose is large and, to be effective for the bites of proteroglyphous snakes, must be given immediately, conditions not easily obtained in most of the regions which cobras inhabit. Danger to man is further enhanced by the fact that the prevalence of rats and mice frequently attracts cobras to the vicinity of villages and houses where they are more likely to come into contact with man. In India also, cobras are often regarded with so much superstitious reverence that no attempt is made to kill them.



THE COMMON COBRA OF INDIA (NAJA NAJA) SHOWING THE BOLD "SPECTACLE" MARKING OF THE HOOD

The best known species is the common Indian cobra (*Naja naja*), which may reach a length of about $5\frac{1}{2}$ ft. and which exhibits great variation in colour; typically it is yellowish to dark brown with a black and white spectacle-shaped marking on the hood, but all gradations between this form and specimens without any trace of such a mark are known. The king cobra or hamadryad (*Ophiophagus hannah*) is another oriental species; it is rarer than the common cobra, larger, reaching a length of 12 ft. or more, and feeds chiefly on other snakes. Like all the cobras it lays eggs. It exercises some parental care; a definite nest of dried leaves is made and the parents remain in the vicinity of the nest until the eggs are hatched. There may be some care of the nest in the common cobra. In Africa there are several species, the hooded or Egyptian cobra (*Naja haje*) and the black-necked cobra (*Naja nigricollis*) being the most widely distributed. The latter species is able to spit its venom, like the spitting cobra or spy slang (*Hemachates haemachaetes*), which is closely allied to the true cobras and is notorious for its habit of "spitting" venom when annoyed. The mechanism of this "spitting" appears to be that by compression of the poison-glands the venom is forced out through the fangs to a distance of several feet and if it strikes an enemy in the eyes intense irritation is set up that results in temporary, and sometimes permanent blindness. In the accomplished venom spitters, the opening near the end of the fang faces directly forward, while in the cobras that spit only occasionally, like the common cobra, this condition is incipient.

(D. M. S. W.; X.)

COBURG, a town in Germany, in the *Land* of Bavaria, on the left bank of the Itz, 40 mi. S.S.E. of Gotha. Pop. (1939) 32,895. Coburg, first mentioned in a record of 1207, was of considerable importance in the 15th and 16th centuries, and owed its existence to the castle and to its position on the great trade route from Nürnberg via Bamberg to the north. In 1245 the castle became the seat of the elder branch of the counts of Henneberg (Coburg-Schmalkalden). The countships passed to Otto V. of Brandenburg, whose grandson sold them to Henry VIII. of Henneberg. The castle, town and countship then passed by marriage into the possession of the Saxon house of Wettin. In the 17th century the castle was strong enough to stand a three years' siege (1632–35) during the Thirty Years' War. In 1835 it became the residence of the dukes of Saxe-Coburg. The town contains many interesting buildings. The ducal palace, known as the Ehrenburg, originally erected on the site of a convent by Duke John Ernest in 1549, was renovated in 1698 and restored in 1816. It contains a decorated hall, the court church and a picture gallery. In the market square are the mediaeval *Rathaus* and the Government buildings. In the Schloss-platz is the Edinburgh palace, built in 1881. The educational establishments include a gymnasium, founded in 1604. The *Zeughaus* (armoury) contains the ducal library and among other public buildings may be mentioned the *Augustenstift,* formerly the seat of the ministerial offices, and the *Marstall* (royal mews). The castle was completely restored in 1835–38 and now contains a natural history museum. The most interesting room is that which was occupied by Luther in 1530. The chief manufactures are machinery, baskets, glass, colours and porcelain. Iron-founding and saw-milling are also important, and there is trade in the cattle reared in the neighbourhood. For the princes of the house of Coburg *see* WETTIN; SAXE-COBURG-GOTHA.

COCA or **CUCA** (*Erythroxylon Coca*), a plant of the family Erythroxylaceae, the leaves of which are used as a stimulant in western South America. It resembles a blackthorn bush, and grows to a height of 8 feet. The branches are straight and the lively green leaves are thin, opaque, oval, more or less tapering at the extremities. A marked characteristic of the leaf is an areolated portion bounded by two longitudinal curved lines one on each side of the midrib, and more conspicuous on the under face of the leaf. Good samples of the dried leaves are uncurled, deep green on the upper, and grey-green on the lower surface, and have a strong tea-like odour; when chewed they produce a sense of warmth in the mouth, and have a pleasant, pungent taste. The flowers are small, and disposed in little clusters on short stalks; the corolla is composed of five yellowish-white petals, the anthers are heart-shaped, and the pistil consists of three carpels united to form a three-chambered ovary. The flowers are succeeded by red berries. The plants thrive best in hot, damp situations, such as the clearings of forests; but the leaves most preferred are obtained in drier localities, on the sides of hills. The leaves are considered ready for plucking when they break on being bent. The green leaves (*matu*) are spread in thin layers on coarse woollen cloths and dried in the sun; they are then packed in sacks, which, in order to preserve the quality must be kept from damp. The composition of different specimens of coca leaves is very inconstant. Besides the important alkaloid *cocaine* (*q.v.*) there are several other alkaloids. Coca leaves and preparations of them have no external action. Internally their action is similar to that of opium, though less narcotic.

COCAINE, one of a series of "cocaines," alkaloids (*q.v.*) occurring in the leaves of coca (*q.v.*), a shrub indigenous to Bolivia and Peru, but now chiefly produced by cultivation in Java.

Cocaine crystallizes from alcohol in colourless prisms, melting at 98° C; it has a specific rotation $[\alpha]_D - 15{\cdot}8°$, and it is readily soluble in ordinary solvents except water. It is generally used in medicine as the hydrochloride but sometimes as the base, dissolved or suspended in oils or fats. It yields well-crystallized salts of which the hydrochloride, $C_{17}H_{21}O_4N,HCl$, is the most important; this crystallizes from alcohol in short colourless prisms, melting at 200–202° C, and having a specific rotation $[\alpha] -67{\cdot}5°$. On hydrolysis with mineral acids or baryta, cocaine breaks up into *ecgonine* (tropine carboxylic acid), benzoic acid and methyl alcohol, so that cocaine is closely related to atropine (*q.v.*). It was synthetized in 1923 by Willstätter and Bode.

All the "cocaines" are found to be derivatives of a simple base, ecgonine, which contains both a hydroxyl (·OH) and a carboxyl (·COOH) group, the latter being esterified with methyl alcohol and the former with an acid group—benzoic acid in the case of cocaine, $C_{17}H_{21}O_4N$, and cinnamic or truxillic acid in the other natural "cocaines." In the process for the manufacture of cocaine the total alkaloids of Java coca leaves are hydrolysed to ecgonine, which is converted by esterification as described, so that most of the cocaine of commerce is a partially synthetic product.

Cocaine produces little or no action on the unbroken skin, but if it is injected subcutaneously, or applied to mucous membranes such as those of the mouth, eye, nose, complete anaesthesia is produced so that slight operations can be carried out painlessly. A 5 or 10% solution is sufficient to abolish pain and touch, but stronger solutions are required to abolish sensations of heat and cold. If cocaine be swallowed its anaesthetic properties act on the mucous membrane of the stomach; the sensation of hunger is deadened and, therefore, persons taking the drug by the mouth can go for a long period without feeling the want of food. The central nervous system is first stimulated and later depressed, the higher centres being affected first. Moderate doses increase the bodily and mental power and give a sense of calmness and happiness; fatigue is abolished. Long exhausting feats can be carried out under the greater bodily power produced and the inhabitants of Peru chew the coca leaves for this reason. A single large dose causes mental excitement, delirium, ataxy, with head-

ache and depression later.

Therapeutically, cocaine is very largely used by oculists to produce anaesthesia of the eye; it is also used to relieve pain locally in other parts such as the mouth, teeth, ear, larynx, etc. Widespread anaesthesia may be produced by injecting cocaine into the spinal canal; thus an injection between the third and fourth lumbar vertebrae will produce anaesthesia of the lower limbs and of the trunk as far up as the umbilicus. Anaesthesia begins in the extremities and spreads upwards, recovery starts at the umbilicus and works downwards. A cocaine spray is often used to spray the throats of sensitive persons before making a laryngeal examination.

In Europe it is practically never used for its restorative effect, only for its anaesthetic effect: it is not a food, the good it does being only temporary. *See* DRUG ADDICTION and NOVOCAIN.

COCANADA, a town of British India, administrative headquarters of the Godavari district of Madras, situated on the coast in the extreme north of the Godavari delta, about 315 mi. N. of Madras. Pop. (1941) 75,140. Cocanada is the fourth port of Madras. The roadstead in Coringa bay is protected but shallow, so that steamers have to lie 7 m. out, and the entrance to the canal, where the piers and wharves are situated has to be constantly dredged. The town is connected by navigable channels with the canal system of the Godavari delta, and by a branch line with Samalkot on the East Coast railway. The chief exports are rice, cotton and oilseeds. The industries include rice and oil mills, tile and salt works and tobacco manufacture. The town contains a college, orphanage and training college.

COCCEIUS, the latinized name of Johannes Koch (1603–1669), Dutch theologian, who was born at Bremen, on Aug. 9, 1603. After studying at Hamburg and Franeker, where Sixtinus Amama was one of his teachers, he taught at Bremen and at Franeker, and in 1650 succeeded Fr. Spanheim the elder as professor of theology at Leyden. He died there on Nov. 4, 1669. His chief services as an oriental scholar were in the department of Hebrew philology and exegesis. As one of the leading exponents of the "covenant" or "federal" theology, he spiritualized the Hebrew scriptures to such an extent that it was said that Cocceius found Christ everywhere in the Old Testament and Hugo Grotius found him nowhere. He taught that before the Fall, as much as after it, the relation between God and man was a covenant. The first covenant was a "Covenant of Works." For this was substituted, after the Fall, the "Covenant of Grace," to fulfil which the coming of Jesus Christ was necessary. He held millenarian views, and was the founder of a school of theologians who were called after him Cocceians. His most distinguished pupil was the celebrated Campeius Vitringa. His most valuable work was his *Lexicon et Commentarius Sermonis Hebraici et Chaldaici* (Leyden, 1669), which has been frequently republished; his theology is fully expounded in his *Summa Doctrinae de Foedere et Testamento Dei* (1648).

His collected works were published in 12 folio volumes (Amsterdam, 1673–1675). *See* Herzog-Hauck, *Realencyklopädie.*

COCCIDIA, parasitic single-celled animals (Protozoa) characterized chiefly by their manner of reproduction. The individuals developed from the spores (sporozoites) are able to reproduce asexually, as well as sexually. For further particulars *see* PROTOZOA.

COCCULUS INDICUS, the commercial name for the dried fruits of *Anamirta Cocculus* (family Menispermaceae), a large climbing shrub, native to India. It contains a bitter poisonous principle, *picrotoxin,* used in small doses to control the night sweats of phthisis.

COCHABAMBA, a central department of Bolivia, occupying a series of fertile valleys on the eastern slope of the great Bolivian plateau, bounded on the north by the department of El Beni, on the east by Santa Cruz, on the south by Chuquisaca and Potosí, and on the west by Oruro and La Paz. Area, 23,327 sq.mi.; population (1940) 653,000.

Cochabamba's average elevation is about 8,000ft., and its mean monthly temperature ranges from 50° to 71° F, making it one of the most agreeable climatic regions in South America. The rainfall is moderate (18in. per year, coming almost entirely from November to March) and the seasons are marked by rainfall rather than by temperature. Cochabamba is essentially an agricultural department, although its mineral resources are good and include deposits of gold, silver, copper and tungsten. Its temperate climate favours the production of wheat, Indian corn, barley and potatoes, and most of the fruits and vegetables of the temperate zone. Coca, cacáo, tobacco and most of the fruits and vegetables of the tropics are also produced. Its forest products include rubber and cinchona. Lack of transportation facilities, however, has been an insuperable obstacle to the development of any industry beyond local needs except those of cinchona and rubber. The population is chiefly of the Indian and mestizo types, education is in a backward state, and there are few manufactures other than those of the domestic stage, the natives making many articles of wearing apparel and daily use in their own homes. Rough highways and mule-paths are the usual means of communication, but a railway from Cochabamba (city) to Oruro, 132m., now brings this isolated region into touch with the commercial world. The capital is Cochabamba; other important towns are Punata, Tarata, Totora, Cliza and Sacaba.

COCHABAMBA, a city of Bolivia, capital of the department of the same name and of the province of Cercado, situated on the Rocha, a small tributary of the Guapay river. Population (1942) 75,000, mostly Indians and mestizos. The city stands in a broad valley of the Bolivian plateau, 8,400 ft. above sea level, overshadowed by the snow-clad heights of Tunari, 127 mi. E.N.E. of Oruro, with which place it is connected by rail. The climate is mild and temperate, and the surrounding country fertile and cultivated. The city is well supplied with foreign goods, and enjoys a large part of the Amazon trade through some small river ports on tributaries of the Mamoré. The city is regularly laid out, and contains many attractive two-story houses built around patios, parks, hotels, banks, churches, schools and other public buildings. Cochabamba was founded in the 16th century, and for a time was called Oropeza. It took an active part in the "war of independence," the women distinguishing themselves in an attack on the Spanish camp in 1815, and some of them being put to death in 1818 by the Spanish forces. In 1874 the city was seized and partly destroyed by Miguel Aguirre, but in general its isolated situation has been a protection against the disorders which have convulsed Bolivia since her independence.

COCHEM, a town of Germany, in the Prussian Rhine province on the Moselle, and 30 m. S.W. of Coblenz by rail. Pop. (1933) 5,459. It is situated at the foot of a hill with a feudal castle dating from 1051. Trade is in wines.

COCHIN, a feudatory state of southern India, in political subordination to Madras, with an area of 1,493 square miles. It is bounded on the north by British Malabar, on the east by British Malabar, Coimbatore and Travancore, on the south by Travancore, and on the west by British Malabar and the Arabian Sea. The state may be divided into three regions: (1) the eastern zone, consisting of broken forested portions of the western Ghats, which, gradually decreasing in height, merge into (2) the central belt comprising the uplands and plains that dip towards the backwaters along the coast (*see* COCHIN: *town*), beyond which lies (3) the western zone, forming the littoral strip. The low country is naturally flat and swampy, but has been drained and cultivated. An undulating country with grassy flats, naked hills and wooded terraces, intersected by numerous torrents, and dotted with homesteads, orchards and cultivated fields, extends up to the foot of the Ghats. Here are great forests which form a considerable source of wealth.

In 1941 the population was 1,422,875, and 568 in every thousand were literate. More than a quarter are Christians, mostly Syrians and Roman Catholics. The tribute is £13,333, and the financial condition of the state is flourishing. The principal products are rice, coconuts and timber. Cochin is the centre of the coconut oil trade and coconut products are the chief export. Salt is manufactured along the coast. The capital is Ernakulam, but the maharaja resides at Tripunthora. The principal commercial centre is Mattancheri, adjoining the British town of Cochin. The chief

means of communication is by boat along the backwaters; but the line of the Cochin State railway connects Ernakulam with Shoranur, and a tramway for work in the forests runs to Chalakudi, a distance of 52 mi.

History.—What is now the native state of Cochin was, until about the middle of the 9th century A.D., part of the Chera or Kerala kingdom (*see* KERALA). Its port of Kodungalur was from early times one of the chief centres for the trade between Europe and India. The history of Cochin is exceedingly obscure previous to the arrival of the Portuguese. The rajas of Cochin, who are of pure Kshattriya blood, claim descent from the Chera king Cheraman Perumal. About the middle of the 9th century this king, according to tradition, resigned his kingdom, embraced Islam, and went on a pilgrimage to Arabia, where he died. Toward the end of the century the Chera kingdom was overrun and dismembered by the Cholas. In 1498 Vasco da Gama reached the Malabar coast; and in 1502 the Portuguese were allowed to settle in the town of Cochin, where they built a fort. By the end of the century their influence had become firmly established, largely owing to the effective aid they had given to the rajas of Cochin in their wars with the Zamorin of Calicut. In 1663, however, the Dutch captured Cochin and held it for about 100 years. In 1776 Hyder Ali of Mysore invaded the state and forced the raja to acknowledge his suzerainty and pay tribute. In 1791 Tippoo, son of Hyder Ali, ceded the sovereignty to the British, who entered into a treaty with the raja, by which he became their vassal and paid an annual tribute of a lakh of rupees. On October 17, 1809, in consequence of an attempt of the hereditary chief minister, Paliyath Achan, in 1808, to raise an insurrection against the British without his master's knowledge, a fresh treaty was made by which the raja undertook to hold no correspondence with any foreign state and to admit no foreigners to his service, without the sanction of the British government.

From this time the state greatly advanced in prosperity under successive rajas. For over 100 years trade was developed until the annual revenue reached 70 lakhs of rupees. In 1923 Cochin with Travancore, Pudukkottai and two smaller states were placed in direct relation with the government of India as the Madras states.

COCHIN, a town in British India, in the district of Malabar, Madras. Pop. (1941) 26,320. The town lies at the northern extremity of a strip of land about 12 mi. in length, but in few places more than a mile in breadth, which is nearly isolated by inlets of the sea and estuaries of streams flowing from the Western Ghats. These form the Cochin backwaters, shallow lagoons lying behind the beach line and below its level, which are broad navigable channels and lakes during the monsoon, but in many places not 2 ft. deep in the hot weather. The first European possessors of Cochin were the Portuguese. Vasco da Gama founded a factory in 1502, and Albuquerque built a fort, the first European fort in India, in 1503. The British made a settlement in 1634, but retired when the Dutch captured the town in 1663. Under the Dutch the town became a great trading centre. In 1795 Cochin was captured from the Dutch by the British, and in 1806 the fortifications and many buildings were blown up by order of the authorities. Cochin is the third port between Bombay and Colombo, and considerable sea-borne trade is carried on, although steamers have to lie 2½ mi. out at sea, and the harbour is practically closed from May to August. An experimental channel was cut through the bar in 1923 in pursuance of a scheme for improving the harbour and reclaiming land for port buildings, in which the British government collaborated with those of Cochin and Travancore.

A dry dock and wharves were built. The railway terminus is at Ernakulam, 2¼ mi. from Cochin. There are brick and coir works, saw and oil mills; and fishing, boatbuilding and mat-making are carried on. The chief exports are coco-nut products, tea and groundnuts.

COCHIN-CHINA, the most progressive, smallest and richest of the five states of French Indo-China (*q.v.*), occupies lower Mekong river delta at the southern tip of the country. Area, 24,981 sq.mi., pop. (1936) 4,616,000, nearly all Annamites except 326,000 Cambodians, 233,000 Chinese and Sino-Annamese and 16,000 Europeans. Chinese predominate in commerce and industry, while the French own large plantations, some industries and hold chief government posts.

It is mainly alluvial plain, the delta of Mekong and Don-Nai, area about 17,200 sq.mi. The soil is mainly river alluvium, which in the quaternary period has covered and filled in the gulfs of the archaean and palaeozoic continental massif (granites, schists, etc.). Volcanic rocks are rare save for the basalts of Bien-Hoa (north of Saigon) and trachytes southwest of the delta. But laterites of volcanic origin, red earths easy to cultivate, are common, as are argillo-silicious gray earths.



BY COURTESY OF FRENCH TOURIST BUREAU
FISH MERCHANTS IN COCHIN-CHINA

The arc of the Annamese Cordillera ends at Cap St. Jacques and extends over the provinces of Tay-Ninh, Bien-Hoa and Baria, without anywhere reaching a height of 2,900 ft. The 180 mi. of low marshy coast from Cap St. Jacques to Cap de la Table has some open bays and the projection of the point of Ca-Mau. The only port is Saigon, 31 mi. from the sea. Waterways are abundant, and from June to October floods of the Mekong (*q.v.*) cover the country, save for dykes and villages and the Plaine des Joncs in the north; and part of the Ca-Mau peninsula. Rivers include the Don-Nai, flowing west and then south from the Annamese mountains to the sea, west of Cap St. Jacques, the Saigon, flowing northwest to southeast and joining the Don-Nai, and the two Vaicos, joining the Don-Nai near its mouth. The deltas of all these rivers are joined to that of the Mekong and to the sea by many canals (arroyos), both natural and artificial. To them the country owes its scheme of communications and the general distribution of fertilizing floodwaters. A network of canals joins Saigon (*q.v.*) with the Mekong and the ocean, facilitating navigation, irrigation and drainage.

The climate depends upon the monsoon; the southwest monsoon, blowing from May to October, brings at times as much as 250 in. of rain (92.5 in. at Soctrang). The dry northeast monsoon blows from November to April. There are no typhoons. The temperature averages 79° in January, 85° in April and 81.5° for the year. The rich forests shelter tiger, leopard, tiger cat, ichneumon, wild boar, deer, buffalo, rhinoceros and elephant, as well as many species of monkeys and rats. Some species of parrakeet, the Mandarin blackbird, and the woodcock are found in the rest of Indo-China. Aquatic birds and venomous reptiles abound in the delta and the Mekong has crocodiles. There is a large annual catch of fish.

Agriculture.—Rice covers most of the cultivated area, most of the country's exports of 1,500,000 tons coming from Cochin-China, with its 5,500,000 ac. of fertile, monsoon-watered riceland. Rubber plantations covered 245,000 ac. in 1936—70% of the country's total. Large French plantations were the rule. Coconuts, pepper, coffee, tobacco, sugar and oilseeds are also grown.

Commerce and Industry.—Saigon, the capital, has half the sea-borne foreign trade of the country, chief exports being rice, rubber, maize, teakwood, tin, tea, pepper and hides. Principal imports are textiles, petroleum products, raw cotton, iron and steel, machinery and paper. Chinese dominate the rice trade, milling and transport, and Chinese merchants live in most villages.

Cholon, Indo-China's largest city, is mainly Chinese, with its 50 large rice mills, the chief distillery and the leading electric power plant of the country.

There are several smaller distilleries in Cochin-China, besides sawmills and factories for the manufacture of chemicals, textiles,

tobacco, beer and soap. Handicrafts consist of woodworking, metalworking, pottery, and the making of salt from sea water, fish paste, jewellery, baskets, embroidery, lace, leather goods and lacquer.

There is an excellent network of modern highways, besides railway connections with northern Indo-China.

Government.—The only "colony" in Indo-China (the other four states are protectorates), Cochin-China has a rather direct French administration. The governor, responsible to the governor-general at Hanoi, is advised by a council of 12 Frenchmen and 12 natives. This council's advice is ordinarily economic, but its power is small. Cochin-China elects one member of the French chamber of deputies.

There are 21 provinces, plus the penal island, Ile de Poulo Condore and the "Region Saigon-Cholon." Each province is under an administrator of native affairs, who has an advisory provincial council to discuss ways and means, public works, etc. In 1936 the provinces were divided into 232 cantons and 1,630 communes or villages.

The commune is an important social and political body, ordinarily administering justice and collecting taxes from its own residents for remission to the authorities. Election to the assembly of notables which governs the village is a coveted honour. Notables elect members of provincial councils.

Tax receipts were 11,370,000 piastres in 1936, real estate and poll taxes being the chief sources. Expenditures were 10,975,000 piastres.

Education, medicine and other social services took over one-fourth of the budget. Of Indo-China's 11,200 registered teachers no less than 3,729 were in Cochin-China, while 145,412 of the 466,720 pupils in Franco-vernacular and vernacular schools were in Cochin-China, as were nearly half the 8,000 pupils in French state-supported schools.

History.—For the first 17 centuries of the Christian era Cochin-China was known as the Kingdom of Fou-nan. Indian culture held sway, and Fou-nan was frequently under the Khmer empire of Cambodia (*q.v.*) although it sometimes ruled parts of Cambodia. The Annamese penetrated peacefully as settlers and belligerently as conquerors from the 17th century, and eventually the population was distinctly Annamite, Cochin-China being merely southern Annam (*q.v.*).

French interest dates from the arrival of Fr. Alexandre de Rhodes in 1610. This scholarly Jesuit wrote books of lasting interest on Indo-China. After the Franco-Spanish expedition of 1857–59 captured Tourane, in Annam, and failed to take Hue, it turned to Cochin-China and took Saigon in 1859. A large force of Annamites besieged the town, but more battles in 1861 established French rule firmly, and the eastern part was annexed in 1862, the remainder being added in 1867 by the second governor, Admiral Pierre de la Grandiere, who succeeded Admiral Bonard in 1863. Cochin-China joined the Federation of Indo-China in 1887.

In 1941 the Japanese, after effectively occupying Tonkin the previous year, used the Saigon region as the chief concentration point for their successful drive into Thailand, Malaya, Netherlands Indies and Burma during Dec. 1941 and the early months of 1942. (J. R. A.)

COCHINEAL, a natural dye-stuff used for the production of scarlet, crimson, orange and other tints, and for the preparation of lake and carmine. It consists of the females of *Dactylopius coccus,* an insect of the family *Coccidae* of the order Hemiptera, which feeds upon various species of *Cactaceae,* especially nopal, *Opuntia coccinellifera,* a native of Mexico and Peru. The dye was introduced into Europe from Mexico, where it had been used long before the entrance of the Spaniards. Cochineal has almost entirely been replaced by aniline dyes. The male of the cochineal insect is half the size of the female, and, unlike it, is devoid of nutritive apparatus; it has long white wings, and a body of a deep red colour, terminated by two diverging setae. The female is wingless, and has a dark-brown plano-convex body; it is found in the proportion of 150–200 to one of the male insect. The dead body of the mother insect serves as a protection for the eggs until they are hatched. Cochineal is now furnished not only by Mexico and Peru, but also by Algiers and southern Spain. It is collected thrice in the seven months of the season. The insects are carefully brushed from the branches of the cactus into bags, and are then killed by immersion in hot water, or by exposure to the sun, steam, or the heat of an oven—much of the variety of appearance in the commercial article being caused by the mode of treatment. The dried insect has the form of irregular, fluted and concave grains, of which about 70,000 go to a pound. The best crop is the first of the season, which consists of the unimpregnated females; the later crops include an admixture of young insects and skins, which contain proportionally little colouring matter.

Cochineal owes its tinctorial power to the presence of a substance termed cochinealin or carminic acid, $C_{22}H_{20}O_{13}$ (the formula shown by Dimeoth in 1920), which may be prepared from the aqueous decoction of cochineal. Cochineal also contains a fat and wax; cochineal wax or coccerin, $C_{30}H_{60}(C_{31}H_{61}O_3)_2$, may be extracted by using benzene; the fat is a glyceryl myristate $C_3H_5(C_{14}H_{27}O_2)_3$.

COCHLÄUS (Dobneck), **JOHANN** (1479–1552), German humanist and controversialist, was born at Wendelstein (near Nuremberg), whence the punning surname Cochläus (spiral). In 1507 he graduated at Cologne and published under the name of Wendelstein his first piece, *In musicam exhortatorium.* He then became a schoolmaster at Nuremberg. In 1515 he was at Bologna, hearing (with disgust) Eck's famous disputation against usury, and associating with Ulrich von Hutten and humanists. He took his doctor's degree at Ferrara (1517), and spent some time in Rome, where he was ordained priest. In 1520 he became dean of the Liebfrauenkirche at Frankfurt, where he first entered the lists as a controversialist against the party of Luther, developing that bitter hatred to the Reformation which animated his forceful but shallow ascription of the movement to the meanest motives, due to a quarrel between the Dominicans and Augustinians. Luther would not meet him in discussion at Mainz in 1521. He was present at the diets of Worms, Regensburg, Speyer and Augsburg. The peasants' war drove him from Frankfurt; he obtained (1526) a canonry at Mainz; in 1529 he became secretary to Duke George of Saxony, at Dresden and Meissen. The death of his patron (1539) compelled him to take flight. He became canon (Sept. 1539) at Breslau, where he died on Jan. 10, 1552.

His best known work is *Commentaria de Actis et scriptis Lutheris* (1549: German ed. 1580 and 1582). His *Kleine Schriften* were edited by J. Schweizer (1920). *See* M. Spahn, *Johannes Cochläus* (1898).

COCKADE, a knot of ribbons or a rosette worn as a badge, particularly in modern usage as part of the livery of servants. The cockade was at first the button and loop or clasp which "cocked" up the side of an ordinary slouch hat. The word first appears in this sense in Rabelais in the phrase *"bonnet à la coquarde,"* explained by Cotgrave (1611) as a "Spanish cap or fashion of bonnet used by substantial men of yore . . . worne proudly or peartly on th' one side." The bunch of ribbons as a party badge developed from this button and loop. The Stuarts' badge was a white rose, and the resulting white cockade figured in Jacobite songs. William III.'s cockade was of yellow, and the house of Hanover introduced theirs of black, which in its present spiked or circular form of leather is worn by the royal coachmen and grooms, and the servants of all officials or members of the services. At the outbreak of the French Revolution of 1789, cockades of green ribbon were adopted. These afterwards gave place to the tricolour cockade, which is said to have been a mixture of the traditional colours of Paris (red and blue) with the white of the Bourbons, the early Revolutionists being still Royalists. The French army wore the tricolour cockade until the Restoration. Each foreign nation had its cockade. Thus the Austrian was black and yellow, Bavarian light blue and white, Belgian black, yellow and red, French the tricolour, Prussian black and white, Russian green and white, and so on, following usually the national colours. Originally the wearing of a cockade, as a badge, was restricted to soldiers. There is still a trace of the cockade as a badge in certain military headgears in England and elsewhere.

Otherwise it has become entirely the mark of domestic service.

See *Genealogical Magazine,* vols. i.–iii. (1897–99); Racinet, *La Costume historique* (1888).

COCKAIGNE (COCKAYNE), **LAND OF,** an imaginary country, a mediaeval Utopia where life was a continual round of luxurious idleness. The origin of the Italian word *cocagna* has been much disputed. It seems safest to connect it, as do Grimm and Littré, ultimately with Lat. *coquere,* through a word meaning "cake," the literal sense thus being "The Land of Cakes." In Cockaigne the rivers were of wine, the houses were built of cake and barley-sugar, the streets were paved with pastry, and the shops supplied goods for nothing. Roast geese and fowls wandered about inviting folks to eat them, and buttered larks fell from the skies like manna. There is a 13th-century French *fabliau, Cocaigne,* which was possibly intended to ridicule the fable of the mythical Avalon, "the Island of the Blest." The 13th-century English poem *The Land of Cockaygne,* is a satire on monastic life. The term has been humorously applied to London, and by Boileau to the Paris of the rich. The word has been frequently confused with Cockney (*q.v.*).

COCKATOO (Kakatoeinae), a group of parrots confined to the Australian region and characterized by a crest of feathers on the head; this can be raised at will. They live in flocks in woods, feeding on fruit, seeds and insects. The note is harsh and their powers of vocal imitation limited. The well-known sulphur-crested cockatoo (*Kakatoe galerita*) inhabits Australia, where it does much damage to the newly sown grain. The white eggs, two in number, are deposited in hollow trees or fissures in rocks. It also ranges northeast to Aru, New Guinea and New Ireland. Leadbeater's cockatoo (*K. leadbeateri*) inhabits South Australia, and its white plumage is tinged with rose, deepening to salmon-pink under the wings; the crest is scarlet. It is a very shy bird. The dark-plumaged funereal cockatoo or wyla (*Calyptorhynchus funereus*) is another Australian species. The smallest of the family is the cockateel (*Nymphicus hollandicus*), which has a long pointed tail. There are five genera and 17 species of cockatoos, some with a number of subspecies recognized.

COCKATRICE, a fabulous monster, the existence of which was firmly believed in throughout ancient and mediaeval times. Produced from a cock's egg hatched by a serpent, it was believed to possess the most deadly powers, plants withering at its touch, and men and animals dying, poisoned, by its look. It stood in awe, however, of the cock, the sound of whose crowing killed it. The weasel alone among mammals was unaffected by the glance of its evil eye, and attacked it at all times successfully; for when wounded by the monster's teeth it found a ready remedy in rue—the only plant which the cockatrice could not wither. The term "Cockatrice" seems also to be largely synonymous with "basilisk."

COCKBURN (kō'burn), **SIR ALEXANDER JAMES EDMUND,** 10TH BART. (1802–1880), lord chief justice of England, born Dec. 24, 1802, of ancient Scottish stock, the son of Alexander, fourth son of Sir James Cockburn, 6th baronet. His father was British envoy extraordinary and minister plenipotentiary to the state of Colombia, and married Yolande, daughter of the vicomte de Vignier. He was educated at Trinity Hall, Cambridge, of which he was elected a fellow and afterwards an honorary fellow. He entered at the Middle Temple in 1825 and was called to the bar in 1829. He joined the western circuit, and for some time such practice as he was able to obtain lay at the Devon sessions. In 1832, however, the petitions following the first general election after the Reform Bill gave him an opening. The decisions of the committees had not been reported since 1821, and with M. C. Rowe, another member of the western circuit, Cockburn undertook a new series of reports. In 1833 he had his first parliamentary brief.

In 1847 he decided to stand for parliament and was elected, without a contest, Liberal M.P. for Southampton. His speech in the House of Commons on behalf of the government in the Don Pacifico dispute with Greece commended him to Lord John Russell, who appointed him solicitor-general in 1850 and attorney-general in 1851, a post which he held till the resignation of the ministry in Feb. 1852. During the short administration of Lord Derby, which followed, Sir Frederic Thesiger was attorney-general and Cockburn was engaged against him in the case of *R. v. Newman,* on the prosecution of Achilli, a criminal information for libel against Cardinal Newman. The jury who tried the case under Lord Campbell found the defence of justification not proved except in one particular. The verdict was set aside and a new trial ordered, but none ever took place. In Dec. 1852, under Lord Aberdeen's ministry, Cockburn became again attorney-general, and so remained until 1856, taking part in many celebrated trials, notably leading for the Crown in the trial of William Palmer, of Rugeley in Staffordshire, for poisoning. In 1854 Cockburn was made recorder of Bristol. In 1856 he became chief justice of the common pleas. He inherited the baronetcy in 1858. In 1859 Lord Campbell became chancellor, and Cockburn became chief justice of the Queen's Bench, continuing as a judge for 24 years and dying in harness. On Saturday, Nov. 20, 1880, he presided over a court for the consideration of Crown cases reserved; he walked home, and on that night he died of *angina pectoris* at his house in Hertford Street.

Sir Alexander Cockburn earned and deserved a high reputation as a judge. He was a man of brilliant cleverness and rapid intuition. He had been a great advocate at the bar, fluent and persuasive rather than learned; before he died he was considered a good lawyer, some assigning unquestioned improvement in this respect to his frequent association on the bench with Blackburn. He had notoriously little sympathy with the Judicature Acts. Many were of opinion that he was inclined to make up his mind prematurely on the cases before him. But he was beyond doubt always in intention, and generally in fact, scrupulously fair. It was thought that he went out of his way to arrange to try *causes célèbres* himself. His successor, Lord Coleridge, writing in 1881 to Lord Bramwell, to make the offer that he should try the murderer Lefroy as a last judicial act before retiring, added, "Poor dear Cockburn would hardly have given you such a chance." But Cockburn tried all cases which came before him, whether great or small, with the same thoroughness, courtesy, and dignity, while he certainly gave great attention to the elaboration of his judgments and charges to juries. His summing up at the Tichborne trial at Bar lasted 18 days.

The greatest public occasion on which Sir Alexander Cockburn acted, outside his usual judicial functions, was that of the "Alabama" arbitration, held at Geneva in 1872, in which he represented the British Government and dissented from the view taken by the majority of the arbitrators, without being able to convince them. He prepared, with C. F. Adams, the representative of the United States, the English translation of the award of the arbitrators and published his reasons for dissenting in a vigorously worded document which did not meet with universal commendation. He admitted in substance the liability of England for the acts of the "Alabama," but not on the grounds on which the decision of the majority was based, and he held England not liable in respect of the "Florida" and the "Shenandoah."

In personal appearance Sir Alexander Cockburn was of small stature, but great dignity of deportment. He was fond of yachting and sport, and at the time of his death was engaged in writing a series of articles on the "History of the Chase in the 19th Century." He had a high sense of the duties of his profession, and his utterance upon the limitations of advocacy, in his speech at the banquet given in the Middle Temple Hall to M. Berryer, the celebrated French advocate, may be called the classical authority on the subject. Lord Brougham had spoken of "the first great duty of an advocate to reckon everything subordinate to the interests of his client." But the lord chief justice, replying to the toast of "the judges of England," said amid loud cheers from a distinguished assembly of lawyers, "The arms which an advocate wields he ought to use as a warrior, not as an assassin. He ought to uphold the interests of his clients *per fas,* not *per nefas.* He ought to know how to reconcile the interests of his clients with the eternal interests of truth and justice" (*The Times,* Nov. 9, 1864). Sir Alexander Cockburn was never married, and the baronetcy became extinct at his death.

BIBLIOGRAPHY.—C. C. F. Greville, *The Greville Memoirs* (ed. H. Reeve, 1874–87); A. E. M. Ashley, *Life of Palmerston* (1876); Justin M'Carthy, *History of our Own Times* (1881–1905); J. W. Croker, *The Croker Papers* (ed. L. J. Jennings, 2nd ed. 1885); T. A. Nash, *Life of Lord Westbury*, (1888); W. Ballantine, *Experiences* (1890); B. C. Robinson, *Bench and Bar* (1891); Lord Russell of Killowen, "Reminiscences of Lord Chief Justice Coleridge," in *North American Review* (Sept., 1894); C. Fairfield, *Life of Lord Branwell* (1898); E. *Manson, Builders of our Law* (1904). *See* also *The Times* Nov. 22, 1880; *Law Journal, Law Times, Solicitors' Journal,* Nov. 27, 1880; *Law Magazine,* new series, vol. xv. p. 193, 1851.

COCKBURN, ALICIA or ALISON (1713–1794), Scottish poet, author of one of the most exquisite of Scottish ballads, the "Flowers of the Forest," was the daughter of Robert Rutherfurd of Fairnalee, Selkirkshire, and was born on Oct. 8, 1713, and died on Nov. 22, 1794. There are two versions of this song—the one by Mrs. Cockburn, the other by Jean Elliot (1727–1805) of Minto. Both were founded on the remains of an ancient Border ballad. Mrs. Cockburn's—that beginning "I've seen the smiling of Fortune beguiling"—is said to have been written before her marriage to Patrick Cockburn of Ormiston in 1731, though not published till 1765. It was composed many years before Jean Elliot's sister verses, written in 1756, beginning, "I've heard them liltin' at our ewe-milkin'." At her house on Castle-hill, and afterwards in Crichton street, Mrs. Cockburn received Mackenzie, Robertson, Hume, Home, Monboddo, the Keiths of Ravelston, the Balcarres family, Lady Anne Barnard, the author of "Auld Robin Gray," and others. As a Rutherfurd she was a connection of Sir Walter Scott's mother, and was her intimate friend. Scott, at six years old, is said to have given as a reason for his liking for Mrs. Cockburn that she was a "virtuoso like himself."

See her *Letters and Memorials . . .*, with notes by T. Craig Brown (1900).

COCKBURN, SIR GEORGE, BART. (1772–1853), British admiral, second son of Sir James Cockburn, Bart., and uncle of Lord Chief Justice Cockburn, entered the navy in his ninth year. After serving on the home station, and in the East Indies and the Mediterranean, he assisted, as captain of the "Minerve" at the blockade of Leghorn in 1796, and fought a gallant action with the Spanish frigate "Sabina," which he took. He was present at the battle of Cape St. Vincent. In 1809, in command of the naval force on shore, he contributed greatly to the reduction of Martinique, and signed the capitulation by which that island was handed over to Great Britain. After service in the Scheldt and at the defence of Cadiz he was sent in 1811 on an unsuccessful mission for the reconciliation of Spain and her American colonies. In 1813–14, as second in command to Warren, he took part in the American War, especially in the capture of Washington. In the autumn of 1815 he carried out, in the "Northumberland," the sentence of deportation to St. Helena which had been passed upon Bonaparte. He was promoted admiral in 1837; he became senior naval lord in 1841, and held office in that capacity till 1846. In 1851 he was made admiral of the fleet. He died on Aug. 19, 1853.

COCKBURN, HENRY THOMAS (1779–1854), Scottish judge, with the style of Lord Cockburn, was born in Edinburgh on Oct. 26, 1779. His father was a baron of the Scottish court of exchequer. He was educated at the high school and the University of Edinburgh, and he was a member of the Speculative Society, to which Sir Walter Scott, Brougham and Jeffrey belonged. He entered the faculty of advocates in 1800, and attached himself, though his connections were Tory, to the Whig or Liberal party, which then offered few prospects to ambitious men. On the accession of Earl Grey's ministry in 1830 he became solicitor-general for Scotland. In 1834 he was raised to the bench, and on taking his seat as a judge in the court of session he adopted the title of Lord Cockburn. Cockburn's forensic style was remarkable for its clearness, pathos and simplicity; and his conversational powers were unrivalled among his contemporaries. In 1852 he published his biography of Lord Jeffrey, and the *Memorials of his Time* appeared posthumously in 1856 (new ed., with introduction by his grandson, H. A. Cockburn, 1909). He died on April 26, 1854, at his mansion of Bonaly, near Edinburgh.

COCKCHAFER (*Melolontha melolontha*), a common European beetle whose larva is destructive to the roots of crops. The white grub spends several years in the soil before emerging as a large beetle which feeds on the leaves of trees, and may often be seen flying in large numbers at dusk. (*See* COLEOPTERA; CHAFER; and ENTOMOLOGY: *Injurious Insects.*)

COCKERELL, CHARLES ROBERT (1788–1863), British architect, was born in London on April 28, 1788. After studying under his father, Samuel Pepys Cockerell (1754–1827), he went abroad in 1810 and studied the great architectural remains of Greece, Italy and Asia Minor. At Aegina, Phigaleia and other places of interest, he conducted excavations on a large scale, enriching the British Museum with many fine fragments. He became R.A. in 1829, and from 1840 to 1857 was professor of architecture at the Academy. In 1837 he was appointed architect to the Bank of England. Among his principal works are the Taylorian Building, Oxford (1842), and the completion of St. George's Hall, Liverpool, and of the Fitzwilliam Museum, Cambridge, with some important bank buildings. Cockerell's best conceptions were inspired by classic models; examples of his Gothic style are the college at Lampeter and the chapel at Harrow. His son, Frederick Pepys Cockerell (1833–78) was also a distinguished architect.

COCKERILL, WILLIAM (1759–1832), English inventor and machinist, was born in England in 1759. He went to Belgium as a simple mechanic, and in 1799 constructed at Verviers the first wool-carding and wool-spinning machines on the continent. In 1807 he established a large machine workshop at Liége. Orders soon poured in on him from all over Europe, and he amassed a large fortune. In 1810 he was granted the rights of naturalization by Napoleon I., and in 1812 handed over the management of his business to his youngest son, John Cockerill (1790–1840), who largely extended his father's business. King William I. of the Netherlands secured him a site at Seraing, where he built large works, including an iron-foundry and blast furnace. The construction of the Belgian railways in 1834 gave a great impetus to these works, branches of which had already been opened in France, Germany and Poland. John Cockerill had practically concluded negotiations to construct the Russian government railways, when his constitution, undermined by overwork, broke down. He died at Warsaw on June 19, 1840. The iron works, among the largest in Europe, are still carried on under the name of La Société Cockerill at Seraing.

COCKERMOUTH, a small town and urban district of Cumberland, England, 32 mi. S.W. of Carlisle, by the L.M.S.R. Pop. (est. 1938) 4,794. Area 3.2 sq.mi. It is situated at the confluence of the Derwent and Cocker at a focus of ways among the lower western hills of the Lake District. Settlement in the neighbourhood goes back at least to Roman times, there being a small fort a mile west of the town at Papcastle.

Cockermouth (*Cokermuth, Cokermue*) was the head of the barony of Allerdale, created and granted to Waltheof in the 12th century. Waltheof probably built the castle, under the shelter of which the town grew up. There are remains of Norman work in the keep, but the castle is in part modernized as a residence. The town received no royal charter, but the earliest records mention it as a borough. In 1295 it returned two members to parliament and then not again until 1640. In 1867 it had one member, and in 1885 it was disfranchised. In 1221 William de Fortibus, earl of Albemarle, was granted a market. The Michaelmas fair existed in 1343, and in 1374 there were two horse-fairs, on Whit Monday and at Michaelmas. In 1638 a fair every Wednesday from the first week in May till Michaelmas was granted. The grammar school was founded in 1676. The county industrial school is established in the town. There are engineering and agricultural machine works, a brewery and a malt house. The town suffered severe depression in the 1930s, unemployment among men being 45.3% in April 1934. The poet Wordsworth was born there.

COCK-FIGHTING or **COCKING,** the sport of pitting game-cocks to fight, and breeding and training them for the purpose. The game-fowl is now probably the nearest to the Indian red jungle-fowl (*Gallus gallus*), from which all domestic fowls are believed to be descended. The sport was popular in ancient times in India, China, Persia, and other eastern countries, and was

introduced into Greece in the time of Themistocles. The latter, while moving with his army against the Persians, observed two cocks fighting desperately, and, stopping his troops, inspired them by calling their attention to the valour and obstinacy of the feathered warriors. In honour of the ensuing victory of the Greeks cock-fights were thenceforth held annually at Athens, at first in a patriotic and religious spirit, but afterwards purely for the love of the sport. On the chair of the high priest of Dionysus, in the Theatre at Athens, there is carved a beautiful figure of a winged Eros holding a game-cock just about to fight. Lucian makes Solon speak of quail-fighting and cocking, and evidently is referring to an era in Asia, about 3,000 years ago, when cocking enthusiasts, lacking the cocks, set quail to fighting quail, and partridges to fighting partridges, since both are natural fighters. From Athens the sport spread throughout Greece, Asia Minor and Sicily, the best cocks being bred in Alexandria, Delos, Rhodes and Tanagra. For a long time the Romans affected to despise this "Greek diversion," but ended by adopting it so enthusiastically that Columella (1st century A.D.) complained that its devotees often spent their whole patrimony in betting at the pitside.

It is not definitely established when metal spurs first were slipped over the natural spurs of the gamecocks. The first used were silver spurs; later, iron spurs, then steel spurs. The metal spur has been known for hundreds of years. The modern short metal spur is $1\frac{1}{2}$ inches, or less, in length; the long spur scales from 2 to about $2\frac{1}{2}$ inches.

From Rome cocking spread northwards, and, although opposed by the Christian church, nevertheless became popular in Great Britain, the Low Countries, Italy, Germany, Spain, and her colonies. It was probably introduced into England by the Romans before Caesar's time. William Fitzstephen first speaks of it in the time of Henry II as sport for schoolboys on holidays, and particularly on Shrove Tuesday, the masters themselves directing the fights, or mains, from which they derived a material advantage, as the dead birds fell to them.

Cock-fighting became very popular throughout England and Wales, as well as in Scotland, where it was introduced in 1681. Occasionally the authorities tried to repress it, especially Cromwell, who put a stop to it for a brief period, but the Restoration re-established it among the national pastimes.

From the time of Henry VIII, who added the famous royal cockpit to his palace of Whitehall, cocking was called the "royal diversion," and the Stuarts, particularly James I and Charles II, were among its most enthusiastic devotees, their example being followed by the gentry down to the 19th century. The king's cockmaster presided over the pits at Whitehall.

Gervase Markham, in his *Pleasures of Princes* (1614), wrote "Of the Choyce, Ordring, Breeding and Dyeting of the fighting Cocke for Battell," his quaint directions being of the most explicit nature.

Cocking-mains usually consisted of fights between an agreed number of pairs of birds, the majority of victories deciding the main; but there were two other varieties that aroused the particular ire of moralists. These were the "battle royal," in which a number of birds were "set," *i.e.*, placed in the pit at the same time and allowed to remain until all but one, the victor, were killed or disabled; and the "Welsh main," in which eight pairs were matched, the eight victors being again paired, then four, and finally the last surviving pair.

Among famous London cockpits were those at Westminster, in Drury lane, Jewin street, and Birdcage walk (depicted by Hogarth). The pits were circular in shape with a matted stage about 20 ft. in diameter and surrounded by a barrier to keep the birds from falling off. Upon this barrier the first row of the audience leaned. Hardly a town in the kingdom was without its cockpit, which offered the sporting classes opportunities for betting.

Perhaps the most famous main in England took place at Lincoln in 1830 between the birds of Joseph Gilliver, the most celebrated breeder, or "feeder," of his day, and those of the earl of Derby. The conditions called for seven birds a side, and the stakes were 5,000 guineas the main and 1,000 guineas each match. The main was won by Gilliver by five matches to two. His grandson was also a breeder, and the blood of his cocks still runs in the best breeds of Great Britain and America. Another famous breeder was Dr. Bellyse of Audlem, the principal figure in the great mains fought at Chester during race-week at the beginning of the 19th century. His favourite breed was the white pile, and "Cheshire piles" are still much-fancied birds. Others were Irish brown-reds, Lancashire black-reds and Staffordshire duns.

In Wales, as well as some parts of England, cocking-mains took place regularly in churchyards, and in many instances even inside the churches themselves. Sundays, wakes, and church festivals were favorite occasions for them. The habit of holding mains in schools was common from the 12th to about the middle of the 19th century. When cocking was at its height, the pupils of many schools were made a special allowance for purchasing fighting-cocks, and parents were expected to contribute to the expenses of the annual main on Shrove Tuesday, this money being called "cockpence." Cock-fighting was prohibited by law in Great Britain in 1849.

Cocking was early introduced into America though it was always frowned upon in New England. Some of the older states, as Massachusetts, forbade it by passing laws against cruelty as early as 1836, and it is now expressly prohibited in Canada and in most states of the Union, or is repressed by general laws for the prevention of cruelty to animals. Although cock fighting has ceased as a public sport, in the United States, Canada and the British Isles, it continues to exist in private in those countries. Portable mains are moved from place to place, so as to avoid police raids, and Sunday morning usually is "fight time." In the United States, the sport is extremely popular along the Atlantic seaboard and in the south.

Cock-fighting is not recognized as a form of sport by the Latin-American countries in general. In Argentina cock-fighting was once one of the most popular amusements; but it is now being abolished by police measures, although it still persists in several provinces. Paraguay prohibits it by law. But in Cuba cock-fighting continues to be a patronized sport regulated by the government. Cubans have always supported it; and, although it was prohibited for a time, it was reinstated during the Gómez administration, and is now regulated by municipal decrees. Puerto Rico is an important cock-fighting centre. Breeders of gamecocks stress pedigree. They regard as fit for championship honours, only those birds which have been produced by the blending of strains of the world's most courageous cocks, through hundreds of years. Famous among the breeds of the 20th century are the "Shawlnecks," "Irish Gliders," "Eslin Red-Quills," "Dominiques," "Clairbornes," "Baltimore Topknots," "War-Horses," "Irish Grays" and "Gordons." Gamecocks usually are put to the main when between one and two years of age. But, preceding their entrance into the fighting pit, they are given intensive training. They do not need to be encouraged to fight. That is their heritage. But great preparations are made to perfect their physical condition, and to teach them the art of fighting.

As youngsters, they are permitted a great deal of exercise. This is to develop muscles. When they are deemed old enough to be readied for battle, they are trained for a period of 30 to 50 days. Chief features of their special diet are cooked corn meal, chopped hard boiled eggs, and occasional helpings of raw beef. This is augmented by regular fowl feed. The birds are given a daily bath, so as to free them from insects; they are massaged with a mixture of alcohol and ammonia. That toughens their skin. Their wings are trimmed at the slope; the hackle and the rump feathers are shortened; the comb is cut as close as possible, so as to reduce it as a target for an enemy bird. In time, the cock is taken to a main, held by a trainer, and brought within a foot, or two, of another trainee, similarly held. The frenzied efforts of the cocks to get at each other, adds strength to their muscles. Later, the birds get actual fight training by being pitted against each other, with heavily-padded leather over their spurs.

In ancient times, cocks were permitted to fight until one or the other was killed. In the more modern era, the rules were amended somewhat. Although some fights still are to an absolute finish, others permit the withdrawal at any time of a badly damaged cock. Other rules fix a time limit for each fight. The average cockpit is 18 feet in diameter, with sidewalls about 16 inches high.

Those who enjoy cock-fights insist that the zest in the sport is provided by the many chances to gamble before a fight begins, and all during its progress. Odds against one bird, or the other, are constantly changed, as the tide of battle shifts, and, in some prolonged fights a score or more of wagers are made on the outcome.

On those rare occasions when a gamecock, taking the worst of it, decides he does not wish to continue battle, he makes his intent known by lifting his hackle. The under part of the hackle is edged with white feathers, and from this act is derived the expression "showing the white feather," which means cowardice. When a cock refuses to fight longer, his handler puts him breast-to-breast with the other bird. If he still refuses, then it is ruled that he has quit, and the fight ends.

At all mains, the judge is in supreme control. His word is absolute law, even as to the gambling, and it is binding on all those identified, either officially, or unofficially, with a cock-fight. There is no appeal from his decisions in anything relating to the main. Because

of this, only the highest type of citizen in a cock-fighting community is regarded as eligible to serve as judge.

BIBLIOGRAPHY.—Cock-fighting possesses an extensive literature of its own. *See* Gervase Markham, *Pleasures of Princes* (1614); Blain, *Rural Sports* (1853); "Game Cocks and Cock-Fighting," *Outing,* vol. xxxix; "A Modest Commendation of Cock-Fighting," *Blackwood's Magazine,* vol. xxii; "Cock-Fighting in Schools," *Chambers' Magazine,* vol. lxv. (F. G. M.)

COCK LANE GHOST, a supposed apparition, the vagaries of which attracted extraordinary public attention in London during 1762. At a house in Cock Lane, Smithfield, tenanted by one Parsons, knockings and other noises were said to occur at night varied by the appearance of a luminous figure, alleged to be the ghost of a Mrs. Kent who had died in the house some two years before. A thorough investigation revealed that Parsons' daughter, a child of eleven, was the source of the disturbance. The object of the Parsons family seems to have been to accuse the husband of the deceased woman of murdering her, with a view to blackmail. Parsons was prosecuted and condemned to the pillory.

See A. Lang, *Cock Lane and Common Sense* (1894).

COCKLE, SIR JAMES (1819–1895), English lawyer, and mathematician, was born on Jan. 14, 1819. He was the second son of James Cockle, a surgeon, of Great Oakley, Essex. Educated at Charterhouse and Trinity College, Cambridge, he entered the Middle Temple in 1838, practising as a special pleader in 1845 and being called in 1846. He joined the western circuit and was appointed chief justice of Queensland in 1863. He was knighted in 1869, retired from the bench, and returned to England in 1879.

Cockle is more remembered for his mathematical and scientific investigations than as a lawyer. He attacked the problem of resolving the higher algebraic equations, notwithstanding Abel's proof that a solution by radicals was impossible. In this field Cockle achieved some notable results, amongst which is his reproduction of Sir William R. Hamilton's modification of Abel's theorem. Algebraic forms were a favourite object of his studies, and he discovered and developed the theory of criticoids, or differential invariants; he also made contributions to the theory of differential equations. He was a member of many scientific societies in Queensland and England. He died in London on Jan. 27, 1895.

A volume containing his scientific and mathematical researches made during the years 1864–77 was presented to the British Museum in 1897 by his widow. *See* the obituary notice by the Rev. R. Harley in *Proc. Roy. Soc.* vol. 59.

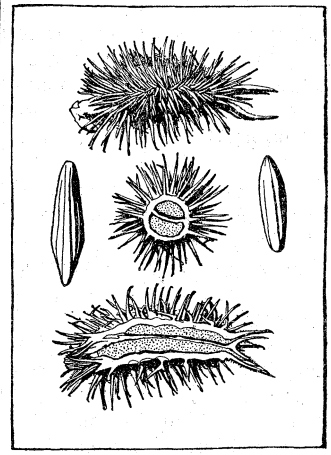
COCKLE, a bivalved marine mollusc of the genus *Cardium,* allied to the oyster and placed in the class Lamellibranchia. About 200 living species of cockles are known and over 330 fossil forms have been described. The common or edible cockle (*Cardium edule*) is the best-known example and is of some economic importance.

The two valves of the shell of the cockle are similar and are characterized by a prominent umbo (*see* LAMELLIBRANCHIA) from which a number of prominent ribs radiate over the surface of the shell. The animal has a long and pointed foot with a knee-like bend in it. The mantle is produced into two short "siphons" which bear numerous finger-like processes. In certain species these processes carry eyes at their tips. The cockle is placed in the order Eulamellibranchiata.

The cockles live on the sea-bottom and are usually found buried below the surface. The common cockle, and probably most of the other species, rarely penetrates below one inch from the surface. The muscular, pointed foot enables it to dig into and plough its way through sand and mud. It has a moderately wide range of habitat, but is rarely found on any soil other than sand and mud. Wright states that *Cardium edule* thrives best in estuarine waters, where the salinity is a little less than that of normal sea-water. Cockle beds formed on the open coast are rarely permanent. In water of high or very low salinity the shell is subject to certain modifications of shape and weight. The cockle, like the rest of the Lamellibranchia, has no organs of mastication. It feeds on minute animals and plants and on the organic particles found in sea-water. The spores of Algae, Foraminifera, Diatoms, etc. usually constitute its diet. The animal is a "current feeder," the food being drawn into the branchial chamber in the water-currents produced by the lower siphon. In England and Wales the most important cockle-fisheries are in the Thames estuary, the Wash, Carmarthen and Morecambe Bays. The animals are gathered by hand or by various kinds of rakes and scrapers and are boiled (in certain places by special methods to ensure the destruction of typhoid bacilli) before being despatched to market. In 1925, 300,221cwt. of cockles were landed in England and Wales. The nutritional value of the common cockle is fairly high, though its tissues contain less protein and fat than those of the oyster and mussel.

See E. Römer, "Cardium" in *Küster's Conchylien Cabinet* (vol. x, 2, 1869); J. Johnstone, *Cardium (Liverpool Mar. Biol. Committee Memoir,* 1899, bibl.); F. Wright, *Fishery Investigations* (Ministry of Agriculture and Fisheries, ix. 5, 1926, bibl.). (G. C. R.)

COCKLEBUR, the name given in the U.S. to species of *Xanthium,* of the family Compositae, called also clotbur and burweed, which in agricultural districts are pernicious weeds.



BY COURTESY OF DR. WM. CROCKER

A DETAILED VIEW OF THE BUR AND THE TWO ENCLOSED SEEDS, SHOWING THE HOOKED PRICKLES WHICH CATCH IN THE WOOL OF SHEEP

They are coarse, rough and sometimes spiny annual herbs with much-branched stems, 1 ft. to 6 ft. high, and mostly long-stalked, variously lobed leaves. The staminate (male) and pistillate (female) flowers, both small and inconspicuous, are borne on the same plant, the staminate clustered at the ends of branches and the pistillate in the axils of the leaves. The fruit (achene) is enclosed in pairs in an oblong bur, about an inch in length, covered with hooked spines and ending in a 1- or 2-toothed beak. The ripe burs adhere to the hair of farm animals who widely disseminate the plant. When abundant, mostly on alluvial soils, cockleburs are injurious to crops, but may be controlled by intensive cultivation or mowing. The germinating seeds and young plants, while in the seed leaf stage, contain a toxic glucoside and cause fatal poisoning when eaten by livestock.

COCKNEY, a colloquial name applied to Londoners generally, but more properly confined to those born within the sound of the bells of St. Mary-le-Bow church. The origin of the word has been the subject of many guesses, but the historical examination of the various uses of "cockney," by Sir James Murray (see *Academy,* May 10, 1890, and the *New English Dictionary,* s.v.) shows that the earliest form of the word is *cokenay* or *cokeney, i.e.,* the *ey* or egg, and *coken,* genitive plural of "cock," "cocks' eggs" being the name given to the small and malformed eggs sometimes laid by young hens (*cf.* Langland, *Piers Plowman,* A., vii. 272). The word then applied to a child overlong nursed by its mother, hence to a simpleton, and Chaucer, *Reeve's Tale,* used it with *daf, i.e.,* a fool. The application of the term by country folk to town-bred people, with their ignorance of country ways, is easy. Thus Robert Whittington or Whitinton (*fl.* 1520), speaks of the "cokneys" in such "great cytees as London, York, Perusy" (Perugia). It was not till the beginning of the 17th century that "cockney" appears to be confined to the inhabitants of London.

The so-called "cockney" accent was chiefly characterized in the first part of the 19th century by the substitution of a *v* for a *w,* or vice versa. The chief consonantal variation which now exists is perhaps the change of *th* to *f* or *v,* as in "fing" for thing, or "farver" for farther. This and the vowel-sound change from *ou* to *ah,* as in "abaht" for "about," are illustrated in the "coster" songs of the late Albert Chevalier. The most marked change of vowel sound is that of *ei* for *ai,* so that "daily" becomes "dyly." The omission of *h* is not peculiar to cockney.

COCK OF THE ROCK, birds of the genus *Rupicola* (subfamily Rupicolinae) of the cotingas (allied to the manakins, *q.v.*), found in the Amazon valley. They are about the size of a pigeon, with orange-coloured plumage, a pronounced crest and orange-red flesh, and build their nests on rock. The males hold elaborate "dancing parties." (*See* BELLBIRD; CHATTERER; UMBRELLA BIRD.)

COCKPIT, originally an enclosed place in which cock-fighting (*q.v.*) was carried on. On the site of an old cockpit opposite Whitehall in London was a block of buildings, used from the 17th century as offices by the treasury and the privy council, for which the old name survived till the early 19th century. The name of a theatre in London, built early in the 17th century on the site of Drury Lane theatre. Applied formerly to a cabin on the lower deck of a man-of-war, where the wounded were tended.

COCKROACH[1], the name applied to members of the *Blattidae,* a family of orthopterous insects, with flattened bodies, long thread-like antennae and shining leathery integument. They are eminently tropical but certain species have become widely disseminated through commerce and are now cosmopolitan. Cockroaches are nocturnal in habit, hiding themselves during the day. The domestic species are omnivorous but are especially addicted to starchy or sweetened matter of various kinds: they also attack food, paper, clothing, books, shoes, bones, etc., and dead insects. As a rule they injure and soil far more than they consume, and most species emit a disagreeable odour.

The oriental cockroach (*Blatta orientalis*), a cosmopolitan household pest, is dark brown; males are short-winged, females subapterous (*see* ORTHOPTERA, fig. 1). The larger, fully winged American cockroach (*Periplaneta americana*) infests buildings throughout the tropics and warm-temperate zones. The German cockroach (*Blattella germanica*), small and pale with two dark lines on the pronotum, occurs with man from the tropics to high latitudes. Blattid eggs are laid in cases (oöthecae) which are carried protruding from the female's body until hidden in some crevice. Those of *P. americana* contain 10–16 eggs which hatch in 40–45 days; nymphal life is 11–14 months, adult life 3–12 months. *B. orientalis* lives about one year.

Some 1,500 species of cockroaches are known, most of them tropical; only 53 species, many introduced, occur in North America, and Britain has only two native species. Although blattids are usually sombrely coloured, some tropical species are elegant in form and beautiful in colouration. The delicate green *Panchlorae* of the American tropics, sometimes introduced with bananas into Britain and the United States, are ovoviparous. Some *Blaberinae* are giants with a wing-spread of over five inches. Cockroaches can be readily destroyed by means of special traps baited with molasses; dusting the places they frequent with either sodium fluoride or powdered borax is also effective. Although these insects are usually viewed with disgust they are not devoid of interest. They are the most primitive of living winged insects, and are among the oldest fossil insects. Their generalized structure and large size make them convenient for study and dissection, and they are widely used as the most suitable type for commencing the scientific study of insects. *See* also ORTHOPTERA.

See L. C. Miall and C. Denny, *Structure and Life History of the Cockroach* (1887); W. J. Lucas, *British Orthoptera* (1920); Morgan Hebard, *Blattidae of North America* (1917); Phil Rau, "Life History of the American Cockroach," *Entomological News,* vol. 51 (1940); E. A. Back, *Cockroaches and Their Control* (U.S. Dept. Agr. Leaflet 144, 1937). (T. H. HL.)

COCKSCOMB, cultivated forms of *Celosia argentea cristata* (family Amaranthaceae), in which the inflorescence is monstrous, forming a flat "fasciated" axis bearing numerous small flowers. The plant is a low-growing herbaceous annual, bearing a large, comb-like, feathery, rolled, or grotesque cluster of dark red, scarlet, purplish or yellow flowers.

Celosia floribunda, a related plant, is cultivated in California under the name cockscomb, but is shrubby.

COCKTON, HENRY (1807–1853), English humorous novelist, was born in London Dec. 7, 1807, and died at Bury St. Edmund's June 26 1853. He is best known as the author of *Valentine Vox, the Ventriloquist* (1840) and *Sylvester Sound, the Somnambulist* (1844).

COCKX (or COCK), **HIERONYMUS** (JEROME) (1510–1570), Flemish painter and engraver, was born at Antwerp, and in 1545 was admitted to the Gild of St. Luke as a painter. It is as an engraver, however, that he is famous, a number of portraits and subject-pictures by him, and reproductions of Flemish masters, being well known. His brother Matthys (1505–1552) was also a painter.

COCOA, INDUSTRY AND TRADE. Cocoa is manufactured from the seed of the cacao tree (generally *Theobroma Cacao,* rarely *T. pentagona* or *T. sphaerocarpa,* small trees of the family Sterculiaceae), a native of tropical America but extensively cultivated elsewhere in the Tropics. The raw product is known commercially as cocoa or the cocoa bean; and scientifically as cacao (Mex. *cacauatl*). The word cocoa is a peculiar English corruption of cacao and will be reserved here solely for the manufactured cocoa powder; whilst cacao will be used for the tree, the "bean," and the butter derived from the bean.

CACAO CULTIVATION

Cacao can be profitably cultivated only within 20 degrees north or south of the equator; it requires a mean shade temperature of 80°F., and an evenly distributed rainfall of 50 to 150in. a year. The cacao tree requires a rich porous soil of considerable depth, and must be protected from the wind; a secluded vale provides the ideal environment.

Planting.—Growers have preferred in recent times to plant the hardy, well-yielding, *forastero* variety rather than the choicer, but more delicate, *criollo.* Seedlings are grown in nurseries, or the seeds are used straight from the pod. They are planted from 10 to 18ft. apart, according to the soil, shade, etc. To protect the

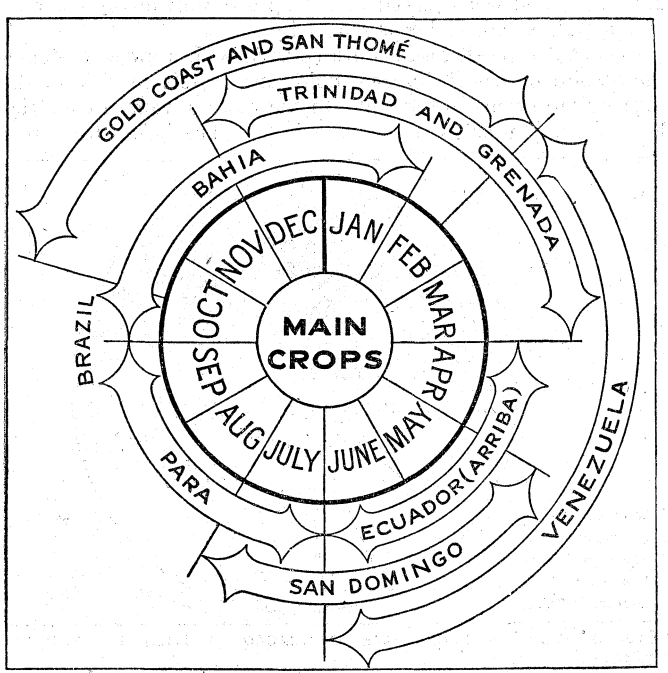


FIG. 1.—DIAGRAM OF CHIEF CACAO HARVESTS, SHOWING THE PERIOD OF THE YEAR DURING WHICH THE MAIN CROP OF EACH OF THE PRINCIPAL PRODUCING COUNTRIES IS GATHERED

soil beneath the trees from the glare of the sun either huge shade trees (*e.g.,* the vermilion flowered *Erythrina*) are grown at intervals of 40 to 50ft., or the cacao trees are planted very closely and hedges are grown to provide wind-breaks.

Harvesting the Crop.—The cacao tree begins to bear in four to five years. The small pink flowers and the succeeding large pods are borne directly on the trunk and main branches.

The chief harvesting periods are shown in the diagram, but ripe pods may be found on the tree all the year round. The pods on the higher branches are cut from the tree by a knife at the end of a

[1]The word is a corruption of Sp. *cucaracha:* in America it is commonly abbreviated to "roach."

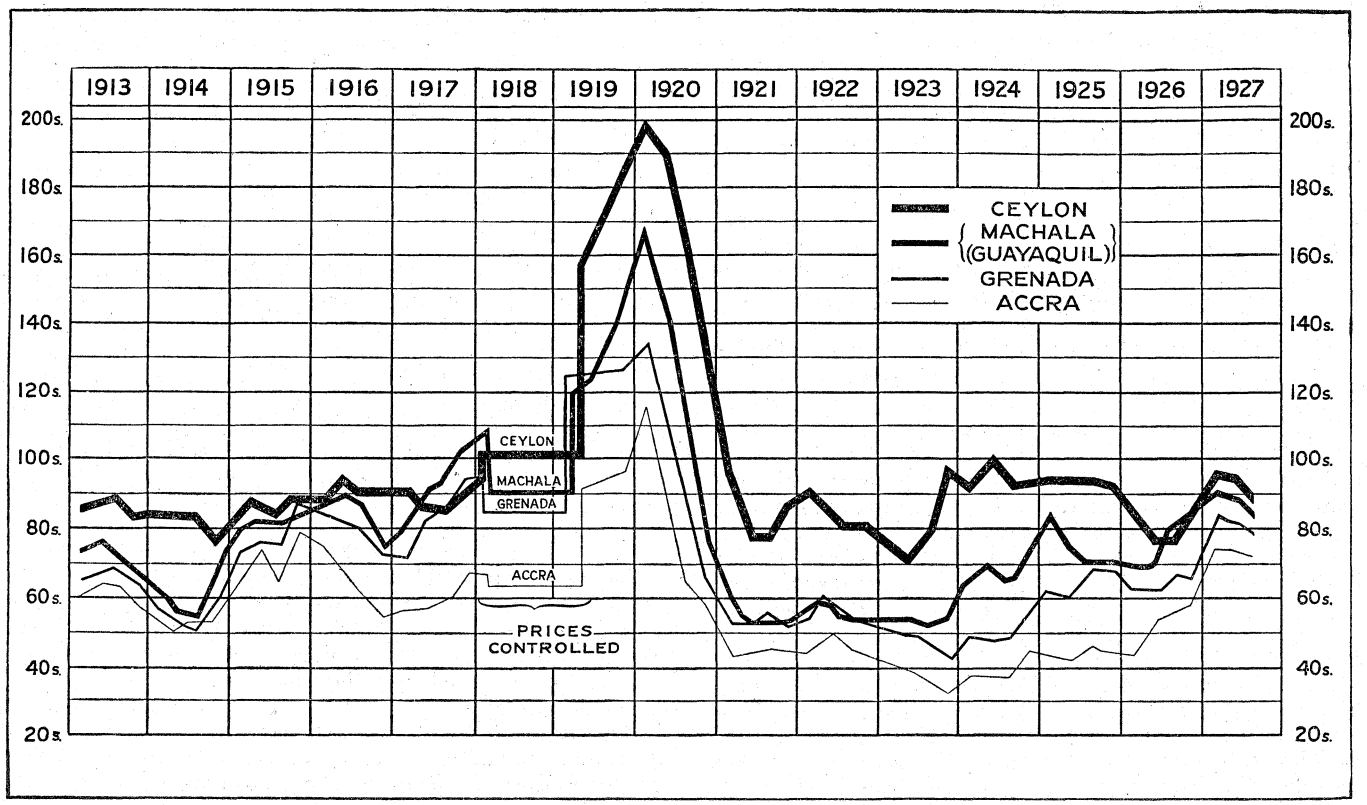


FIG. 2.—CHART OF AVERAGE MARKET SPOT PRICE OF CACAO, 1913–1927

20ft. pole, and when placed in a heap are individually cut open with a cutlass and the beans scooped out.

Fermenting.—The beans are covered with a sweet glistening snow-white or pale heliotrope pulp, and if left in a heap this sugary pulp begins to ferment. In the more advanced countries, however, it is usual to ferment in boxes. The beans are turned

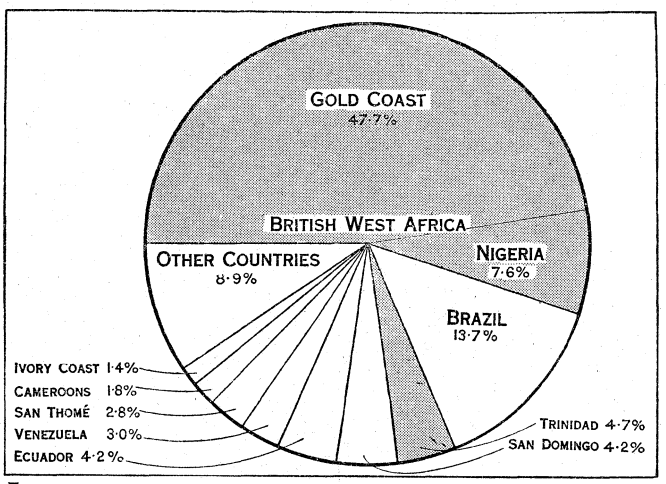


FIG. 3.—WORLD'S PRODUCTION OF CACAO (BRITISH POSSESSIONS SHADED)

The total production for 1927 of raw cacao beans is estimated at 482,000 metric tons, of which the British Empire supply is some 60%, the Gold Coast being responsible for 208,348 metric tons

from one box to another preferably every day, and their temperature rises to 89°F., 98°F. and 115°F. in one, two and three days respectively, reaching an exceptionally high temperature for yeast fermentation. The criollo variety requires two days' fermentation, and the forastero from five to nine days. The pulp drains away as a fermenting resembling sweet cider. This is allowed to run to waste. A trace of acetic acid produced in the later stages gives the cacao a characteristic pungency resembling vinegar. This is a doubtful advantage, but the total effects of fermentation on colour, flavour and texture increase the value of the bean.

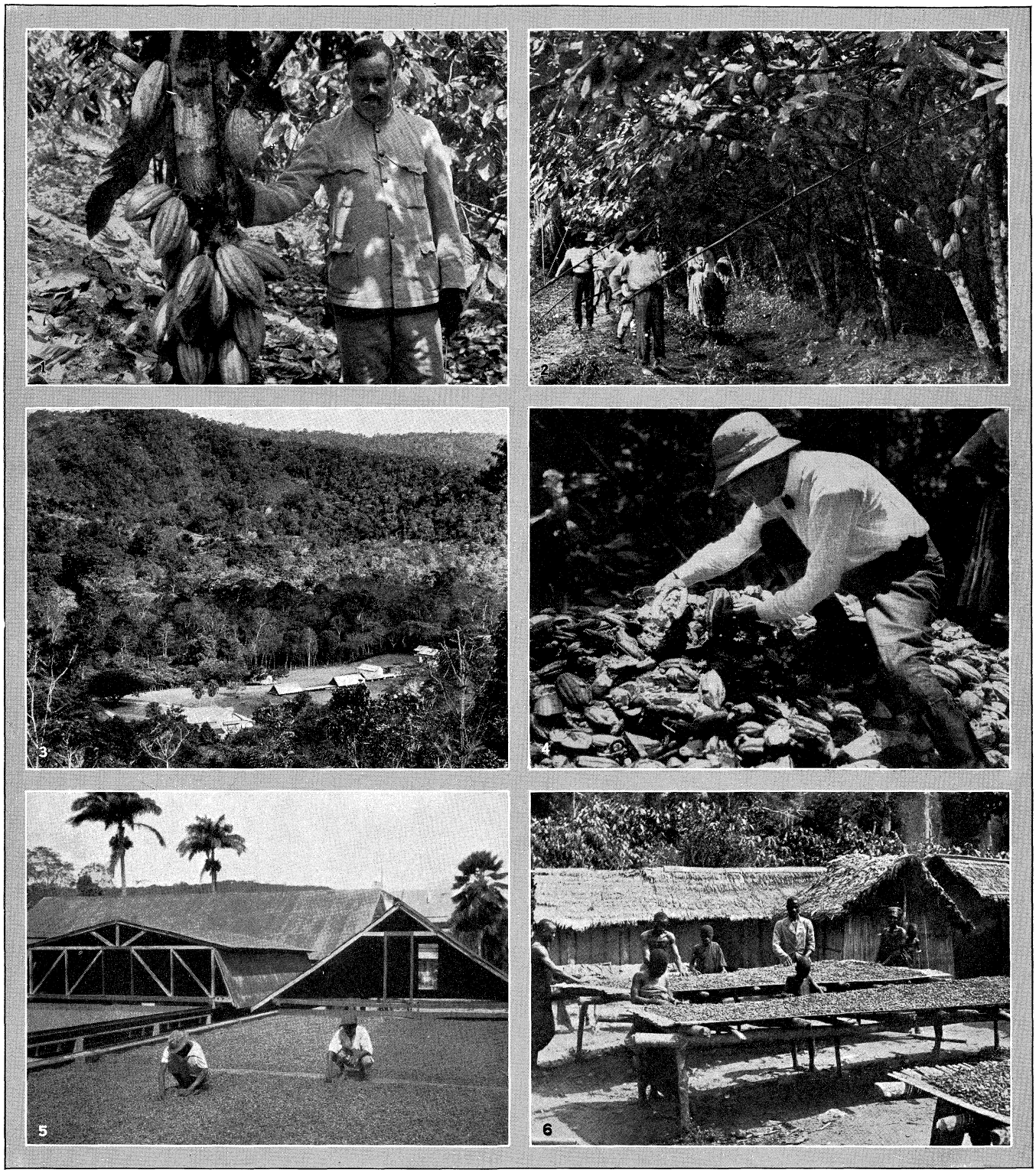
Drying, Washing, Etc.—The bean as it comes from the pod contains 33% of water. This must be reduced to 5 or 6% to give a satisfactory commercial product. The drying is generally done in the sun on cement or brick floors, on mats of coconut fibre, or on wooden platforms; or, as on the Gold Coast, on light bamboo mats on trestles. Whilst the best results are always obtained by the slow and even drying which is produced by turning over and over in the sun for three days, the climate may necessitate the use of artificial dryers. To a limited extent heated platforms are used in San Thomé, drying rooms in Ceylon and Grenada, and drying machines in Costa Rica, Bahia, etc.

The processes of washing, claying and polishing, peculiar to certain places, have few advantages beyond pleasing the eye of the buyer. In Ceylon and Java the pulp is partly removed by washing and the shell of these beans is fragile and gets broken in handling. In Venezuela a thin coat of red earth is rubbed on to the beans. The similar practice of claying was followed in Trinidad until 1923, when it was prohibited. In some countries polishing machines are used.

Yield.—On an average a full-grown tree may bear 6,000 flowers, of which only 20 will become cacao pods. A pod weighs about 1 lb. and contains 4 oz. of pulp-covered seeds, which yield 1½ oz. of the dry, cured, cacao beans of commerce. From these figures is derived the startling fact that, taking all trees in the world, the average yield of cacao beans to the tree is not more than two pounds per annum, and even on first-class estates rarely exceeds three pounds.

Cacao beans in shape resemble almonds, but are not so pointed; they weigh about 400 to the pound. The skin, or shell, is brown. The inside of a superior kind of bean is the colour of cinnamon; of ordinary kinds, dark brown or purple; and of poor unfermented kinds, slate colour. The taste is more or less bitter and astringent, nutty, and faintly aromatic.

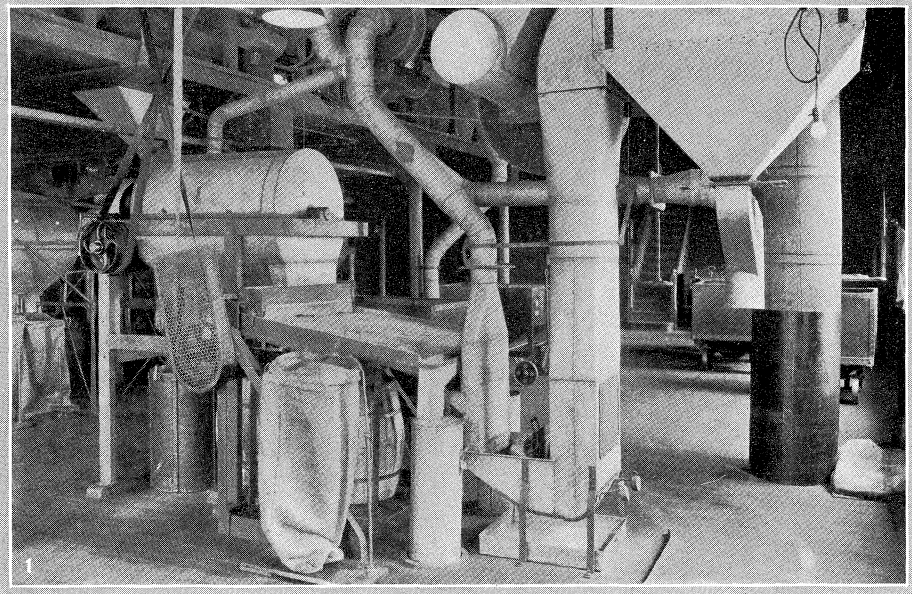
The leading ports for the shipping of cacao are Accra and Secondee (Gold Coast), Bahia and Para (Brazil), Guayaquil (Ecuador), Port of Spain (Trinidad), Lagos (Nigeria), San Thomé (San Thomé) and Sanchez (San Domingo). Whilst some manufacturers have agents at certain producing centres, the great bulk of cacao buying is done through brokers and merchants on cost and freight contracts. The chief cacao markets are New York (where there is a cacao exchange), Hamburg, London,

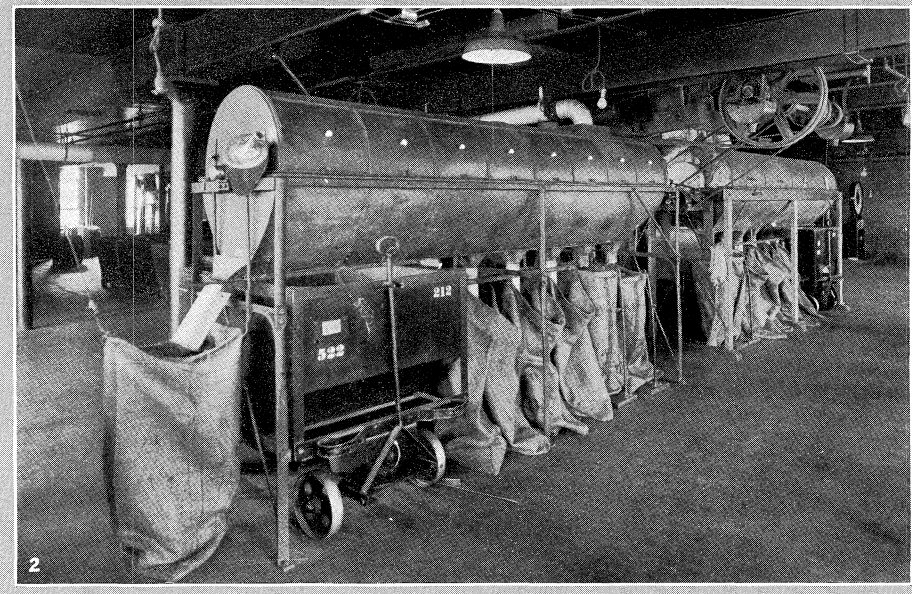


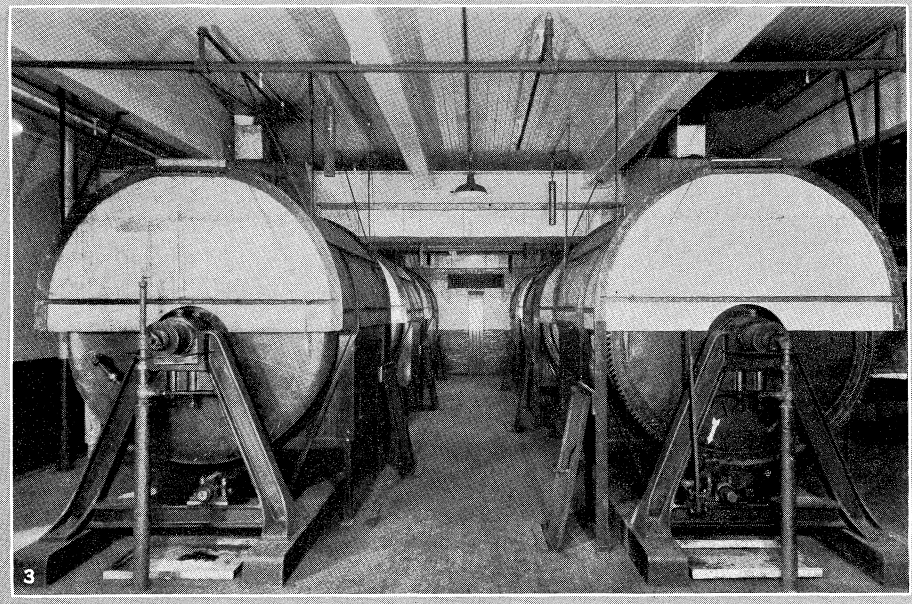
BY COURTESY OF (3) CADBURY BROTHERS, LTD.; PHOTOGRAPHS, (1, 5) PUBLISHERS PHOTO SERVICE, (4) THOMAS F. LEE FROM EWING GALLOWAY

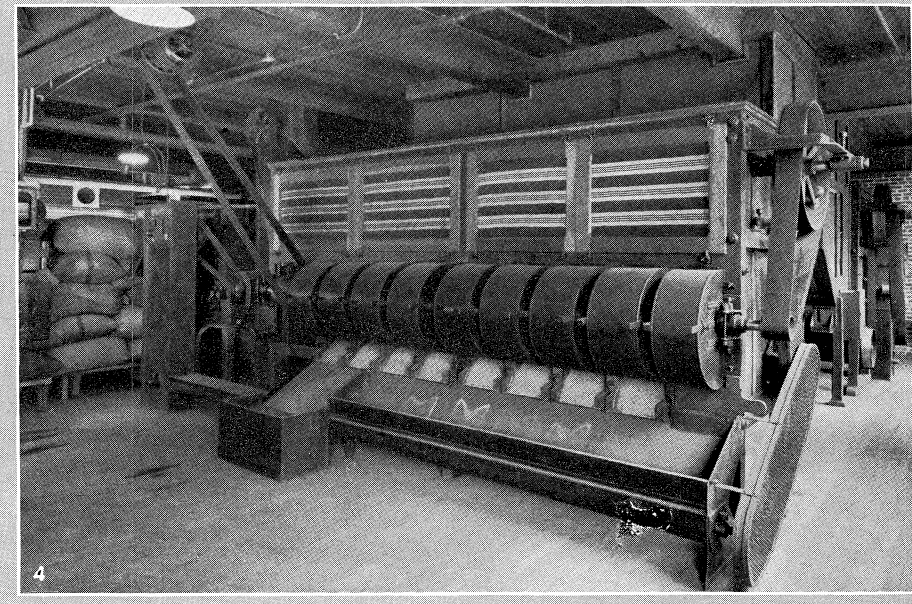
CACAO-GROWING IN THE WEST INDIES AND IN BRITISH WEST AFRICA

1. Port of Spain, Trinidad. A cacao tree, showing the formation of the pods around the branches
2. Gathering cacao pods. Long bamboo poles wielded by men bring down the pods, which are then gathered into baskets by women
3. A cacao estate on the island of Trinidad, in the West Indies, showing the paddock-like clearing in the centre, where the fermenting house and drying platforms are situated
4. Cacao pods that have been slit so that the beans may be scooped out
5. Drying cacao beans on the government plantation in Trinidad. This process consists in turning the beans over and over in the sun for three days
6. Cacao cultivation in British West Africa, showing natives in Ashanti drying cacao on crudely constructed tables fashioned of bamboo mats





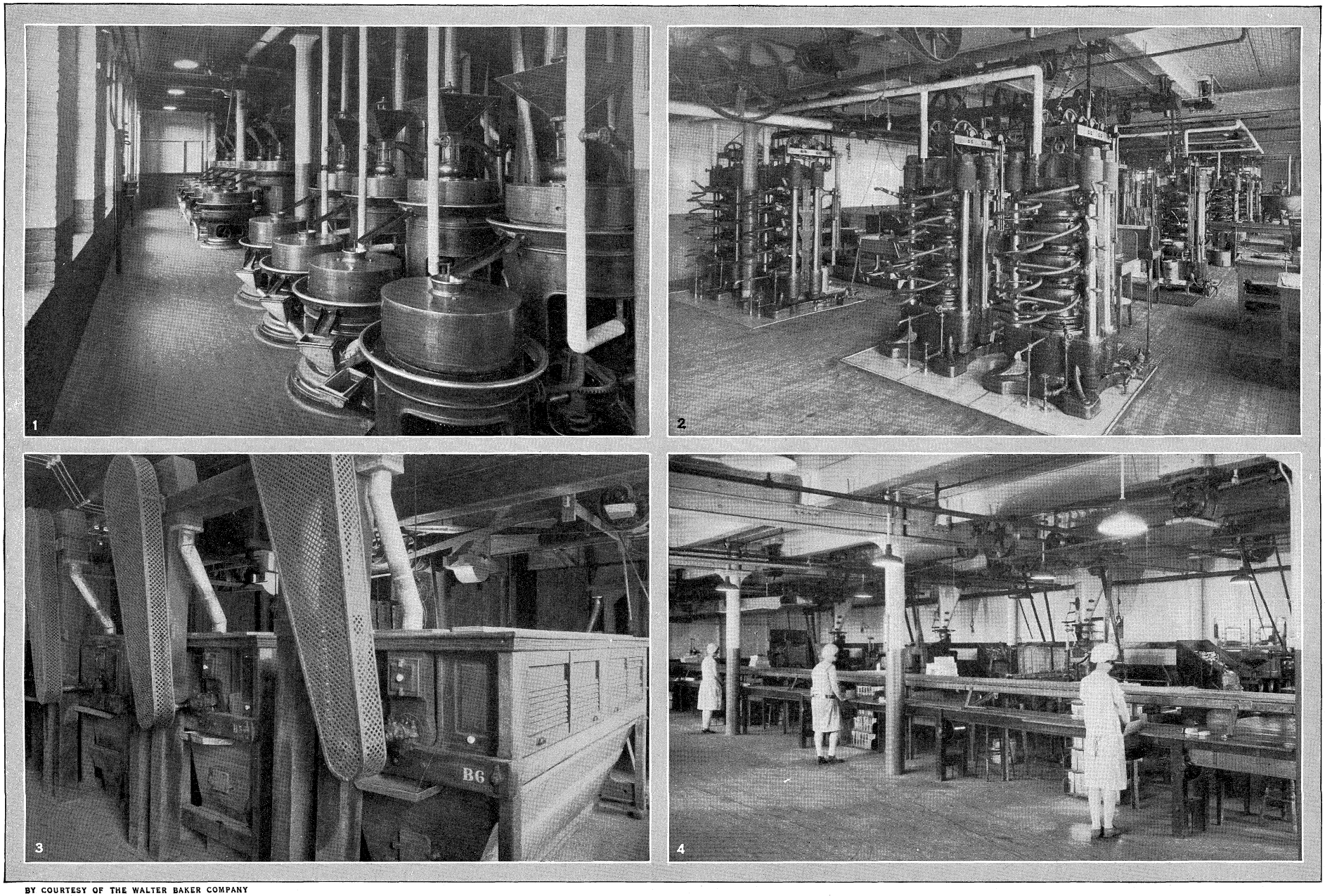




BY COURTESY OF THE WALTER BAKER COMPANY

MACHINES USED IN THE PROCESSES OF COCOA MANUFACTURE

1. Sorting and cleaning the cacao beans
2. Magnetic extractor and sorter used for selecting beans for roasting
3. Machine used for roasting beans
4. A machine used for cracking and fanning the roasted beans to remove shells



BY COURTESY OF THE WALTER BAKER COMPANY

FURTHER STEPS IN THE MANUFACTURE OF COCOA

1. Steel rolls used in the process of milling the cacao nibs into liquor
2. Presses shown for removing part of the cacao butter from the cacao fluid
3. Flour bolters sifting the cocoa powder through silk meshes
4. Packing cocoa for the retail market

Liverpool, Amsterdam and Havre.

Where Cacao Is Grown.—The diagram below gives an accurate impression of the relative proportions of the world's supply exported by the chief producing centres in 1926:—

The table below is compiled from a journal published in Hamburg, the *Gordian,* which is the most reliable source of cacao statistics. It shows changes in cacao production between 1906 and 1926:—

World's Harvest of Cacao Beans
(In tons of 1,000 kilos.)

Producing country.	1906.	1916.	1926.
Africa			
Gold Coast	9,004	73,205	229,537
Nigeria	735	9,099	36,520
San Thomé	24,477	34,336	13,581
Cameroons	..	..	8,706
French Ivory Coast	..	..	6,833
America			
Brazil	25,135	42,879	65,806
Trinidad	12,983	24,893	22,710
Santo Domingo	14,313	22,485	20,477
Ecuador	23,427	42,667	20,036
Venezuela	12,865	15,196	14,300
Other countries	25,000	31,227	42,905
Total	147,939	295,987	481,411

The other countries include Costa Rica (5,318), Grenada (4,103), Ceylon (3,372), Jamaica (3,057), Java (904), Belgian Congo, Surinam, Samoa, St. Lucia (494), Dominica (320) and Cuba. The figures in parentheses are for 1926.

The finest type of bean, the criollo, is grown in Venezuela, Ceylon, Java, Samoa, Madagascar and Nicaragua; but in Ceylon, and other places, criollo is being replaced by forastero, and it is doubtful if the world's production of criollo reaches 10% of the whole. During the first quarter of this century cacao production quadrupled, mainly owing to the increased supply from the Gold Coast. The quantity of Nigerian cacao exported from Lagos is rapidly increasing, and the quality, though still poor, is slowly improving. The output of Brazil has also grown and the sum of its Bahia and Para cacaos has established it as the second largest producer in the world. Trinidad cacao is well known for its good quality and

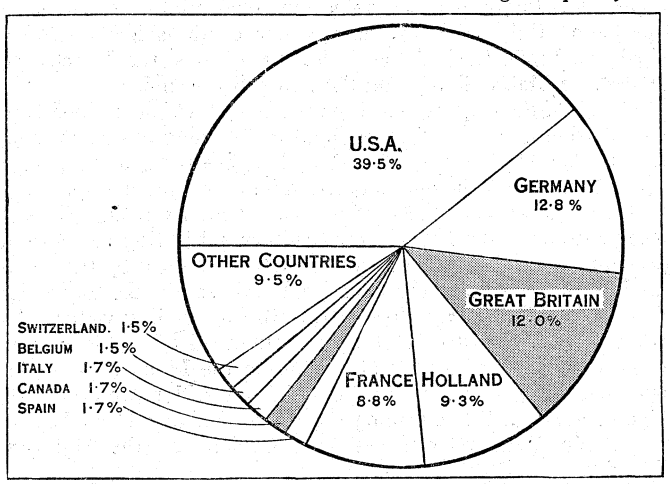


FIG. 4.—THE WORLD'S CONSUMPTION OF CACAO BEANS. IN 1926, THE TOTAL CONSUMPTION WAS 475,241 METRIC TONS

excellent preparation. The Sanchez and Samana cacaos of San Domingo are purchased in New York for the same price as Gold Coast cacao. The Arriba and Machala cacaos of Ecuador are valuable and distinctive, and it is to be regretted that, owing to the outbreak in 1922 of a disease of the cacao tree (appropriately called Witch Broom, *Colletotrichum luxificum*), their output had been reduced to one-half by 1926.

It will be noted that British possessions are responsible for over 60% of the world's supply, and the Gold Coast alone for nearly 50%.

Gold Coast.—The conditions here are unusual, the land being held, and the cacao farms managed, by the native people. It is doubtful if any native-owned industry ever developed with such rapidity as cacao cultivation on the Gold Coast. Figures showing the cacao exported epitomize its history:—

Year.	*1896.*	*1906.*	*1916.*	*1926.*
Tons	34	9,004	73,205	229,537

The cacao grown is the *amelonado* variety of forastero. In the early days the preparation of the cacao was poor, but an ever-increasing amount of sound, fermented cacao has since been produced. Great credit is due to the natives and to the Government for the manner in which difficulties have been overcome. The presence of the tsetse fly, and hence the absence of pack animals, renders the transport of this immense amount of cacao a difficult problem, which has been solved to a considerable extent by the construction of 495 miles of railways and over 3,000 miles of roads suitable for motor lorries. The difficulty of shipping cacao to ocean liners, which is increased by the presence of a heavy surf, has been countered by the construction of a deep sea harbour at Takoradi. The two dangers which threaten cacao cultivation—the reduction of rainfall by the destruction of the moisture-drawing forests, and the destruction of the cacao trees by disease or pest—are recognized as problems by the department of agriculture and the educated native.



BY COURTESY OF GOLD COAST GOVERNMENT COMMERCIAL INTELLIGENCE BUREAU

FIG. 5.—A GOLD COAST CACAO TREE, SHOWING HOW THE FRUIT SPRINGS FROM THE TRUNK AND MAIN BRANCHES

Prices.—Below is a chart showing the variation in price of four different classes of cacao from 1913–27. The chief points of interest are the Government control of prices during 1918, and the phenomenal rise and fall which followed the removal of the control.

The prices given in the chart do not include import duties. The table below shows changes in import duty; since 1919 British empire-grown cacao has had a preferential duty.

Duty on Cacao, Cacao Butter and Cacao Shell
(Imported in Great Britain, 1853–1927.)

Year.	Raw cacao, per lb.		Cacao butter, per lb.		Cacao shell, per cwt.	
	British.	Foreign.	British.	Foreign.	British.	Foreign.
	d.	d.	d.	d.	s. d.	s.
1853–1915	1	1	1	1	2 0	2
1915	1½	1½	1½	1½	3 0	3
1916 (April-June)	6	6	6	6	12 0	12
1916–19	4½	4½	4½	4½	6 0	6
1919–22	3¾	4½	3¾	4½	5 0	6
1922–24	2½	3	2½	3	3 4	4
1924	1¼	1½	1¼	1½	1 8	2

MANUFACTURE AND CONSUMPTION

Cacao beans, if roasted and crushed in the palm of the hand, produce the fragrant odour of chocolate and are broken up into brown, crisp, angular fragments which are termed "nibs." It is a simple matter to blow away the thin flakes of the husk, or shell, without losing the nib. The nib contains 54–55% of cacao butter, and if simply ground with sugar, gives with hot water a very fatty beverage which for over 100 years has been served out to the British navy. To produce a less rich beverage two methods have been adopted. The first is the addition of corn-flour or arrow-root. Such mixtures cannot in most countries legally be described as pure cocoa. The second is the removal of part of the cacao butter by pressure. This is the usual method, and cocoa may be defined as the finely ground cacao nib from which part of the cacao butter has been removed. The factory operations are as follows:—

The clean sorted beans pass along a conveyor to the roasting machines. Roasting is a delicate operation requiring experience and discretion, and is usually conducted in revolving drums heated externally by gas. The temperatures used are lower than for coffee roasting, and seldom exceed 140°C. The roasted beans pass between rolls of serrated cones, which are placed at such a distance apart that the beans are cracked rather than crushed. The fragments are sieved into fractions, from which the shell is carried off by an air blast. There is 12% of shell on the beans and this voluminous by-product was sold during the war at high prices for making "cocoa tea"; its chief use in normal times is as an appetiser in compound cattle cakes, although a certain amount may be found in inferior cocoas. The nibs are ground either between mill stones or steel rolls. As half the cacao bean is butter, and grinding generates heat, the crisp, nutty cacao nib emerges as a thick chocolate-brown fluid. (If cooled this solidifies to a hard block and is known as unsweetened chocolate or cacao "mass.") The cacao fluid is run into circular steel pots, and hydraulic pressure up to 6,000 lb. to the sq.in. is applied. The cacao butter which is squeezed out is filtered and solidified. The hard, dry cake of compressed cocoa, containing 20 to 30% of cacao butter, is removed from the pot, ground and sieved. Many cocoas receive a special treatment in addition to the above, and are known commercially, though somewhat inaccurately, as "soluble." The process, in its original form, was invented by C. J. van Houten in 1828. It consists of treating the cacao nib or mass with a small percentage of potassium carbonate, bicarbonate or other salt of the alkalies. The alkaline salt reacts with the astringent constituents and partly neutralizes the natural acidity of the cacao. This is considered to improve the cocoa, which becomes darker in colour and less liable to sink to the bottom of the cup.

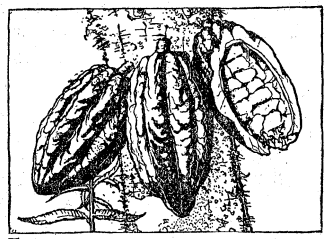


FIG. 6.—GROUP OF CACAO PODS
One pod is cut open to show the inside closely packed with pulp-covered beans

Cocoa has a high food value, and is mildly stimulating owing to the presence of theobromine (2·2%) and caffeine (0·1%). Dr. R. H. A. Plimmer's *Analyses and Energy Values of Foods* (1921) for use by His Majesty's Services gives the following mean analyses of six cocoas: Fat (cacao butter) 26·8%, carbohydrates 40·3%, protein 18·1%, fibre 3·7%, ash 6·3%, water 4·9%; and the energy value as 2,214·5 calories per pound.

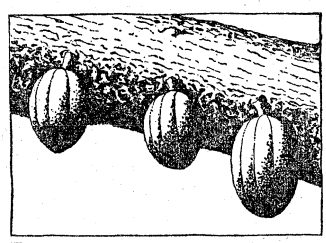


FIG. 7.—CACAO PODS OF THE HARDY FORASTERO TYPE

Cocoa Consumption.—Whilst the world's appetite for cacao preparations has continually grown, the war was responsible for a special increase. In the United States the increase has also been influenced by the absence of import duty. The chart below illustrates the relative consumption in various countries in 1926, whilst the table shows the changes in consumption between 1906 and 1926:—

World's Consumption of Cacao Beans
(In tons of 1,000 kilos.)

Consuming country.	1906.	1916.	1926.
United States	37,949	105,361	187,882
Germany	35,261	11,000	61,484
Great Britain	20,132	38,798	57,321
Holland	11,224	20,019	44,143
France	23,404	39,576	41,650
Switzerland	6,467	14,705	6,710
Spain	5,637	7,449	8,400
Belgium	3,862	2,300	7,423
Italy	1,385	6,745	7,566
Canada	1,035	4,289	7,780
Other countries	11,132	19,421	44,882
Total	157,488	269,663	475,241

Over 90% of the raw cacao consumed in Great Britain in 1926 was grown in the British empire.

For bibliography, history and production of manufactured products *see* CHOCOLATE. (A. W. KN.)

COCOA BUTTER, the pure fat extracted by pressure from the ground and crushed cocoa bean. It is used in the manufacture of confectionery, cosmetics and other toilet preparations. Cocoa butter is sold free from combination with other drugs for treating skin irritations where a pure fat is necessary.

COCO DE MER or **DOUBLE COCO-NUT,** a palm, *Lodoicea maldivica,* a native of the Seychelles islands. The flowers are borne in enormous fleshy spadices, the male and female on distinct plants. The fruits, among the largest known, take ten years to ripen; they have a fleshy and fibrous envelope surrounding a hard nut-like portion which is generally two-lobed, suggesting a double coco-nut. The contents of the nut are edible. The empty fruits (after germination of the seed) are found floating in the Indian ocean, and were known long before the palm was discovered.

COCOMA or CUCAMAS, a tribe of South American Indians living on the Marañon and lower Huallaga rivers, Peru, speaking dialects related to the Tupi-Guarani stock.

COCONUCAN, a linguistic stock or sub-stock of South American Indians, so called from the Coconucos, its best known tribe. The Coconucan tribes lived on the western slopes of the Cordillera Central, east of Popayan in southern Colombia. Although formerly regarded as an independent linguistic stock, Rivet believes the languages of these tribes to be related to the Chibchan (*q.v.*). The Coconucos were a sedentary, agricultural people, warlike in character, and of the same general level of culture as the neighbouring Chibchan tribes. Apart from scanty references in the early chronicles, little is known of them.

See H. Beuchat and P. Rivet, *Affinités des langues du sud de la Colombie et du nord de l'Equateur* (Museon, 1910, vol. xi.).

COCO-NUT OIL AND CAKE. The bulk of the world's supply of coco-nut oil and coco-nut cake is derived from the fruit of the coco-nut palm, variety *Cocos nucifera.* This tree grows wild on the coasts of all tropical countries and is also extensively cultivated for the many products made by natives from the flowers, fruit, leaves, and other parts of the plant. Copra, the dried kernel or meat of the coco-nut from which coco-nut oil is obtained, is the most important commercial product of the coco-nut palm. Cultivation of the tree for copra is localized principally in India, Ceylon, the Philippine Islands, the Dutch East Indies, the Malay States, and the South Sea islands.

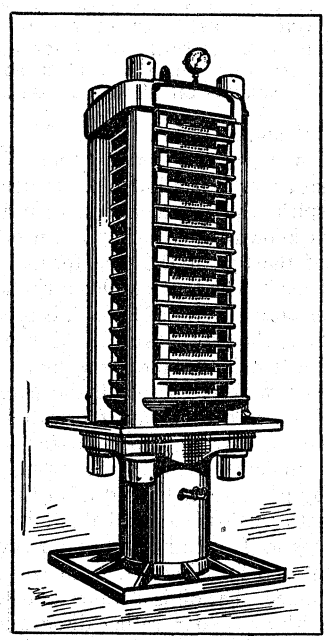
The oil of the coco-nut has been used as an article of food from ancient times. The earliest method of obtaining it was to break the raw kernels into small pieces and expose them to the sun in heaps, from which the oil ran out. An improved method, practised in India from a very early date, consists in triturating the sun-dried coco-nut meat in a mortar and then subjecting the mass to pressure in simple primitive presses. When obtained by the native method that produces the finest and whitest oil, the fresh kernels are pounded to a pulp and thrown into boiling water. The clear oil as it rises to the surface is skimmed off. This process, carried out on a large scale at Cochin on the Malabar coast, has survived to the present day, "Cochin" oil still representing the highest quality. Oils equalling the finest Cochin oil can be, and are, produced in other places (*e.g.,* Ceylon and the Philippine Islands).

The fresh kernel of the coco-nut contains about 50% water and 30% to 40% oil. Therefore, in production of copra the nuts are opened and dried to separate the oil-bearing meat from the shell and to prevent spoilage by putrefaction and fermentation. The earliest method of drying was to expose the kernels to the air and sun, a practice still extensively followed, which gives a good quality white copra ("sun-dried" copra). A more rapid primitive process, adopted particularly in districts where the humidity of the air is excessive, is drying by fire ("kiln drying"). The older method of drying the kernels on a grating of bamboo over a slow fire exposed the material to smoke and resulted in copra of inferior quality. Moreover, copra dried in these prim-

itive kilns was frequently charred, causing it to yield a yellowish oil almost impossible to bleach. A more satisfactory method, first introduced in India and Samoa, is to dry by means of hot air. The meats are spread over a lattice of bamboo sticks and drawn slowly through a heated tunnel meeting a counter-current of hot air. This method yields a fine and white copra of higher value than the sun-dried article. Even better results are claimed for rotary driers introduced in the West Indies. The fresh kernel yields about 60% of dried copra. The proportion of oil in well dried copra averages from 60 to 65%.

Processing Copra.—In Europe and the United States large quantities of coco-nut oil are obtained from imported copra by pressing or by extracting the oil with a solvent. In India and Ceylon large terminal expeller and hydraulic installations are gradually superseding the primitive native presses. Before processing, the dried copra is passed over a magnetic separator to remove any pieces of iron (bolts, nails, etc.). The material is ground finely and then treated as follows:

(a) *Expelling followed by hydraulic pressing.*—The finely ground meats are heated in a tempering conveyor to about 180° F. just before entering the expeller. An expeller is a mechanical press consisting essentially of a cylinder or "barrel" in which an impelling worm turns and continuously forces the tempered copra through a small terminal orifice. The barrel is composed of a series of rectangular steel bars, separated by spacers to form slots. Pressure and heat of friction release the oil which escapes through the slots of the barrel. The capacity of an expeller when producing 18% oil in expeller cake is 15 to 30 tons per 24 hours, depending on its size. The expeller cake is next ground finely and flaked by passing it between a series of steel rolls riding one above the other. This flaked material is cooked at 180° F. and formed into cakes approximately 14x26x3 inches. The cakes are wrapped in human hair or wool cloth and placed in hydraulic box presses. A box press (*see* fig.) consists of a number of rectangular plates set one above the other with angle iron side walls to form "boxes" in which the wrapped cakes are placed. A hydraulic ram gradually presses the plates together, exerting an increasing and finally an enormous sustained pressure on the enclosed cakes. The oil escaping through the cloth wrappings drains from the cakes for an interval ranging from 20 to 60 minutes. The cakes are removed, the cloths stripped away, and the oily edges are trimmed off and reworked. In this manner the oil in the pressed cake is reduced to about 6%. The pressed cakes are broken, cooled and ground to make the product, coco-nut meal.



BY COURTESY OF FRENCH OIL MILL MACHINERY COMPANY

BOX TYPE HYDRAULIC PRESS

Cooked expeller meal is formed into cakes between hair cloth, placed in the boxes and hydraulic pressure applied

(b) *Single expelling of copra.*—Oil expellers have been developed which can express the oil from copra in a single pressing. These expellers may have a horizontal and a vertical pressing barrel, and each may be operated by a separate motor. In order to express the oil in a single mechanical pressing it is necessary first to dry the finely ground copra to a low moisture content (1·5%). This is done in rotary driers in which the ground material tumbles continuously over steam-heated tubes. From the driers the hot meats enter the expeller tempering conveyor, where they are brought to the proper expelling temperature. An expeller of this type has a capacity of about 20 tons of copra per 24-hour day. It reduces the oil in the pressed cake to about 5%. The expeller cake is ground directly into meal.

(c) *Solvent extraction.*—In Europe some coco-nut oil is extracted by means of petroleum solvents (hexane type) from finely ground copra and also from copra which has been prepressed through large expellers. These large prepressing expellers have a capacity of 50 to 60 tons of copra per day and reduce the oil from 65% in copra to about 25–30% oil in expeller meal. In either case the oil-bearing material is treated continuously in a counter-current flow with solvent until the oil left in the extracted meal has been reduced to about 1·5%. The solvent is removed from the extracted meal by means of steam-jacketed, agitated conveyors. The solvent from the oil is recovered by distillation and the last traces of solvent are removed by steam distillation of the oil *in vacuo*.

Copra Meal.—The meal from pressed cake contains 18 to 20% protein and 5 to 7% oil. Solvent extracted cake contains less oil and a proportionately greater amount of protein. Copra meal is valued as a dairy feed principally for its proteins. It is also favoured by some because of the presumed effect of the oil in stimulating milk production.

Coco-nut Oil.—The oil is colourless to yellowish in appearance and melts at about 74° F. Crude coco-nut oil has a characteristic coco-nut odour. Coco-nut oil possesses the exceptional property of undergoing saponification when mixed with warm concentrated caustic lyes. It forms the principal ingredient of cold process soaps. Coco-nut oil is valued for making milled soaps because of the free lathering properties it imparts to them. Because coco-nut oil soap is soluble in brine, it is used in "marine soaps" intended for use in sea water.

Edible coco-nut oil is the product of refining and deodorizing the crude oil to remove free fatty acids, flavours, and other impurities. The refined oil has special qualities which have led to its extensive use in margarine, vegetable butters, shortenings, cooking and salad oils, and as a substitute for cacao butter in the manufacture of chocolates. For the latter a harder stearin fraction is obtained by controlled

TABLE I. *Copra: International Trade, Averages 1930–34, Annual 1937–38*

Country	Average 1930–34		1937		1938*	
	Exports	Imports	Exports	Imports	Exports	Imports
PRINCIPAL EXPORTING COUNTRIES	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds
Netherland India	935,308	310	1,098,422	8	†7,150	†1
Philippine islands	501,432	625	521,484	723	754,121	104
British Malaya	438,043	211,021	450,215	280,889	§417,243	§263,229
Ceylon	179,201	279	158,702	917	168,413	516
New Guinea‡	137,445	0	§171,165	0	§170,636	0
Fiji	45,692	0	67,202	0	§74,978	0
Solomon islands¶	47,048	0	..	0	..	0
Mozambique	57,819	§22	78,893	0	85,048	0
Zanzibar	27,427	0	32,281	0	26,201	0
Tonga	23,708	0	27,525	0	§27,844	0
Samoa, West	24,506	0	29,882	0	§25,177	0
Indo-China	15,487	0	24,524	18	23,114	..
Thailand (Siam)¶	15,073	0	9,870	0	..	0
New Hebrides	19,221	0	26,311	0	..	0
Tanganyika	16,030	0	16,849	0	§8,973	0
Trinidad and Tobago	18,816	1,724	17,277	777	§9,392	§816
Seychelles	10,691	0	12,372	0	§10,318	0
Gilbert and Ellice islands‡	14,044	0	11,444	0	..	0
Total	2,527,591	213,981	2,754,418	283,332	1,808,608	264,666
PRINCIPAL IMPORTING COUNTRIES						
United States	0	513,368	0	537,750	0	513,017
Germany	438	340,783	0	401,953	0	††611,874
France	‖90	422,083	0	303,362	0	314,926
Netherlands	431	154,492	548	102,246	249	117,146
United Kingdom	0	197,719	0	176,357	0	255,228
Denmark	0	160,644	0	163,343	0	166,024
Spain**	0	113,386	0	..	0	..
Australia§	0	28,432	0	53,175	0	49,184
Italy	10	85,999	0	52,633	0	64,674
Czechoslovakia	0	58,379	0	94,250	0	††129,098
Norway	0	79,335	0	81,978	0	99,074
Austria	0	20,542	0	27,361	0	†† 33,346
Sweden	0	21,905	0	71,410	0	87,876
Belgium	119	17,367	877	35,129	55	51,468
Latvia	0	4,257	0	3,711	0	3,416
British India	111	33,102	199	105,087	278	95,977
Japan	0	15,465	0	25,781	0	20,788
Poland	0	28,798	0	19,628	0	43,901
Hungary	0	§§14,310	0	16,311	0	§22,906
Total	1,199	2,301,366	1,624	2,331,465	582	2,679,923

*Preliminary. †Java and Madura only. ‡Year ended June 30. §*International Yearbook of Agricultural Statistics*. ¶Year beginning April. ‖4-year average. **Copra and similar raw materials. §§2-year average.

††Beginning April 1938 trade between Germany and Austria no longer reported as foreign trade in the German statistics. The same applies to trade between Germany and Sudetenland (Czechoslovakia) for the period Sept.–Dec. 1938.

Bureau of Agricultural Economics. Official sources except as otherwise stated.

crystallization of the oil at definite temperatures, followed by pressure filtration.

TABLE II. *Coco-nut Oil*: International Trade, Averages 1930–34, Annual 1937–1938*

Country	Average 1930–34		1937		1938†	
	Exports	Imports	Exports	Imports	Exports	Imports
PRINCIPAL EXPORTING COUNTRIES	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds
Philippine islands	322,517	0	360,005	0	365,133	0
Netherlands	72,347	7,880	39,065	28,819	36,830	17,679
Ceylon	116,701	6	149,759	2	168,889	2
Netherland India	20,827	10,675	61,629	10,431	‡43,600	‡..
Germany	11,687	12,703	1,811	2,949	**2,988	**4,100
France	14,839	14,856	22,374	24,277	19,369	14,334
Denmark	49,467	10,613	40,350	6,826	41,409	8,038
British Malaya	34,251	948	90,738	1,671	§110,883	§813
Australia§	1,493	2	714	4	265	2
Total	644,129	57,683	766,445	74,979	789,366	44,968
PRINCIPAL IMPORTING COUNTRIES						
United States	23,593	304,619	8,909	337,376	7,090	363,941
United Kingdom	6,300	64,525	*706	59,298	556	85,708
Poland	¶123	¶25,125	0	21	0	20
Belgium	¶4,051	¶12,946	258	244	172	404
Sweden	3,820	41,984	20,209	38,703	21,562	58,918
British India	340	43,961	547	52,956	611	55,123
Egypt	0	15,740	0	20,753	0	25,974
Finland	0	8,473	0	16,478	0	18,058
Italy¶	75	4,262	2	2,601	5	1,068
China	0	11,022	0	1,300	0	10,759
Switzerland¶	20	9,728	4	10,970	0	14,657
Czechoslovakia	451	9,888	27	8,492	**108	**11,390
Rumania	1	793	0	7	§0	§20
New Zealand	0	1,070	0	2,440	0	§2,476
Canada	0	9,738	0	45,437	0	34,743
Total	38,774	563,874	30,662	597,076	30,104	683,259

*Crude and refined added without converting. †Preliminary. ‡Java and Madura only. §*International Yearbook of Agricultural Statistics*. ¶Includes similar oils. Bureau of Agricultural Economics. Official sources except where otherwise noted.

**Beginning April 1938 trade between Germany and Austria no longer reported as foreign trade in the German statistics. The same applies to trade between Germany and Sudetenland (Czechoslovakia) for the period Sept.–Dec. 1938. (H. G. K.)

COCO-NUT PALM (*Cocos nucifera*), a beautiful and lofty palm-tree, growing to a height of 60 to 100ft. with a cylindrical stem which attains a thickness of 2ft. The tree terminates in a crown of graceful waving pinnate leaves. The leaf, which may attain to 20ft. in length, consists of a strong mid-rib, whence numerous long acute leaflets spring, giving the whole the appearance of a gigantic feather. The flowers are arranged in branching spikes 5 or 6ft. long, enclosed in a tough spathe, and the fruits mature in bunches of from 10 to 20. The fruits when mature are oblong, and triangular in cross section, measuring from 12 to 18in. in length and 6 to 8in. in diameter. Each consists of a thick external husk or rind of a fibrous structure, within which is the ordinary coco-nut of commerce. The nut has a very hard, woody shell, enclosing the nucleus or kernel, the true seed, within which again is a milky liquid called coco-nut milk. The three well-known marks on the shell correspond to the three original cavities of the ovary but only one cavity, that containing the "milk," remains in the native fruit. One of the marks, that leading to the single cavity, is soft and easily perforated; beneath it lies the embryo. The palm is so widely disseminated throughout tropical countries that it is impossible to distinguish its original habitat. It flourishes on the coast of the East Indies, throughout the tropical islands of the Pacific, and in the West Indies and tropical America. It, however, attains its greatest luxuriance and vigour on the seashore, and it is most at home in the innumerable small islands of the Pacific seas, of the vegetation of which it is eminently characteristic. Its wide distribution, and its existence in even the smallest coral islets of the Pacific, are due to the character of the fruit, which is eminently adapted for distribution by sea. The fibrous husk renders the fruit light and the leathery skin prevents water-logging. The seed will germinate readily on the seashore, the seedling growing out through the soft germ-pore on the upper end of the hard nut. The fruits dropping into the sea from trees growing on any shores would be carried by tides and currents to be cast up and to vegetate on distant coasts.

The coco-nut palm, being the most useful of its entire tribe to the natives of the regions in which it grows, and furnishing many valuable and important commercial products, is the subject of careful cultivation in many countries. On the Malabar and Coromandel coasts of India the trees grow in vast numbers; and in Ceylon, which is peculiarly well suited for their cultivation, it is estimated that 20 millions of the trees flourish.

The uses to which the various parts of the coco-nut palm are applied in the regions of their growth are almost endless. The nuts supply no inconsiderable proportion of the food of the natives, and the milky juice enclosed within them forms a pleas-



BY COURTESY OF THE GOLD COAST GOVERNMENT COMMERCIAL INTELLIGENCE BUREAU

ONE TREE FROM A PLANTATION OF COCO-NUT PALMS, SHOWING GENERAL HABIT OF GROWTH. THE 50 OR 60 NUTS PROBABLY GROWING ON THIS TREE WILL YIELD ABOUT 25 POUNDS OF COPRA, FROM WHICH 1⅕ GALLONS OF OIL SHOULD BE OBTAINED

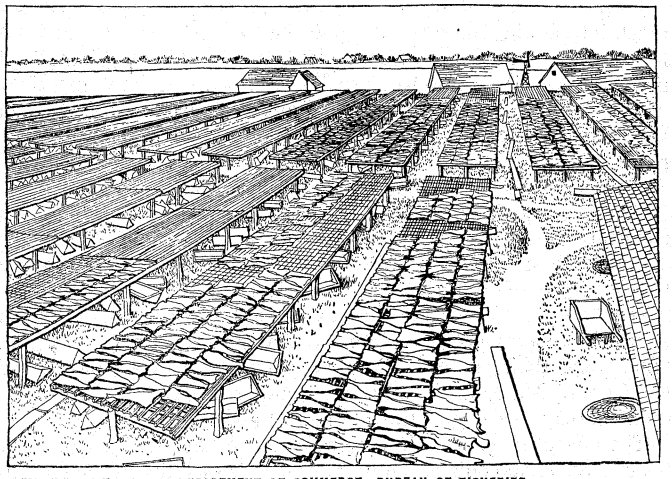
ant and refreshing drink. The juice drawn from the unexpanded flower spathes forms "toddy," which may be boiled down to sugar, or it is allowed to ferment and is distilled, when it yields a spirit which, in common with a like product from other sources, is known as "arrack." As in other palms, the young bud cut out of the top of the tree forms an esculent vegetable, "palm cabbage." The trunk yields a timber (known in European commerce as porcupine wood) which is used for building, furniture, firewood, etc.; the leaves are plaited into cajan fans and baskets, and used for thatching the roofs of houses; the shell of the nut is employed as a water-vessel; and the external husk or rind yields the coir fibre, with which are fabricated ropes, cordage, brushes, etc. The coco-nut palm also furnishes very important articles of external commerce, of which the principal is coco-nut oil. It is obtained by pressure or boiling from the kernels, which are first broken up into small pieces and dried in the sun, when they are known as *copra.* It is estimated that 1,000 full-sized nuts will yield upwards of 500 lb. of copra, from which 25 gallons of oil should be obtained. The oil is a white solid substance at ordinary temperatures, with a peculiar, rather disagreeable odour, from the volatile fatty acids it contains, and a mild taste. Under pressure it separates into a liquid and a solid portion, the latter, coco-stearin, being extensively used in the manufacture of candles. Coco-nut oil is chiefly used in manufacture of soap and margarine. Coir is also an important article of commerce, being in large demand for the manufacture of coarse brushes, door mats and woven coir-matting for lobbies and passages. (*See* MATTING.) A considerable quantity of fresh nuts is exported, chiefly from the West Indies.

COCOPA, the Yuman tribe nearest the mouth of the Colorado river, similar in customs to the Yuma and Mohave. The population, originally not far from 3,000, has decreased to about 600, mostly on Mexican soil.

COCYTUS (Gr. kō-kü-tŏs, anglicized kọ-sī′tụs), a tributary of the Acheron, which flows into the Ionian sea about 20m. N.

of the Gulf of Arta; identified with a tributary of the Acheron or of the Styx, a river in Hades (*cp.* Virgil's *Aeneid,* vi. 132). The etymology suggested is from κωκύειν, to wail, in allusion to the cries of mourners; this is probably a reduplicated form, akin to Skt. kû, cry, with intensive kokuyate.

COD, the name given to the typical fish of the family Gadidae of the order Anacanthini, which includes fishes without spinous fin-rays, with no duct to the air-bladder, and with the pelvic fins anterior in position. The pelvic fins are often many-rayed, and the pelvic bones are not directly attached to the pectoral arch,



BY COURTESY OF U.S. DEPARTMENT OF COMMERCE, BUREAU OF FISHERIES

COD FLAKE YARD, WHERE THE FISH IS SPLIT, SALTED AND DRIED

The greater part of the season's catch in Newfoundland and Norway, the chief cod fisheries of the world, is cured. The split portions are cod flakes

these characters distinguishing the Anacanthini from certain Blennioid fishes of the order Percomorphi, with which they were formerly associated, and indicating their relationship to more primitive orders. The Anacanthini include two principal families, the Macruridae, which are deep-sea fishes without a caudal fin and with the long second dorsal and anal fins continued to the end of the tapering tail, and the Gadidae, in which the caudal fin is composed mainly of dorsal and anal fin-rays, the homocercal fin being greatly reduced, an indication that the ancestral form may have been eel-shaped. The Gadidae are marine with the exception of the burbot (*Lota lota*), which is a freshwater fish. They are most abundant in northern seas, where there are several species of great economic importance, *e.g.,* cod, haddock (*q.v.*), whiting (*q.v.*), ling (*q.v.*), and hake (*q.v.*). In warmer seas there are some deep-water forms of no great value, and the hake genus (*Merluccius*) is the only important one represented in both the north and south temperate zones. The flesh of all these fishes is more digestible than nutritious, being poor in fat.

The cod (*Gadus morrhua*) in common with other fishes of the genus *Gadus,* has three dorsal and two anal fins; the upper jaw projects beyond the lower, and there is a barbel at the chin. The colour varies considerably, but is generally olive-green above with darker spots, and white below; the lateral line is white and conspicuous. The cod is found in the north Atlantic and Baltic but not in the Mediterranean; it also occurs in the north Pacific. Generally it lives on the bottom at depths of 10 to 100 fathoms, and feeds on other fishes, such as herring and sand-eels, and also on squids, mussels, whelks, etc. The spawning season is from January to March; the eggs are minute and are produced in enormous numbers, sometimes 10,000,000 from one female; they float in the water. The young fish attain a length of about two feet in four years; three feet is an average size, but some grow to more than five feet long and weigh over 100lb. The cod is the object of extensive fisheries by line and trawl on the Newfoundland banks, off Iceland and in the North Sea. The greater part of the catch is split, salted and dried; the livers are used for the preparation of cod-liver oil, and the roes are sent to France to be used as groundbait in the sardine fishery; isinglass is made from the air-bladder. (C. T. R.)

C.O.D.: *see* CASH ON DELIVERY.

CODA, in music, a term for a passage which brings a movement or a separate piece to a conclusion. (Ital. for "tail"; from the Lat. *cauda.*) This developed from the simple chords of a cadence into what is often an elaborate and important feature of a composition on a large scale. Beethoven raised the "coda" to a feature of the highest importance. A codetta (diminutive of coda) is merely a small coda, employed to round off, not a complete work, but an intermediate section of it.

CODDE, PIETER (1599–1678), Dutch painter of the school of Haarlem, was born on Dec. 11, 1599, at Amsterdam. He was probably a pupil of Franz Hals, whose painting of the Doelen of "Captain Reaels," left unfinished in 1637, he was asked to complete. He was active as a genre painter at Amsterdam and Leyden, and he liked to represent ladies and gentlemen dancing—Sievers' Collection, Dorpat (1627); Mauritshuis, The Hague (1636); Academy in Vienna (1633), or scenes with soldiery—Mauritshuis, The Hague (1628); Dresden Gallery (1628). He also executed some small portraits (National Gallery, London). He died at Amsterdam on Oct. 12, 1678.

CODDINGTON, WILLIAM (1601–1678), one of the founders of Rhode Island, was born in Lincolnshire, England. He was sent out to the colony at Massachusetts bay as a magistrate, arriving at Salem on June 12, 1630. He was for some time treasurer of the colony, and is said to have built the first brick house in Boston. He supported the cause of Anne Hutchinson, the antinomian, and when she was exiled he left, in 1638, for Rhode Island. His name appears first in the covenant of the settlers (*see* RHODE ISLAND). When Portsmouth and Newport were united (1640) Coddington was appointed the first governor, and he was president of the colony in 1648–49. During his year of office he tried, without success, to secure the inclusion of Rhode Island in the confederacy of the United Colonies of New England. He was again governor in 1674–76. He died on Nov. 1, 1678.

CODE. By codification is now meant "an orderly and authoritative statement of the leading rules of law on a given subject" (Ilbert), but the early collections of laws known as codes were of a different character. "The ancient codes" (wrote Maine) "were doubtless originally suggested by the discovery and diffusion of the art of writing. . . . Their value did not consist in any approach to symmetrical classification, or to terseness and clearness of expression, but in their publicity. . . . They mingled up religious, civil and merely moral ordinances without any regard to differences in their essential character." The oldest known code is that of Khammurabi, for which *see* BABYLONIAN LAW. In ancient India the laws applying to the Hindu community of the time were codified.

Roman law began with the Twelve Tables—a primitive code—and culminated in the code of Justinian, which was given the force of law in A.D. 534. (*See* ROMAN LAW.) "Though the name was invented and used in a somewhat different sense by the Romans, the thing is of far more modern origin. . . . The Romans never advanced beyond a digest," whereas, properly, "a code is a digest of which every title has been consolidated" (Holland). The peoples who overran the Roman empire made collections of rules of law, *e.g.,* the law of the Salian Franks and other Frankish laws. (*See* SALIC LAW; GERMANIC LAWS, EARLY.)

The Rhodian Sea-Law was a collection of rules of maritime law, mainly derived from local customs, originally put together between A.D. 600 and 800. Collections of maritime usages and customs, drawn up for the use of merchants and lawyers, acquired in the 14th and 15th centuries great authority throughout Europe. Some were compiled in Mediterranean ports, and others for the use of merchants trading in the north of Europe. There were, for instance, the laws of Oleron (an island near Bordeaux), the laws of Wisby in Gothland, the *Consolato del Mare* (a collection of the maritime laws of Barcelona), the Oak Book of Southampton, and other collections.

Mediaeval France was divided into *Pays de Droit Ecrit* and *Pays de Droit Coutumier.* In the former, feudal rules overlay the Roman law; in the latter, customs differed in each province, county and municipality. Despite the promulgation of a series of ordinances, an extraordinary diversity of laws continued until,

after the Revolution, they were superseded by the Codes Napoleon which were then drawn up. (*See* CODE NAPOLEON.)

Several European countries have modelled their codes upon those prepared in France under Napoleon, but in Germany events followed an independent course. From 1495 the German common law was a modified form of Roman law, but it was subject to modification by local customs, codes and State laws. Prussian common law was codified in 1794, this step being to some extent an anticipation of the idea of the French codes. With the formation of the North German Confederation in 1866 federal legislation began and a general commercial code was enacted. In 1874 (three years after the formation of the German empire) preparations for general codification commenced. After many revisions the German civil code came into force in 1900 and along with it a remodelled commercial code.

The steps taken in more recent years towards the codification of law, not only in England but also elsewhere, originated in the reforming energy of Jeremy Bentham (1748–1832). Bentham's philosophy of law did not take sufficiently into account the march of events either in the past or in the future. He lived before it had become the practice to work by methods which include historical research, and he did not sufficiently appreciate that there is no finality in law, that it must be revised from time to time as circumstances change. Nevertheless, in this matter he was a great moving spirit. "What he did was to set up an ideal towards which legislation should tend, an ideal which has been materially modified by subsequent reflection and experience, but which has profoundly influenced the thought and action of lawyers and legislators since his time. He has not shown the necessity, but he has shown the utility, of codification" (Ilbert).

In British India the codification of the law may be attributed directly to the influence of Bentham exercised through James Mill and Macaulay. The penal code became law in 1860 and was followed by two codes dealing with procedure, and, in course of time, by a number of others on various branches of the law.

Following earlier attempts made in England to improve the form of the law, a number of statute law commissions were appointed during the earlier part of the Victorian period. Various reforms resulted, and many consolidation acts were passed, dealing with, *e.g.*, the customs, public health, merchant shipping, and so forth. With lapse of time the need for re-consolidation, so as to incorporate later amendments, manifested itself, and from the beginning the process in most instances fell short of full codification because consolidation covered only statutory provisions and did not extend to common law rules. In more recent years some measures have been passed codifying both the statute and the common law relating to particular subjects, *e.g.*, the Bills of Exchange Act, 1882, the Partnership Act, 1890, the Sale of Goods Act, 1893, and the Marine Insurance Act, 1906.

English law is the basis of the law in force in most of the States of the United States, an exception being Louisiana, where a civil code based on the Code Napoleon was adopted in 1808. Much codification of law was carried out in many of the States during the latter part of the 19th century, the first move in this direction being the adoption of a code of civil procedure by the State of New York in 1848. The laws of the South American republics have for the most part been codified.

In Egypt a series of codes came into force in 1875. Japanese law has been codified on the basis of an investigation into the laws of European countries which extended over the greater part of the last quarter of the 19th century. The civil code (which is now the main foundation of the Japanese legal system), and the commercial code are largely modelled on German law.

International Codes.—Besides the codification of national laws something has been done towards codifying rules of law regulating the relations between States and between the subjects of different States. These rules are commonly referred to as those of public and private international law respectively. The advisory committee of jurists which met at The Hague in 1920 to draft the plan for the Permanent Court of International Justice recommended that, in continuation of The Hague Conferences of 1899 and 1907, steps should be taken to bring about the re-statement of the established rules of international law and the formulation of additional rules. Pursuant to this the League of Nations in 1924 appointed a committee of experts for the progressive codification of international law composed of jurists from 17 countries.

This Committee reported in 1927 and is continuing its work. Pursuant to its recommendations a first codification conference was held at The Hague in 1930 to consider (1) nationality, (2) territorial waters and (3) responsibility of States for damage done in their territory to the person or property of foreigners.

Proposals for codification of international law have aroused much interest in America. In 1906 the third Pan-American Conference adopted a convention under which codes of private and public international law were to be prepared. At later meetings of the Pan-American Conference (including that at Havana in 1928) further discussion of projects of conventions has taken place.

On the subjects selected for the first codification conference of 1930 as well as other possible subjects for the work of codification the progress which may prove to be practicable will be due in large measure to unofficial spade work done in the past by the Institute of International Law and the International Law Association. These, since 1873, have been busy with the problems to which Governments have more recently turned their attention. Since 1896 their activities have been supplemented by those of the Comité Maritime International, and since 1905 by those of the American Society of International Law.

The official movements above referred to have not yet brought about any actual codification of rules of law of international application, but in certain directions codification or unification has already been accomplished. In the absence of an international legislature no actual codification by means of international legislation is possible, but an equivalent result has been produced in relation to certain matters by national legislation being passed in conformity with an international convention, or (in some commercial matters especially) unification has been achieved by the formulation and common adoption of standard clauses for incorporation by reference in contracts. In this way the International Law Association brought about the unification of some of the rules of law and practice relating to general average. International rules drawn up for this purpose and incorporated by reference in shipping documents are known as the York-Antwerp Rules. The first rules adopted were those dated 1877. They were revised in 1890 and in 1924 were again revised and expanded into what is practically a code of general average (*see* AVERAGE). On the other hand the regulations for the prevention of collisions at sea, having been adopted by all maritime nations, are an example of standardized national legislation. Working after this method, the Comité Maritime International has drafted international conventions, some of which have been carried into effect by national legislation, while others await further action by maritime States. In the United States steps to standardize certain commercial laws throughout the different States of the Union have brought about the passing of uniform acts relating to negotiable instruments, sale of goods, bills of lading, warehouse receipts, etc.

BIBLIOGRAPHY.—Sir H. S. Maine, *Ancient Law* (1861); T. E. Holland, *Essays upon the Form of the Law* (1870); C. Ilbert, *Legislative Methods and Forms* (1901); W. Burge, *Commentaries on Colonial and Foreign Laws* (1907–28); E. J. Schuster, *Principles of German Civil Law* (1907); W. Ashburner, *The Rhodian Sea-Law* (1909); A. F. Schuster, *The German Commercial Code* (1911); S. D. Cole, "Codification of International Law," in *Grotius Society Transactions* (1927). (S. D. C.)

CODEINE occurs naturally in opium, being one of the alkaloids (*q.v.*) of the phenanthrene group and a derivative of morphine (*q.v.*), retaining in a modified form the characteristic physiological action of the latter. It crystallizes with one molecule of water, $C_{18}H_{21}O_3N,H_2O$, in large translucent prisms, melts at 155° C and has a specific rotation $[\alpha]$ −137·7°. It behaves as a monoacidic base, forming salts of which the sulphate and the phosphate are those most frequently used in medicine.

CODE NAPOLÉON, the first code of the French civil law, known at first as the *Code civil des Français,* was promulgated in

its entirety by a law of the 30th Ventose in the year XII. (March 21, 1804). On Sept. 3, 1807, it received the official name of Code Napoléon, although the part that Napoleon took in framing it was not very important. A law of 1818 restored to it its former name, but a decree of March 27, 1852, re-established the title of Code Napoléon. Since Sept. 4, 1870, the laws have quoted it only under the name of the Code Civil.

Never has a work of legislation been more national in the exact sense of the word. Desired for centuries by the France of the *ancien régime,* and demanded by the *cahiers* of 1789, this "code of civil laws common to the whole realm" was promised by the constitution of 1791. However, the two first assemblies of the Revolution were able to prepare only a few fragments of it. The preparation of a coherent plan began with the Convention. The *ancien régime* had collected and adjusted some of the material. There was, on the one hand, a vast juridical literature which by eliminating differences of detail, had disengaged from the various French "customs" the essential part which they had in common, under the name of "common customary law"; on the other hand, the Roman law current in France had in like manner undergone a process of simplification in numerous works, the chief of which was that of Domat; while certain parts had already been codified in the *Grandes Ordonnances,* which were the work of d'Aguesseau. This legacy from the past, which it was desired to preserve within reason, had to be combined and blended with the laws of the Revolution, which had wrought radical reforms in the conditions affecting the individual, the tenure of real property, the order of inheritance and the system of mortgages. Cambacérès, as the representative of a commission of the Convention, brought forward two successive schemes for the Code Civil. As a member of one of the councils, he drew up a third under the Directory, and these projected forms came in turn nearer and nearer to what was to be the ultimate form of the code. So great was the interest centred in this work, that the law of the 19th Brumaire, year VIII., which, in ratification of the previous day's *coup d'état* nominated provisional consuls and two legislative commissions, gave injunctions to the latter to draw up a scheme for the Code Civil. This was done in part by one of the members, Jacqueminot, and finally under the constitution of the year VIII., the completion of the work was taken in hand. The legislative machinery established by this constitution, defective as it was in other respects, was eminently suited for this task. Indeed, all projected laws emanated from the Government and were prepared by the newly established Council of State, which was so well recruited that it easily furnished qualified men, mostly veterans of the Revolution, to prepare the final scheme. The Council of State naturally possessed in its legislative section and its general assembly bodies both competent and sufficiently limited to discuss the texts efficiently. The *corps législatif* had not the right of amendment, so could not disturb the harmony of the scheme. It was in the discussions of the general assembly of the Council of State that Napoleon took part, in 97 cases out of 102 in the capacity of chairman, but, interesting as his observations occasionally are, he cannot be considered as a serious collaborator in this great work.

Those responsible for the scheme have in the main been very successful in their work; they have generally succeeded in fusing the two elements which they had to deal with, namely ancient French law, and that of the Revolution. The point in which their work is comparatively weak is the system of hypothec (*q.v.*), because they did not succeed in steering a middle course between two opposite systems, and the law of March 23, 1855 (*sur la transcription en matière hypothécaire*) was necessary to make good the deficiency. A fault frequently found with the Code Civil is that its general divisions show a lack of logic and method, but the division is practically that of the *Institutes* of Justinian, and is about as good as any other: persons, things, inheritance, contracts and obligations, and finally, in place of actions, which have no importance for French law except from the point of view of procedure, privileges and hypothecs, as in the ancient *coutumes* of France, and prescription. It is, *mutatis mutandis,* practically the same division as that of Blackstone's *Commentaries.*

Of late years other objections have been expressed; serious omissions have been pointed out in the code; it has not given to personal property the importance which it has acquired in the course of the 19th century; it makes no provision for dealing with the legal relations between employers and employed which modern complex undertakings involve; it does not treat of life insurance, etc. But this only proves that it could not foretell the future, for most of these questions are concerned with economic phenomena and social relations which did not exist at the time when it was framed. The code needed revising and completing, and this was carried out by degrees by means of numerous important laws. In 1904, after the celebration of the centenary of the Code Civil, an extra-parliamentary commission was nominated to prepare a revision of it, and at once began the work.

(J. P. E.)

Dissemination of the Code.—The influence of the Code Civil has been very great, not only in France, but also abroad. It should be remembered that when the Revolution broke out France had for a century and a half held, almost without a rival, the leading place among the nations of the world. Her language was well on the way to succeeding Latin as the common speech of civilized men; her literature, her arts, the fascination of her culture, the splendour of her capital city, the devotion of her missionaries, held all mankind spell-bound. Yet her law had no admirers or imitators in other countries. Few foreigners thought it worth while to study her meagre legal literature; few students from abroad sought admission to her law-schools. The Revolution and the empire, by the alarm which they excited and by the spirit of nationalism which they stimulated in other countries, went far to forfeit for France the pre-eminence which she had won and was winning by peaceful penetration. But the code saved the situation; and ever since its promulgation (March 21, 1804), France has exerted an incomparable influence upon the institutions and legal culture of the civilized world. Indeed, until the promulgation of the German civil code (Aug. 24, 1896) the Code Napoléon has been without a competitor as a model for law reformers throughout all parts of the world outside the British empire and the United States. In the absence of an English code, the English common law has, in spite of the great place which it occupies, found acceptance in no country outside the circle of those which, by reason of conquest, or of colonization, possess English-speaking rulers. The 19th century was pre-eminently an age of nation-making. In Europe it saw the creation or the unification of Germany, Italy, Belgium, Rumania, Bulgaria and Greece; on the American continent it saw the Spanish and Portuguese colonies transformed into 15 new nations; and in the East it witnessed Japan, Siam, Turkey and Egypt attempting with greater or less success to grasp the secret of European pre-eminence. Of these 25 nations almost all sought to mark their succession to political maturity, and to proclaim their adherence to the European world, by a general revision and codification of their laws; and in most cases the model followed was that furnished by the Code Napoléon. The code was attractive in form; it was written in French; it was, or seemed to be, easy to understand; it bore the name of the greatest man of the age; it claimed to be catholic, rational, imperial and universal; it was secular without being irreligious and democratic without being revolutionary. In short, according to the ideas of 19th-century liberalism, it set forth in chapter and verse the fundamental articles of the social contract.

Nor did the code have to rely upon its intrinsic merits alone. The reorganization of the French educational system, and particularly of the universities, which constituted one of Napoleon's principal achievements, created law-schools which in their turn produced an imposing literature of exposition and commentary on the code. This literature has been an important factor in promoting the adoption and assimilation of the code by foreign countries.

The Napoleonic Empire.—When first promulgated in 1804, the French code came automatically into force in all those countries which were at that time subject to the empire. These were Belgium, Luxemburg, the Palatinate, those parts of Rhenish Prussia and Hesse-Darmstadt which were situated on the left bank of

the Rhine, the territory of Geneva, Savoy, Piedmont and the duchies of Parma and Piacenza. Napoleon subsequently promulgated the code in the following countries as they were successively conquered: Italy (by decree of March 30, 1806); Holland (Oct. 18, 1810), the Hanseatic departments (*senatus-consultum* of Dec. 13, 1810); grand duchy of Berg (decree of Dec. 17, 1811). The following countries adopted the code *proprio motu*, though doubtless under some pressure, before the fall of the empire: Westphalia, Hanover, the grand duchies of Baden, Frankfurt, Nassau and Warsaw, several of the Swiss cantons, the free city of Danzig, the Illyrian provinces and the kingdom of Naples.

The blows delivered at Leipzig (1813) and Waterloo (1815) to French prestige gave a check, but only for a short time, to the dissemination of the code. In many parts of Italy, for example, the Restoration Governments revived the old laws; but they were speedily compelled to recognize that the clock could not be put back in so violent a fashion, and to revert to codes on the French model. The code of the two Sicilies (1819), the code of Parma, promulgated by the ex-empress, Marie-Louise, in 1820, the important Sardinian or "Albertine" code promulgated for Piedmont in 1848, and the civil code of Este (1851) all bear the mark of French influence. These essays in legislation led up to and were replaced by the general civil code for the new kingdom of Italy which came into force on Jan. 1, 1866. The similarity of this code, which is still in force, to the French code is particularly marked in all those parts in which both remain closest to Roman law, *i.e.*, in the sections treating of obligations and real rights. The degree of this similarity may be judged by the fact that for some years past a committee composed of French and Italian jurists has been engaged in the preparation of drafts with a view to a uniform revision of those parts of the two codes which relate to the law of obligations.

Europe After Waterloo.—The restitution, after Waterloo, of their possessions on the left bank of the Rhine, to Prussia and the German States, was not followed by the abandonment of the French code, which remained in force until replaced in 1900 by the general code for the German empire. In Baden the Code Napoléon was transmuted and preserved, without substantial change, in the *Badisches Landrecht* and in this form had a similarly long lease of life. The code not only remained in force in this country, but was the subject of influential exposition. The *Commentary* of Zachariae, a Heidelberg professor, published in 1808 was the first general treatise on the code in any language. Not only was it destined to reappear in numerous successive editions in German, but it served as the basis for the French *Commentary* of Aubry and Rau, of which the last edition, completed in 1922, still bears on the title page "d'après la méthode de Zachariae." Puchelt's *Zeitschrift für französisches civilrecht*, founded in 1870 and published at Mannheim, continued to appear till early in the present century.

Egypt.—Egypt offers an example of the reception not only of the Code Civil, but of its four companion codes, by a people totally alien to Europe in all cultural traditions. When, in 1874, the Egyptian Government obtained the consent of the Powers to the institution of the mixed tribunals, it was agreed without debate that the only possible law with which to equip them was that of the French code. The Code Civil, as adapted for application by the new tribunals, was shorn of all matters relating to personal status and to the effects on property of marriage and death. In 1883, the year following the British occupation, the French codes were extended, in a form almost identical with that adopted by the mixed courts, to the newly organized native jurisdiction. The result of this twofold "reception" of the French codes has been that for the last 50 years Egypt has looked to French text-books, to French judicial decisions and in a large measure to French professors, for the progressive elucidation of the law. It is largely for this reason that in spite of the British occupation the social and cultural influence of France has remained supreme in that country. It has been remarked that proposals for innovation made by English advisers have as often met with opposition on the ground that they offended against the principles of French law as on the ground that they trespassed against the sacred law of Islam.

Japan.—The course of events in Japan has been different, and even more instructive. One of the first acts of the Restoration Government, so early as 1870, was to cause the Code Napoléon to be translated, and to send for French jurists to supervise the administration of justice and to organize legal education. Though not promulgated as law, the French code in this way and in the absence of any serious rival, either indigenous or foreign, acquired great authority from the beginning of the new regime. In 1880 there was published a draft civil code, prepared by M. Boissonade, a member of the French legal mission. This code, though it, too, was not promulgated as law, exercised for 16 years as great an influence in the country as if it had been legally in force, and was treated by the judges as a statement of the principles of natural reason and equity. Meanwhile, concurrently with the academic teaching of French law, provision had been made by the Japanese Government for instruction in Anglo-American law at the University of Tokyo.

In 1892 M. Boissonade's code was on the eve of being put into force, when the Diet voted that it should be submitted to a further revision. This decision appears to have been due to dissensions between the French and English schools of legal thought. The result was that when the revised code was finally promulgated in 1896 it was found to be neither English nor French but German in inspiration.

Competition of German Civil Code.—This *dénouement* was symbolic. The German civil code, published in its final form in 1895, was the first serious rival which Napoleon's code had had to encounter. As compared with its French predecessor, the German code had the advantage derived from a century of progress in legal science; it was a more carefully thought out piece of work; it was greatly superior in arrangement; it distinguished more clearly between substance and accident, between principle and application; in short, it was a more scientific piece of work. There are strong indications that it may now be taken to have replaced the French code as the model for future essays in codification. The Swiss civil code, for example, which bears date Dec. 10, 1907, is largely modelled on the German code, though in form it is shorter and simpler. The Turkish republic has adopted it, almost without alteration, as the civil code of Turkey. (M. S. A.)

BIBLIOGRAPHY.—V. A. and P. A. Dalloz, *Code civil* (3 vols., 1873–90) and *Additions au code civil* (1911, etc.) in *Jurisprudence Générale* (1873, etc.); *Le code civil: livre du centenaire* vol. ii. (1904); E. Blackwood Wright, *The French Code Civil as amended up to 1906* (trans. with notes, 1908); M. Planiol, *Traité élémentaire de droit civil français*, 6th ed. vol. i. pp. 53 *et seq.*

CODES: *see* UNITED STATES.

CODES AND CIPHERS, general terms designating the methods employed in the practice of cryptography, or secret writing; often also used to designate the cryptograms produced thereby. In recent years, because of the growth of governments, the expansion of commerce, and especially the remarkable progress made in the art of electrical communications, they have become essential adjuncts to the conduct of diplomatic, naval, military and commercial affairs.

The final text of cryptograms to be transmitted electrically should, for reasons of practicability, be composed exclusively of letters of the alphabet, and, for reasons of economy, be arranged in regular groups of five or ten letters; cryptograms composed of groups of figures, although acceptable, are more costly and therefore not so common; those composed of intermixtures of letters and figures are rarely encountered, and those containing characters other than letters or figures are not accepted for transmission. Although in theory no sharp line of demarcation can be drawn between code systems and cipher systems, in modern practice the technical differences between them are sufficiently marked to warrant their being treated as separate categories of methods. It is convenient to consider cipher systems first, then code systems, with the understanding that only a very few of the limited number of systems suitable for serious usage can here be outlined.

Cipher Systems.—In general, cipher systems involve a cryptographic treatment of textual units of constant length, usually single letters, sometimes pairs, rarely sets of three letters, these

being treated as symbols without reference to their identities as component parts of words, phrases and sentences. Every practical cipher system must combine (1) a basic method of treatment which is constant in character, with (2) a keying principle which is variable in character and employs specific secret keywords, phrases, or numbers, the individual compositions of which determine or control the exact results under the basic method. The basic method must be such that even if known to the "enemy" no messages can be read by him unless he also knows the specific keys applicable to those particular messages.

Despite a great diversity in the external appearance and internal constitution of ciphers, there are only two basic classes of systems, transposition and substitution. The former involves a rearrangement or change in the sequence of the plain-text letters, without any change in their identity; the latter, a replacement of the plain-text letters by other letters or by figures, without any change in their original sequence. The two systems may be combined in a single cryptogram.

Transposition systems usually involve the inscribing of plain-text letters in a more or less regular geometrical design, beginning at a prearranged initial point and following a prescribed route, and then transcribing the letters from the design, beginning at another prearranged initial point and following another prescribed route. The design may take the form of a rectangle, trapezoid, octagon, triangle, etc., but systems in which the specific keys consist solely in keeping the designs, the initial points, and the routes secret are not often employed because of their limited variability. In this same class also fall systems which employ perforated cardboard designs called grilles, descriptions of which will be found in works listed in the bibliography. The system most commonly used in practice is that designated as columnar transposition, wherein the transposition design takes the form of a simple rectangular figure, the dimensions of which are determined in each instance jointly by the length of the individual message and the length of the specific key. An example is shown in fig. 1.

Plain-text message: **DELAY DEPARTURE UNTIL FURTHER NOTICE.**

T	E	L	E	G	R	A	P	H
9	2	6	3	4	8	1	7	5
D	E	L	A	Y	D	E	P	A
R	T	U	R	E	U	N	T	I
L	F	U	R	T	H	E	R	N
O	T	I	C	E				

Key

Cryptogram

ENEET FTARR CYETE AINLU UIPTR DUHDR LO

Fig. 1.—An example of simple columnar transposition. The numerical key is derived by numbering the letters of the keyword ("telegraph") in accordance with their relative order of appearance in the ordinary alphabet, repeated letters, if present in the key, being numbered in sequence from left to right. The message is written in the normal manner from left to right in successive horizontal lines underneath the key, forming a "rectangle" of columns of letters. These letters are then transcribed in regular groups of five from the rectangle by reading down the columns, taking the latter in the sequence indicated by the key numbers. The last line of the rectangle may be completely filled with letters, nonsignificants being added if necessary; but the security of the method is considerably increased if the last line shows one or more blank spaces, as in this example.

In the foregoing case the letters undergo a single transposition; in cases involving double transposition, that is, wherein the letters undergo two successive transpositions, the security of the cryptograms is very greatly increased, provided the methods selected are such as will effectively disarrange individual letters and not merely whole columns or rows. A practical system of double transposition is illustrated in fig. 2.

The principal advantages of transposition systems lie in their comparative simplicity, speed of operation, and, in the case of true double transposition, their high degree of security; but despite these important considerations they do not at the present time play a prominent rôle in practical cryptography because of certain defects inherent in and common to all methods of transposition.

Substitution systems involve the use of conventional alphabets called substitution alphabets or cipher alphabets, and the complexity of any particular system depends upon three conditions: (1) the nature of the cipher alphabets employed, (2) the number of them involved in a single cryptogram, and (3) the specific

Plain-text message: **DELAY DEPARTURE UNTIL FURTHER NOTICE.**

T	E	L	E	G	R	A	P	H
9	2	6	3	4	8	1	7	5
D	E	L	A	Y	D	E	P	A
R	T	U	R	E	U	N	T	I
L	F	U	R	T	H	E	R	N
O	T	I	C	E				

(a)

T	E	L	E	G	R	A	P	H
9	2	6	3	4	8	1	7	5
E	N	E	E	T	F	T	A	R
R	C	Y	E	T	E	A	I	N
L	U	U	I	P	T	R	D	U
H	D	R	L	O				

(b)

Cryptogram

TARNC UDEEI LTTPO RNUEY URAID FETER LH

Fig. 2.—An example of true double transposition. The cipher letters resulting from the first transposition rectangle (a) are written under the key of the second transposition rectangle (b) just as though they constituted plain-text, that is, from left to right, in successive horizontal rows. The final transposition is then performed in exactly the same manner as in fig. 1, yielding five-letter groups. The two rectangles may be based upon the same keyword, as in this example, or upon wholly different keywords.

manner in which they are used in the enciphering process. As to their nature, cipher alphabets are of various types, and are known under various names, such as standard, direct, reversed, systematically-mixed, keyword-mixed, random-mixed, reciprocal, conjugate, etc., all having reference to the nature of the sequences of letters composing them, their manner of production, the interrelations existing among them internally or externally, etc. The most important factor in connection with a cipher alphabet is whether the sequence, regardless of its nature, is known or unknown to the enemy; for if its sequence is known, any conventional or disarranged alphabet may be handled with the same facility as the normal or ordinary alphabet. As to the number of alphabets involved, substitution systems are either monoalphabetic, involving a single alphabet, or polyalphabetic, involving two or more alphabets. In essence the difference between them lies in the fact that in the former the equivalence between plain-text and cipher letters is of a constant or invariable nature throughout the cryptogram, whereas in the latter it is of a changing or variable nature. So far as secrecy is concerned, the third condition mentioned above, the manner in which the various cipher alphabets are employed, is the most important.

Monoalphabetic systems, an example of which is shown in fig. 3, can be passed over in a few words. They represent the simplest

Plain-text message: **DELAY DEPARTURE UNTIL FURTHER NOTICE.**

3	2	6	8	5	1	7	4
G	E	T	Y	S	B	U	R
A	C	D	F	H	I	J	K
L	M	N	O	P	Q	V	W
X	Z						

Cipher Alphabet

A B C D E F G H I J K L M
B I Q E C M Z G A L X R K

N O P Q R S T U V W X Y Z
W S H P T D N U J V Y F O

Enciphering

Plain-text: **DELAY DEPARTURE UNTIL FURTHER NOTICE**
Cipher: **ECRBF ECHBTNUTC UWNAR MUTNGCT WSNAQC**

Cryptogram

ECRBF ECHBT NUTCU WNARM UTNGC TWSNA QC

Fig. 3.—An example of monoalphabetic substitution. Each letter of the message is replaced by its equivalent as given in the cipher alphabet. The latter is a good example of a systematically-mixed alphabet, derived from an easily remembered word, in this case "Gettysburg." The keyword is written on one line, repeated letters, if present, being omitted, and the remaining unused letters of the ordinary alphabet are written in horizontal lines below the keyword. The numerical key (326851174) is derived from the first line. The resulting incomplete rectangle of 26 letters is then treated exactly as in figure 1, yielding the sequence BIQECMZ . . . , which is then written under the ordinary alphabet and forms the cipher alphabet.

types of substitution and, regardless of the type of cipher alphabet employed, practically every example can be readily solved by the well-known principles of frequency.

The foregoing example illustrates monoalphabetic substitution which is monoliteral in character, that is, each letter is replaced by another single letter; biliteral monoalphabetic substitution, where each letter is replaced by a pair of letters, is sometimes encountered, and is illustrated in fig. 4.

Polyalphabetic systems are often referred to as double-key systems, and, as noted above, employ two or more cipher alphabets

Plain-text message: **DELAY DEPARTURE UNTIL FURTHER NOTICE.**

First letter \ Second letter	A	B	C	D	E
A	T	E	L	G	R
B	A	P	H	B	C
C	D	F	I	K	M
D	N	O	Q	S	U
E	V	W	X	Y	Z

Enciphering

Plain: D E L A Y D E P A R T
Cipher: CA AB AC BA ED CA AB BB BA AE AA

Plain: U R E U N T I L F U R
Cipher: DE AE AB DE DA AA CC AC CB DE AE

Plain: T H E R N O T I C E
Cipher: AA BC AB AE DA DB AA CC BE AB

Cryptogram

CAABA CBAED CAABB BBAAE etc.

Fig. 4.—An example of biliteral, monoalphabetic substitution. A keyword alphabet of 25 letters (I serving also for J) is written in a square 5 x 5. (In this case the alphabet is based upon the word "telegraph.)" The letters (A,B,C,D, E) at the side and top of the square, taken in pairs, can then be used to represent the letters within the square. Thus, D = CA, E = AB, etc. The letters at the side of the square may be the same as or different from those at the top; in both cases keywords, identical or different, may be used instead of the letters A,B,C,D,E.

in the encipherment of single dispatches. In a given system the alphabets may be entirely independent of and bear no relation to one another, or they may be interrelated. In the former case their number may be unlimited, the separate alphabets being drawn up at random and arranged in any convenient manner; in the latter case the alphabets are limited in number and are interrelated because they are secondary alphabets derived by juxtaposing two basic or primary alphabets at the 26 possible points of coincidence and noting the 26 different values given for plain text A, B, C . . . Z, for the 26 successive juxtapositions. In the simplest case of interrelated alphabets, that resulting when the two primary alphabets are both normal sequences, proceeding in the same direction, the secondary alphabets are called standard alphabets, which when successively tabulated yield a symmetrical table (fig. 5) known in the literature under various names such as Vigenère table, square table, quadricular table, etc. Such a table may be used in several ways. The most common method employs the top line as the plain-text alphabet and the successive horizontal lines as the cipher alphabets, each of which may be designated by its initial letter. Thus, the fourth or D alphabet is the one in which plain-text A is represented by cipher D, plain-text B, by cipher E, etc. In the ninth or I alphabet, A=I, B=J, etc. Therefore, when several alphabets are to be employed in a message, the letters of a prearranged keyword can serve to indicate the number, identity, and sequence of the alphabets to be selected.

Plain-text letter

Key letter	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

Fig. 5.—The simple Vigenère table. The cipher equivalent of a given plain-text letter enciphered by a given key letter is that letter which stands at the intersection of the vertical column headed by the former and the horizontal row begun by the latter. Thus, plain-text letter E enciphered by key letter M yields cipher letter Q, or, in brief notation, $E_p(M_k) = Q_c$; $E_p(X_k) = B_c$, etc.

Various modifications of the simple Vigenère table are encountered, these involving different types and arrangements of alphabetic sequences in the table, but in every case where these sequences can be arranged so as to exhibit symmetry of position as regards the order in which the letters fall in the successive rows or columns, sliding or concentric primary alphabets may be employed to produce the same results as the table, and are often more convenient than the latter.

Polyalphabetic substitution systems may be classified as periodic or aperiodic, depending upon whether or not the cryptograms produced by them exhibit external phenomena of a cyclic nature. Periodicity is exhibited externally whenever the substitution process involves the use of repeating keying elements which operate in conjunction with a constant number of cipher alphabets. Periodic systems may be further classified into multiple alphabet and progressive alphabet systems. In the former type only limited numbers and specific members of the complete set of alphabets pertaining to the system are employed in a single message, the number, sequence and identities of the alphabets being governed in each case by the key, which is repeated as often as necessary to encipher the message. An example is shown in fig. 6.

In progressive systems all the cipher alphabets pertaining to the system are employed in succession in a single, definite sequence which may be repeated. Hence, the length of the period corresponds to the total number of cipher alphabets involved in the system. Usually the sequence in which the alphabets are used varies with each message, this constituting one of the important factors in secrecy. To illustrate, suppose the system embodies a set of 50 mixed alphabets, each designated by a number. A numerical key consisting of the numbers from 1 to 50, constructed either by random selection or by derivation from a word, phrase or sentence, is employed to control the sequence in which the alphabets are to be used in enciphering a specific message; if the latter contains 500 letters, the sequence passes through 10 cycles. Another message may be enciphered by a different numerical key; with 50 alphabets the total number of different numerical keys possible is $50 \times 49 \times 48 \times \ldots \times 1$, an extraordinarily great number.

Key:	T	R	O	Y	T	R	O	Y	T	R	O	Y	T	R	O	Y	T	R	O	Y
Plain-text:	L	E	T	T	E	R	N	O	T	Y	E	T	R	E	C	E	I	V	E	D
Cipher:	E	V	H	R	X	I	B	M	M	P	S	R	K	V	Q	C	B	M	S	B

Fig. 6.—An example of multiple alphabet substitution. The alphabets of the simple Vigenère table (fig. 5) are used in conjunction with the keyword TROY, which is written above the plain text and repeated as many times as required. Each letter is then enciphered by the keyletter above it. Thus, for the first letter, $L_p(T_k) = E_c$; for the second letter, $E_p(R_k) = V_c$, etc. Usually all the plain-text letters governed by the first letter of the key are enciphered in succession, then those governed by the second, etc., this method reducing the possibility of error. In practice, the keyword, and therefore the period, is usually longer than that employed in this example, words and phrases of 15 to 20 or more letters being common. Much more important, however, is the fact that the alphabets employed in modern times are seldom those of the simple Vigenère table, but are mixed alphabets, the use of which makes the cryptograms more secure against solution.

Polyalphabetic systems of the aperiodic type present the greatest diversity in construction. In these systems periodicity is either entirely lacking because of the inherent nature of the method, or it is suppressed by incorporating variable elements as period interrupters. In the aperiodic system designated as the running or nonrepeating key system, periodicity is avoided by employing for the key the continuous text of a book, identical copies of which are in possession of the correspondents. The starting point of the key is agreed upon in advance, or is signalled by special indicators to designate the exact point where the key begins. Another type of nonrepeating key system, often designated as the auto-key system, is that in which, beginning with a preconcerted keyletter, each cipher letter (or sometimes each plain-text letter) becomes the keyletter for the encipherment of the next plain-text letter.

Among the systems in which periodicity is suppressed by introducing a variable element, or interrupter, one of the simplest is that wherein encipherment is performed according to word lengths, each letter of the key serving to encipher a complete word by the same alphabet. Words being irregular in length, periodicity is suppressed. Another system, called the interrupted-key method, employs a keyword which is broken at irregular intervals by a

subsidiary key, or by the insertion of a specially agreed upon letter serving as an indicator. Thus, using the keyword WEDNESDAY, a message may be enciphered according to the interrupted key WED/WEDNES/WE/WEDN/WEDNESD, etc. If a special indicator is used, the interrupter may be inserted at will, since in decipherment its reappearance serves to indicate where the breaks in the keying sequence occur. Sometimes a prearranged plain-text letter serves as the interrupter itself; sometimes a cipher letter.

The various systems of substitution thus far mentioned are monographic in nature, involving single letters; in digraphic systems, substitution takes place by pairs, usually by means of squares in which the letters of the alphabet are disposed according to agreement and the cipher equivalents of pairs are found by following certain rules. One of the best known methods is that called the Playfair method, illustrated in fig. 7.

L	E	X	I	N
G	T	O	A	B
C	D	F	H	K
M	P	Q	R	S
U	V	W	Y	Z

1. Message: **AM FOLLOWING ON NEXT TRAIN.**
2. Plain-text: **AM FO LX LO WI NG ON NE XT TR AI NX**
3. Cipher: **GR QF EI XG YX LB BX LX EO AP HA LI**

Cryptogram

4. **GRQFE IXGYX LBBXL XEOAP HALI**

Fig. 7.—The Playfair cipher; an example of digraphic substitution. An alphabet square of 25 letters (I serving also as J) based upon a keyword (in this case "Lexington") is drawn up, and substitution is performed with pairs of letters. Three cases as regards the position occupied in the square by the members of a pair are possible; they lie (1) in the same horizontal row, or (2) in the same vertical column, or (3) at the opposite ends of one of the diagonals of an imaginary rectangle. By studying the following examples under each case the method of finding equivalents will become apparent: Case (1) LI = EN, AB = BG, OB = AG; Case (2) ED = TP, EV = TE, PV = VE; Case (3) ER = IP, IM = LR, ST = PB. The text of the message to be enciphered, line 1 in the figure, is divided up into pairs, line 2. Double-letter pairs in the text are to be separated by an interposed letter such as X, as shown in the case of the word "following" in this example. Note also the addition of the letter "X" to the end of the message in order to make a pair of letters. The cipher equivalents are shown in line 3, the final cryptogram in five-letter groups, in line 4. Various arrangements of letters in the alphabet square are possible, and completely disarranged alphabets may be employed.

Properly selected methods of transposition and substitution when combined into a single system result in the production of cryptograms of great security, but because of the additional complexities of operation introduced by the combination, with the resultant increased possibilities of error, such systems are not often encountered in practice. A good example, ingenious because of its simplicity and security, is that illustrated in fig. 8.

	A	B	C	D	E
A	T	E	L	G	R
B	A	P	H	B	C
C	D	F	I	K	M
D	N	O	Q	S	U
E	V	W	X	Y	Z

(1)

Substitution

Plain: D E L A Y D E P A R T
Cipher: CA AB AC BA ED CA AB BB BA AE AA

Plain: U R E U N T I L F U R
Cipher: DE AE AB DE DA AA CC AC CB DE AE

Plain: T H E R N O T I C E
Cipher: AA BC AB AE DA DB AA CC BE AB

T	E	L	E	G	R	A	P	H
9	2	6	3	4	8	1	7	5
C	A	A	B	A	C	B	A	E
D	C	A	A	B	B	B	B	A
A	E	A	A	D	E	A	E	A
B	D	E	D	A	A	A	C	C
A	C	C	B	D	E	A	E	A
A	B	C	A	B	A	E	D	A
D	B	A	A	C	C	B	E	A
B								

(2)

Transposition

Cryptogram

BBAAA EBACE DCBBB AADBA
AABDA DBCEA ACAAA AAAEC
CAABE CEDEC BEAEA CCDAB
AADB

Fig. 8.—An example of a combined substitution-transposition cipher. The substitution method of fig. 4 is here combined with the transposition method of fig. 1. The substitution square (1) is used in enciphering the text by substitution. The cipher equivalents of this step are then written under a key forming a transposition rectangle (2) and simple columnar transposition forms the second step, yielding the text of the final cryptogram. The latter text can be brought back to monoliteral terms, if desired, by referring to the substitution square and using it in the reverse manner. Thus, BBAAAEBACE would become PTRAM, etc. The keywords for the substitution square and the transposition rectangle may be the same, as in this example, or they may be different.

Cryptographic devices and machines for facilitating cipher operations have been known for many years; they vary in complexity from simple, superimposed, concentrically or eccentrically rotating disks to large, mechanically or electrically operated typewriting and telegraph apparatus suitably modified for cryptographic purposes. One of the best cryptographs of the more simple, mechanical type is that known as the Bazeries cylinder, named after the Frenchman who is commonly credited with its invention in 1891. The principle upon which the device is based

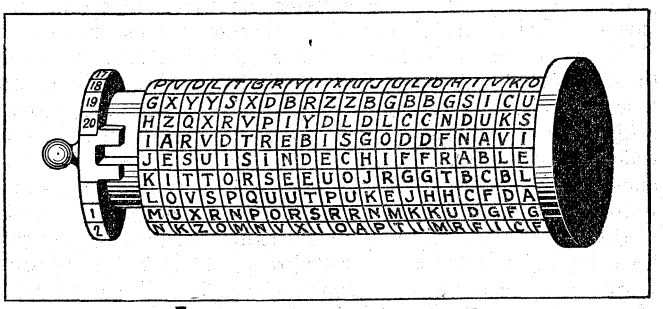


FIG. 9.—THE BAZERIES CYLINDER

was, however, conceived many years before by Thomas Jefferson (*see* Jefferson's Papers, Vol. 232, item 41,575). The Bazeries cylinder consists of a set of 20 disks, each bearing on its periphery a different mixed alphabet. The disks, which bear identifying numbers from 1 to 20, are assembled upon a common shaft from left to right according to a numerical key. In encipherment the disks are revolved so as to bring the plain-text letters on a single horizontal line, and then the letters of any other horizontal line are taken as the cipher equivalents. The text is thus enciphered 20 letters at a time. In deciphering, the cipher letters are "set up" upon one horizontal line by revolving the disks and locking them into position. By slowly revolving the whole cylinder and examining each horizontal line, only one of the latter will be found to yield intelligible text. One of the most ingenious of the more complicated types of cipher machines is that embodied in certain printing telegraph apparatus of modern design. In this system electrical encipherment, transmission, reception and decipherment, controlled by perforated tapes, may be accomplished simultaneously at a high rate of speed. Of the many devices and machines that have been invented, constructed and marketed, only a remarkably small number have ever been, or are now, in use. In general, the degree of secrecy afforded by the types heretofore constructed is not sufficiently high to warrant their adoption for diplomatic, naval or military telegraphic correspondence; and the fact that in international correspondence the cost of transmitting telegrams in cipher language (unpronounceable groups) has for over a quarter of a century been twice that for telegrams in code language (pronounceable groups) has constituted an effective deterrent to the use of cipher machinery in commercial telegraphic correspondence.

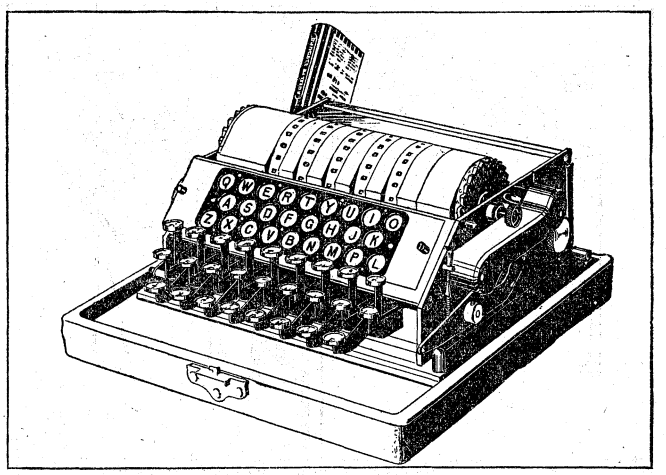


FIG. 10.—ELECTRICAL CRYPTOGRAPH EMPLOYING A TYPEWRITER KEYBOARD

Code Systems.—These are simple but highly specialized forms of substitution systems, and the most important developments in them since the advent of electro-magnetic telegraphy have always been either American or British in origin. They merely involve the use of modified conventional dictionaries termed code books, by means of which textual units of variable length—usually whole words, phrases and sentences—can be replaced by arbitrarily assigned signals termed code groups. From the point of view of practical usage to-day, code systems are more important than cipher systems, their simplicity and economy constituting their chief advantages. In encoding a message it is necessary merely to refer to the code book, find the desired words, phrases, sentences, numbers, etc., and replace them by the code groups assigned them, building the message up step by step in the fewest code groups possible. The condensing power of codes, brought about by the fact that a single code group may represent a long word, a phrase, or a complete sentence, depends upon the extent of the code and the skill used in its compilation; an average condensation of 1:5 (that is, one code group replacing five plain-text words) is quite common in commercial codes. The older types of codes employed either dictionary words or figure groups as code equivalents, but since 1904 such codes have been almost completely superseded by codes employing five-letter groups constructed by means of elaborate permutation tables. The most important feature of such a table is that it facilitates the construction of a series of 100,000 or more five-letter, pronounceable, artificial "words," all of which differ from one another in at least two letters. For example, if BERAM is a bona fide member of a given series, there will not be present in the same series any group differing from BERAM in only a single letter, such as *C*ERAM, B*I*RAM, BE*S*AM, BER*I*M, BERA*N*, etc. In the latest codes an additional safeguard has been incorporated, having as its object the suppression of errors introduced by the accidental transposition of adjacent letters in a code group. For example, if BERAM is a bona fide member of a given series, there will not be present in the same series any of the following groups: *EB*RAM, B*RE*AM, BE*AR*M, BER*MA*. In some codes an attempt is made to suppress errors introduced by the accidental transpositions of alternate letters as well as adjacent letters. These features, though of comparatively recent origin, are very important in that they have greatly increased the accuracy of code communication. The

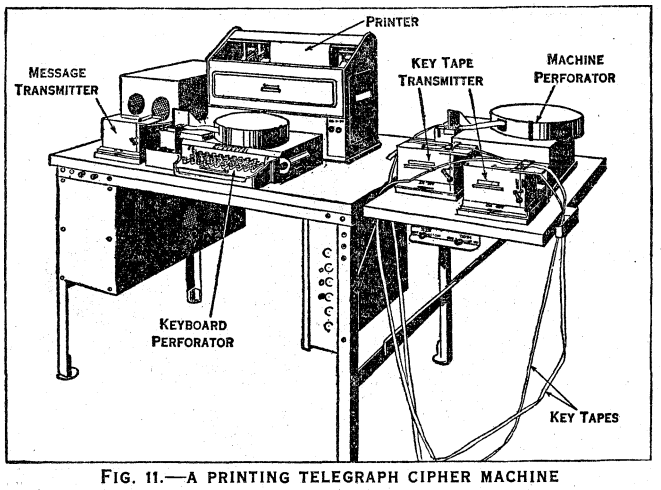


FIG. 11.—A PRINTING TELEGRAPH CIPHER MACHINE

natural evolution of code words and code language has been to some extent guided by regulations drawn up from time to time by international telegraph conferences.

The principal purpose of code in commerce is to effect economy, secrecy being usually of secondary importance (except in banking operations); in governmental affairs, however, the situation is exactly reversed. A code system is secret or nonsecret, depending upon the distribution and construction of the code book, and upon whether or not it is used in conjunction with a superimposed cipher system. Codes for general business correspondence are purchasable from their publishers and therefore provide in themselves no secrecy. Many business firms, however, have private codes which, if carefully restricted in distribution, may constitute codes that may be regarded as secret except to experts. Governmental codes are, of course, very carefully guarded in their production, distribution and usage. As to their construction, codes may be of the "one-part" or the "two-part" type, the principal difference between them being shown in fig. 12.

One-part Code	Two-part Code	
	Encoding	*Decoding*
ABABA—A		
ABACE—Abandon-ing-s		
ABADI—Abandoned	KABOL—A	ABABA—Abeyance
ABAFO—Abate-ing-s	STOLG—Abandon-ing-s	ABACE—Procedure
ABAGU—Abated	EXIFO—Abandoned	ABADI—To purchase
ABAHY—Abeyance	ZUMRA—Abated	ABAFO—Commenced
ABEBE—Abide-ing-s	ABABA—Abeyance	ABAGU—Do not think
ABECI—Abided	ROABY—Abide-ing-s	ABAHY—Recorded
. . . . .	. . . . .	. . . . .
ZYZYZ—Zone-s	BIKUR—Zone-s	ZYZYZ—According to

Fig. 12.—Extracts from typical one-part and two-part codes. In the one-part type the code groups and the vocabulary are arranged in parallel, alphabetic (or numerical) sequences, so that a single book serves for encoding as well as for decoding. In the two-part type the encoding book lists the elements of the vocabulary in alphabetic order but the code groups are in random order, so that a decoding book, in which the code groups appear in alphabetic (or numerical) order accompanied by their meanings, is essential. The degree of secrecy afforded by a code of the latter type is much greater than that afforded by one of the former type, all other things being equal.

When the code words of a simple code message undergo encipherment by a superimposed cipher system the result is termed enciphered code. Its purpose is to afford secrecy, in the case of purchasable commercial codes, or additional secrecy, in the case of private or governmental codes. The superimposition of a suitable cipher system upon code text prepared by means of an extensive two-part code imparts an exceedingly high degree of secrecy to messages and constitutes a practical system much in use by large governments for voluminous correspondences.

The science of solving cryptograms by analysis, having undergone great development in recent years, has been deemed worthy of being designated by a special name, cryptanalysis, to distinguish the indirect methods of reading cryptograms from the much more direct methods, called deciphering and decoding, which imply a knowledge of the basic method and specific key, in the case of ciphers, or possession of the code book, in the case of codes. Apart from the more simple, classical types, nearly every scientifically constructed cryptographic system presents a unique case in cryptanalysis, the unraveling of which requires the exercise of unusual powers of inductive and deductive reasoning, much concentration, perseverance and a vivid imagination; but all these qualities are of little avail without a special aptitude based upon extensive, practical experience. A preliminary requisite to the analysis of a cryptogram is a determination of the language in which its plain text is written, information which is either already at hand in the case of official correspondence, or which, in the case of private correspondence, can usually be obtained from extraneous circumstances. Next comes a determination as to whether a cipher or a code system is involved; this is based upon the fact that differences in their external appearance are usually sufficiently well marked to be detectable by experts. If the cryptogram is in cipher, the next step is to determine whether it belongs to the transposition or to the substitution class. This determination rests upon the fact that in plain text the vowels and consonants are present in definite proportions. Since transposition involves only a rearrangement of the original letters, it follows that if a cryptogram contains vowels and consonants in the approximately normal proportions it is of the transposition class; if not, it is of the substitution class. The solution of transposition ciphers involves much experimentation with geometrical designs of various types and dimensions, clues to which are afforded by the number of letters in the messages and extraneous circumstances. The assumption of the presence of probable words is often necessary. Special methods of solution based upon a study of messages of identical lengths, or with identical beginnings or endings, are often possible to apply when much traffic has been intercepted. Finally, the presence of letters which individually are of low frequency, but which when present have a great affinity for each other and form pairs of moderate or high

frequency, such as QU in Spanish, or CH in German, afford clues leading to solution.

The basis upon which the solution of practically all substitution ciphers rests is the well-known fact that every written alphabetic language manifests a high degree of constancy in the relative frequencies with which its individual letters are employed. For example, English telegraphic text shows the following relative frequencies in 1,000 letters, based upon an actual count of 100,000 letters appearing in telegrams of a commercial and military nature.

E	T	R	I	N	O	A	S	D	L	C	H	F
126	90	83	76	76	74	72	58	40	36	33	33	30
U	P	M	Y	G	W	V	B	X	K	Q	J	Z
30	27	25	21	18	14	13	11	5	3	3	2	1

These characteristic relative frequencies serve as a basis for identifying the plain-text values of the cipher letters, but only when the cipher has been reduced to the simple terms of a single alphabet. Thus, the problem of solving a monoalphabetic substitution cipher involves only one step, since the text is already in the simplest possible terms, but the problem of solving a polyalphabetic substitution cipher involves three principal steps: first, determining the number of cipher alphabets involved; second, distributing the cipher letters to the respective monoalphabetic frequency tables to which they belong; third, analyzing each of the latter on the basis of normal frequencies in plain text. In the case of ciphers exhibiting periodicity, the cyclic phenomena are employed in determining the number of alphabets involved, as well as in distributing each cipher letter to the monoalphabetic frequency table to which it belongs. In the case of aperiodic ciphers, because of the absence of cyclic phenomena, both of these steps are often very difficult, especially when the volume of text is limited. Frequently the only recourse is to employ repetitions as a basis for superimposing separate messages so that, irrespective of the number of alphabets involved, or their sequence, the letters pertaining to identical cipher alphabets fall into the same columns, and then the separate columns are treated as monoalphabetic frequency tables. The analysis of the frequency distributions of a polyalphabetic cipher is effected much more readily when the alphabets are interrelated than when they are independent.

The question as to whether an absolutely unsolvable cipher system can be devised is of more interest to laymen than to professional cryptographers. Edgar Allan Poe's dictum that "it may be roundly asserted that human ingenuity cannot concoct a cipher which human ingenuity cannot resolve" is misleading unless qualified by restricting its application to the great majority of the practical systems employed for a voluminous, regular correspondence. For isolated, short cryptograms prepared by certain methods may resist solution indefinitely; and there is at least one cipher system which may be mathematically demonstrated as being absolutely unsolvable without the specific key, even though the basic method be completely known.

BIBLIOGRAPHY.—For history and references to the older works *see* under CRYPTOGRAPHY. Modern works are relatively few in number. The only ones in English are Parker Hitt, *Manual for the Solution of Military Ciphers* (1916); W. F. Friedman, *Elements of Cryptanalysis* (1924); and A. Langie, *Cryptography* (1922), the latter being a translation (by J. C. H. Macbeth) from the French version, *De la Cryptographie* (1918). A scholarly treatise on the origins of modern systems will be found in A. Meister, *Die Anfänge der moderne diplomatischen Geheimschrift* (1902) and in *Die Geheimschrift im Dienste der päpstlichen Curie von ihren Anfängen bis zum Ende des XVI. Jahrhunderts* (1906) by the same author. Detailed explanations and illustrations of modern methods will be found in A. Figl, *Systeme des Chiffrierens* (1926); M. Givierge, *Cours de Cryptographie* (1925); A. Lange et E.-A. Soudart, *Traité de Cryptographie* (1925); Dröscher, *Die Methoden der Geheimschriften* (1921); F. Delastelle, *Traité élémentaire de Cryptographie* (1902); E. Bazeries, *Les Chiffres secrets dévoilés* (1901); de Viaris, *L'art de chiffrer et de déchiffrer les dépêches secrètes* (1893); H. Josse, *La cryptographie et ses applications à l'art militaire* (1885); A. Kerckhoffs, *La cryptographie militaire* (1883); and F. W. Kasiski, *Die Geheimschriften und die Dechiffrirkunst* (1863). Among a number of technical papers by W. F. Friedman the following are the most important: *The Index of Coincidence and its Applications in Cryptographic Analysis* (1922); *Several Machine Ciphers and Methods for their Solution* (1918); *Methods for the Solution of Running Key Ciphers* (1918). In justice to the many publishers of commercial telegraphic codes, no reference to any special ones can here be given, but any bookdealer can furnish a good list. For the history of codes *see* W. F. Friedman, *The History of the Use of Codes and Code Language, the International Telegraph Regulations pertaining thereto, and the bearing of this History on the Cortina Report* (1928). (W. F. F.)

CODEX, the name given to the earliest forms of manuscript in book form, *i.e.*, the collection of written pages stitched together which replaced the earlier *roll* of papyrus and the wax tablets (which when hinged or bound together formed the first *codex* or *caudex*); also the Latin form of the English word code (*q.v.*), meaning a body of law or regulations. For examples of famous codices, *see* the articles BIBLE, PALAEOGRAPHY, and LIBRARIES.

CODIAEUM, a small genus of Indo-Malayan shrubs belonging to the family Euphorbiaceae. One variety, *C. variegatum pictum,* a native of Polynesia, is cultivated in greenhouses and throughout the tropics under the name of croton for its magnificently variegated leaves.

CODINUS, GEORGE (GEORGIOS KODINOS), the reputed author of three extant works in Byzantine literature, two of which are anonymous in the mss. It is supposed that Codinus lived towards the end of the 15th century. The works referred to are:

(1) *Patria* (Τὰ Πάτρια τῆς Κωνσταντινουπόλεως). It is divided into five sections: (*a*) the foundation of Constantinople; (*b*) its topography; (*c*) its works of art and sights; (*d*) its buildings; (*e*) the construction of the church of St. Sophia. It was written in the reign of Basil II. (976–1025), revised under Alexius I. Comnenus (1081–1118), and perhaps copied by Codinus, whose name it bears in some (later) mss. The chief sources are: the *Patria* of Hesychius Illustrius of Miletus, an anonymous (*c.* 750) brief chronological record (Παραστάσεις σύντομοι χρονικαί), and an anonymous account (διήγησις) of St. Sophia (ed. T. Preger in *Scriptores originum Constantinopolitanarum,* fasc. i., 1901, to be followed by the *Patria* of Codinus). (*See* also Procopius, *De Aedificiis* and the poem of Paulus Silentiarius on the dedication of St. Sophia.)

(2) *De Officiis,* a sketch of court and higher ecclesiastical dignities and ceremonies (*cf. De Cerimoniis* of Constantine Porphyrogenitus).

(3) A chronological outline of events from the beginning of the world to the taking of Constantinople by the Turks (called Agarenes in the ms. title). It is of little value.

BIBLIOGRAPHY.—Complete editions are (by I. Bekker) in the Bonn *Corpus scriptorum Hist. Byz.* (1839–43, where, however, some sections of the *Patria* are omitted), and in J. P. Migne, *Patrologia graeca,* clvii.; *see* also C. Krumbacher, *Geschichte der byzantinischen Literatur* (1897).

CODLING MOTH (*Carpocapsa pomonella*), a small moth, the larva (caterpillar) of which is very destructive to apples and other fruit. Indigenous to Europe, it has spread, through the agency of commerce, wherever the apple is cultivated. The most effective methods of moth control are by sack-binding the tree trunks and by spraying with lead-arsenate.

(*See* ENTOMOLOGY: *Economic.*)

COD-LIVER OIL (*Oleum Morrhuae,* or *Oleum Jecoris Aselli*), the oil obtained from the liver of the common cod (*Gadus morrhua*). The usual process is to heat the fresh, cleaned livers by steam to a temperature above that of boiling water, or, by more recent practice, to a lower temperature, the livers being kept as far as possible from contact with air. The oils so obtained are termed "steamed-liver oils." The "pale" and "light brown" oils are used in pharmacy; the "brown" oil, the cod oil of commerce, being obtained from putrid and decomposing livers, has an objectionable taste and odour and is largely employed by tanners. By boiling the livers at a somewhat high temperature, "unracked" cod oil is obtained, containing much "stearine," which separates on cooling and is sold as "fish stearine" for soap-making, or as "fish-tallow" for currying. The oil when freed from the stearine is known as "racked oil." "Coast cod oil" is the commercial name for oil obtained from the livers of various kinds of fish; *e.g.,* hake, ling, haddock, etc. The chief centres of the cod-liver oil industry are Lofoten and Romsdal in Norway; the oil is also pre-

parer in the United States, Canada, Newfoundland, Iceland and Russia.

Cod-liver oil contains palmitin, stearin and other more complex glycerides; the "stearine" mentioned above, however, contains very little palmitin and stearin. Therapic and jecoleic acids have been identified and apparently do not occur elsewhere in the animal kingdom. Other constituents are cholesterol (0.46–1.32%), traces of calcium, magnesium, sodium, iodine, chlorine and bromine and various aliphatic amines which are really secondary products.

Cod-liver oil is very readily absorbed from the skin and exerts all its therapeutic actions when thus exhibited. This method is often used for infants or young children with abdominal or other forms of tuberculosis. When taken by the mouth it is easily assimilable. It may cause nausea at first, but usually tolerance is soon established.

Cod-liver oil may be given in all wasting diseases, in tuberculosis and in rickets. It is occasionally valuable in chronic rheumatoid arthritis. Care must be taken to avoid the nausea, loss of appetite and diarrhoea, easily induced by this oil. It may be given in capsules, or as an emulsion, with or without malt-extract. The value of cod-liver oil depends partly on the food value of the oil itself, partly on the fat-soluble vitamin (*see* VITAMINS) and iodine it contains.

Cod-liver oil is used extensively in poultry feeds, either unmixed or combined with other oils, as a growth-accelerator for young chicks. It has proved especially valuable when their exposure to sunlight is restricted, making it commercially practicable to raise chicks in poorly lighted structures.

CODRINGTON, CHRISTOPHER (1668–1710), British soldier and colonial governor, whose father was captain-general of the Leeward Isles, was born in the island of Barbados, West Indies, in 1668. Educated at Christ Church, Oxford, he was elected a fellow of All Souls, and served later on with the British forces in Flanders, being rewarded in 1695 with a captaincy in the guards. In 1697, he was appointed captain-general and commander in chief of the Leeward Isles. In 1703 he commanded the unsuccessful British expedition against Guadeloupe. After this he resigned his governorship and spent the rest of his life in retirement and study on his Barbados estates. He died on April 7, 1710, bequeathing these estates to the Society for the Propagation of the Gospel in Foreign Parts for the foundation of a college in Barbados. This college, known as the Codrington college, was built in 1714–42.

CODRINGTON, SIR EDWARD (1770–1851), British admiral, belonged to a family long settled at Dodington in Gloucestershire. He was the youngest of three brothers, who were left orphans at an early age, and were educated by an uncle, Bethell. Edward Codrington was sent for a short time to Harrow, and entered the navy in July 1783. He served on the American station, in the Mediterranean and at home, till he was promoted lieutenant on May 28, 1783. Lord Howe selected him to be signal lieutenant on the flagship of the channel fleet at the beginning of the revolutionary war with France. In that capacity he served on the "Queen Charlotte" (100 guns) during the operations which culminated in the battle of June 1, 1794. The notes he wrote on John Barrow's account of the battle in his *Life of Howe,* and the reminiscences he dictated to his daughter, which are to be found in her memoir of him, are of great value for the history of the action. On Oct. 7, 1794, he was promoted commander, and on April 6, 1795, attained the rank of post captain and the command of the "Babet" (22).

He continued to serve in the channel, and was present at the action off Lorient on June 23, 1795. Codrington wrote notes on this encounter also, which are to be found in the memoir. They are able and valuable, but, like all his correspondence throughout his life, show that he was of a somewhat censorious disposition, was apt to take the worst view of the conduct of others and was liable to be querulous. He next commanded the "Druid" (32) in the channel and on the coast of Portugal, till she was paid off in 1797. Codrington remained on shore and on half pay for some years. In Dec. 1802 he married Jane, daughter of Jasper Hall of Kingston, Jamaica.

On the renewal of war after the breach of the peace of Amiens, he was appointed (May 1805) to the command of the "Orion" (74) and was attached to the fleet on the coast of Spain, then blockading Admiral Villeneuve in Cadiz. The "Orion" took a conspicuous part in the battle of Trafalgar. Codrington's correspondence contains much illuminative evidence as to the preliminaries and the events of the victory.

From 1805 till 1813 he continued to serve first on the "Orion" and then (1808) on the "Blake" (74) in European waters. He was active on the Mediterranean coast of Spain in co-operating with the Spaniards against the French. In 1814 he was promoted rear admiral, at which time he was serving on the coast of North America as captain of the fleet to Sir Alexander Cochrane during the operations against Washington, Baltimore and New Orleans. In 1815 he was made K.C.B., and was promoted vice-admiral on July 10, 1821. In Dec. 1826 he was appointed to the Mediterranean command, and sailed on Feb. 1, 1827. From that date until his recall on June 21, 1828, he was engaged in the arduous duties imposed on him by the Greek war of independence, which had led to anarchy and much piracy in the Levant. On Oct. 20, 1827, he destroyed the Turkish and Egyptian naval forces at Navarino, while in command of a combined British, French and Russian fleet. As the battle had been unforeseen in England, and its result was unwelcome to the ministry of the day, Codrington was entangled in a correspondence to prove that he had not gone beyond his instructions, and he was recalled by a despatch, dated June 4th.

After the battle Codrington went to Malta to refit his ships. He remained there till May 1828, when he sailed to join his French and Russian colleagues on the coast of the Morea. They endeavoured to enforce the evacuation of the peninsula by Ibrahim peacefully. The pasha made diplomatic difficulties, and on July 25 the three admirals agreed that Codrington should go to Alexandria to obtain Ibrahim's recall by his father Mohammed Ali. Codrington had heard on June 22 of his own supersession, but, as his successor had not arrived, he carried out the arrangement made on July 25, and his presence at Alexandria led to the treaty of Aug. 6, 1828, by which the evacuation of the Morea was settled. His services were recognized by a G.C.B. After his return home he was occupied for a time in defending himself and then in leisure abroad. He commanded a training squadron in the channel in 1831, and became admiral on Jan. 10, 1837. From Nov. 1839 to Dec. 1842 he was commander in chief at Portsmouth. He died on April 28, 1851.

Sir Edward Codrington left two sons, Sir William (1804–1884), a soldier who commanded in the Crimea, and Sir John Henry (1808–1877), a naval officer, who died an admiral of the fleet.

See *Memoir of the Life of Admiral Sir Edward Codrington,* by his daughter Jane, Lady Bourchier (1873). This book contains much useful first hand criticism of the operations at Lorient (1795) and at Trafalgar (1805).

CODRUS, in Greek legend, the last king of Athens. It was prophesied at the time of the Dorian invasion of Peloponnesus (*c.* 1068 B.C.) that only the death of their king at the enemy's hands could ensure victory to the Athenians. Devoting himself to his country, Codrus made his way disguised into the enemy's camp, and provoked a quarrel, in which he was killed. The Dorians, on discovering that Codrus had been slain, retreated, despairing of success. No one being thought worthy to succeed Codrus, the title of king was abolished, and that of archon (*q.v.*) substituted for it.

See Lycurgus, *Leocr.* xx (=84–7); Justin ii, 6; Vell. Pat. i, 2; Grote, *Hist. of Greece,* pt. i, ch. 18; Busolt, *Griechische Geschichte,* i.

CODY, WILLIAM FREDERICK (1846–1917), U.S. scout and showman, known under the name of "Buffalo Bill," was born in 1846 in Scott county, Ia. He was a rider of the "Pony Express," a mail service established in the spring of 1860 by the Central Overland California and Pike's Peak Express company to carry the mails overland from St. Joseph, Mo., to Sacramento, Calif., a distance of 1,950 mi., by means of relays of ponies, each rider being expected to cover about 75 mi. daily. When the "Pony

Express" was discontinued in 1861, upon the completion of the Pacific Telegraph company's line, young Cody became a scout and guide for the U.S. army. In 1863 he enlisted in the 7th Regiment of Kansas cavalry, in which he served until the close of the Civil War. In 1867 he made a contract with the Kansas Pacific railway to furnish its employees with buffalo meat while the line was being extended through the wilderness, whence arose the name "Buffalo Bill." In 1868–72 he was again an army scout and guide, serving against the Sioux and Cheyennes; and in 1872 was a member of the Nebraska house of representatives. During the Sioux-Cheyenne war of 1876 he served in the 5th U.S. cavalry, and at the battle of Indian Creek killed the Cheyenne chief, Yellow Hand, in single combat. In 1883 he organized his "Wild West Show," a spectacular performance on a large scale, his first European tour taking place in 1887. In the Nebraska national guard he again served against the Sioux in 1890–91. He died in Denver, Colo., on Jan. 10, 1917, and was buried in a tomb blasted from solid rock on Lookout mountain, 20 mi. from Denver.

COEDUCATION is the education of both sexes in the same classes in an institution. This term has been given several interpretations, the most extreme of which is that girls and boys "shall be taught the same things, at the same time, in the same place, by the same faculty, with the same methods, and under the same regimen." This is based upon the assumption that there are no differences between girls and boys and consequently they should be given precisely the same education. The more accepted interpretation is that there are differences in their physical and mental powers and needs, but that because of their fundamental similarities they should be educated together, uniting in many classes, in many sports, and in much of their social life, but modifying all these to suit their special differences.

Coeducation as a definite educational method or policy is modern and comparatively recent in its adoption. The constitution of society in the early centuries, with war and religion—which engendered belligerency—as the chief occupations and interests, confined education to men and boys. As far back as the 1st century Greece had schools for boys. France and Germany established them in the 4th century and England has a record of a similar school in 598. Private education for boys of certain classes was possible long before this both in Europe and the orient. More than 1,000 years passed before education of girls was attempted on any scale whatever. What education girls had received had been secured either privately or in convents or a few segregated schools, and such opportunities were confined almost entirely to families of wealth. In a few instances girls—princesses or members of the aristocracy—had been taught with their brothers at home, or occasionally a young woman had been permitted to attend a few lectures with her brothers. Although several of the teachers of ancient and mediaeval days advocated ultimately teaching girls, and even the sexes together, it remained a theory except in such special cases.

As long as the idea prevailed that women were designed to be "decorative, pleasant toys for man's amusement," or that "education would render them less useful and agreeable to men," very little education except with these objects in view could be obtained. With changing social, economic and religious conditions, the status of woman changed. Since educational opportunities were so firmly established for boys in all countries existing through ancient and mediaeval days, education for girls became a question of method. With few exceptions, at first segregated schools were provided. Then as a matter of economy girls were admitted to some boys' schools, or small schools were established for both together, usually elementary in character. In Scotland coeducation in the elementary schools was established as a definite policy in the late 17th century, though boys and girls had attended the same parish schools together previous to this.

An innovation in matters of education was promulgated by the Massachusetts colony in the new world when it passed laws in 1642 and 1647 providing for free compulsory education for all its children, this being almost as soon as the colony was settled and this being also the basis upon which all education in the colonies and the United States has since been developed.

In the 19th century women began to demand an education equal to that of their brothers. As they edged or fought their way into various institutions the question of coeducation—its efficacy and desirability—became a widely debated subject, especially in the old world countries where tradition and custom have held through many centuries and where changes of a radical nature are made slowly. As yet coeducation is not popular there though it has been adopted in a number of countries for the earlier grades where the government has assumed the responsibility of giving free education to its children.

England.—Coeducation was tried in England as an experiment in a number of private schools established either by individuals or societies in the middle of the 19th century. Free elementary schools, coeducational in character, were established as a result of the Education acts of 1870 and 1902, but they have never found favour with the "classes," and are attended almost entirely by the "masses." In the '70s, when the desire for higher education spread among women, the two colleges for women, Girton and Newnham (1874), did not give what was wanted. Then began the long struggle, led by the Headmistresses' association, to secure entrance to and degrees from the universities of England, especially Oxford and Cambridge, which has been fully accomplished only recently.

France.—Compulsory education was established in France in the early 19th century, but after 1867 each commune with population of over 500 has been obliged to support a separate school for girls. While there are some 20,000 mixed schools in France, these are attended almost exclusively by children of the middle and artisan classes. Segregation above the 13th year is almost the invariable rule. A number of universities, established exclusively for men, have admitted women and to that extent they are coeducational.

Germany.—With the adoption of compulsory elementary education in Germany, mixed or coeducational schools developed in the smaller cities, and about two-thirds of the children were educated in this manner. After the overthrow of the monarchy changes in educational matters as well as social and political took place. Higher education was much in demand by German women and while no coeducational universities were established after World War I, many old universities admitted women.

The Orient.—In the east women as a whole have hardly started on the road to education of any kind. Thousands of years of tradition, the great diversity of religions and the texture of society have all been responsible for the slow progress of their education. In China, Roman Catholic and American Protestant missionaries in the middle of the 19th century established mission schools which started the movement for the education of girls. As yet schools are not numerous and coeducation is practically nonexistent.

Japan, which established its first school for boys in 794 A.D., paid little heed to the education of girls until the last half of the 19th century. Affected by the overthrow of the feudal system, and by the results of the study of educational systems in the United States and Europe, the Japanese government adopted (about 1871) free, compulsory, secular education for boys and girls in a common school. Segregated high schools are provided for children over 12. Japanese women have been greatly influenced by contact with the women of the United States where many go for study, and are requesting more opportunities in their own country. In increasing numbers, they are attending the Imperial universities (opened to them in 1920) and the free universities which have followed this example.

India.—The factors involved in India's problem of education are numerous and most complicated—antagonistic religions, the caste system, the child brides and child widows, the economic situation, lack of efficient teachers, apathy of adults—these make a seemingly almost hopeless array. In 1928 1% of the girls were literate and only 1.03% were under instruction. Coeducation is confined to the village schools for an economic reason, but separate schools for girls are being established as soon as the village can do so. Less than a thousand women are studying in girls' colleges, a few hundred in men's colleges and technical schools.

There is little interest in education for girls and practically none in coeducation though prejudice toward both is slowly lessening.

Italy.—Italy made great changes after World War I in its educational policy for women. Many women were forced into men's occupations and as they realized the need for more preliminary training the situation was met at first by permitting them to go to the liceo, or higher school for boys. As the numbers increased Italy had neither time nor money to build separate schools. Consequently coeducation exists in the higher schools established for boys, leading to the universities—many of which are now open to women.

South America.—The varying political and economic changes in South American countries, the difficulties of communication between countries and parts of the same country, the immense distances, small population, the topography and the general apathy or hostility toward education of women have all contributed to its slow progress. Though coeducation exists to a limited extent in some South American countries, it is neither popular with nor patronized by those who can afford to send their daughters to convents or church schools. Argentina has made the greatest progress, dating from 1868, when North American methods and teachers were introduced by the president. About half the schools are coeducational. Brazil, 3% of whose population attend school, has, after the establishment of the republic in 1889, set up free, primary, secular schools, a few of which are coeducational—though they serve mostly as models. Sixteen-seventeenths of the population are Roman Catholics which makes separation of church and state difficult. Chile admitted women to its teacher training schools after 1890, at first with reluctance and some reservations. Latin American universities which form a chain from the University of Mexico (1551) to southern Argentina were established for religious purposes for men. Their character has been somewhat modified and women are now admitted to many such universities.

United States.—Coeducation is a distinctive feature of education in the United States and extends from the kindergarten through the college. It probably originated in colonial days in New England before the advent of public schools when boys and occasionally girls with them were instructed in the Dames' schools and later in private schools as a matter of expediency or necessity.

Coeducation received a great impetus following each of the three great wars of the United States. The Revolutionary War brought new ideas, stabilizing the new government and the quiescent development of a new country. The Civil War opened up and widely extended the profession of teaching for women. World War I brought tremendous changes in the economic, political and social status of women, and opened hundreds of occupations previously closed to them.

Owing to a difference in type and purpose of the early settlers of New England and of the more southern colonies, a difference in their attitude toward education developed, and these differences appeared in the new settlements opened by migrants farther west. The colonial south, because of its early indifference, because of its greater economic freedom and because of its institution of slavery, developed public education and coeducation more slowly. The New England idea of coeducation was transplanted throughout the middle west and northwest, and gradually this type was adopted throughout the country, due also to economic conditions, sparsely settled country, lack of transportation, growing ideas of democracy and the women's rights movement. Coeducation predominates in public elementary and secondary schools of the United States. Practically all of the 183,000 elementary schools and all but approximately 160 of the 25,000 secondary schools are coeducational. Enrollments in elementary and secondary schools for the year 1943–44 were 23,266,616.

The establishment of coeducational colleges and universities by private endowment, by churches and by states has been remarkably rapid west of New York state. The east has been slow to adopt coeducation, largely owing to the age and prestige of its men's colleges, these having been founded when the colonies were young; and to the prestige of the women's colleges opened to meet an unfulfilled demand of eastern women for college training. St. Lawrence university was chartered in 1861 as a coeducational institution and was followed by Cornell in 1868 and Swarthmore in 1869, these being the first in the east. Others followed rapidly, Syracuse (1870), Boston (1873), and then a few institutions, exclusively men's for 40 to 100 years, began to admit women, notably Vermont (1871), Maine (1872), Pittsburgh (1874), Pennsylvania (1877), etc.

Collegiate coeducation began much earlier in the middle west and northwest. Oberlin opened as an academy in 1833 and in the same year what is now Kalamazoo college was chartered. In the '40s such coeducational institutions as Buffalo, Earlham, Grinnell, Eureka, Iowa Wesleyan, Lawrence, Mt. Union, Otterbein, Pacific and Williammette were founded; and Knox and Albion admitted women. The '50s saw the first coeducational state universities established, Utah in 1850 and Iowa in 1855, and the formation of numerous middle west coeducational colleges continued. During the '60s seven more state universities were chartered as coeducational, and Indiana, Minnesota and Missouri admitted women. All but five states have coeducational universities, two only partially. Four of the five have no state universities. The universality of coeducation west of the Mississippi is made apparent by the fact that in all this territory there are but four women's colleges, one established in 1927. In this same territory almost without exception the leading institutions are the state universities. Practically every department of collegiate instruction is open to women,—professional courses as well as liberal arts, and many institutions whose undergraduates are entirely men are admitting graduate women.

Experience is the only method of testing the results of coeducation and with the fourth generation of coeducationally trained women now in colleges in the United States, the old objections there have been refuted.

Other Countries.—A coeducational system is being built up in Canada similar to and influenced by that of the United States since intercommunication is easy and their economic problems and types of settlers are similar. Denmark has developed its coeducation largely through the co-operation of several families in the matter of establishing schools. This custom and the later establishment of free schools for boys and girls have led to its public school system. The other Scandinavian countries, and Holland, Belgium and Switzerland, have all developed coeducation to a certain degree in the public school system.

Summary.—The old arguments against coeducation—that it will effeminate the men and coarsen the women, that the women have not sufficient health, strength or mental ability for higher education or to compete with the men—have been repeatedly disproved. The remaining objection seems to be largely a matter of centuries of custom, of racial differences and class prejudice. Tradition and prejudice still favour the segregated schools where possible.

The numerous changes in the character of government after 1875 greatly affected educational policies, and definite conclusions are not yet reached as to the best methods—coeducation or segregation. With the development of mental hygiene and psychology some educators are again speculating whether it might not be advisable to separate the sexes, at least during a few years of adolescent life, especially as there seems to be a natural segregation in some fields because of the increase of vocational and professional courses adapted to the different sexes. In the United States and Canada the tendency continues to be toward coeducation in all schools, working out individual interests because of sex differences in coeducational public schools rather than in private segregated schools. Nowhere in the world is coeducation developed to the extent and with the democratic spirit that exists in the United States. (R. L. F.)

BIBLIOGRAPHY.—Hon. D. Campbell, *Mixed Education of Boys and Girls* (1874); R. G. Boone, *Education in the United States* (1889); Alice Wood, ed., *Co-education,* a series of essays by various authors (1903); E. G. Grant, *History of Education in the U.S.* (1909); C. Brereton, *Studies in Foreign Education* (1913); A. F. Leach, *Proceedings of the British Academy* (1914); P. Sandiford, ed., *Comparative Education* (1918); E. P. Cubberley, *Public Education in the United States* (1919).

COEFFICIENT. This term was introduced into algebra by François Vieta at the close of the 16th century to denote either of the two rational factors of a monomial. Thus in the expression ab, either a or b is the coefficient of the other. In the case of a product of a constant by a variable, it is usual to call the constant factor the coefficient. Thus the numbers 2, −1, 0, a are the coefficients of the polynomial $2x^3-x^2+a$.

The integer $\binom{n}{r}=\frac{n!}{r!(n-r)!}$ is the coefficient of the term $x^r y^{n-r}$ in the expansion of $(x+y)^n$ by the binomial theorem. Such integers are called *binomial coefficients*.

If $z=f(x,y)$, then $dz=\frac{\partial f}{\partial x}dx+\frac{\partial f}{\partial y}dy$ so that the partial derivatives $\partial f/\partial x$ and $\partial f/\partial y$ are often called *differential coefficients*.

In physics and mechanics, the term coefficient is applied to a number of constants which have to be determined experimentally. Thus if F is the force due to friction between two surfaces, and if N is the normal pressure between the surfaces, then $F=\mu N$ where μ is a constant depending on the condition and nature of the surfaces in contact, called the *coefficient of friction*.

A body normally expands when heated, and the change in length of a bar of unit length per degree change in temperature is a constant, called the *coefficient of linear expansion* of the substance.

The *coefficient of pressure* of a gas is the ratio of the change in pressure per degree to the pressure at the ice point, the volume remaining constant.

In the division of one polynomial by another, the *method of detached coefficients* may be used. When the divisor is of the form $x-c$, the method is particularly simple, and is known as *synthetic division*. Let it be required to divide $3x^4-8x^3-2x+5$ by $x-3$. The coefficients of the dividend are written down in order, 0's being supplied if not all powers of x are present. The first coefficient is brought down unchanged. This is multiplied by 3 and added to the next coefficient. The sum 1 is multiplied by 3 and added to the next coefficient, etc. The partial quotient is $3x^3+x^2+3x+7$ with the remainder 26. (*See* ALGEBRA; POLYNOMIAL.) (C. C. M.)

3	−8	0	−2	5	
	9	3	9	21	3
3	1	3	7	26	

COEHOORN, MENNO, BARON VAN (1641–1704), Dutch soldier and military engineer, of Swedish extraction, was born at Leeuwarden in Friesland, and became a captain in the Dutch army. In 1673 he took part in the defence of Maastricht and in the siege of Grave, where the small mortars (called coehorns) he invented troubled the French garrison. He was made a colonel for his conduct at the battle of Seneff (1674), and was also at the battles of Cassel (1677) and Saint Denis (1678). He was an innovator in fortification, and his first published work, *Versterckinge de Vijfhoeks met alle syne Buytenwerken* (Leeuwarden, 1682) caused a controversy with Louys Paan (Leeuwarden, 1682, 1683); Coehoorn was entrusted with the reconstruction of several fortresses in the Netherlands, and became the worthy rival of his great contemporary Vauban. In his chief work, *Nieuwe Vestingbouw op en natte of lage horizont,* etc. (Leeuwarden, 1685), he laid down three "systems," the feature of which was the multiplicity and great saliency of the works, eminently suited for flat sites such as those of the Low Countries. He borrowed many details from his Dutch predecessor Freytag, or from Albrecht Dürer, and Speckle, and studied the individual case, not theoretical perfection; *e.g.,* at Groningen.

From 1688 to 1697 Coehoorn was a brigadier. At Fleurus he distinguished himself. In 1692 he lost Namur, a fortress of his own, to Vauban, but retook it in 1695. Coehoorn became lieutenant-general and inspector-general of the Netherlands fortresses, and the high-German peoples as well as the Dutch honoured him. He commanded a corps in Marlborough's army from 1701 to 1703, and in the constant siege warfare his skill was of the highest value. The swift reduction of Bonn and the siege of Huy in 1703 were his crowning successes. He died of apoplexy at Wijkel on March 17, 1704.

His "first system" was applied to Nijmwegen, Breda, Bergen-op-Zoom, and Mannheim, his second to Belgrade and Temesvár among other places. His son, Gosewijn Theodor van Coehoorn, wrote his life (re-edited Syperstein, Leeuwarden, 1860). His *Nieuwe Vestingbouw* was translated into English by T. Savery (1705); *see* also the article FORTIFICATION AND SIEGECRAFT and the bibliographies under that heading.

COELENTERATA (sē-lĕn-tur-ā'tą). The term Coelenterata is applied to a large group or phylum of animals of a lowly grade of organization. Only three types of animals possess a more simple structure than the Coelenterata: the sponges, the Mesozoa and Protozoa. Protozoa are organisms whose body usually consists entirely of a single cell, which is generally of microscopic size. In certain instances a number of these cells become banded together to form a colony, but in such a case they are not arranged so as to constitute tissues, and are individually autonomous and self-supporting. In the case of the sponges we are dealing with animals consisting of a multitude of cells of different kinds which are massed together, and many of which are segregated into definite sheets or tissues, each sheet performing a function or functions of its own. A sponge develops from a definite embryo which is the outcome of the cleavage of a fertilized egg, but apart from this it is very unlike the animals of the higher groups in that it constitutes in its adult condition a fixed plant-like object often of somewhat indefinite shape. The sponges probably represent a series of products of evolution which diverged from protozoan ancestors in a direction distinct from that pursued by any other animals and which led on to nothing beyond the sponges themselves. The Coelenterata, however, from beginnings similar to those of the sponges, achieved an altogether higher grade of organization, producing not only tissues but also a much more definite form and individuality than the sponges, involving the differentiation of nervous and muscular systems and consequently efficient co-ordination of parts and considerable powers of movement and locomotion. In the sponges primitive muscular tissue exists locally, but there is no nervous system.

Structure of a Coelenterate.—The body of a Coelenterate resembles in architectural principle that stage which may be recognized in the early development of so many animals above the degree of sponges, and which is known as a *gastrula* (fig. 5). A gastrula consists of a small sac, with a single opening at one end of it (the *blastopore*). The walls of the sac possess two layers of cells, one passing into the other at the margin of the blastopore. The inner layer is known as endoderm, the outer as ectoderm. No Coelenterate, however complex may be its structure, passes beyond the fundamental plan thus outlined; though its size may be great and its parts elaborate, it remains an animal possessing one principal internal cavity only, the *coelenteron,* which opens to the exterior by a single main aperture, the mouth. In a typical higher animal the body contains two principal cavities, the food canal, and another main cavity situated between the wall of the food canal and the outer integuments of the body. In such a form the food canal opens to the exterior by a second aperture (the anus) through which the undigested material is voided; the Coelenterata possess no such opening and waste substances are ejected through the mouth.

There is, in fact, no existing Coelenterate in which the adult animal is quite as simple as a gastrula; but there do exist creatures in which the main differences are that the cells of the ectoderm exhibit a differentiation into more than one kind, and that there lies between ectoderm and endoderm a thin sheet of non-cellular material, the *mesogloea,* which supports the other layers. An example of such a grade of structure may be found in *Protohydra.*

The majority of Coelenterata, however, develop a complexity far exceeding this. The actual form of the body varies almost infinitely, but usually a prominent feature of the organization is the presence of a number of tentacles placed in a definite manner around the mouth. These tentacles may be solid structures, containing a core of endoderm and a covering of ectoderm, or they may be hollow, the wall in such case including both cell-layers. The symmetry of the body is usually characterized by the fact that the various parts are arranged about the radii of a circle with

the mouth as its centre, and that the same structures are repeated in a regular manner in different sectors. In other words, the animal is radially symmetrical and can be divided by suitable radial cuts into a varying number of parts each of which is exactly equivalent to the others. This symmetry is not invariably present, but is extremely prevalent, although in one section of Coelenterata (the Anthozoa) it is accompanied by an underlying bilateral symmetry which mars its perfection. The middle layer or mesogloea varies greatly in bulk in different cases, being sometimes extremely tenuous and small in amount, sometimes very extensive and forming the greater part of the mass of the organism.

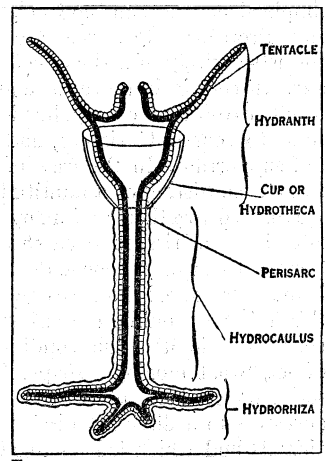
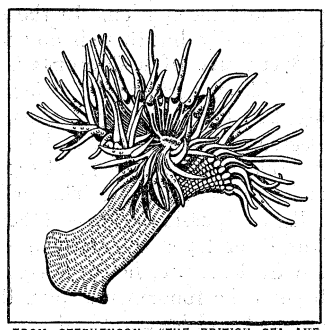


FIG. 1.—DIAGRAM OF A TYPICAL HYDROID POLYP

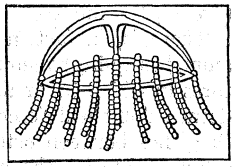
Polyp and Medusa.—The Coelenterata exhibit two main types of shape, both founded upon the gastrula plan.

1. *The Polyp.* The name *polyp* (figs. 1 and 2) is derived from the French *poulpe,* a term applied to an octopus. There is no actual relationship whatever between a Coelenterate polyp and an octopus, the comparison having been suggested by the fact that both of them possess mobile tentacles. A good example of a polyp is a sea anemone, the essentials of its structure being a hollow cylindrical body closed in below by an adherent disc-like base, above by another disc (the *peristome*) bearing the mouth in its centre and a circlet of tentacles round its outer part. Details of the structure of different kinds of polyps are given in the articles HYDROZOA, ANTHOZOA and SCYPHOZOA.

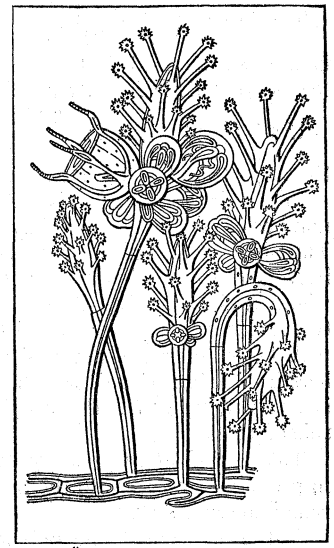

FROM STEPHENSON, "THE BRITISH SEA ANEMONES," BY COURTESY OF THE RAY SOCIETY
FIG. 2.—A SEA ANEMONE, ILLUSTRATING THE APPEARANCE OF A TYPICAL POLYP

2. *The Medusa.* Those Coelenterates popularly known as "jelly-fish" are scientifically christened medusae, the name referring to the resemblance borne by the long mobile tentacles of some of these animals to the writhing, snaky tresses of the Gorgon Medusa. The body of a medusa (fig. 3) is shaped like an umbrella, and hanging down inside it from the point at which the handle of the umbrella would be attached, is a structure known as the *manubrium,* at the end of which is the mouth. In this case the tentacles form a circlet round the margin of the umbrella. *See* HYDROZOA and SCYPHOZOA.

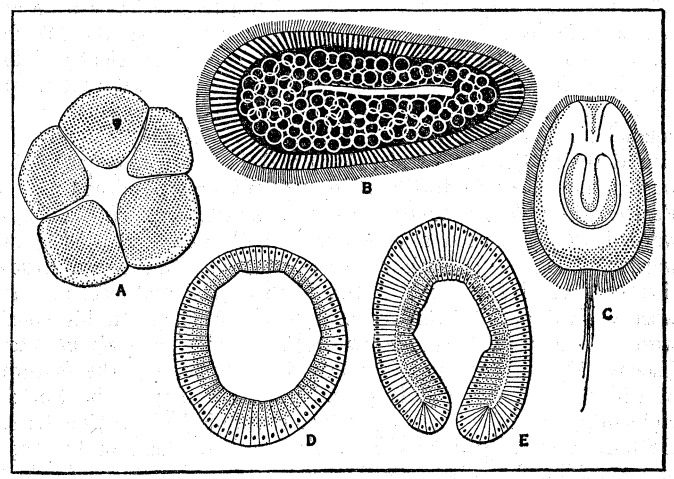
Alternation of Generations.—One of the most interesting features connected with the Coelenterata is the fact that a single animal may for part of its life be a polyp and for part a medusa; or from a polyp, buds may be formed which develop into medusae. In cases such as the latter it is the polyp which is developed from an egg, and this polyp itself produces no sex-organs; it is able however to give origin to vegetative buds which develop into medusae, and these in their turn bring forth sex-cells which after fertilization initiate further polyps. In this way there is regular alternation between polyp and medusa and the phenomenon is termed *metagenesis* or alternation of generations. By some authors the polyp is viewed not as a "generation" but as a persistent larval stage; the medusa is then regarded as the adult.


FROM PARKER & HASWELL, "TEXT BOOK OF ZOOLOGY" (MACMILLAN & CO. LTD.)
FIG. 3.—THE MEDUSA OF OBELIA

Polymorphism and the Formation of Colonies.—Another marked characteristic of the Coelenterata is their tendency to form colonies of individuals united to each other by a common stem, plate or mass of intermediate tissue. The colonies so formed are generally attached permanently to foreign surfaces, but in some cases they form strings or aggregations of individuals which float or are propelled through the sea. Coelenterate colonies are frequently characterized moreover by the production in one and the same colony of different kinds of individuals, among which the various functions are distributed. There may co-exist in a single colony not only polyps as well as medusae (fig. 4), but more than one kind of each of these types of individuals. There may be sexual medusae and medusae transformed into locomotory organs; polyps whose main function is digestion and others which catch and paralyse prey; and so forth. The phenomenon thus outlined is known as *polymorphism* and metagenesis is a form of it; it is one of the most interesting manifestations of the diversity of animal life, and is considered in more detail at the end of the article HYDROZOA.


FROM KÜKENTHAL, "HANDBUCH DER ZOOLOGIE" (WALTER DE GRUYTER & CO.)
FIG. 4.—PART OF A COLONY OF CORYNE, MUCH ENLARGED

Development.—The Coelenterata pass during the course of their life-history through a series of stages very unlike the adult animal. A simple instance of these stages is provided by the embryology of the common sea anemone, *Metridium senile* (fig. 5). In this species the eggs are shed into the sea by the parent and are there fertilized. After fertilization the egg divides into halves and each of these once more into two. The four cells (or *blastomeres*) so formed are equal or sub-equal in size. This process of subdivision is continued until a considerable number of small cells have been formed, and these are so arranged as to constitute a hollow sphere containing fluid. The sphere is known as a *blastula* and the cavity as a *blastocoele.* The blastula continues to develop in such a way that one side of the sphere first flattens and then becomes concave, being finally completely invaginated into the other half. This process practically obliterates the blastocoele, and forms in its stead a second internal cavity, the *archenteron,* which communicates with the exterior by means of a small opening, the *blastopore.* There has thus been produced a typical gastrula such as has been previously described; its archenteron becomes directly transformed into the coelenteron of the



AFTER CARLGREN & GEMMILL, FROM STEPHENSON "THE BRITISH SEA ANEMONES," BY COURTESY OF THE RAY SOCIETY; WITH AN ADDITION
FIG. 5.—STAGES IN DEVELOPMENT OF CERTAIN COELENTERATES
A. Section through an early stage in cleavage of the egg of a sea anemone (*Metridium*). D. and E. later stages—blastula and gastrula. B. A planula belonging to a hydrozoan. C. Late larva of a sea anemone

adult, and the blastopore becomes the adult mouth. During its early stages the animal moves through the water by the aid of cilia which appear on its outer surface during the blastula stage, but before it begins to assume the adult shape it tends to remain at the bottom, moving horizontally and resting from time to time, and often becoming temporarily attached to the bottom mouth downwards, during which time it may execute slow creeping movements. From this larva the adult anemone-polyp is achieved by degrees. At a given time the larva settles down and attaches itself to a foreign surface; its proportions change, it acquires tentacles, and becomes a small polyp.

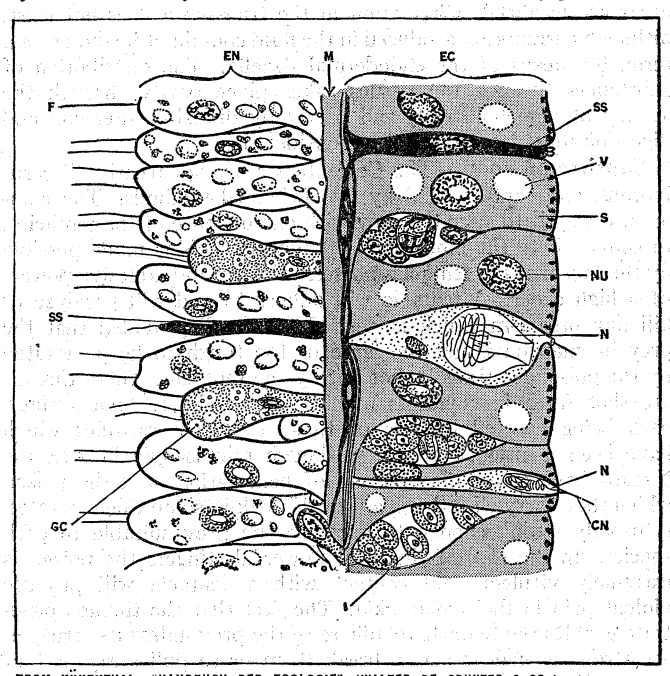
The embryology of the Coelenterata varies considerably from one species to another, but generally speaking it is characterized by the presence of a gastrula-stage or of some equivalent. Frequently no actual gastrula exists but instead a corresponding stage known as *planula* is produced, in which there is no blastopore, the embryo consisting either of a hollow two-layered organism or of a central mass of endoderm-cells covered externally by a layer of ectoderm (fig. 5). Planulae and gastrulae may be free-swimming organisms moving by means of cilia, or may be contained within the coelenteron of the parent or within a protective enclosure so that they have no actual free existence, and are born as young polyps.

Motion.—The movements of which a Coelenterate is capable depend upon its shape, organization and mode of life. A jellyfish is an active free-swimming creature which progresses through the water as a result of rhythmic or spasmodic contractions of its bell-like body brought about by the action of muscles. Different kinds of jellyfish are active in varying degrees; some are much stronger swimmers than others, some are decidedly sluggish, whilst a few are creepers. Movement in polyps varies according to whether they possess a skeleton or not; in those provided with such a structure movement is naturally limited to those actions which the tentacles or other parts of the polyp can perform unrestricted by the hard parts. If a polyp is free from skeleton, it can move in a variety of ways; rarely, it swims actively by concerted lashing movements of the tentacles; sometimes it will creep on these organs; or it may attach itself by the base, bend over and attach the tentacles, then loosen the base, move its body and re-attach the base elsewhere. On the other hand it may simply loosen its hold and allow the motion of the water to carry it elsewhere, and in such case may inflate itself with water in order to become more buoyant; or it may creep upon its base, a method characteristic of many of the large polyps of the sea anemones.

The movements exhibited, apart from those connected with actual locomotion, consist of contractions and expansions of the tentacles and body, movements of the mouth, and so forth, connected with capture and swallowing of food, with retraction for the purpose of sheltering from adverse conditions, and with similar matters. Tentacles are usually highly contractile, and in their most concentrated condition are very much smaller than when expanded. The whole body may be relatively rigid and not, as a whole, very contractile, in forms possessing a high development of the mesogloea; but in many cases it is as contractile as the tentacles and may be reduced at need to a bulk very much smaller than its size when expanded; *e.g.*, to an eighth of its maximum bulk.

Muscles.—Although the general substance of a Coelenterate is contractile, the definite movements which it performs are the result of muscular or ciliary action. The muscular system in its simplest condition consists of a single layer or sheet of muscle-fibres, lying on the inner or outer surface of the mesogloea. The muscle-sheets of Coelenterates are normally only one fibre thick, and each fibre lies directly upon a supporting surface of mesogloea. Consequently if strong localized muscles (as distinct from diffuse sheets) are required, these are generally attained by the simple expedient of pleating the surface of the mesogloea into ridges, on the surface of which lie the fibres, still in a single layer. In certain cases muscle becomes embedded in the mesogloea. The individual fibres are not in the simpler instances independent structures, but belong to and form part of epithelial cells of the ectoderm or endoderm. Thus the combination of each cell with its "muscle tail" (or tails) constitutes a musculo-epithelial cell, a structure characteristic of Coelenterata but rare among higher animals (fig. 8). In more specialized cases the muscle-fibres of the ectoderm become separate structures, the epithelial cells which produced them being of insignificant proportions.

The Finer Structure of the Tissues.—The structure of the layers of the body must now receive short notice (fig. 6). The



FROM KÜKENTHAL, "HANDBUCH DER ZOOLOGIE" (WALTER DE GRUYTER & CO.)

FIG. 6.—PART OF A LONGITUDINAL SECTION OF HYDRA, ENLARGED
CN. cnidocil; EC. ectoderm; EN. endoderm; F. flagellum; GC. gland cell; I. interstitial cell; M. mesogloea; N. nematocyst; S. supporting-cell; SS. sensory-cell; V. vacuole; NU. nucleus

mesogloea is a sheet of very variable structure; sometimes it is gelatinous in texture, sometimes almost cartilaginous, or again it may be very watery and unsubstantial. It contains within its substance cells which have wandered there from the other layers, and the functions of which are not fully understood. Some of them at least are amoeboid cells which carry or transmit nutriment from the endoderm (the digestive layer) to other parts of the body. Others probably add to the mesogloeal substance by secretion, whilst it is possible that some of them constitute part of a mesogloeal nervous system. At its highest development the mesogloea possesses fibres as well as cells, but these are not at all of the same nature as the muscular fibres. The cell-layers are best considered separately, and the following details apply to a sea anemone, which will serve as a suitable example. The ectoderm is an epithelium consisting of elongated supporting cells which are ciliated in some parts of the body, and among these occur large numbers of cells of other kinds. There are glandular cells which secrete mucus, etc., sensory cells which constitute the peripheral receptive elements of the nervous system, cnidoblasts which secrete curious explosive capsules about which more will be related shortly, and undifferentiated interstitial cells which may give rise to other kinds at need. In the deeper parts of the epithelium lie nerve cells (the nervous system is further described below) and on the surface of the mesogloea, in given parts of the body, are the muscle fibres, which are here independent of the supporting cells. The endoderm resembles the ectoderm in general constitution, but its supporting cells, instead of being ciliated, bear each a single large cilium or flagellum, and each possesses a basal muscle fibre, and so constitutes an epithelio-muscular cell. Many of them are digestive in function. Gland-cells are to be found in the endoderm, as also are sensory, nervous and interstitial cells; cnidoblasts are most characteristic of the ectoderm, but also occur freely in the endoderm where necessary.

The germ cells of the Coelenterata, those cells which will in due course form eggs or spermatozoa, are formed sometimes from

interstitial cells, sometimes from differentiated epithelial cells. They may originate in either ectoderm or endoderm, but are not necessarily first formed in the region in which they will ripen.

General Functions.—The Coelenterata possess no special organs for respiration or excretion, and possess neither blood nor blood-vessels. Respiration and excretion are performed by the general surfaces of the body, but sometimes the chief excretory areas are localized. Circulation in the true sense does not exist, although currents are produced in the fluid contained in the coelenteron by means of the endodermal flagella. The distribution of substances through the tissues takes place partly through the agency of amoeboid cells and partly by diffusion. Feeding and digestion must be more closely considered.

Capture of Food.—The Coelenterata are apparently all carnivorous, and capture food by two principal methods. The commonest way is to seize the prey with one or more of the tentacles, to convey it to the mouth and swallow it. This is made possible by the fact that the tentacles possess stinging and adhesive powers of a high order. A tentacle will adhere to and will paralyze or kill any organism which is desired for food, provided that the prey in question is not too large or too tough to be penetrated by the poisonous threads shot out by the tentacle. These threads are shot forth in countless numbers from the tentacle-surface, each being everted by one of those explosive capsules which have been mentioned above. Although microscopic in size, the threads have astonishing powers of penetration, and the poison which they carry with them, although weak in some Coelenterates, is usually strong enough to paralyze the prey suitable to each species. In the case of the most powerful stingers the poison is extremely virulent, and contact with a tentacle will produce violent pain in the human skin. The fact that the threads penetrate enables the tentacle to adhere to the prey unless its struggles are strong enough either to break them or to pull away part of the ectoderm, and in some cases there exist, in addition to the capsules with penetrating threads, others whose threads do not enter the prey but are covered with sticky material and adhere to it. The prey captured by this method is transferred by the tentacles to the mouth, which is generally very extensile and can open widely so as to engulf objects which in some cases are enormous in relation to the size of the swallower. The Coelenterate has not necessarily finished stinging the prey after it has been taken in, for in many cases there exist internal stinging organs.

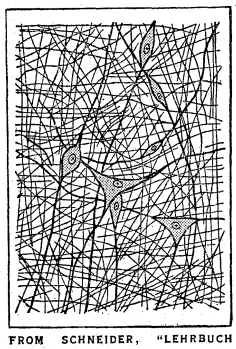
There is another method of feeding which may supplement or replace the characteristic one. Small food particles which come in contact with some part of a Coelenterate become entangled in slime secreted by that part, and these are transported by means of cilia acting in definite directions to the mouth. This method of feeding is probably the predominating one in certain species—for instance, in some sea anemones—and a good example of its working may be seen in the jellyfish *Aurelia.*

When *Aurelia* is feeding, planktonic organisms become entangled in strings of slime on the outside of the swimming-bell, and are conveyed by the movements of the bell aided by the action of cilia to the edge of the umbrella. Arrived at this point they are concentrated into eight masses at points situated at regular intervals round the margin of the bell. From time to time these masses are licked off by one or other of the four large arm-like processes which hang down under the bell round the mouth; and since each of these arms contains a groove leading directly into the mouth, the food mass is from this point onwards easily transported into the stomach. The underside of the swimming-bell also contributes to the eight food masses and the oral arms themselves collect plankton independently. This seems to be a normal mode of feeding in *Aurelia,* but at the same time it can and does, at any rate when young, catch fishes and other organisms as well as plankton.

The Food of Coelenterata.—The food of Coelenterates includes a great variety of animals—fishes and their eggs, crabs and all manner of other Crustacea, worms, molluscs, other Coelenterates, etc., not to mention the innumerable small planktonic organisms imbibed. Some Coelenterata are omnivorous, but others again will select their food more or less definitely. Certain special forms have been supposed to feed upon unicellular Algae (*Zooxanthellae*), but later work showed that these, also, are carnivorous and that the *Zooxanthellae* contained in their tissues are of importance in connection with their excretory process and are not used as food.

Digestion.—Digestion in Coelenterates is a process involving two stages. If a large object has been swallowed it is first broken up into particles and the latter are then engulfed or ingested by individual endoderm cells within which each particle becomes surrounded by a fluid-containing vacuole and there the remaining processes of digestion and absorption take place. Thus the whole process involves first *extra-cellular* digestion in the coelenteron, and then *intra-cellular* digestion in the endoderm; or if the food is small enough it may be directly ingested by endoderm-cells without previous breaking down. The details of this process vary according to the anatomy of the Coelenterate in question. In a simple case such as that of *Hydra,* the coelenteron is lined by a simple and fairly uniform layer of endoderm, not concentrated into special structures; and in such case this layer performs the double function of secreting digestive material which will break up a large prey and of ingesting the fragments so produced. In a higher form such as a sea anemone or coral the endoderm is differentiated into regions; there are definite tracts of epithelium in which gland-cells are concentrated, and these constitute together with the adjacent endoderm the main digestive area. These tracts, the mesenterial filaments, have been shown to secrete a digestive juice; and although they may also themselves ingest, in the most specialized cases the main absorptive region is not the filament itself but the endoderm on either side of it. The area of endoderm which will ingest food in such cases varies according to the size of the meal. The digestive ferments of Coelenterates are specialized for dealing with animal prey.

Nervous System.—This is of a very primitive grade in Coelenterata, and possesses neither actual nerves nor any central controlling organ. Its essential parts are the sensory cells and nerve cells of the ectoderm and endoderm, together with a network of fine fibrils connecting these cells with the muscle fibres and with each other. The nerve cells and fibrils constitute a "nerve net" which runs in the deeper part of the epithelium (fig. 7) and perhaps also penetrates the mesogloea. The net is sometimes fairly evenly distributed, sometimes better developed in one part than in another, and sometimes decidedly concentrated in given regions. It is not, as was formerly thought, a continuous network in the sense that the processes of one cell are actually fused with those of another, as it is now known that the cells are separate entities with their fibrils in contact, the junctions having the physiological properties of elementary synapses (*q.v.*). The mode of action of the network has received considerable study in the later years (*see,* for instance, the references to work by Pantin at the end of this article), but it cannot be described adequately in a few words. The behaviour of the individual nerve cells resembles that of the similar cells of higher animals more closely than was originally supposed; but the distinguishing feature of the net is its tendency to conduct impulses in all directions, in spite of which it may develop special tracts along which impulses travel rapidly for the production of certain particular responses. The net also exhibits in a high degree the phenomena known as interneural and neuromuscular facilitation (*see* the articles by Pantin referred to above).



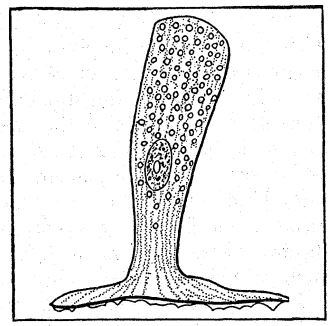
FROM SCHNEIDER, "LEHRBUCH DER VERGLEICHENDEN HISTOLOGIE DER TIERE" (FISCHER)

FIG. 7.—PART OF THE NERVE NET OF A COELENTERATE

Many Coelenterata possess definite sense-organs. These are naturally found in the more active members of the group, that is to say the medusae; they are absent altogether in the polyps. The chief types of sense-organs are two in number, and these are described in connection with the animals possessing them, in the articles HYDROZOA and SCYPHOZOA. The first type includes organs sensitive to light and termed *ocelli;* and these structures, though often simple, may attain at their

highest development the grade of eyes (see *Charybdaea,* in SCYPHOZOA). The second type comprises organs of variable structure (*statocysts* and *tentaculocysts*) which include hard particles (*statoliths*) in their constitution, and whose function is not yet fully understood. Although they might be expected to be organs of balance this does not necessarily appear to be the case. It has been ascertained experimentally, however, that certain of these organs initiate the stimuli which produce the swimming-contractions of the bell of the medusa possessing them, and consequently control the rate of pulsation. The bell pulsates at the rate of whichever organ is initiating stimuli most rapidly at a given time. The sense organs also appear to exert an influence on the general metabolic activities of the animal.

Stinging Capsules.—The cnidoblasts with their explosive capsules or *cnidae* will now be described (fig. 9). These capsules are among the most extraordinary structures to be found in the animal kingdom, and the physiological problem presented by the question of their explosion is a difficult one. It is probable that several factors are involved, and that these are called into play in fluctuating intensity according to the structure of the capsule and cnidoblast in question. Each cnida is a refringent transparent capsule with a gelatinous or more probably fluid content. In unexploded state, the capsule contains a hollow thread (*i.e.,* a capillary tube of incredible fineness) coiled or folded up within it; and the wall of capsule and thread are continuous with one another at one pole of the capsule. The cell (*cnidoblast*) in which the capsule lies and which originally produced it commonly bears at its free surface a fine hair-like projection, known as a *cnidocil.* The contact of a foreign body suitable as food with this cnidocil ordinarily leads directly to the explosion of the capsule. On the other hand such contact does not necessarily explode the capsule. For instance the reactions of a well-fed sea anemone are not the same as those of a hungry one; the tentacles may refuse food altogether, neither the tactile nor the chemical stimuli involved producing any effect on the capsules. When, however, a capsule does explode the thread is shot forth instantaneously. Although the action is so rapid, the thread as it is ejected turns completely inside out, in the manner in which one may turn the finger of a glove; in other words it is evaginated.



FROM SCHNEIDER, "LEHRBUCH DER VERGLEICHENDEN HISTOLOGIE DER TIERE" (FISCHER)

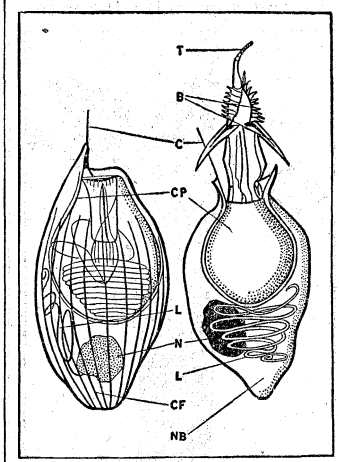
FIG. 8.—A SINGLE MUSCULO-EPITHELIAL CELL. THE CELL CONTAINS A NUCLEUS AND A SINGLE MUSCLE FIBRE

The structure of both cnidae and cnidoblasts varies greatly from one Coelenterate to another, and both may be complex. The cnidoblast possesses, in a number of cases at least, contractile fibres of varying disposition, and may also contain a coiled spring-like structure (the *lasso*) which probably resists the tearing away of the nematoblast from the tissues by a struggling prey. In a typical cnida the thread is provided with a series of spirally arranged barbs which help to fix it in the tissues of the prey, and bears with it poison which enters by the wound it has made. This kind of cnida, which is very frequent, is known as a *nematocyst,* in contrast to another type common in sea anemones and known as a *spirocyst.* The latter has no armature, but the outer surface of its evaginated thread has strongly adhesive properties, and is probably not poisonous.

True cnidae occur nowhere in the animal kingdom save in the Coelenterata. There are similar structures developed in at least two other kinds of animals (the myxosporidean Protozoa and certain nemertine worms), but they are not exactly the same; a number of other structures which have been confused with nematocysts are not actually such. The most interesting cases which have been investigated in this connection are those of certain animals in whose tissues actual Coelenterate nematocysts are present in an unexploded and functional condition. It has been conclusively shown that an animal may feed upon a Coelenterate, thus swallowing quantities of nematocysts, and that a number of these may pass unexploded through its food-canal, and may subsequently become arranged in a definite manner in its tissues. The best known instance of this is provided by certain of the Nudibranch molluscs or sea slugs. In some cases at least these stolen nematocysts appear to be of value to their host.

Nematocysts and spirocysts, which are produced by interstitial cells, are not developed in the place where they will function. In some cases this means simply that they develop in the deeper layers of the epithelium and move up to the surface as they mature. In other cases, however, a much more interesting story is involved. The capsules are here secreted by cnidoblasts far removed from the site of their ultimate explosion, and in order to bring them into the situation and orientation which will permit them to function, the cnidoblasts, which are amoeboid and possess the power of independent movement, drag their capsules between the epithelial cells (or transport them by other means) until the proper locality is reached. A most interesting example of the processes involved is supplied by the state of affairs which exists in an unusual jellyfish known as *Haliclystus.* This animal has the edge of its bell produced into eight arms, each tipped by a tuft of tentacles; and on the middle of the outside of the bell it bears a stalk by the end of which it can attach itself to seaweed and other objects. It has been found that the tentacles contain two kinds of nematocyst, and that both kinds are produced in definite parts of the ectoderm of the inner surface of the bell. It has further been discovered that the cnidoblasts containing the two kinds of capsules migrate from their nursery to the tentacles; but that on the way some of those of one pattern (and not those of the other) disappear into little ectodermal pockets which lie close to the margin of the bell. The function of the pockets appears to be that of reservoirs whence a supply of capsules may be drawn in case of special need—for instance, if the tentacles belonging to one side of the animal be cut off, new ones are regenerated and a large supply of capsules is needed to stock them; and it has been found that under such circumstances the pockets nearest to the regenerating tentacles were empty.

Reproduction.—Coelenterates reproduce their kind in a variety of ways. They produce in the manner common to animals, eggs and spermatozoa, which after union develop into new creatures. But in addition to this universal method they have an extraordinarily strong tendency toward "vegetative" or asexual modes of reproduction, and correlated with this a very marked ability to regenerate lost parts. This manner of increase is much like the ability of a strawberry-plant to produce runners. It exists under a variety of forms; sometimes an animal within the space of a few hours or less will tear itself completely in half vertically; each half will regenerate new parts and will so develop into a complete animal. This process is known as fission; it does not always take the form of actual tearing, but may result from a gradual process of constriction whereby an individual separates either completely into halves or becomes partly double. In other varieties of fission the separation into two or more parts takes place horizontally; and again, neither in vertical nor horizontal fission does it follow that the pieces formed will be at all equal in size. Equally characteristic of Coelenterates, but generally speaking of different ones, is the process known as budding (figs. 4 and 10). In this case a polyp may send out a rootlet (like the strawberry-runner) at the end of which a new polyp grows up;



FROM KÜKENTHAL, "HANDBUCH DER ZOOLOGIE" (WALTER DE GRUYTER & CO.)

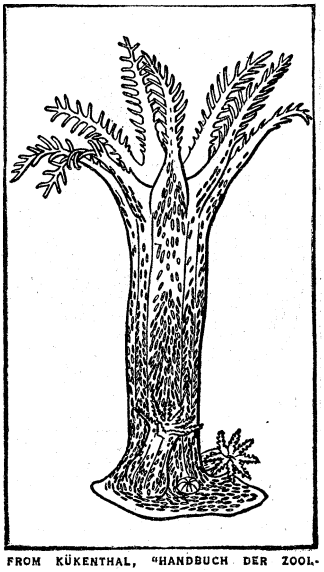
FIG. 9.—NEMATOCYSTS, OR STINGING ORGANS

On right, an exploded nematocyst contained within its cell; at left, a similar nematocyst before explosion. B. barbs; C. cnidocil; CF. contractile fibrils; CP. capsule; L. lasso; N. nucleus; NB. cnidoblast; T. thread

or a new polyp may arise direct from the tissues of an existing one. Polyps give rise by budding to other polyps or to medusae; medusae by budding may produce fresh medusae but never polyps, these being always developed from eggs or from other polyps. The processes of regeneration which succeed certain types of asexual reproduction are both definite and interesting; and the regenerative results which arise from the cutting away of various parts of Coelenterates, or from the division of these animals into portions by cuts in different directions, provide material for a study from which much of general biological interest may be gained. Further details relating to budding and fission will be found in the articles HYDROZOA, SCYPHOZOA and ANTHOZOA, whilst for information relating to regeneration reference should be made to the article on that subject.

Commensalism and Symbiosis.—There are to be found among the Coelenterata a number of examples of those types of relationship between one organism and another which are respectively known as *commensalism* and *symbiosis*. Commensalism, as exemplified by the regular partnership which exists between certain sea anemones and hermit crabs, is well represented in the group (*see* also next section); and a number of Coelenterata contain in their tissues those unicellular symbiotic algae known as *Zooxanthellae*.

The Poison of Coelenterates.—A certain amount of work has been done on the lines of making extracts of one sort and another of the tissues of Coelenterates and injecting these into other animals in order to study the effect of the poison of the Coelenterate on the animal in question. It has been known for a long time that the poisons of certain Coelenterates are very virulent and that contact of the stinging organs with human skin may produce serious results. In the case of medusae belonging to the *Charybdaeidae* for instance, jellyfish which outstrip all others in the strength and rapidity of their swimming-movements, the stinging organs may cause intense pain after contact with the skin, and symptoms such as swelling of the legs, etc., follow; fatal results may even ensue. An investigation of particular interest has been made on the poison of *Adamsia palliata* which throws light not only on the question of Coelenterate poisons but also upon the relationship between this anemone and another animal. *Adamsia palliata* lives in permanent association with a hermit crab known as *Eupagurus prideauxi,* and apparently these two organisms never normally occur apart. The soft tail-end of the crab is protected by the anemone, which is wrapped round it like a cloak; and the mouth of the anemone lies just below that of the crab, so that meals become a communal affair. Now it is possible to make an extract containing the poison of the tentacles or other stinging organs of an *Adamsia,* and such extracts have been injected in varying strengths into a number of animals. Certain of these, for instance Cephalopod molluscs (cuttle-fishes, etc.) and other sea anemones, appear to be completely immune from the *Adamsia* poison; other animals succumb to it. It has been found that the Decapod Crustacea (crabs, etc.) are the most sensitive to it, and its action on a number of these has been studied.



FROM KÜKENTHAL, "HANDBUCH DER ZOOLOGIE" (WALTER DE GRUYTER & CO.)

FIG. 10.—A POLYP IN PROCESS OF BUDDING

The following experiment is a case in point. Three shore-crabs (*Carcinus maenas*), three common hermit-crabs (*Eupagurus bernhardus*) and three of the hermits proper to *Adamsia* (*E. prideauxi*) were selected, and into the body-cavity of each was injected 0.1ml. of a filtered maceration of *Adamsia.* At the end of three minutes the *bernhardi* were completely paralyzed after a short phase of tetanization; and at the end of an hour they were dead. The shore-crabs died between five and nine hours after having exhibited the symptoms characteristic of this poison. On the other hand the *prideauxi* showed no apparent trouble; they retained all their agility and all the accustomed vivacity of their movements. At the end of 24 hours their condition was normal and they survived indefinitely. Other experiments confirm the result of this one, and the interesting fact emerges that *E. prideauxi* is immune from the poison of its anemone unless injected in inordinately large amount. Thus the association between the two animals includes a physiological as well as a morphological adaptation. It has been shown further that the serum of *E. prideauxi* is able to neutralize the *Adamsia* poison and that if a shore-crab be inoculated with *prideauxi* serum, it can afterwards withstand and recover from a dose of poison which would otherwise be fatal. It is probable that *E. prideauxi* gains its immunity in the first instance as a result of the fact that its close association with the anemone involves the constant entanglement of small portions of the latter, or of stinging cells derived from it, in the hermit's food. The intestinal content of the hermit usually contains such fragments of the anemone. Although in these experiments the poison of *Adamsia* did no harm to other anemones, yet in other cases one anemone may sting another, even of the same kind, and produce a wound which may prove fatal—so that an anemone is not necessarily immune from poison produced by its own kind. It is possible, however, that the injured animal in such cases is, to begin with, in a poor condition.

Distribution, Environment and Length of Life.—The distribution of the Coelenterata is world-wide, but the great majority are marine; a few kinds only inhabit brackish or fresh water, and these are further mentioned in the articles HYDROZOA and ANTHOZOA. The mass of Coelenterata then, inhabit one or other of the regions of the sea; and it cannot be said that they are characteristic of one kind of habitat more than of another. Many of them inhabit the littoral zone between tidemarks. Others colonize the sea-floor at greater or lesser depths, some of them occurring in extremely deep water (*e.g.*, 2,900 fathoms). The remainder are pelagic at varying depths and may live in the open sea, some of them floating and some swimming. A number of Coelenterates are perennial, living for a number of years, their length of life in some cases probably being extremely great. The best measured example of this is that of some sea anemones alive in 1945, which were known to be nearly 90 years old and possibly were much more. Other Coelenterates, on the other hand, are seasonal; many hydroids die down in winter and regenerate new polyps in spring; and many medusae live for a brief period only. Neither the tropics nor the cold regions can be regarded as the more typical habitat for Coelenterata, though it is true that corals, anemones and Siphonophores for instance, attain their maximum profusion or considerable complexity of development (sometimes both these features) in the warm seas. The variety of Coelenterates which may occur within a broadly similar environment is great, but as in the case of many other animals a certain proportion at least of the genera permanently colonizing the various available habitats show a sympathetic reaction to their environment; thus it may be expected with reason that an average anemone living at great depths will be different from a typical inhabitant of a coral-reef, and a typical mud-dweller from an ordinary adherent form. Certain single species however range in suitable habitats from the arctic to the equator, others occur both in the arctic and the antarctic; whilst some are circumpolar in distribution. With regard to the distribution of jellyfish it may be noted that their swimming powers are adapted rather for maintaining their position in the water and for moving up and down in it than for making long journeys; the main agents in their distribution are currents and tides.

Classification.—The Coelenterata are divided into three great classes, the *Hydrozoa, Scyphozoa* and *Anthozoa.* To these are sometimes added the *Ctenophora;* but the latter are animals which are actually very different from any Coelenterata, and the reasons which lead to this conclusion are stated in the article dealing with them. The characteristics of the three great classes of Coelenterata are also described in articles dealing with each series separately.

BIBLIOGRAPHY.—General Accounts: E. A. Minchin, G. C. Bourne and G. H. Fowler, "The Porifera and Coelentera," in *A Treatise on Zoology,* pt. 2 (ed. Sir E. Ray Lankester, 1900); Y. Delage and E. Hérouard, *Traité de zoologie concrète,* vol. ii, pt. 2 (1901); S. J. Hickson, "Coelenterata and Ctenophora," in *Camb. Nat. Hist.,* vol. i

(ed. A. E. Shipley and S. F. Harmer, 1906); H. Broch, T. Krumbach, W. Kükenthal, F. Moser and F. Pax, in W. Kükenthal, *Handbuch der Zoologie,* vol. i (ed. T. Krumbach, 1923–25); L. H. Hyman, *The Invertebrates: Protozoa through Ctenophora* (1940).

Development: E. W. MacBride, "Invertebrata," in W. Heape, *Text-Book of Embryology,* vol. i (1914). Histology: K. C. Schneider, *Lehrbuch der Vergleichenden Histologie der Tiere* (Jena, 1902) and *Histologisches Praktikum* (Jena, 1908). Nematocysts: L. Will, *Naturforschenden Gesellschaft* (Rostock, 1909–10); P. Schulze, *Archiv für Zellforschung,* with bibl. (ed. R. Goldschmidt, Leipzig, 1922); and in animals other than Coelenterata; C. H. Martin, *Biologische Centralblatt* (ed. J. Rosenthal, Erlangen, Leipzig, 1914); C. F. A. Pantin, *Journ. Exper. Biol.* (1942). Nervous System and Behaviour: G. H. Parker, *The Elementary Nervous System* (1919); C. F. A. Pantin, *Journ. Exper. Biol.* (1935), *Proc. Roy. Soc. B.* (London, 1937). Digestion: H. Boschma, *Biological Bulletin* (1925); R. Beutler, *Zeitschr. für vergl. Physiol.* (1924–26); C. M. Yonge, *Great Barrier Reef Exped., Sci. Reports* vol. i, (London, 1940). *See* also H. Boschma, etc., for *Zooxanthellae.* For recent lists of literature *see* W. Kükenthal's *Handbuch* (*supra*), and for further references the articles HYDROZOA, ANTHOZOA and GRAPTOLITES. (T. A. S.)

COELLO, ALONSO SANCHEZ (1515–1590), Spanish painter, according to some authorities a native of Portugal, was born, according to others, at Benifacio, near the city of Valencia. He studied many years in Italy; and returning to Spain in 1541 he settled at Madrid, and worked on religious themes for most of the palaces and larger churches. He was a follower of Titian, and, like him, excelled in portraits and single figures, elaborating the textures of his armours, draperies, and such accessories in a manner so masterly as strongly to influence Velazquez in his treatment of like objects. Many of his pictures were destroyed in the fires that consumed the Madrid and Prado palaces, but many good examples are yet extant, among which may be noted the portraits of the infantes Carlos and Isabella, now in the Madrid gallery, and the St. Sebastian painted in the church of San Gerónimo, also in Madrid. Coello left a daughter, Isabella Sanchez, who studied under him, and painted excellent portraits.

COELLO, ANTONIO (1611–1652), Spanish dramatist and poet, was born at Madrid and entered the household of the duke of Albuquerque. His best known plays are *El conde de Sex, El Celoso extremeño* (dramatizing one of Cervantes' *Novelas Exemplares*) and *Los Empeños de seis horas.* The latter was adapted by Samuel Tuke, under the title of *The Adventures of five Hours,* and was described by Pepys as superior to *Othello.*

COELLO, CLAUDIO (*c.* 1630–1693), Spanish painter born at Madrid, son of a well-known worker in bronze of Portuguese origin. He studied under Francisco Rizi, and was dominated at first by an overcharged, exaggerated style, which was then beginning to be admired in Madrid. He assisted his master in the execution of an altarpiece for S. Placido. He then studied and copied the works of Titian, Rubens and Van Dyck in the royal collections, to which he secured access through his friendship with the court painter D. Juan Carreño. He also profited by his friendship with Josef Donoso, who had studied seven years in Rome, and, with his co-operation, painted frescoes in some churches and palaces of Madrid. In 1671 he decorated the ceiling of the vestry in Toledo cathedral. In 1683 he was commissioned by the archbishop of Saragossa to paint frescoes in the cupola and the transept of the Augustine church. On his return to Madrid he became court painter to King Charles II., and undertook the altarpiece for the sacristy in the Escorial representing the "Transfer of the Holy Eucharist." The scene is represented as taking place in the same room in which the picture is hung. It is a fine arrangement of space in the baroque style containing some 50 life-like portraits including that of Charles II. and his prime minister. This work is his masterpiece. It is nearly allied to the realistic art of Velasquez and Carreño, and Coello here shows himself as a brilliant and strong colourist, a fine and careful draughtsman. He seems to have tried to stem the decadence, which was engulfing Spanish art. His work was universally admired, he was appointed Seneschal and his son received a pension of 300 ducats. Then Luca Giordano arrived in 1692. The preference shown by the court to the Italian favourite, hurt Coello's sensitive nature. His last work was the "Martyrdom of St. Stephen," painted for the Dominican church at Salamanca. He died on April 2, 1693, at Madrid, and was buried in the church of San Andres. He was the last important master of the great Madrid school of the 17th century.

His works are to be seen in the churches of Madrid and other cities of Spain, at the Prado, in the galleries of Munich, Budapest and Frankfurt. "The Betrothal," presented to the National Gallery, London, as by Velazquez, is perhaps an early work by Coello, who is also represented in the collections at Apsley house and Grosvenor house.

See A. de Beruete y Moret, *The School of Madrid* (1909).

COELOM AND SEROUS MEMBRANES. In human anatomy the body-cavity or coelom is divided into the *pericardium,* the two *pleurae,* the *peritoneum* and the two *tunicae vaginales.*

The *pericardium* is a closed sac in the thorax and contains the heart. Like all the serous membranes it has a visceral and a parietal layer, the former being closely applied to the heart and consisting of endothelial cells with a slight fibrous backing: to it is due the glossy appearance of a freshly removed heart. The parietal layer is double; externally there is a strong fibrous coat continuous with the other fibrous structures in the neighbourhood, while internally is the endothelial layer which is reflected from the surface of the heart, where the great vessels enter. Hence everywhere the two layers of the membrane are in contact except for a trace of fluid secreted by the serous walls.

The *pleurae* resemble the pericardium except that the fibrous outer coat of the parietal layer is not nearly as strong; it is closely attached to the inner surface of the chest walls and mesially to the outer layer of the pericardium; above it is thickened by a fibrous contribution from the scalene muscles, and forms the *dome of the pleura* which fits into the concavity of the first rib and contains the apex of the lung. The reflection of the serous layer of the pleura, from the parietal to the visceral part, takes place at the root of the lung. The upper limit of the pleural cavity reaches about half an inch above the inner third of the clavicle, while, below, it may be marked out by a line drawn from the twelfth thoracic spine to the tenth rib in the mid axillary line, the eighth in the nipple line, and the sixth at its junction with the sternum.

The *peritoneum* is a more extensive and complicated membrane; it surrounds the abdominal and pelvic viscera, and, like the other sacs, has a parietal and visceral layer. The line of reflection of these, though continuous, is very tortuous. The peritoneum consists of a *greater* and *lesser sac* which communicate through an opening (*foramen of Winslow*) and the best way of understanding these is to follow the reflections first in a vertical median (sagittal) section and then in a horizontal one, the body being supposed to be in the upright position. If a median sagittal section be studied first, and a start be made at the umbilicus (*see* fig. 1), the parietal peritoneum is seen to run upward, lining the anterior abdominal wall, and then to pass along the under surface of the diaphragm till its posterior third is reached; here there is a reflection on to the liver, forming the anterior layer of the *coronary ligament* of that viscus, while the membrane now becomes visceral and envelops the front of the liver as far back as the transverse fissure on its lower surface; here it is reflected on to the stomach forming the anterior layer of the *gastro-hepatic* or *lesser omentum.* It now covers the front of the stomach, and at the lower border runs down as the anterior layer of an apron-like fold, the *great omentum,* which sometimes reaches as low as the pubes; then it turns up again as the posterior or fourth layer of the great omentum until the transverse colon is reached, the posterior surface of which it covers and is reflected, as the

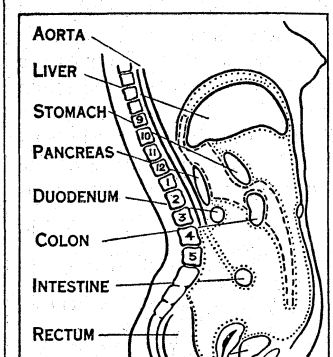


FIG. 1.—VERTICAL MEDIAN SECTION OF ABDOMEN TO SHOW ARRANGEMENT OF THE PERITONEUM
The peritoneum is indicated by a dotted line for the greater sac and a broken line for the lesser sac

posterior layer of the *transverse mesocolon* to the lower part of the pancreas; after this it turns down and covers the anterior surface of the third part of the duodenum till the posterior wall of the abdomen is reached, from which it is reflected on to the small intestine as the anterior layer of the *mesentery,* a fold varying from 5 to 8 in. between its attachments. After surrounding the small intestine it becomes the posterior layer of the mesentery and so again reaches the posterior abdominal wall, down which it runs until the rectum is reached. The anterior surface of this tube is covered by peritoneum to a point about 3 in. from the anus, where it is reflected on to the uterus and vagina in the female and then on to the bladder; while in the male, on the other hand, the reflection is directly from the rectum to the bladder. At the apex of the bladder, after covering the upper surface of that organ, it is lifted off by the urachus and runs up the anterior abdominal wall to the umbilicus, from which the start was made. All this is the greater sac. The tracing of the lesser sac may be conveniently started at the transverse fissure of the liver, whence the membrane runs down to the stomach as the posterior layer of the lesser omentum, lines the posterior surface of the stomach, passes down as the second layer of the great omentum and up again as the third layer, covers the anterior surface of the transverse colon and then reaches the pancreas as the anterior layer of the transverse mesocolon. After this it covers the front of the pancreas and in the middle line of the body runs up below the diaphragm to within an inch of the anterior layer of the coronary ligament of the liver; here it is reflected on to the top of the Spigelian lobe of the liver to form the posterior layer of the coronary ligament, covers the whole Spigelian lobe, and so reaches the transverse fissure.

This section, therefore, shows two completely closed sacs without any visible communication. In the female, however, the great sac is not absolutely closed, for the Fallopian tubes open into it by their minute *ostia abdominalia,* while at the other ends they communicate with the cavity of the uterus and so with the vagina and exterior.

A horizontal section through the upper part of the first lumbar vertebra will, if a fortunate one (*see* fig. 2), pass through the foramen of Winslow and show the communication of the two sacs. A starting-point may be made from the mid-ventral line and the parietal peritoneum traced round the left side of the body wall until the outer edge of the left kidney is reached; here it passes in front of the kidney and is soon reflected off on to the spleen, which it nearly surrounds; just before it reaches the hilum of that organ, where the vessels enter, it is reflected on to the front of the stomach, forming the anterior layer of the *gastro-splenic omentum;* it soon reaches the lesser curvature of the stomach and then becomes the anterior layer of the lesser omen-

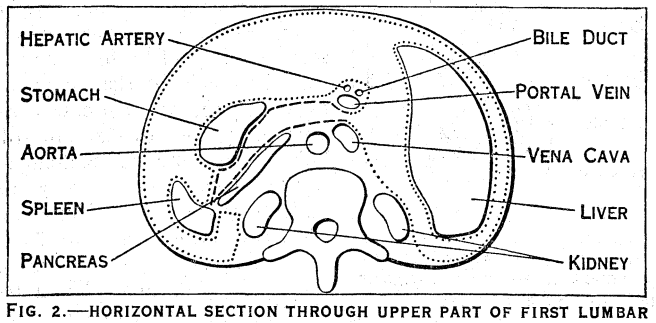
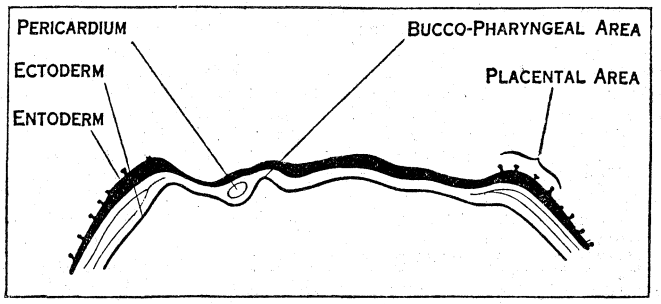


FIG. 2.—HORIZONTAL SECTION THROUGH UPPER PART OF FIRST LUMBAR VERTEBRA, SHOWING ARRANGEMENT OF THE PERITONEUM

tum, which continues until the bile duct and portal vein are reached at its right free extremity; here it turns completely round these structures and runs to the left again, as the posterior layer of the lesser omentum, behind the stomach and then to the spleen as the posterior layer of the gastro-splenic omentum. From the spleen it runs to the right once more, in front of the pancreas, until the inferior vena cava is reached, and this point is just behind the portal vein and is the place where the lesser and greater sacs communicate, known as the foramen of Winslow. From this opening the lesser sac runs to the left, while all the rest of the peritoneal cavity in the section is greater sac. From the front of the vena cava the parietal peritoneum passes in front of the right kidney and round the right abdominal wall to the mid-ventral line. The right part of this section is filled by the liver, which is completely surrounded by a visceral layer of peritoneum, and no reflection is usually seen at this level between it and the parietal layer. Some of



FROM CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD UNIVERSITY PRESS)

FIG. 3.—LONGITUDINAL SECTION SHOWING THE DIFFERENT AREAS OF THE BLASTODERMIC VESICLE IN EARLY DEVELOPMENT OF THE OVUM

the viscera, such as the kidneys and pancreas, are retro-peritoneal; others, such as the small intestines and transverse colon, are surrounded, except at one point where they are attached to the dorsal wall by a *mesentery* or *mesocolon* as the reflections are called; others again are completely surrounded, and of these the caecum is an example; while some, like the liver and bladder, have large uncovered areas, and the reflections of the membrane form ligaments which allow considerable freedom of movement.

The *tunica vaginalis* is the remains of a peritoneal pocket which descends into the scrotum during foetal life before the testis itself descends. After the descent of the testis the upper part usually becomes obliterated, while the lower part forms a serous sac which nearly surrounds the testis. The parietal layer lines the inner wall of its own side of the scrotum.

Embryology.—As the mesoderm spreads over the embryo it splits into two layers, the outer of which (*somatopleure*) lines the parietal or ectodermal wall, while the inner lines the entoderm (*splanchnopleure*); between the two is the coelom. The pericardial area is early differentiated from the rest of the coelom and at first lies in front of the neural and bucco-pharyngeal area; here the mesoderm stretches right across the mid-line, which it does not in front and behind. As the head of the embryo is formed the pericardium is gradually turned right over, so that the dorsal side becomes the ventral and the anterior limit the posterior; this will be evident on referring to figs. 3 and 4.

The two primitive aortae lie at first in the ventral wall of the pericardium, but with the folding over they come to lie in the dorsal wall and gradually bulge into the cavity as they coalesce to form the heart, so that the heart drops into the dorsal side of the pericardium and draws down a fold of the membrane called the *dorsal mesocardium.* In mammals A. Robinson (*Jour. Anat. and Phys.,* xxxvii. I) has shown that no ventral mesocardium exists, though in more lowly vertebrates it is present. Laterally the pericardial cavity communicates with the general cavity of the coelom, but with the growth of the Cuvierian ducts (*see* development of veins) these communications disappear. Originally the mesocardium runs the whole length of the pericardium from before backward, but later on the middle part becomes obliterated.

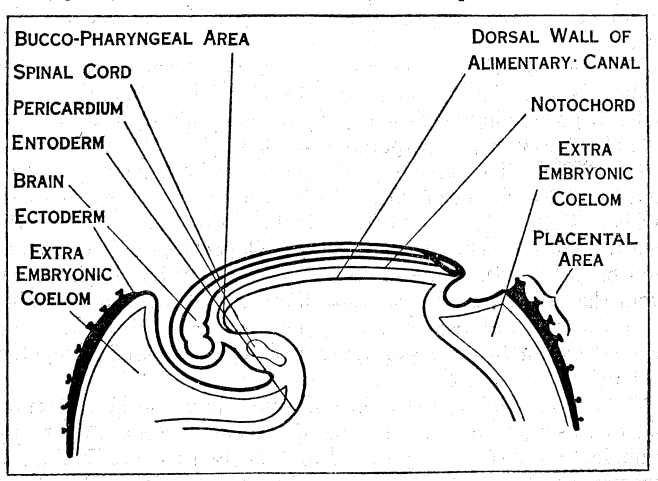
Just behind the pericardium and in front of the umbilicus, which at first are close together, the mesoderm forms a mass into which the developing lungs push bag-like protrusions of the coelom. These lose their connection with the rest of the coelom, as the diaphragm develops, and become the pleural cavities. The remainder of the coelom persists as the peritoneum. At first the stomach and intestine form a straight tube, connected to the dorsum of the embryo by a *dorsal mesentery* and to the mid-ventral wall in front of the umbilicus by a *ventral mesentery.* Into the ventral mesentery the liver grows as diverticula from the duodenum, so that some of the mesentery remains as the *falciform ligament* of the liver and some as the lesser omentum. Into the

dorsal mesentery the pancreas grows, also as diverticula, from the duodenum, while the spleen is developed from the mesoderm contained in the same fold. As the stomach turns over and its left side becomes ventral, the dorsal mesentery attached to it is pulled out, so that part forms the great omentum and part the gastro-splenic omentum. When the caecum is formed as a diverticulum from the intestine it is close to the liver but gradually travels down into the right iliac fossa. This passage to the right is accompanied by a throwing over of the duodenal loop to the right, so that the right side of its mesentery becomes pressed against the dorsal wall of the abdomen and obliterated. This accounts for the fact that the pancreas and duodenum are only covered by peritoneum on their anterior surfaces in man. The formation of the lesser sac is due to the turning over of the stomach to the right, with the result that a cave is formed behind it. Originally the whole colon had a *dorsal mesocolon* continuous with the mesentery, but in the region of the ascending and descending colon this usually disappears and these parts of the gut are uncovered by peritoneum posteriorly. The transverse mesocolon persists and at first is quite free from the great omentum, but later, in man, the fourth layer of the great omentum becomes continuous with the posterior layer of the transverse mesocolon.

Comparative Anatomy.—In *Amphioxus* the coelom is developed in the embryo as a series of bilateral pouches from the sides of the alimentary canal; these are therefore entodermal in their origin, as in *Sagitta* and the Echinodermata among the invertebrates. In the adult the coelom is represented by two dorsal canals communicating with a ventral canal by means of branchial canals which run down the outer side of the primary gill bars. Into the dorsal canals the nephridia open. In the intestinal region the coelom is only present on the left side.

In the higher vertebrates (*Craniata*) the coelom is developed by a splitting of the mesoderm into two layers, and a pericardium is constricted off from the general cavity. In all cases the ova burst into the coelom before making their way to the exterior, and in some, e.g., *Amphioxus,* lamprey (Cyclostomata), eels and mud-fish (Dipnoi), the sperm cells do so too. The Cyclostomata have a pair of *genital pores* which lead from the coelom into the urino-genital sinus, and so to the exterior.

In the Elasmobranch fish there is a *pericardio-peritoneal canal* forming a communication between these two parts of the coelom;



AFTER YOUNG AND ROBINSON, FROM CUNNINGHAM, "TEXT-BOOK OF ANATOMY"

FIG. 4.—LONGITUDINAL SECTION SHOWING RELATION OF PARTS TO SEROUS MEMBRANES IN THE EARLY DEVELOPING EMBRYO

also a large common opening for the two oviducts in the region of the liver, and two openings (*abdominal pores*) on the surface close to the cloacal aperture. In the Teleostomi (Teleostean and Ganoid fish) abdominal pores are rare, but in most Teleostei (bony fish) the ova pass directly down oviducts, as they do in arthropods, without entering the peritoneal cavity; there is little doubt, however, that these oviducts are originally coelomic in origin. In the Dipnoi (mud-fish) abdominal pores are found, and probably serve as a passage for the sperm cells, since there are no vasa deferentia. In fishes a complete dorsal mesentery is seldom found in the adult; in many cases it only remains as a tube surrounding the vessels passing to the alimentary canal.

In the Amphibia, Reptilia and Aves, one cavity acts as pleura and peritoneum, though in the latter the lungs are not completely surrounded by a serous membrane. In many lizards the comparatively straight intestine, with its continuous dorsal mesentery and ventral mesentery in the anterior part of the abdomen, is very like a stage in the development of the human and other mammalian embryos. In the mammalia the diaphragm is complete (*see* DIAPHRAGM) and divides the pleuroperitoneal cavity into its two constituent parts. In the lower mammals the derivatives of the original dorsal mesentery do not undergo as much fusion and obliteration as they do in adult man; the ascending and descending mesocolon is retained, and the transverse mesocolon contracts no adhesion to the great omentum. It is common, however, to find a fenestrated arrangement of the great omentum which shows that its layers have been completely obliterated in many places.

In those animals, such as the rabbit, in which the testes are sometimes in the scrotum and sometimes in the abdomen, the communication between the peritoneum and the tunica vaginalis remains throughout life.

BIBLIOGRAPHY.—Full bibliography in Quain's *Anatomy.*

COELOMATA, a zoological term denoting those animals that have a true coelom, *i.e.,* a space within the entomesoderm. Animals with no space between the digestive canal and body wall, as the flatworms (*Platyhelminthes*), are termed Acoelomata, and those in which this space is not a true coelom are called Pseudocoelomata.

COELOSTAT, a mirror driven by clock-work so as to reflect continually the same region of the sky into the field of view of a fixed telescope. The mirror is mounted so as to rotate about an axis in its own plane which points to the pole of the heavens, and is driven at the rate of one revolution in 48 (sidereal) hours. The image of a star seen in the mirror is then stationary. The device is particularly useful in eclipse expeditions when elaborate equatorial mounting of the telescopes is impossible. Other instruments for somewhat similar purposes are the heliostat and siderostat (*q.v.*).

COEN, JAN PIETERSZOON (1587–1630), fourth governor-general of the Dutch East Indies, was born at Hoorn, and spent his youth at Rome in the house of the famous merchants the Piscatori. In 1607 he sailed from Amsterdam to the Indies as second commercial agent, and remained away four years. In 1612 he was sent out at the head of a trading expedition. In 1613 he was made a councillor and director-general of the East Indian trade. Afterwards he became president at Bantam, and on Oct. 31, 1617, he was promoted in succession to Laurens Reaal to the post of governor-general. To his vigour and intrepidity the Dutch in no small measure owed the preservation and establishment of their empire in the East. He took and destroyed Jacatra, and founded on its ruins the capital of the Dutch East Indies, to which he gave the name of Batavia. In 1622 Coen obtained leave to resign his post and return to Holland, but in his absence great difficulties had arisen with the English at Amboina (the so-called massacre of Amboina), and in 1627 under pressure from the directors of the East India Company he returned as governor-general to Batavia. In 1629 he was able to beat off a formidable attack of the sultan of Mataram, sometimes styled emperor of Java, upon Batavia.

COENWULF (d. 821), king of Mercia, successor of Ecgfrith, son of Offa, in 796. In 798 he invaded Kent, imprisoned Eadberht Praen, and made his own brother Cuthred king. On Cuthred's death (807) Coenwulf seems to have taken Kent into his own hands. He abolished the archbishopric of Lichfield, probably before 803, as the Hygeberht who signed as an abbot at the council of Cloveshoe in that year was presumably the former archbishop. Coenwulf appears from the charters to have had a long dispute with Wulfred of Canterbury, who was consecrated in 806. It was probably only settled in 825, when the lawsuit of Cwoenthryth, his daughter, with Wulfred was terminated. He died in 821 and was succeeded by his brother Ceolwulf I.

See Earle and Plummer's edition of the *Anglo-Saxon Chronicle,*

796, 819 (Oxford, 1892); W. de G. Birch, *Cartularium Saxonicum*, 378 (1885–93).

COERCION, an application of moral or physical compulsion by which a person is forced to do or refrain from doing some act apart from his own voluntary motion. Where the coercion is direct or positive, *i.e.*, where the person is compelled by physical force to do an act contrary to his will, his act is not legally a crime. Where the coercion is implied as where moral force is used, the person coerced is responsible, as in the case of duress or threats. Formerly where a married woman committed a crime in the presence of her husband she was presumed to have acted by his coercion and to be entitled to acquittal. Now by s. 47 of the Criminal Justice Act 1925 any such presumption is abolished; but on a charge against a wife for any offence other than treason or murder it is a good defence to show that the offence was committed in the presence of and under the coercion of her husband. In civil matters, such as the making of a contract, where the law requires the free assent of the person who undertakes the obligation, coercion is a ground for invalidating the instrument.

COEUR, JACQUES (*c.* 1395–1456), founder of the trade between France and the Levant, was born at Bourges, the son of a rich merchant. About 1429 he formed a commercial partnership with two brothers named Godard; and in 1432 he was at Damascus, buying and transporting to France the wares of the Levant. Within a few years he placed his country in a position to contend not unsuccessfully with the great trading republics of Italy, and acquired such reputation as to be able to render material assistance to the knights of Rhodes and to Venice herself.

In 1436 Coeur was summoned to Paris by Charles VII., and made master of the mint. The country was at that time deluged with the base moneys of three reigns, charged with superscriptions both French and English, and Charles had determined on a sweeping reform. Jacques Coeur inspired or prepared all the ordinances concerning the coinage of France issued between 1435 and 1451. In 1438 he was made steward of the royal expenditure; in 1441 he and his family were ennobled by letters patent. In 1444 he was sent as one of the royal commissioners to preside over the new *parlement* of Languedoc. In 1445 his agents in the East negotiated a treaty between the sultan of Egypt and the knights of Rhodes; and in 1447, at his instance, Jean de Village, his nephew by marriage, was charged with a mission to Egypt. The results were most important; concessions were obtained which greatly improved the position of the French consuls in the Levant and laid the foundations of the important French commerce in the Near East. In the same year Coeur took part in a mission to Amadeus VIII., former duke of Savoy, who had been chosen pope as Felix V. by the council of Basel. In 1448 he represented the French king at the court of Pope Nicholas V., and was able to arrange an agreement between Nicholas and Amadeus, and so to end the papal schism. From about this time he made large advances to Charles for carrying on his wars; and in 1449, after fighting at the king's side through the campaign, he entered Rouen in his train.

At this moment the great trader's glory was at its height. He had represented France in three embassies, and had supplied the sinews of that war which had ousted the English from Normandy. He was invested with various offices of dignity, and possessed the most colossal fortune that had ever been amassed by a private Frenchman. The sea was covered with his ships; he had 300 factors in his employ, and houses of business in all the chief cities of France. He had built houses and chapels, and had founded colleges in Paris, at Montpellier and at Bourges. The magnificent house at Bourges remains to-day one of the finest monuments of the middle ages in France. He also built there the sacristy of the cathedral and a sepulchral chapel for his family. His brother Nicholas was made bishop of Luçon, his sister married Jean Bochetel, the king's secretary, his daughter married the son of the viscount of Bourges, and his son Jean became archbishop of Bourges.

In Feb. 1450 Agnes Sorel, the king's mistress, suddenly died. Eighteen months later it was rumoured that she had been poisoned, and Jacques Coeur was accused of having poisoned her by Jeanne de Vendôme, wife of François de Montberon, and an Italian, Jacques Colonna. There was not even a pretext for such a charge, but for this and other alleged crimes the king, on July 31, 1451, gave orders for his arrest and for the seizure of his goods, reserving to himself a large sum of money for the war in Guienne. Commissioners extraordinary, the merchant's declared enemies, were chosen to conduct the trial, and an enquiry began, the judges in which were either the prisoner's debtors or the holders of his forfeited estates. A conviction was indispensable, and after 22 months of confinement, he was condemned to do public penance for his fault, to pay the king a sum equal to about £1,000,000 of modern money, and to remain a prisoner till full satisfaction had been obtained; his sentence also embraced confiscation of all his property, and exile during royal pleasure. For nearly three years nothing is known of him. It is probable that he remained in prison; it is certain that his vast possessions were distributed among the intimates of Charles.

In 1455 Jacques Coeur, wherever confined, contrived to escape into Provence. He was pursued; but a party, headed by Jean de Village and two of his old factors, carried him off to Tarascon, whence, by way of Marseilles, Nice and Pisa, he managed to reach Rome. He was honourably and joyfully received by Nicholas V., who was fitting out an expedition against the Turks. On the death of Nicholas, Calixtus III. continued his work, and named his guest captain of a fleet of 16 galleys sent to the relief of Rhodes. Coeur set out on this expedition, but was taken ill at Chios, and died there on Nov. 25, 1456.

See the admirable monograph of Pierre Clément, *Jacques Coeur et Charles VII.* (1858, 2nd ed. 1874); A. B. Kerr, *Jacques Coeur* (1927).

COEUR D'ALÊNE, a tribe of North American Indians of Salishan stock. The name is said to have been originally that of a chief noted for his cruelty and means "awl-heart," the French translation of the native name *skitswish*. The tribe gave its name to a lake, river, city and range of mountains in Idaho, where on a reservation about 400 of the remaining 600 survivors were settled in 1942.

COEUR D'ALENE, a city of Idaho, U.S.A., 33 mi. E. of Spokane, at the head of Lake Coeur d'Alene; the county seat of Kootenai county. It is on Federal highways 10 and 95, and is served by the Northern Pacific, Chicago, Milwaukee and St. Paul, Spokane International and Great Northern railways. The population was 8,297 in 1930, and 10,049 in 1940 by the federal census.

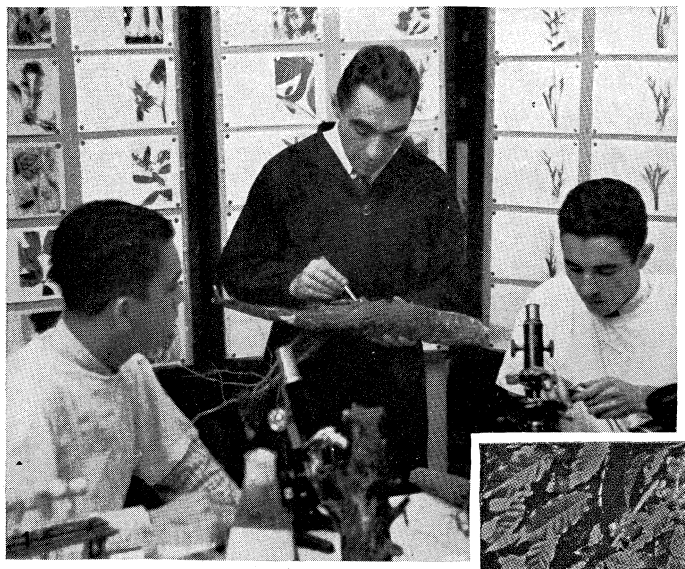
It is in the rich lumbering, mining and agricultural region known as the "inland empire." The city has saw and planing mills, boat-building yards and a railroad-tie factory. It was settled about 1880, and incorporated in 1889.

COFFEE. The discovery of coffee is quite generally accredited to Africa, although earliest cultivation is traced to southern Arabia. Coffee grew in Africa only in a wild state until fairly modern times, when it began to be developed there on a production basis by British interests. Coffee probably derives its name from the original Arabic *qahwah*, indirectly through its Turkish form *kahveh*, although some etymologists connect it with the name *Kaffa*, a town in southwest Ethiopia (Abyssinia) reputed to be the birthplace of coffee.

History concerning the origin of coffee is vague and obscure, but rich in legend and myth. One of the most accepted tales surrounding its discovery, about A.D. 850, is that of Kaldi, the Arabian goatherd. Bewildered by the queer antics of his flock, he is supposed to have eaten berries of the evergreen bush on which the goats were feeding and, overjoyed at the feeling of exhilaration which he experienced, has been pictured in legend as dashing off to proclaim his great find to the world.

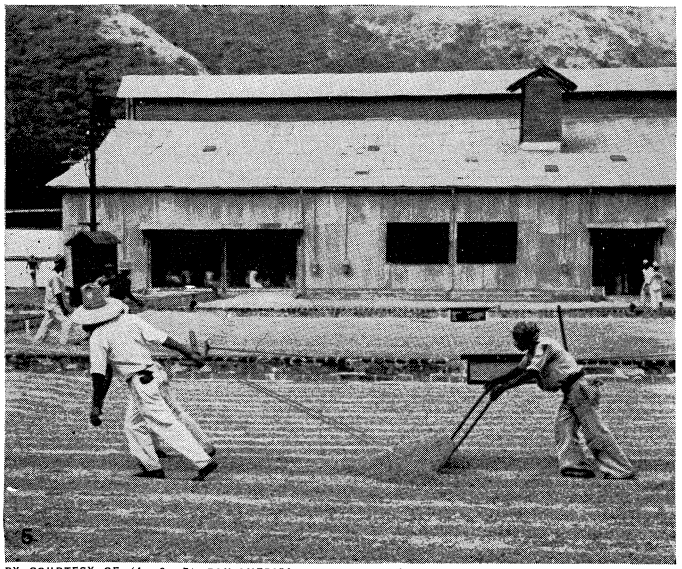
The early record of coffee in Europe, where it was first introduced soon after the beginning of the 17th century, is filled with accounts of its use as a religious, political and medical potion. Earlier still are the stories regarding its approval or prohibition by rulers of olden days. The physiological action of coffee in dissipating drowsiness was taken advantage of in connection with the prolonged religious service of the Mohammedans, but the strictly orthodox and conservative section of the priests claimed

COFFEE









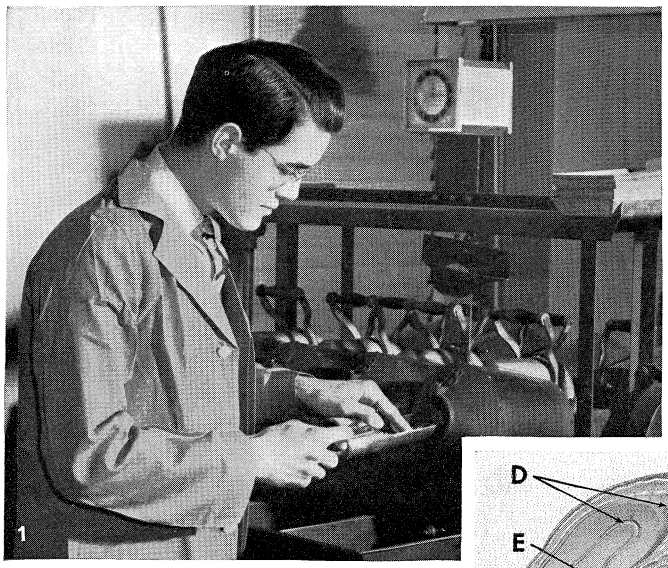


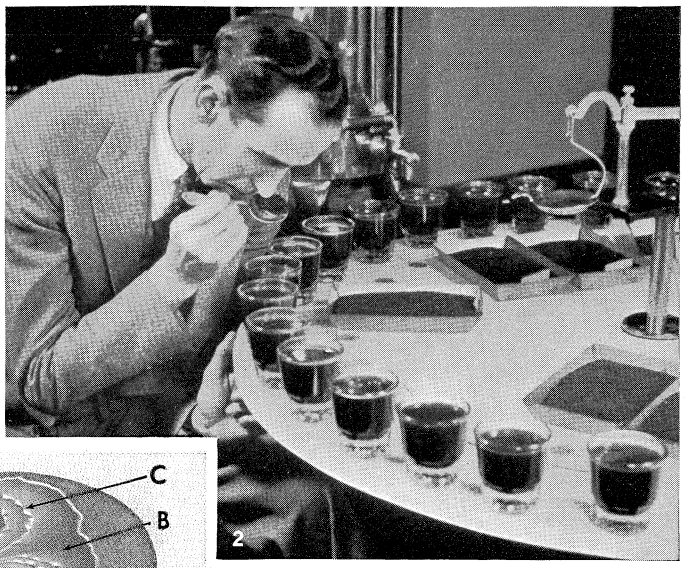
BY COURTESY OF (1, 2, 5) PAN-AMERICAN COFFEE BUREAU, (3, 4, 6) HILLS BROS. COFFEE, INC.

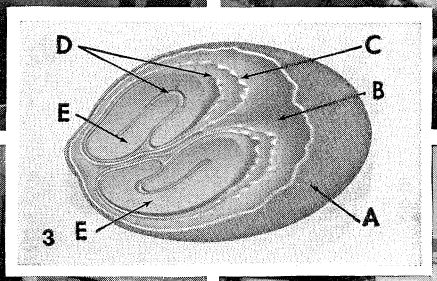
COFFEE CULTURE

1. Research laboratory for the scientific study of all phases of coffee culture
2. Coffee is generally grown from seed. Small plants are nurtured in shaded nursery beds until they are about 18 months old
3. Coffee cherries are similar in appearance to the U.S. domestic fruit cherry, but slightly smaller and somewhat elongated
4. Thorough washing by movement through troughs of water cleans the green coffee beans before drying
5. Drying coffee beans by turning them over in the sun
6. Hand sorting green coffee to remove imperfect beans

COFFEE







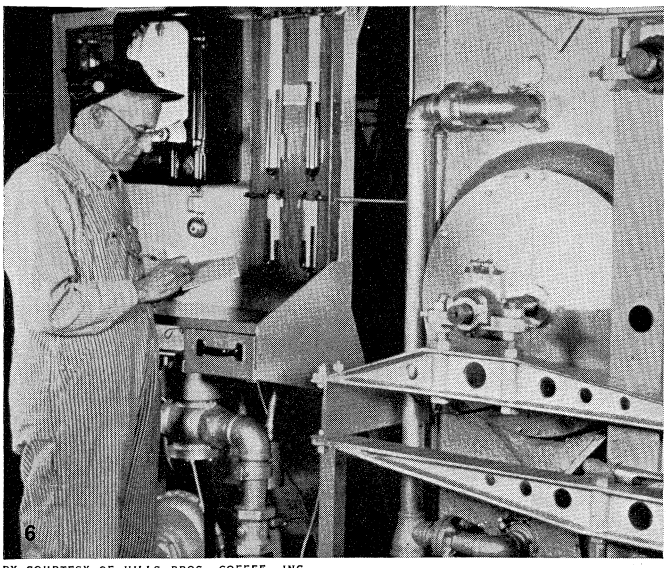
3

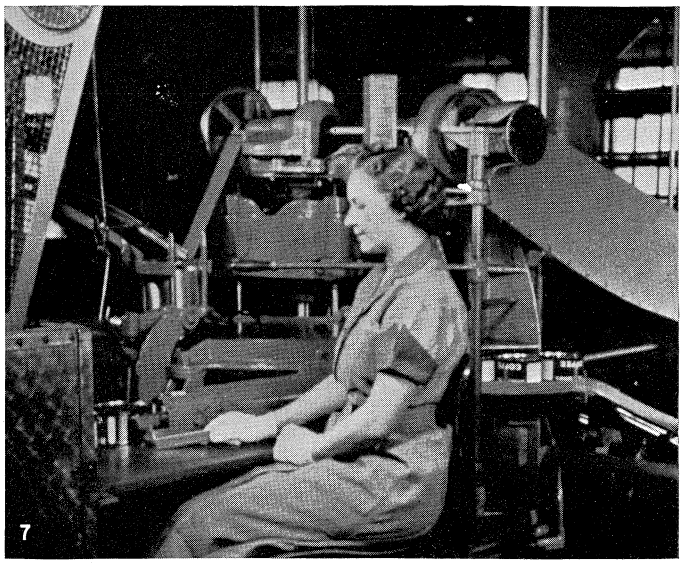




4

5





6

7

BY COURTESY OF HILLS BROS. COFFEE, INC.

PREPARATION OF COFFEE FOR MARKET

1. Preparing samples for testing in miniature coffee roasters
2. Testing coffee by tasting and smelling before making the blend
3. Cross-section of a coffee cherry: A. pulpy skin. B. jelly layer. C. parchment. D. silver skin. E. coffee bean
4. Emptying sacks of coffee into the mixing hopper for blending
5. Coffee-grinding mill
6. Automatically controlled coffee-roasting machine
7. Vacuum-packing coffee

it was an intoxicating beverage and therefore prohibited by the Koran. Severe penalties were threatened upon those addicted to its use. Nevertheless, coffee drinking spread rapidly among the Arabian Mohammedans and its growth and use as a national beverage became general in Arabia.

Coffee gained its first real popularity as a beverage in the London coffeehouses, which became centres of political, social and literary influence. The wits, philosophers and writers of the day warmed their hearts and loosened their tongues over the steaming cup. Continental Europe, too, became well implanted with the idea of coffee and the coffeehouse later in the 17th century. Captain John Smith, the founder of Virginia, is said to have been the first to bring coffee to America in 1607, but it was 1670 before the first licence to sell coffee was issued in the United States.

Until toward the close of the 17th century, the world's rather limited supply of coffee was obtained almost entirely from the Province of Yemen, in southern Arabia. But with the increasing popularity of coffee the propagation of the plant spread outward by leaps and bounds from the southern parts of Arabia to Ceylon, to Dutch Guiana in 1714, to Jamaica in 1718, thence rapidly to the tropical countries of the new world. By the 20th century coffee was responsible in large measure for the income and livelihood of many countries lying between the Tropic of Capricorn and the Tropic of Cancer. Although practically every country within this area around the globe produces some coffee, the concentration of production has centred in the new world. The largest supplies of green coffee come from South and Central America, a very high percentage of the world's total being produced in Brazil alone.

Botany of Coffee.—Coffee is botanically classified as follows:

Class	Dicotyledoneae
Subclass	Sympetalae or Metachlamydeae
Order	Rubiales
Family	Rubiaceae
Genus	*Coffea*
Species	*Coffea arabica*

The genus *Coffea,* to which the common coffee tree belongs, contains about 25 species in the tropics of the old world, most of which grow only wild.

Of the various species, *Coffea arabica* makes up the bulk of world production. Others commercially known are *C. liberica, C. stenophylla,* and *C. robusta.*

The common Arabian coffee shrub (*C. arabica*) is an evergreen plant which under natural conditions may grow to a height of 30 ft. or more. But for commercial purposes, particularly in countries where coffees are picked by hand, the trees are usually kept, by topping, to heights under 15 ft., which gives more easy access for harvesting. Leaves of the coffee tree resemble laurel in form (oblong-ovate-acuminate, 4 to 6 in. in length, 1½ to 2½ in. wide) and have a deep rich green colour and a waxy-looking surface. Flowers of the coffee tree, which are produced in dense clusters in the axils of the leaves, have a five-toothed calyx, a tubular five-parted corolla, five stamens and a single bifid style. Coffee trees in blossom are things of beauty, but the white jasmine-like flowers last only a few days. Their disappearance is followed by clusters of green cherries which advance through various stages of green and golden brown until fully ripe, when they are a bright red, similar in colour and shape to ordinary fruit cherries, although somewhat less plump and slightly elongated.

The red outside covering of the coffee cherry is a thick pulpy skin. Inside is a layer of yellowish jelly-like substance that completely surrounds the two beans or berries, which lie with their flat faces together, similar to the two halves of a peanut. Each bean or berry is enclosed in a membranous endocarp, commonly called the "parchment," which is brittle when dried. Inside this, completely surrounding each individual coffee bean, is a delicate spermoderm (seed-skin) commercially called the "silver skin." Malformation in coffee cherries frequently results in their containing only a single bean, which is not flat on one side, but completely circular. Such beans are called "pea-berry" coffee. The seeds or beans of the coffee cherry are of a soft, semitranslucent, bluish or greenish colour, hard and tough in texture.

Cultivation and Preparation of Green Coffee.—Primitive methods were used in the production of coffee for many years, but by the 20th century the large commercial growers of coffee were using intensive cultivation methods, giving the same care to preparing their plantations and cultivating their trees as do growers of grains and fruits. Effort is made to obtain the maximum production of quality coffee for the smallest outlay of money and labour.

Cultivation of the coffee plant over a period of a few hundred years brought about considerable variation in local types as a result of climatic and soil conditions. The colour of coffee beans after curing may differ considerably as to shade, and variations in size and shape of the beans make it possible to differentiate commercial types by appearance, although these characteristics are largely indistinguishable to the eye as far as quality is concerned. In general, it may be said that the greatest differences in quality of the coffee bean are produced by altitude—the higher the altitude, up to the limit of cultivability, the milder the product. High-altitude coffee beans are usually "mild" in character, and this mildness may be translated into terms of aromatic substance, which has much to do with contributing to the pleasurable aroma and taste of the beverage.

Coffee is grown under varying weather conditions at altitudes from 1,500 to 6,000 ft., but it is more or less generally conceded that the finest coffees usually come from the higher elevations—3,000 to 6,000 ft. Coffee requires a warm and humid climate, preferably with the sun on the plant only part of the day, which perhaps explains why hilly or mountainous countries are preferred for planting of trees, since the sun shines on the plant only part of the day. Desirable temperature averages 65° F. to 75° F. the year around, although coffee grows well in some places where lower or higher extremes occur (over 80° F. or under 60° F.). It should be noted that in tropical countries elevations up to 6,000 ft. or more are not accompanied by the extremes of low temperature found at such elevations in the northern latitudes.

Coffee trees are planted with great regularity but become so thick and dense after a few years that they almost appear to be growing wild. The tree begins to produce a small number of cherries at the age of three but on the average it is the fifth year before a tree comes into full bearing. It may continue to yield profitably for as long as 50 to 60 years, although 25 to 30 years is average, and some growers prefer to replace trees after 12 to 15 years.

The steps involved in the cultivation and processing of green coffee differ somewhat from country to country, and from locality to locality, but the overall procedure may be summarized in a very general way. Coffee trees are propagated either from seeds or from slips. In the latter case, a unique transplanting method is used which consists of bending down the lower branches of the tree and burying the tops in the earth. After about four months, roots form and the new growth starts.

Propagation from seeds is usually done in carefully prepared nursery beds. Seeds, selected from trees of known productivity in quality and quantity, are usually planted in January or February, about an inch apart, in rows marked off in the nursery beds. To protect the tender shoots from too much sun as they come through the ground, nursery beds must have a shade covering. This is usually constructed from various kinds of brush or other tropical growth. When seedlings are four to six months old they have to be transplanted to allow more room for development of the plants that are healthy and virile. At about 18 months, when the plants are approximately 20 in. in height, they are transplanted for the last time to whatever permanent planting spot has been selected. As the coffee trees continue to grow and begin to reach maturity they require more and more sunshine for proper development and ripening of the cherries, so frequent pruning of shade trees among which they have been planted is necessary.

The coffee tree is not free of destructive pests and plant diseases. The Ceylon coffee-leaf disease (*Hemileia vastatrix*), a fungoid growth which appeared in Ceylon in 1869 and spread throughout the coffee-growing sections of the eastern hemisphere

and is found in almost every coffee-producing country, is at least partially to blame for having destroyed the coffee-growing industry of the old world. Insects and fungi of various types are the cause of most concern to coffee growers. The *stephanodores* (coffee-bean borer, referred to in Brazil as the "coffee plague"), coffee "leaf-miner," Mediterranean fruit fly, and various forms of root disease are among the other worst and most common, and it is only through rigorous and continuous effort on the part of growers that they are kept under control.

In some producing countries, coffee cherries are allowed to ripen to a point where they shrivel and begin to dry on the trees and are then shaken off onto large canvasses. The higher grades of coffee, however, are picked when the cherries are at the desired stage of ripeness. Picking is done by hand in a very selective manner. Trees are not stripped. Only the ripe cherries are removed, and it takes several pickings before a crop is completely harvested. In some countries the harvesting is entirely seasonal, while in others, it is almost a year-round process, several crops being produced each year. Picking is done by men, women and children. Under good conditions, a fair day's pick is from 100 to 125 lb. of coffee cherries. It takes about 5 lb. of cherries to make 1 lb. of green coffee berries, so, in terms of usable coffee, it might be said that a picker's capacity is from 25 to 30 lb. a day. On the average, a coffee tree will produce from 1½ to 2 lb. of green coffee a season; thus a plantation must be of a rather extensive size to produce tonnage of any great consequence.

Coffee may be cured by either a "dry" or a "wash" process. By the dry method, sometimes called "unwashed" or "natural," the coffee cherries are washed and spread out on cement floors in the air and sun to dry. After drying, the coffee is repeatedly run through fanning and hulling machines to remove the hulls, dried pulp and parchment and then is subjected to further cleaning machines which remove portions of the silver skin.

The wash process is quite different. The cherries are first put through a pulping machine which breaks them open and virtually squeezes the beans right out of the mass of pulpy skin. Then the beans go into big tanks where they are left for about 24 hours. Slight fermentation takes place in the jelly-like substance, which the coffee grower calls "honey." This fermentation loosens the honey so it can easily be removed by thorough washing back and forth through several hundred feet of washing canals. After washing, the coffee is spread out in *patios* to dry. It takes two to three weeks in the sun for the coffee to become thoroughly dried, and during this time it must be continuously turned over so that every berry will receive its share of tropical warmth. When the desired stage of drying has been reached, the berries are put through hulling and polishing machines which crack and remove the brittle parchment and silver skin.

In the case of the highest quality coffees, there is then a careful hand inspection to remove imperfect berries, which is the final step before packing the coffee in bags for shipment to the coffee ports of the world. (In Brazil, coffee is sacked in 60-kg. bags—132.276 lb. In other countries, the shipping unit may vary from 140 to 150 lb., and in a few instances may run as high as 200 lb. However, 132 lb. or 60 kg. is the figure used in most all computations of world production, exports or imports in terms of "bags.")

Tasting and Blending.—In European countries, where coffee has been sold to a great extent in the whole bean, purchase has been predominantly on the basis of fine appearance of the bean. In the United States, over a period of years, a more selective manner of purchasing was established; coffees are bought primarily on the basis of cup test for taste and quality. Coffee testing is the work of a lifetime. Proficiency cannot be attained in a few months, or even a few years. Most coffee testers start training at an early age and continue study almost without interruption, for they must depend entirely upon taste and smell and devote great attention to the development of those senses. It has been said that the test to which coffee is subjected is one of the "most delicate known to science," since coffee defies all known chemical tests for evaluation of quality. It can be determined only by man's senses of taste and smell.

Coffees from various countries, and in fact from different plantations in the same producing sections, nearly always show a wide variety of characteristics. The task of the coffee tester is an intricate one in combining many different lots of coffee to produce a satisfactory blend.

Roasting.—Until roasted, coffee has none of the flavour or taste that a layman might recognize as coffee. Roasting gives the brown colour and transforms the natural elements into others which give coffee its aromatic qualities and pleasing taste. Full development of the flavour depends to a great degree on the avoidance of underroasting or overroasting. Skill is required to detect the slight variations which might yield an undesirable result. Coffee-roasting firms in the United States lead the world in equipment, some having developed mechanical controls of roasting operations which are considered to be foolproof to the extent of eliminating the element of human error in the detection of variation in roast. Green coffee loses about 16% of its weight through the roasting process.

Grinding.—Coffees packaged by the manufacturer are usually ground immediately after roasting. In most modern roasting plants, this is done by feeding the coffee through steel rollers which first crack it and then cut it to whatever the particular roaster considers the proper degree of fineness. Coffees not intended for package distribution are usually left in the whole bean to be ground in the grocery store at time of purchase by the ultimate user, or in some cases ground in the home. Ideas with respect to granulation vary to some extent. Some roasters put out their product in several different degrees of grind, each intended to be especially suited for a specific method of brewing. Other roasters work on the theory that coffee should be ground to release its taste and aromatic qualities, rather than to suit a particular method of coffee making, and produce what is referred to as an "all-purpose grind" composed of certain proportions of coarse, medium and fine particles intended to permit proper extraction of the taste and strength elements, which are claimed to brew a balanced cup of beverage from the standpoints of aroma, flavour and strength by any method of preparation. Regardless of the type of grind, uniformity of granulation is important, and various methods of checking, which might be described as semi-scientific in nature, are used to make sure that the proportion of the various-sized grains run uniformly throughout all production.

Packaging.—Generally speaking, roasted coffee is sold in bulk, in paper packages, or in vacuum-packed containers. Bulk coffee is distributed through retail outlets in sacks or wooden drums (like the old "cracker barrel") and weighed out to the purchaser. Coffee in paper bags or paper cartons is usually packaged by the manufacturer and distributed over reasonably small geographic areas. Roasters operating over wide areas (and this is particularly true in the United States) pack coffee by the vacuum process, either in metal cans or in glass jars. This is done immediately after the roasting process is completed.

The value of vacuum-packing lies in the fact that ground coffee begins to lose its freshness when exposed to the air. Oxygen in the air oxidizes the essential strength and flavour-giving elements and causes them to be liberated by the formation of what is commonly known as "coffee gas." Efforts to prevent this loss of freshness resulted in the discovery of the vacuum-packing process, which was first applied to the packing of coffee in 1900 by a firm in San Francisco, California, U.S.A. Some adaptation of this process is now used by a large majority of roasters throughout the United States for the packing of higher grades of coffee.

After the can or glass jar is filled with coffee, the air is withdrawn from the container, which is hermetically sealed, thereby preventing the entrance of air until the container is first opened. Whereas the majority of vacuum-packed coffee in the United States was packed in metal cans prior to 1942 (about one-third the total consumption of the country), the majority of this production was converted to glass jars during World War II due to shortages of metal containers.

World Production.—The shift of predominance in coffee production, centring originally in Arabia and other sections of the old world, found the countries of South and Central America

in the 20th century growing 85% or more of the coffee produced in the world. South America alone accounts for approximately three-fourths of the world's supply, and of the countries in that continent, Brazil alone approaches—and has at times surpassed—60% of the world total. To these Latin-American countries, coffee represents from 30% to 90% of the total value of all their exports.

Table I shows production by principal countries from 1919 to 1940 and indicates the shifts in output between the more important growing centres of the world.

Coffees grown in the various countries differ by types and kind, as well as by grades. In the parlance of the trade, "Brazils" and "milds" are the terms generally used to distinguish between coffees grown in Brazil and those grown in other countries. All those grown in Central and South America, with the exception of Brazil, fall into the "mild" classification. Broadly speaking, the "mild" coffees are regarded as superior in characteristics to "Brazils," although this is not a strictly true differentiation, for a great deal of the product of Brazil is of finer quality than some of those which come from "mild" producing countries. In general, those grown in Africa and Asia fall into the "mild" classification. Further distinctions are made as to "hardness" or "softness," "high grown," "washed," "unwashed," "naturals," etc., but these are distinctions of grading which become technical in nature and primarily concern only the grower or the buyer.

World Exports.—Table II, showing world exports of coffee by countries from 1909 to 1941, offers an interesting comparison with the foregoing table of production. It illustrates a phase of the operation of the law of supply and demand which has had considerable influence on the price of coffee, up and down, over a period of many years. Note, for instance, the apparent overproduction (production versus exports) in Brazil from 1924 on to 1940—a circumstance which accounted in a large measure for that country's destruction of approximately 68,000,000 bags of coffee during the 10-year period ending about 1938.

World Imports and Consumption.—As will be observed in Table III, imports into principal world markets (1909 to 1939), the United States became the world's largest user of coffee after the beginning of World War I. Prior to that time Europe imported more than half the world's supply, and the United States about one-third. The trend from 1914 on was in the reverse direction, and by 1934 the United States was importing approximately 50% of the total amount. In 1940, when the European markets were lost as a result of wartime conditions, the United States imported 71.1% of the world's total exports.

In per capita consumption, however, the United States, with an average of 13 lb. per capita (1929 to 1938 average), lagged behind Denmark with 13.6 lb. per capita; Sweden, 16.6 lb.; and Norway, 13.2 lb. Per capita consumption for other important consuming countries during the same period was as follows: Belgium, 12.8 lb.; Finland, 11 lb.; Netherlands, 10.1 lb.; France, 9.8 lb.; Switzerland, 8.2 lb.; Germany, 5.1 lb. In spite of the early historical preference for coffee in England in the 17th and 18th

TABLE I.—*Production of Principal Coffee-Producing Countries, Marketing Years 1919–20 to 1939–40**

Area	Thousand bags of 60 kg.					Per cent of world total				
	1919–20 to 1923–24 average	1924–25 to 1928–29 average	1929–30 to 1933–34 average	1934–35 to 1938–39 average	1939–40[a]	1919–20 to 1923–24 average	1924–25 to 1928–29 average	1929–30 to 1933–34 average	1934–35 to 1938–39 average	1939–40[a]
World total	20,410	28,606	37,860	37,867	37,782	100.0	100.0	100.0	100.0	100.0
South America	15,040	21,621	29,633	28,347	27,832	73.7	75.6	78.3	74.9	73.7
Brazil	11,989	17,327	24,519	22,441	22,067	58.7	60.6	64.8	59.3	58.4
Colombia	1,966	2,830	3,545	4,154	4,450	9.6	9.9	9.4	11.0	11.8
Venezuela	806	1,093	940	988	800	4.0	3.8	2.5	2.6	2.1
Bolivia	160	203	395	400	...	.8	.7	1.0	1.1	...
Ecuador	77	109	134	238	215	.4	.4	.3	.6	.6
Other	42	59	100	126	300	.2	.2	.3	.3	.8
Central America, Mexico, and West Indies	3,615	4,016	4,389	4,898	4,933	17.7	14.0	11.6	12.9	13.1
El Salvador	666	748	1,000	1,013	1,117	3.3	2.6	2.6	2.7	3.0
Guatemala	725	761	749	919	917	3.5	2.7	2.0	2.4	2.4
Mexico	647	627	635	714	873	3.2	2.2	1.7	1.8	2.3
Cuba	200	320	416	520	533	1.0	1.1	1.1	1.4	1.4
Haiti	500	550	532	441	270	2.4	1.9	1.4	1.1	.7
Costa Rica	250	295	373	391	400	1.2	1.0	1.0	1.2	1.1
Dominican Republic	25	202	284	396	350	.1	.7	.7	1.0	.9
Nicaragua	204	231	225	249	255	1.0	.8	.6	.6	.7
Other	398	282	175	255	218	2.0	1.0	.5	.7	.6
Africa	435	878	1,371	2,138	2,600	2.1	3.0	3.6	5.6	6.9
British East Africa	174	290	457	746	852	.8	1.0	1.2	2.0	2.3
Italian East Africa	61	215	331	283	...	.3	.8	.9	.7	...
French Africa	54	68	246	523	743	.3	.2	.6	1.4	2.0
Belgian Congo	2	10	109	304	383	.0	.0	.3	.8	1.0
Angola	137	289	219	272	317	.7	1.0	.6	.7	.8
Other	7	6	9	10	...	.0	.0	.0	.0	...
Asia	1,273	2,039	2,377	2,381	2,317	6.3	7.2	6.3	6.3	6.1
Netherlands Indies	961	1,706	1,978	1,999	1,888	4.7	6.0	5.2	5.3	5.0
India	174	170	263	255	250	.9	.6	.7	.7	.6
Other	138	163	136	127	179	.7	.6	.4	.3	.5
Oceania	47	52	90	103	100	.2	.2	.2	.3	.2

*Data from Brazil, Departamento Nacional do Café, *Anuário Estatística do Café, 1939–40*, pp. 5–11. In the absence of production estimates, exports have been used for certain countries in some years. In other cases where one or more years were missing in the source cited, four-, three-, or two-year averages are shown above.

[a]Data from International Institute of Agriculture, *International Yearbook of Agricultural Statistics, 1940–41*, pp. 85–87. Data are preliminary and otherwise not strictly comparable with earlier years.

(Table through courtesy of V. D. Wickizer—"The World Coffee Economy, with Special Reference to Control Schemes"—Food Research Institute, Stanford University, California.)

TABLE II.—*World Exports of Coffee by Chief Exporters, 1909–41**

(Thousand bags of 60 kg.)

Area	1909–13 average	1914–18 average	1919–23 average	1924–28 average	1929–33 average	1934–38 average	1939	1940	1941[a]
World total	18,116	17,695	20,559	22,949	25,297	27,021	...	...	...
South America	14,333	13,905	15,669	17,440	19,131	19,552	20,970	17,287	...
Brazil	12,042	11,882	12,799	14,091	14,963	14,579	16,498	12,097	11,055
Colombia	774	1,116	1,863	2,327	3,111	3,831	3,702	4,426	2,912
Venezuela	843	843	898	861	836	794	456	479	730
Other	74	64	109	161	221	348	314	285	...
Central America, Mexico, and West Indies	2,784	2,789	2,902	3,259	3,463	3,764	3,864	...	...
El Salvador	478	578	615	736	853	903	930	942	687
Guatemala	633	650	718	753	728	788	732	692	696
Mexico	366	360[b]	289	395	497	608	584	429	464
Haiti	499	406	565	552	514	463	488	270	463
Costa Rica	215	235	237	289	375	387	337	289[a]	391
Nicaragua	155	167	195	252	220	255	290	255	209
Other	438	393	283	282	276	360	503	...	...
Africa	182	195	417	647	1,154	2,029	...	...	...
British East Africa	32	55	186[b]	193	440	684	848	...	...
Belgian Congo	0	1	2	5	63	258	332	...	...
Angola	79	67	105	169	180	251	346	263	...
Somali coast[c]	54	62	80	201	266	209	...	...	...
Other French Africa	4	8	28	64	187	594	...	...	...
Other Africa	13	2	16	15	12	33	...	...	...
Asia	783	771	1,531	1,558	1,472	1,589	1,311	...	...
Netherlands Indies	401	446	1,077	1,360	1,300	1,409	1,091	...	...
India	210	193	194	163	144	146	188	...	...
Other	172	132	260	35	28	34	32	...	...
Oceania	34	35	40	45	77	87	76	...	...

*Data for 1909–23 from M. L. Bynum, *The World's Exports of Coffee* (U. S. Dept. Comm., Trade Prom. Ser. 110, 1930), pp. 10–11; for 1924–40 from successive issues of *International Yearbook of Agricultural Statistics*, which give net exports of net exporting countries. These two series are not strictly comparable, but totals differ by 1.5 per cent or less in overlapping periods. Data are for calendar years as far as possible. Totals have been adjusted to secure data for the same period throughout. Dots (...) indicate that data are not available.

[a]From *Coffee Statistics* (Pan-American Coffee Bureau), Release No. 7, January–June 1942, pp. 24–25.

[b]Four-year average.

[c]Transit trade from Ethiopia.

(Table through courtesy of V. D. Wickizer—"The World Coffee Economy, with Special Reference to Control Schemes"—Food Research Institute, Stanford University, California.)

TABLE III.—*Net Imports of Coffee into Principal World Markets, 1909–39**
(Thousand bags of 60 kg.)

Area	1909–13 average	1914–18 average	1919–23 average	1924–28 average	1929–33 average	1934–38 average	1939
World total	17,554	16,040	19,830	22,134	24,907	26,534	29,184[a]
United States	6,828	8,364	9,682	10,546	11,834	13,089	15,083
Europe	9,591	6,375	8,723	9,879	11,268	11,503	11,667[a]
United Kingdom	174	494	200	286	301	236	295[b]
France	1,862	2,364	2,861	2,724	3,087	3,077	1,727[c]
Germany	3,016	...	922[d]	1,698	2,387	2,762	1,552[c]
Czechoslovakia	...	...	188	223	222	188	...
Belgium	592	...	641	661	772	821	907
Netherlands	715	285	604	602	658	599	666
Sweden	564	401	668	689	738	801	934
Denmark	253	234	378	308	447	466	661
Finland	217	123	191	275	278	343	440
Norway	219	246	303	269	275	294	353
Italy	438	712	701	754	720	618	347[c]
Spain	222	267	354	359	396	407[c]	...
Switzerland	190	212	203	215	246	261	369
Other Europe	1,129	1,037	509	717	741	630	...
Other countries	1,135	1,301	1,425	1,718	1,805	1,942	2,434
Canada	106	126	156	181	232	283	351
Argentina	213	282	316	392	380	380	418
Algeria	126	124	143	155	221	244	123[f]
Union of S. Africa	199	243	205	217	215	237	288
All other	491	526	605	773	757	798	...

*Data for 1909–23 from M. L. Bynum, *International Trade in Coffee* (U. S. Dept. Comm., Trade Prom. Ser. 37, 1926), pp. 34–35; for 1924–39 from successive issues of *International Yearbook of Agricultural Statistics*, which give net imports of net importing countries; and for the United States, from *Statistical Abstract of the United States 1941*, p. 771. Data are for calendar years as far as possible. Totals have been adjusted to secure data for the same countries throughout, with the exception of Europe, 1914–18. The subgroup "other Europe" included different areas prior to 1918; hence data are not comparable with those for later years. Dots (...) indicate that data are not available.

[a]International Institute of Agriculture estimate.
[b]Eight months.
[c]Seven months, January–July.
[d]Four-year average.
[e]Two-year average.
[f]Six months.

(Table through courtesy of V. D. Wickizer—"The World Coffee Economy, with Special Reference to Control Schemes"—Food Research Institute, Stanford University, California.)

centuries, the United Kingdom by the 20th century ranked low as a coffee market. In 1941, per capita consumption in the United States increased to 15.7 lb., highest in the world, a heavy increase over the four-year period 1909–1913, when it used only 9 lb. per capita.

Pan-American Coffee Bureau.—Described as "An Instrumentality of the Governments of the Member Countries," the Pan-American Coffee bureau was organized in furtherance of a resolution adopted at the first Pan-American Coffee conference which met in Bogotá, Colombia, in October 1936. Its original membership included the government coffee departments or the officially recognized coffee associations of Brazil, Colombia, Cuba, El Salvador, Nicaragua and Venezuela. During the period from organization up to 1943, Costa Rica, the Dominican Republic and Mexico joined the bureau.

One of the outstanding objectives of the bureau was to formulate a co-operative effort for the promotion of increase in per capita consumption of coffee in the United States through the creation of a fund to conduct an educational and advertising campaign by an assessment in the growing countries on each bag of coffee exported to the United States by member countries of the bureau. This co-operative effort represented a change from the previous situation, where the trend had been for each producing country to undertake plans for promoting its individual crop in the United States and elsewhere. During the first four-year period from the start of the bureau's advertising (1938 to 1941), United States coffee consumption increased from approximately 13.1 lb. per capita to 15.7 lb. per capita (approximately 20%), while it took 24 years (1914 to 1937) for a similar increase (2.9 lb.) to take place. Other factors naturally entered into the accomplishment of this increase (lower prices and expanded imports), but the joint effort of the members of this bureau possibly represented the most effective single influence.

The Inter-American Coffee Agreement.—Of significance as a pioneer effort in international co-operation between "customer" and "producer" to assure long term stability of a market, the Inter-American Coffee agreement was signed in Washington, D.C., November 28, 1940, by representatives of the governments of 14 Latin-American coffee-producing countries and by the United States of America. (In alphabetical order, the 14 countries were: Brazil, Colombia, Costa Rica, Cuba, the Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Peru, and Venezuela.)

After the start of the 20th century, coffee had been subjected to more forms of artificial control of market and price than any other commodity in world commerce. At the turn of the century, schemes for valorization were started in Brazil in an effort to control production and support prices. In the 40 years that followed, several such plans were developed and eventually discarded, including the Brazilian government's program for "the permanent defense of coffee" (started in 1925). Ventures of similar nature were tried by other producing countries but never with any great measure of success.

After the invasion of Norway and the Netherlands early in World War II (May 1940), almost all of the European coffee market was lost, and it became necessary for producers to attempt to sell their entire output to the United States. In the face of enormous over-production, there followed a demoralization of prices which created a distinct threat to the economic stability of the producing countries. This condition likewise held grave implications for the continued development of international relations necessary for cementing the solidarity of the western hemisphere against its common enemies. The full significance of this situation became wholly apparent when representatives of the coffee-growing countries met in New York for the Third Pan-American Coffee conference in June and July, 1940, and it was the outgrowth of that meeting which led to the Inter-American Coffee agreement, the "first truly international co-operative scheme for the regulation of the coffee trade and the support of coffee prices." To quote Paul C. Daniels of the state department of the U.S., first chairman of the Inter-American Coffee board: "The Inter-American Coffee agreement is an attempt to provide effective measures for bringing the supplies of coffee in the international markets more nearly in line with existing demand, at prices which will be reasonable to both producers and consumers."

Uniqueness of the Inter-American Coffee agreement lies in the fact that it marked the co-operation of a consuming country (the United States), having no producers of its own, with the producing countries, which depended on the United States as almost their sole consuming market at the time the agreement was formulated.

The Inter-American Coffee agreement, ratified by the United States senate, has the status of an international treaty obligation of that country. Summarized, the treaty provides:

Equitable allocation of the United States coffee market among the participating countries by limitation of exports from those countries to an agreed basic annual quota totalling for all participating countries 15,545,000 bags of approximately 132 lb. (green weight). The United States government, on its part, agreed to limit the entry into the United States for consumption, of coffee from any of the participating countries to the amount of its quota, and further agreed to limit the quantity of coffee which might be entered for consumption from all nonparticipating countries to a basic annual total of 355,000 bags.

The agreement set up as its administrative agency the Inter-American Coffee board, consisting of one delegate representing each of the participating governments. Votes, however, were not uniform but divided as follows: United States 12; Brazil 9; Colombia 3; and one vote each for the other 12 participating countries (based on relative coffee volume). A majority of 36 votes was, in general, necessary for action by the Board. Provision was made, in case of imminent coffee shortage in the United States market, for emergency increases in quotas, and the board was given general power, upon majority vote, to increase or decrease quotas for the United States market by no more than 5% at any one time, and not oftener than once in six

months. Similarly the board could reduce quotas in case of emergencies by unanimous vote. The significant provision of this agreement was that participating governments agreed to maintain, insofar as possible, normal and usual operations of the coffee trade, and the board was authorized to appoint advisory committees so that consumers, importers, distributers of green and roasted coffee, as well as other interested persons, might be given an opportunity to express their views.

The Inter-American Coffee agreement also covered the problem of markets outside the United States. It limited the amounts for exportation from each producing country to markets outside of the United States and did not exclude other producing areas from entering into participation in the agreement should they wish to do so. In limiting exports from producing countries to countries other than the United States, quota limitations were not assigned to particular countries or regions, but only in total.

The agreement, although signed November 28, 1940, did not go into effect immediately, since formal ratification by the respective governments was necessary. On April 15, 1941, nine governments signed a protocol making it binding on themselves to respect the quota agreement effective for the year starting Oct. 1, 1940. The agreement had been previously ratified by the United States senate Feb. 3, 1941, and enabling legislation was passed by the congress of the United States April 11, 1941.

The main purpose of the Inter-American Coffee agreement was to make possible the orderly marketing of coffee under the extraordinary conditions existing from world conflict at the time of its inception, and there is little doubt that its original objective was accomplished, in assuring terms of trade equitable for both producers and consumers of coffee.

Coffee in the United States During World War II.—In the year or two preceding 1941, European countries had been almost wholly lost as markets for coffee-producing countries. Exports to Asia had always been extremely limited, which left only North America, particularly the United States, as almost the sole market for producing countries.

The New York Coffee and Sugar exchange was closed by order of the office of price administration almost immediately after the United States declared war on the Axis powers. Price ceilings were established on green coffee in contemplation of a shortage due to shipping problems, which developed early in 1942 as the result of ship sinkings in the sea lanes travelled by coffee ships. To conserve available supplies in the United States and to assure equitable distribution throughout the entire country, conservation order M-135 was issued by the war production board of the United States, April 28, 1942, limiting deliveries of roasted coffee by domestic distributors to 75% of that during the corresponding period of 1941. To establish control and regulation of imports, the United States government placed coffee under general imports order M-63. Shipping allocations (although high in priority after essential war materials) were insufficient to maintain domestic inventories, and in September, 1942, permissible deliveries were reduced to 65% of the base period. Almost simultaneously, shipping requirements for war purposes increased and visible supplies in the United States were reduced to a point where it was determined that equitable distribution to consumers could not be maintained without the institution of rationing. This was put into effect November 22, 1942. Retail sales were "frozen" for one week, and after midnight November 28, 1942, under direction of the rationing division of the office of price administration, consumers in the United States began to buy coffee on the surrender of designated ration stamps from their war ration book 1. The original ration was a pound in five weeks for each person over the age of 15; this was later reduced to a pound in six weeks, and then over a period of several months, gradually increased to a pound in three weeks.

Reasonable improvement in the shipping situation, aided by satisfactory progress against the submarine menace, so boosted the condition of coffee imports into the United States that at midnight, July 28, 1943, its purpose accomplished, rationing was eliminated. Thus coffee, having been among the first food commodities rationed under wartime conditions, was actually the first to be removed from the restrictions of wartime control.

Scientific Developments.—*Decaffeinated Coffee.*—A process was developed in Germany about 1900 by Dr. Ludwig Roselius, a coffee merchant, for the production of roasted coffee from which a large percentage of the caffeine had been removed. The technique was later improved by manufacturers in the United States, and a fairly large volume of sale developed. The details of processes for accomplishing decaffeination remained more or less secret. In general, however, it may be said that the result is attained through the use of steam, or by soaking green coffee in a benzine derivative (ether). The result is a product that is pure coffee, minus the exhilarating and stimulating effects of the natural product. Quality of the flavour and taste of decaffeinated coffee are matters of opinion on the part of users.

Soluble Coffee.—There are two types of soluble coffee: (1) liquid extract and (2) dried, or dehydrated. In both instances, the product represents coffee that, in effect, has been brewed into beverage from roasted and ground beans and reduced partially or wholly into solid form. Liquid coffee extract had not, as late as 1943, proved practical, due largely to the factor of spoilage over a period. The popularity of soluble coffee in 1942 and 1943, however, was considerably enhanced by its military use as "field rations" under war conditions (prepared simply by the addition of hot water).

Coffee Plastic.—During the early years of World War II, after the European markets were lost, when excess production became an inescapable fact and coffee prices were at an extremely low point, there was a great incentive to try to develop new uses for coffee. Experiments led to the development of coffee plastic, which by 1943 had reached the pilot-plant stage in Brazil. After caffeine and other by-products had been extracted from green coffee, it was found that the remaining cellulose material could be converted into plastic—one bag of coffee (132 lb. green weight) producing about 40 sq.ft. of plastic, ½ in. thick. As late as 1943 it appeared questionable, however, whether such plastic would eventually hold an economic standing, in relation to other plastics, with coffee at normal cost.

HOW TO MAKE COFFEE

Making a cup of good coffee is an art in which anyone can become proficient. Yet it requires the same careful attention as is given to the preparation of other articles of food. There are five essential rules to be followed in making coffee.

(1) *Measure both coffee and water accurately.* It is important to use the same proportions every time coffee is made to be sure it will always taste the same. One heaping tablespoon (or more accurately *two level tablespoons*) of coffee to each cup of water is a generally accepted standard. A "cup" of water may vary from 6 oz. (¾ standard measuring cup) to 8 oz. (½ pint), depending on individual taste as to strength.

(2) *Time coffee-making carefully.* Coffee should be in contact with water for a definite length of time, depending upon the type and capacity of the coffee-maker, as well as the strength of beverage desired. After the correct timing for any individual method or taste has been determined, it should be adhered to; otherwise, results will not be uniform.

(3) *Keep the coffee-maker clean.* A scrupulously clean coffeepot is essential. Coffee oils have a tendency to cling to the inner surfaces of utensils and eventually give an undesirable flavour to the brew. In addition to regular and careful washing every time coffee is made, it is advisable to boil the coffee-maker at least every two weeks in a solution of soda and water, using a tablespoon of soda to a quart of water. This keeps the coffeepot sweet in taste and free of musty odours. Metal coffeepots should be scrubbed with steel wool and a solution of vinegar and water used for boiling out, instead of soda.

(4) *Never boil or overheat coffee.* Boiling drives off the aromatic substances from coffee and is detrimental to the quality of the beverage. Coffee can be *brought to a boil* but should not be allowed to continue boiling.

(5) *Serve coffee as soon as possible after it is made.* Coffee always tastes best if served immediately after brewing is completed. It cannot be allowed to cool and then reheated without

injuring its flavour. If it is necessary to let coffee stand for any length of time after making, it should be kept at serving temperature by placing the utensil in a pan of hot water, putting it on an asbestos plate over a very low flame, or moving it to the back of the stove where it will keep hot without a rise in temperature.

There are four different types of coffee-makers in general use for coffee-making in the home: old-fashioned coffeepot (or saucepan); drip pot; vacuum-type coffee-maker; and percolator. The important question is not so much "what is the best method of coffee-making," as "what is the best procedure for making coffee by any particular method," since there is a right way and many wrong ways for each.

Coffeepot.—Coffee can be made in the old-fashioned coffeepot in two ways—the "usual method" or the "steeping method."

Usual Method.—Bring the required amount of coffee and water *just to boiling* (do not allow boiling to continue for more than a few seconds). Stir well and remove from the fire. A dash of cold water helps to settle the grounds and the coffee should be allowed to set for about 5 min., when it is ready to be served. It is best to pour the beverage off the grounds into a serving pot or some other vessel.

Steeping Method.—Pour boiling water over the ground coffee and stir well. After 2 or 3 min. stir again and then allow to steep for about 10 min. Decant into a serving pot. Beverage will be quite free of sediment or suspended matter. Particularly good for making only one or two cups at a time.

Drip Method.—There are many kinds of drip pots. In general, ground coffee is placed in an upper basket section and fresh, briskly boiling water is poured over it and is allowed to drip into a lower receptacle. Some drip pots use cloth or paper filters; others do not, depending upon the construction of the dripping section. The best drip pots are those which hold water in contact with the ground coffee somewhere between six and eight minutes. Faster dripping is likely to result in weak and unsatisfactory beverage. It is important, in using drip pots, to operate them at not less than two-thirds capacity. If smaller amounts are made, the water will drip through too fast and the resulting brew be thin and weak.

Vacuum-type Coffee-maker.—This usually consists of an upper and lower bowl, with a filter made of cloth, glass or porcelain. Water should first be permitted to boil in the lower bowl before the upper bowl containing the filter and coffee is set into position. Water in lower bowl is forced by steam pressure into the upper bowl, and after the mixture in the upper bowl has been stirred, it should be allowed to infuse from 3 to 6 min., the exact time depending upon the particular pot, speed of filtering, and individual preference as to strength. When the coffee-maker is removed from the heat, vacuum causes the liquid to be drawn back into the lower bowl. Filter cloths used in this type of coffee-maker should be carefully taken care of. Never wash with soap. Rinse cloth well and keep immersed in a glass of clean cold water. Never allow to dry out. Coffee oil cannot easily be washed out and it creates a stale taste if cloth is allowed to become dry.

Percolator.—Timing is particularly important to make certain coffee will taste the same at every meal. Underpercolation results in weak, thin beverage. Overpercolation gives a "cooked" or "stewed" taste and unsatisfactory flavour. The time required for brewing in percolators varies with different makes and sizes, the temperature of water used (that is, starting with hot or cold water) and volume of water to be heated, as well as the point at which the percolator begins regular pumping. These are all factors to be taken into consideration. Generally good results can be expected, however, if gentle "perking" *under reduced heat* is continued for seven to ten minutes after steady pumping starts.

BIBLIOGRAPHY.—William G. Ukers, *All About Coffee* (2d ed. 1935) and *Coffee Merchandising* (1930); Dean Freiday, "The Story of Coffee" in *Natural History* (Dec. 1939); Heinrich Eduard Jacob, *Coffee —The Epic of a Commodity* (1935); V. D. Wickizer, *The World Coffee Economy, with Special Reference to Control Schemes* (1943).

(T. C. W.)

COFFER, in architecture, a sunk panel in a ceiling or vault; also a casket or chest in which jewels or precious goods are kept, and, if of large dimensions, clothes. The marriage coffers in Italy were often richly carved and gilded, and sometimes painted by great artists. (*See* CHEST.)

COFFER-DAM, a dam formed to enable foundations to be laid in a site which is under water. The engineer surrounds the site with an embankment in such fashion as to form an enclosure from which the water is excluded.

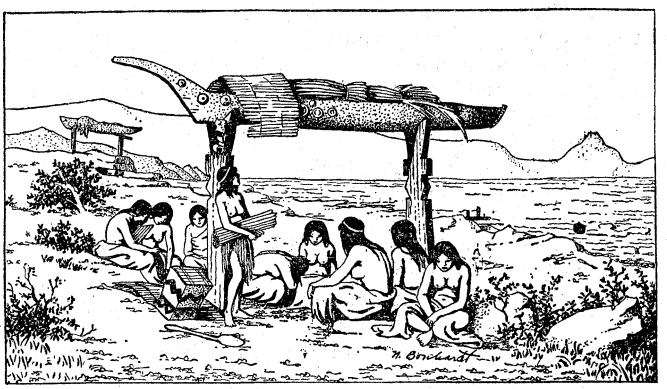
Where the depth of water is small and the current slight, simple clay dams may be used, but in general coffer-dams consist of two rows of piles, the space between which is packed with clay puddle. The dam must be sufficiently strong to withstand the exterior pressure to which it is exposed when the enclosed space is pumped dry. *See* DAMS.

COFFEYVILLE, a city of Montgomery county, in southeastern Kansas, U.S.A., on the Verdigris river, near the southern boundary of the state. It is on federal highways 166 and 169 and is served by the Missouri Pacific, the Santa Fe, the Missouri-Kansas-Texas and the Union Electric railways. It has two airports. The population was 16,229 in 1925; 16,198 in 1930; 17,355 in 1940.

Coffeyville is an industrial, business, agricultural and dairy centre; is in the mid-continent gas and oil field. It has two oil refineries, zinc smelter, four flour and feed mills, two brick and tile plants, tank car plant, two foundries, four oil and gas machinery industries and aircraft factories.

Coffeyville was founded in 1869 and incorporated in 1872. It was named after Colonel James A. Coffey, who established a trading post there in 1868. After the railway came through it became a shipping point for cattle from Texas and Indian Territory and a trade centre for a wide area. Natural gas was discovered in 1892.

COFFIN, the receptacle in which a corpse is confined (Lat. *cophinus,* a coffer, chest or basket, but not "coffin" in its present sense). The Greeks and Romans disposed of their dead both by burial and by cremation. Greek coffins varied in shape, being in the form of an urn, or like the modern coffins, or triangular, the body being in a sitting posture. The material used was generally burnt clay, and in some cases this obviously had first been moulded



FROM THE SMITHSONIAN BUREAU OF ETHNOLOGY REPORT

CANOE BURIAL. FORMERLY PRACTICED AMONG AMERICAN INDIAN TRIBES

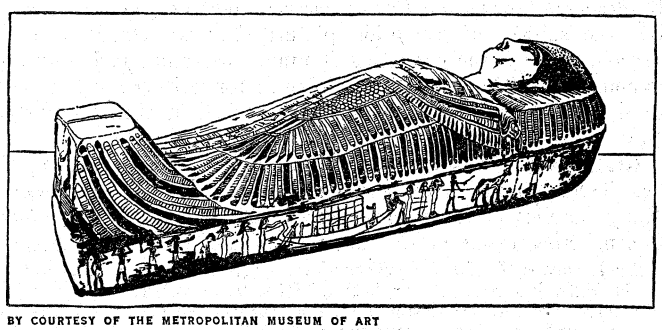
The corpse, wrapped in skins or other covering, was laid in a canoe and placed on a wooden scaffold, where it remained for a certain period while mourners kept watch below. Sometimes the canoe coffin was set afloat on the water, to be carried in the direction of the current

round the body, and so baked. In the Christian era stone coffins came into use. Examples of these have frequently been dug up in England. Those of the Romans who were rich enough had their coffins made of a limestone brought from Assos in Troas, which it was commonly believed "ate the body"; hence arose the name sarcophagus (*q.v.*).

The coffins of the Chaldaeans were generally clay urns with the top left open, resembling immense jars, moulded round the body, as the size of the mouth would not admit of its introduction after the clay was baked. The Egyptian coffins, or sarcophagi, as they have been improperly called, are the largest stone coffins known and are generally highly polished and covered with hieroglyphics, usually a history of the deceased. Mummy chests shaped to the form of the body were also used, being made of hard wood or

papier mâché painted, and bore hieroglyphics. Unhewn flat stones were sometimes used by early European peoples to line the grave. One was placed at the bottom, others stood on their edges to form the sides, and a large slab was put on top, thus forming a rude cist. In England after the Roman invasion these rude cists gave place to the stone coffin which was used until the 16th century.

Primitive wooden coffins were formed of a tree-trunk split down the centre, and hollowed out—a type still in use among peoples in



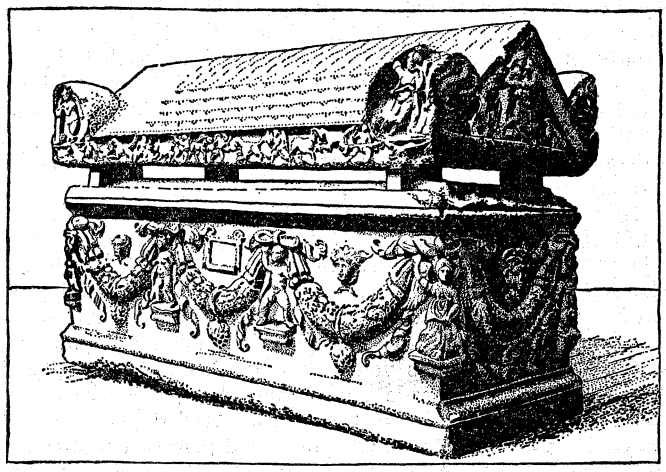
BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A MUMMY CHEST COVERED WITH STUCCO, XVII–XVIIITH DYNASTY

This type of coffin, shaped in the form of the body of the deceased, was favoured by less wealthy Egyptians. The example above was excavated at Thebes

the lower culture. The earliest specimen of this type is in the Copenhagen museum, the implements found in it proving that it belonged to the Bronze Age. This type of coffin, more or less modified by planing, was used in mediaeval Britain by those who could not afford stone, while the poor were buried without coffins, wrapped simply in cloth or even covered only with hay and flowers. Towards the end of the 17th century, coffins became usual for all classes.

Among the American Indians some tribes, *e.g.*, the Sacs, Foxes and Sioux, used rough hewn wooden coffins; others, such as the Seris, sometimes enclosed the corpse between the carapace and plastron of a turtle. The Seminoles of Florida used no coffins, while at Santa Barbara, California, canoes containing corpses have been found buried, though they may have been intended for the dead warrior's use in the next world. Rough stone cists, too,



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A SCULPTURED ROMAN SARCOPHAGUS FOUND AT TARSUS

In the resemblance of this lid to the roof of a house, is preserved the original idea of the coffin as a dwelling-place for the dead. Since the Roman coffin was usually placed against a wall inside a tomb, the back is generally free of decoration

have been found in Illinois and Kentucky. In their tree and scaffold burial the Indians sometimes used wooden coffins or travois baskets, or the bodies were simply wrapped in blankets. Canoes, mounted on a scaffold, near a river, were used as coffins by some tribes; while others placed the corpse in a canoe or wicker basket and floated it out into the stream or lake. The aborigines of Australia generally used coffins of bark, but some tribes employed baskets of wicker-work.

Lead coffins were used in Europe in the middle ages, shaped like the mummy chests of ancient Egypt. Iron coffins were certainly used in England and Scotland as late as the 17th century. The coffins used in England to-day are generally hexagonal in shape, of elm or oak lined with lead, or with a leaden shell. In America glass is sometimes used for the lids, and the inside is lined with copper or zinc. The coffins of France and Germany and the Continent in general usually have sides and ends parallel. Coffins used in cremation throughout the civilized world are of some light material easily consumed and yielding little ash. Ordinary thin deal and *papier mâché* are the favourite materials. Coffins for what is known as Earth to Earth Burial are made of wicker-work covered with a thin layer of *papier mâché* over cloth.

BIBLIOGRAPHY.—Dr. H. C. Yarrow, "Study of the Mortuary Customs of the North American Indians," *Report of Bureau of Amer. Ethnol.* vol. i. (1881); Rev. J. Edward Vaux, *Church Folk-lore* (1894). C. V. Creagh, "On Unusual Forms of Burial by People of the East Coast of Borneo," *J.A.I.* vol. xxvi. (1896–97); David I. Bushnell, Jr., "Burials of the Algonquian, Siouan and Caddoan Tribes, west of the Mississippi," Smithsonian Institution, Bureau of Ethnology, *Bulletin 83* (1927).

COG. (1) A broadly built, round-shaped ship, used as a trader and also as a ship of war till the 15th century (M.E. *cogge, cf.* O.Fr. *cogue,* from which "cock-boat" is derived). (2) A tooth in a series of teeth, on the circumference of a wheel, which works with the tooth in a corresponding series on another wheel (*see* MECHANICS). (3) A slang term for a form of cheating at dice.

COGERS' HALL, a London tavern debating society. Instituted in 1755 at the White Bear Inn, Fleet street, and moved about 1850 to Shoe lane; in 1871 it migrated to the Barley Mow Inn, Salisbury square, E.C., and has since moved to the Cannon Inn, Cannon street, E.C. The accepted derivation is from Descartes' *Cogito, ergo sum,* "The Society of Thinkers." The aims of the Cogers were "the promotion of the liberty of the subject and the freedom of the press, the maintenance of loyalty to the laws, the rights and claims of humanity and the practice of public and private virtue." Among its early members Cogers' Hall reckoned John Wilkes, one of its first presidents, and Curran. Later Dickens was a prominent member.

See Peter Rayleigh, *History of Ye Antient Society of Cogers* (1904).

COGHLAN, SIR TIMOTHY AUGUSTUS (1856–1926), Australian civil servant, second son of Thomas Coghlan, an Irish Roman Catholic, was born in Sydney and educated at Sydney Grammar School. He went into Government service in 1873, in the Public Works Department, and in 1884 became assistant engineer of harbours and rivers. In 1885 he was appointed head of the newly-created department of statistics, and was responsible for the preparation of much valuable material, including a full statistical register of trade and commerce in New South Wales. His most important work is the *History of Labour and Industry in Australia* (4 vols. 1918). He also published: *Wealth and Progress of New South Wales* (1887); *Statistical Account of Australia and New Zealand* (1891); *Progress of Australia in the 19th century,* in collaboration with the Hon. T. T. Ewing (1903).

From 1905 to 1915 he held the post of Agent-General for New South Wales, and was knighted in 1914. He was re-appointed from 1916–17, 1920–25, and again on the resignation of Sir Arthur Cocks. With Sir Joseph Cook he represented Australia on the Pacific Cable Board, and he held various public appointments in New South Wales (Chairman of Board of Old Age Pensions, etc.), serving also on several Royal Commissions. He took a great interest in vital statistics, and was in charge of the census in New South Wales in 1891 and 1901. He died on April 30, 1926.

COGHLAN, CHARLES FRANCIS (1841–1899), Irish actor, was born in Paris, and made his first London appearance in 1860. He went to America in 1876, where he remained for the rest of his life, playing first in Augustin Daly's company and then in the Union Square stock company, during the long run of *The Celebrated Case.* He also played with his sister, and in support of Mrs. Langtry and Mrs. Fiske, and in 1898 produced a version of Dumas' *Kean,* called *The Royal Box,* in which he starred during the last years of his life. He died in Galveston (Texas), on Nov. 27, 1899.

His sister, the actress ROSE COGHLAN (1853–1932), went to

America in 1871, was again in England from 1873 to 1877, playing with Barry Sullivan, and then returned to America, where she became prominent as Countess Zicka in *Diplomacy*, and Stephanie in *Forget-me-not*. She was at Wallack's almost continuously until 1888, and subsequently appeared in melodrama in parts like the title-role of the *Sporting Duchess*.

COGNAC, a town of southwestern France, capital of an *arrondissement* in the department of Charente, on the left bank of the river Charente, 23 mi. W.N.W. of Angoulême. Pop. (1936) 15,604. The streets of the old town are very narrow, but the newer parts have open spaces such as the Parc François Ier overlooking the Charente. In 1526 Cognac gave its name to a treaty concluded against Charles V by Francis I, the pope, Venice and Milan. Its possession was contested during the wars of religion, and in 1570 it became one of the Huguenot strongholds. In 1651 it successfully sustained a siege against Louis II, prince of Condé, leader of the Fronde. The 12th century church of St. Léger preserves a fine Romanesque façade and a tower of the 15th century. A castle of the 15th and 16th centuries, once the residence of the counts of Angoulême, and a mediaeval gate stand in the older part of the town. Cognac is the seat of a subprefect and has tribunals of first instance and of commerce, a council of trade arbitrators and a chamber of commerce. Its most important industry is the distillation of the brandy (*q.v.*) to which the town gives its name.

Large quantities of brandy are carried, by way of the river, to the neighbouring port of Tonnay-Charente. The industries subsidiary to the brandy trade, such as the making of cases and bottles, occupy many hands. A considerable trade is maintained in grain and cattle.

COGNE, a village, province of Aosta, Italy, from which town it is 16 mi. due south by road (9 mi. direct). Pop. (1936) 617 (of commune, 1,791). It lies at the northern foot of the Gran Paradiso and is a favourite summer resort. Victor Emanuel II formed a shooting reserve here for wild goat and chamois. The important iron mines belonging to the Ansaldo company lie east of the village.

COGNITION means "knowing," in the widest sense of the term. In psychology it is used to denote one of the three ultimate functions or processes of consciousness, the others being feeling and conation (or willing). Cognition includes every mental process that can be described as an experience of knowing as distinguished from an experience of feeling or of willing; it includes, in short, all process of consciousness by which knowledge is built up. In its most familiar and fully developed form it is known as judgment, in which a certain object (known logically and grammatically as a "subject") is discriminated from other objects and characterized by some concept or concepts. Although cognition is readily distinguishable from feeling and conation, yet in the actual flow of mental life the three types of experience are always found together, not separate, but one of them is usually predominant in one total experience, another in another, and this fact facilitates their mutual discrimination. Psychology, as a descriptive science, is not concerned with the epistemological question, how external objects can be revealed in subjective experiences; it simply takes at their face value these cognitive experiences in which objects appear to be known somehow, and leaves the critical problems to epistemology and logic.

See PSYCHOLOGY, and KNOWLEDGE, THEORY OF, and authorities there quoted.

COGNIZANCE, knowledge, notice, especially judicial notice, the right of trying or considering a case judicially, the exercise of jurisdiction by a court of law. In heraldry a "cognizance" is an emblem, badge or device used as a distinguishing mark by the body of retainers of a royal or noble house.

COHAN, GEORGE MICHAEL (1878–1942), American actor, author and producer, was born in Providence, R.I., July 4, 1878. His parents were of the theatrical profession, and at an early age he appeared with them in juvenile parts, subsequently taking comedy roles in vaudeville and on the legitimate stage. Also at an early age he began writing plays and popular songs. A description of his early experiments and the stage career of the "Four Cohans" is in his autobiography, *Twenty Years on Broadway and the Years It Took to Get There* (1925).

Among his productions may be mentioned *The Governor's Son* (1901); *Forty-five Minutes from Broadway* (1905); *The Talk of New York* (1907); *Get-Rich-Quick Wallingford* (1910); *Broadway Jones* (1912); *Seven Keys to Baldpate* (1913); *The Tavern* (1920); *The Song and Dance Man* (1923); *American Born* (1925). Among his best-known appearances were in *Ah Wilderness!* (1933) and *I'd Rather Be Right* (1937). His career was the subject of a motion picture, *Yankee Doodle Dandy* (1942). He was the composer of numerous songs, including the famous "Over There" of World War I; for writing the latter he received a Congressional medal. Cohan died in New York city Nov. 5, 1942.

COHEN (Hebrew for "priest"), a Jewish family name, implying descent from Aaron and the Hebrew priests (*Cohanim*). Many families claiming such descent are, however, not named Cohen. Other forms of the name are Cohn, Cowen, Kahn, etc.

See J. Jacobs, *Jewish Encyclopaedia*, iv, 144. For Cohen=*Episcopus*, *see* H. P. Stokes, *Stud. in Anglo-Jew. Hist.*, 1913, p. 18: for variations of Cohen, *see* A. M. Hyamson, *Jew. Lit. Annual* (for 1903), 1904, p. 70.

COHEN, ERNST JULIUS (1869–), Dutch chemist, was born at Amsterdam on March 7, 1869. He studied chemistry under Arrhenius at Stockholm, Moissan at Paris, and Van t'Hoff at Amsterdam; he became assistant to the latter in the university chemical laboratories at Amsterdam in 1893 and in 1902 he was appointed professor of physical chemistry at the University of Utrecht.

Cohen's most important work was on the allotropy of metals, and particularly of tin; this was published mainly in the periods 1900–02 and 1911–12. He was the author of a large number of papers on physical and electro-chemistry, and his piezo-chemical studies are important. His papers were published chiefly in the Dutch and German scientific journals.

Cohen also wrote *Studies in Chemical Dynamics after Van t'Hoff* (1896); *Physical Chemistry for Biologists*, *Inorganic Chemistry for Medical Students* (1907); and *Jacobus, Henricus Van t'Hoff, His Life and Work* (1912). Cohen in 1926 was made a foreign member of the Royal Society of London.

COHERER, a device by means of which a feeble oscillating electric current may be detected by a galvanometer (*q.v.*) or telephone (*q.v.*), the essential characteristics being that the current through the coherer is concentrated at a point and that the resistance (*see* RESISTANCE, MEASUREMENT OF) of the material has a negative temperature coefficient so that the coherer is self-restoring. A simple form of coherer consists of an oxidized iron plate against which rests the point of a steel needle. (*See* TELEPHONE.)

COHESION: *see* SOLID STATE, THEORY OF.

COHN, FERDINAND JULIUS (1828–1898), German botanist, was born on the 24th of January 1828 at Breslau. He was educated at Breslau and Berlin, and in 1859 became extraordinary, and in 1871 ordinary, professor of botany at Breslau university. He was contemporary with N. Pringsheim, and worked with H. R. Goeppert, C. G. Nees von Esenbeck, C. G. Ehrenberg and Johannes Müller. He made remarkable advances in the establishment of an improved cell-theory, discovered the cilia in, and analyzed the movements of, zoospores, and pointed out that the protoplasm of the plant-cell and the sarcode of the zoologists were one and the same physical vehicle of life. Although these early researches were especially on the Algae, in which group he instituted marked reforms of the rigid system due to F. T. Kützing, Cohn studied such varied subjects as *Aldorovanda*, torsion in trees, the nature of waterspouts, the effects of lightning, physiology of seeds, the proteid crystals in the potato, which he discovered, formation of travertin, the rotatoria and luminous worms.

It is, however, in the introduction of the strict biological and philosophical analysis of the life-histories of the lower and most minute forms of life that Cohn's greatest achievements consist, for he applied to these organisms the principle that we can only know the phases of growth of microscopic plants by watching every stage of development under the microscope, just as we

learn how different are the youthful and adult appearances of an oak or a fern by direct observation. His account of the life-histories of *Protococcus* (1850), *Stephanosphaera* (1852), *Volvox* (1856 and 1875), *Hydrodictyon* (1861), and *Spaeroplea* (1855–1857) among the Algae have never been put aside. The first is a model of what a study in development should be; the last shares with G. Thuret's studies on *Fucus* and Pringsheim's on *Vaucheria* the merit of establishing the existence of a sexual process in Algae. Among the Fungi Cohn contributed important researches on *Pilobolus* (1851), *Empusa* (1855), *Tarichium* (1869), as well as valuable work on the nature of parasitism of Algae and Fungi.

Cohn may be said to have founded the science of bacteriology. He seems to have been always attracted particularly by curious problems of fermentation and coloration due to the most minute forms of life, as evinced by his papers on *Monas prodigiosa* (1850) and "Über blutähnliche Färbungen" (1850), on infusoria (1851 and 1852), on organisms in drinking-water (1853), "Die Wunder des Blutes" (1854), and had already published several works on insect epidemics (1869–1870) and on plant diseases, when his first specially bacteriological memoir (*Crenothrix*) appeared in the journal, *Beiträge zur Biologie,* which he then started (1870–71), and which has since become so renowned. Investigations on other branches of bacteriology soon followed, among which "Organismen der Pockenlymphe" (1872) and "Untersuchungen über Bacterien" (1872–1875) are most important, and laid the foundations of the science. Cohn brought out and helped R. Koch in publishing his celebrated paper on *Anthrax* (1876), the first clearly worked out case of a bacterial disease.

Among his most striking discoveries may be mentioned the nature of Zoogloea, the formation and germination of true spores —which he observed for the first time, and which he himself discovered in *Bacillus subtilis*—and their resistance to high temperatures, and the bearing of this on the fallacious experiments supposed to support abiogenesis; as well as works on the bacteria of air and water, the significance of the bright sulphur granules in sulphur bacteria, and of the iron oxide deposited in the walls of *Crenothrix.* His discoveries in these and in other departments attest his acute observation and reasoning powers. Cohn had clear perceptions of the important bearings of Mycology and Bacteriology in infective diseases, as shown by his studies in insect-killing fungi, microscopic analysis of water, etc. He was a foreign member of the Royal Society and of the Linnean Society, and received the gold medal of the latter in 1895. He died at Breslau on June 25, 1898.

Lists of his papers will be found in the *Catalogue of Scientific Papers of the Royal Society,* and in *Ber. d. d. bot. Gesellsch.,* vol. xvii. p. 196 (1899); *see* also P. Cohn, *Ferdinand Cohn,* with Life by F. Rosen.

COHN, GUSTAV (1840–1918), German economist, born on Dec. 12, 1840, at Marienwerder, West Prussia, was educated at Berlin and Jena and became professor of political science first at Zurich (1875), and then at Göttingen (1884). He died at Göttingen on Sept. 20, 1918. His principal works are:

Untersuchungen über die englische Eisenbahnpolitik (Leipzig, 1874–75); *System der Nationalökonomie* (Stuttgart, 1885); *Finanzwissenschaft* (1889); *Nationalökonomische Studien* (1886), and *Zur Geschichte und Politik des Verkehrswesens* (1900).

COHNHEIM, JULIUS (1839–1884), German physiologist, was born at Demmin on July 20, 1839, and died on Aug. 15, 1884 at Leipzig. After serving as an army surgeon in 1864–65 he became an assistant in the Pathological institute in Berlin and was the most distinguished of Virchow's pupils. He was subsequently professor of pathology at Kiel (1868), Breslau (1872) and Leipzig (1876), where he was also director of the Pathological institute. He was a brilliant teacher, and Ehrlich was among his pupils at Breslau. His first important dissertation on inflammation of serous membranes appeared in 1861, and was followed by other important papers on that subject from 1869 to 1873. On this question his teaching was opposed to that of Virchow. He showed that inflammation is due to the passage of white corpuscles through the walls of the capillaries and that pus is formed largely of these corpuscles in a disintegrated state. Cohnheim made many useful innovations in the method of microscopical work. His most important book is his *Vorlesungen über allgemeine Pathologie* (2nd ed. 1882).

COHOES, a manufacturing city of Albany county, New York, U.S.A., 9m. N. of Albany, on the Hudson river at the mouth of the Mohawk. It is served by the Delaware and Hudson and the New York Central railways, and by the State barge canal. The population in 1920 was 22,987 (22.9% foreign-born white), and was 21,955 in 1940 by the federal census.

Water power from the falls of the Mohawk (75ft. high and 900ft. across) is supplemented by a hydro-electric plant developing 54,000 horsepower.

Chief among the many manufactures are cotton and woollen knit goods, cotton fabrics, collars and shirts, machinery, wall-paper and tractors. Cohoes was part of the manorial grant made to Killian van Rensselaer, and probably it was settled soon after 1629. It was incorporated as a village in 1848 and as a city in 1869. The van Schaick manor house was the headquarters of Gen. Schuyler during part of the Revolutionary War. The old colonial military road from Albany to Ft. Edward and Lake George runs through the city.

COHORT (Lat. *cohors*), originally a place enclosed; in the Roman army, the name of a unit of infantry. The troops of the first grade, the legions, were divided into cohorts, of which there were ten in each legion: the cohort thus contained 600 men. Among the troops of the second grade (the *auxilia*) the cohorts were independent foot regiments 500 or 1,000 strong, corresponding to the *alae,* which were similar regiments of cavalry; they were generally posted on the frontiers of the empire in small forts of four to eight acres, each holding one cohort or *ala.* The special troops of Rome itself, the Praetorian Guard, the *Urbanae Cohortes,* and the *Vigiles* (fire brigade), were divided into cohorts (*see* further ROMAN ARMY). The phrase *cohors praetoria* or *cohors amicorum* was sometimes used, especially during the Roman republic, to denote the suite of the governor of a province; hence developed the Praetorian cohorts which formed the emperor's bodyguard.

In biology, "cohort" is a term for a group of allied orders or families of plants or animals.

See J. E. Sandys, *Companion to Latin Studies* (1921), sections 380, 463, 714 *et seq.,* 723–4, 728, 730, 773, 1089.

COIF, a close-fitting covering for the head. Originally it was the name given to a head-covering worn in the middle ages, tied like a night-cap under the chin, and worn out of doors by both sexes; this was later worn by men as a kind of night-cap or skull-cap. The coif was also a close-fitting cap of white lawn or silk, worn by English serjeants-at-law as a distinguishing mark of their profession (*see* SERJEANTS-AT-LAW).

COIMBATORE, city and district, British India, in the Madras presidency. The city is situated on the left bank of the Noyil river, 305 mi. from Madras by the South Indian railway. In 1941 it had a population of 130,348. The city stands 1,437 ft. above sea level, is healthy, and is rendered additionally attractive to European residents by its picturesque position on the slopes of the Nilgiri hills. The famous temple of Perur lies 3 mi. E. of Coimbatore. Coimbatore is an important industrial centre, carrying on cotton weaving and spinning, tanning and the manufacture of coffee, sugar, manure and saltpetre. It has two second-grade colleges, a college of agriculture, training and industrial schools, and a school of forestry.

THE DISTRICT OF COIMBATORE has an area of 7,121 sq.mi. It is a flat, open country, hemmed in by mountains on the north, west and south, but opening eastwards on to the great plain of the Carnatic; the average height of the plain above sea level is about 900 ft. The principal mountains are the Anamalai hills, in the south of the district, rising at places to a height of between 8,000 and 9,000 ft. In the west the Palghat and Vallagiri hills form a connecting link between the Anamalai range and the Nilgiris, with the exception of a remarkable gap known as the Palghat pass. This gap, which completely intersects the Ghats, is about 20 mi. wide. In the north the Cauvery chain extends

eastwards from the Nilgiris, and rises in places to 4,000 ft. The principal rivers are the Cauvery, Bhavani, Noyil and Amravati. There are numerous canals, wells and tanks for irrigation. Coimbatore district was acquired by the British in 1799 at the close of the war which ended with the death of Tippoo. In 1941 the population was 2,809,648.

The principal crops are millet, rice, other food grains, pulse, oilseeds, cotton and tobacco; and raw silk is produced. Forests, yielding valuable timber, cover a large area. There are cotton mills and factories for pressing cotton, preparing coffee, making soap and dyeing.

The southwest line of the Madras railway runs through the district and the South Indian railway (of metre gauge) joins this at Erode.

COIMBRA, Portuguese city on the north bank of the river Mondego, 115 mi. N.N.E. of Lisbon, on the Lisbon-Oporto railway. Pop. (1940), 35,437. Coimbra derives its present importance from the fact that it is the seat of the only university in the kingdom—an institution which was originally established at Lisbon in 1291, was transferred to Coimbra in 1306, was again removed to Lisbon, and was finally fixed at Coimbra in 1537. There are five faculties—theology, law, medicine, mathematics and philosophy.

The library of Coimbra contains about 150,000 volumes, and the museums and laboratories are on an extensive scale. Among the other educational establishments are a military college, a royal college of arts, a scientific and literary institute and an episcopal seminary.

The city, picturesquely situated on a hill above the river, is the seat of a bishop, suffragan to the archbishop of Braga; its new cathedral, founded in 1580, is of little interest, but the old one is a fine specimen of 12th-century Romanesque, and retains portions of the mosque which it replaced. The principal churches are Santa Cruz, of the 16th century, and San Salvador, founded in 1169.

On the banks of the Mondego stand the ruins of the once splendid monastery of Santa Clara, established in 1286; and the celebrated *Quinta das Lagrimas,* where Inez de Castro (*q.v.*) is believed to have been murdered in 1355.

A Latin inscription of the fourth century identifies Coimbra with the ancient Aeminium; while Condeixa, 8 mi. S.S.W., represents the ancient Conimbriga or Conembrica. In the ninth century, however, when the bishopric of Conimbriga was removed hither, its old title was transferred to the new see, and hence arose the modern name Coimbra. The city was for a long time a Moorish stronghold, but in 1064 it was captured by Ferdinand I. of Castile and the Cid.

Until 1260 it was the capital of the country, and no fewer than six kings—Sancho I and II, Alphonso II and III, Pedro and Ferdinand—were born within its walls. It was also the birthplace of the poet Francisco Sá de Miranda (1495–1558), and, according to one tradition, of the more famous Luis de Camoens (1524–1580), who was a student at the university between 1537 and 1545. In 1755 Coimbra suffered considerably from the earthquake. In 1810 it was sacked by the French under Marshal Masséna. In 1834 Dom Miguel made the city his headquarters; and in 1846 it was the scene of a Miguelist insurrection. The administrative district of Coimbra coincides with the southwestern part of Beira. Population of Coimbra (1930) 387,808; (est. 1935) 405,153; (1940) 411,677; its area is 1,527 sq.mi.

COÍN, a town of southern Spain, in the province of Málaga, 18 mi. by rail W.S.W. of Málaga. Pop. (1940) 9,631 (mun., 17,348). Coín, on the north slope of the Sierra de Mijas, is the centre of a rich agricultural district. It exports large quantities of oranges, lemons, grapes and raisins, and marble from neighbouring quarries.

COIN. This is properly the term for a wedge-shaped die used for stamping money, and so transferred to the money so stamped; hence a piece of money. The form "quoin" is used for the external angle of a building (*see* QUOIN), and "coign," also a projecting angle, survives in the Shakespearean phrase "a coign of vantage."

The older forms of the word are *coyne, quoin* and *coign,* all derived from the Lat. *cuneus,* a wedge, through the O.Fr. *coing* and *cuigne.*

For a discussion of coins and coinage, *see* MINT and NUMISMATICS.

COINAGE OFFENCES: *see* COUNTERFEIT MONEY.

COIR, the outer covering of the husk of the coco-nut; an exceedingly strong fibrous material which has many uses in industry, notably in the manufacture of coarse mats and brushes. The name is derived from the Malay *Kāyar,* cord, *Kāyaru,* to be twisted.

Very large quantities of coir are exported from the Pacific, and there is a considerable market in England, the imports and re-exports reaching big figures.

COIRE: *see* CHUR.

COISLIN, a French family of Brittany, originally named Camboust, which first came into prominence in the 16th century when it inherited the seigniory of Coislin in the modern department of Loire-Inférieure. Pierre (1636–1706), son of Pierre César du Camboust, marquis of Coislin, was cardinal archbishop of Orléans and grand almoner of France. His fame rests largely on his tolerant treatment of the Huguenots at the time of the revocation of the Edict of Nantes. His nephew, Henri Charles (1664–1732), was bishop of Metz, royal almoner and a member of the Académie française. He was possessor of a well known library which he bequeathed to the abbey of St. Germain des Prés in Paris and which was later transferred in part to the Bibliothèque Nationale.

COITIER, JACQUES (? –1505), French physician and politician, was born in Poligny in the modern department of Jura.

He was attached to the royal court in Paris and became the personal physician of King Louis XI. As such, he exercised a great influence over the king until the latter's death in 1483. He was rewarded with various lucrative offices and lands and became, in 1482, president of the *chambre des comptes* and bailiff of the palace.

Although his political influence waned somewhat after his patron's death, Coitier retained his rank and offices under Charles VIII and Louis XII, with the exception of the presidency of the *chambre des comptes.*

COKAIN, SIR ASTON (1608–1684), English author, was the son of Thomas Cokain (or Cokayne) and Ann, half-sister of the first earl of Chesterfield.

He was born at Elvaston, Derbyshire, and was educated at Trinity college, Cambridge. He started on a tour of the continent in 1632, and in 1635 completed his first literary work, a translation of *Dianea,* an Italian romance by one Giovanni Francisco Loredano, which work was not published, however, until some 19 years later.

His volume of *Small Poems* was published in 1658; none of them was of great merit. Included in the volume was a "Masque presented at Bretbie (Derbyshire) on Twelfth Night, 1639" and a comedy entitled *The Obstinate Lady.* In a re-issue of the poems dated 1669 appeared *The Tragedy of Ovid,* best known because it introduced into England for the first time the legend of Don Juan (*q.v.*).

Sir Aston, who had been created a baronet in 1642, died impoverished at Derby in 1684.

COKE, SIR EDWARD (1552–1634), English judge, was born at Mileham in Norfolk on Feb. 1, 1552. He was educated at Norwich Grammar school and Trinity college, Cambridge, and in 1572 entered the Inner Temple.

He was called to the bar in 1578, and the next year was chosen reader of Lyon's Inn, a responsible position usually held by counsel of ten years' standing. His early cases included the Cromwell libel case (4 Rep. 13) and *Shelley's Case* (1 Rep. 94), and his reputation became great. In 1582 he married Bridget Paston, who brought him a fortune. In 1589 he became M.P. for Aldeburgh, and in 1592 solicitor-general, recorder of London and speaker of the house of commons, a post that involved difficulties with Elizabeth over the commons' passion for discussing ecclesiastical matters.

In 1594 he first crossed Bacon's course. The attorney-generalship fell vacant, and Bacon, supported by Essex, became his rival for the post. Coke got it, and then kept Bacon out of the solicitorship as well, or so Bacon thought. Coke's wife died in 1598 and six months later he married Lady Elizabeth Hatton, Bacon again being his unsuccessful rival.

As attorney-general, Coke was busy. He started a series of State prosecutions for libel on a large scale. The theory he advocated was that all comment on the doings of authority was unjustified; the remedy of those aggrieved was to be sought in the courts or in parliament. He also had the conduct of several of the great trials of the day. In 1600—the year in which the first volume of his *Reports* appeared—he prosecuted Essex and Southampton, in 1603 Raleigh, and in 1605 the Gunpowder Plot conspirators. (*See* Cobbett, *State Trials,* vol. ii.)

In 1606 Coke was made chief justice of the common pleas, and there began at once that series of conflicts which eventually broke his career. At the time of his appointment archbishop Bancroft had already started his attempt to shake off the control which the common law courts exercised by prohibition, and James, as ever, was ready to support any cause that looked likely to break the supremacy of the common law. This matter came to a head in 1607, when, on Bancroft renewing his protests, James took up the position that, as fountain of justice, he could remove any cases he pleased from his judges and try them himself. Coke refuted him, in spite of some precedents under the early kings that must have been difficult to get round. But the disputes with the ecclesiastical courts went on. In 1610 Coke gave his celebrated opinion before the Council that the King's proclamation cannot change the law, and in 1611, he had a brush with the court of high commission, with the result that the next year he was put on the commission himself; Coke evaded this attempt to muzzle him by finding legal flaws in the commission's appointment. In 1613 Bacon, with an eye to his own advancement, and to get Coke into a position where he would be less troublesome, had him "promoted" to be chief justice of the king's bench, an office of higher dignity and less salary. Coke was made a privy councillor, and was the first to be called Lord Chief Justice of England, which was remembered against him afterwards. Here his predominance was still as great; and he had to protest, in *Peacham's Case,* against the practice of consulting the judges privately, which James, abetted by Bacon, was more or less driven to follow because when the whole Bench was consulted together the rest of the judges merely echoed Coke. In 1615, still an implacable and bigoted adherent of the common law, he tried his strength too high. The Court of King's Bench started a dispute with the chancery over the right of the chancellor to interfere where a common law court had given a decision, and Coke was believed to be at the bottom of the attempt to make some who had been suitors in a case of this sort liable to the penalties of a *praemunire,* an attempt which failed. The disputes continued, embittered by Coke's personal dislike for Egerton, the chancellor. Meanwhile Coke had further endangered his position by throwing out dark hints from the bench in his conduct of the Overbury trials ("God knows what became of that sweet babe, prince Henry, but I know somewhat"). Finally he came into collision with James once more over the king's right to allow *commendams* (holding of livings in plurality). The other judges submitted, but Coke merely said that he would do what an honest and just judge ought to do.

In June 1616 the privy council, with Bacon at the back of it, formulated three charges against him. One was a trumpery matter, never proved, about a bond that had passed through his hands when he was attorney-general. The other two were charges of interference with the court of chancery, and of disrespect to the king in the matter of *commendams.* He was also ordered to revise the "errors" in his reports. Bacon, then attorney general, made himself very unpopular by engaging Coke on this last issue. Coke remained impenitent, and was dismissed. Thereupon, presumably in search of a friend in high places, he offered his daughter in marriage to Sir John Villiers, brother of the duke of Buckingham. His wife, supported by Bacon, objected, and hid the child, who was then only fourteen. Coke found her and married her, strongly against her will, to Villiers. She ran away from him soon afterwards. However, Coke got back into the privy council by 1617, and sat in the Star Chamber. In 1620 he entered parliament as member for Liskeard, in theory as a supporter of the King. But for the rest of his career he was a leading member of the popular party. He strongly opposed the Spanish marriage proposals, took a part in drawing up the charges against Bacon, and spoke in the Liberties of Parliament debate, spending nine months in prison as a result. But nothing was found that could incriminate him. It was his Bill of Liberties that ultimately took the form of the Petition of Right. His last appearance was at the time when he saved the awkward situation caused by the speaker's suppressing Eliot's attack on the duke of Buckingham, who was, however, not mentioned by name. The House was at a loss, and in turmoil. Coke rose, and, having named the duke first, went on to say what the House thought of him; whereupon "as when one good hound recovers the scent the rest come in with a full cry so they . . . laid the blame where they thought the fault was." At the end of the session he retired, and died at Stoke Poges on Sept. 3, 1634. His papers were instantly seized, and some, including his will, never recovered.

Barrister, judge, and reporter of the first rank, Coke is the greatest common lawyer of all time. He was inclined to be overbearing and impatient both at the bar and on the bench, he was undoubtedly rather narrow, and he was not always logical. But his knowledge of the law, in days when it was far more difficult to come by than it is now, was unequalled, and to him more than anyone we owe the reduction of the chaos of the old authorities to the comparatively orderly state of the law as he left it. As a judge he is noted for his wholehearted adherence to the Common Law. He upheld it against the Church, the Admiralty, the Star Chamber, and, most dangerous of all, the royal prerogative, with success. He tried to uphold it against the Chancery, but that was too strong for him. While he was issuing his *Reports* no others came out. They are not so much reports in the modern sense as compendia of the law bearing on a particular case, with comments on points raised or general remarks. The best estimate of his importance as a legal authority is that of C. J. Best—"The fact is that Lord Coke had no authority for what he states, but I am afraid we should get rid of a great deal of what is considered law in Westminster Hall if what Lord Coke says without authority is not law. He was one of the most eminent lawyers that ever presided as a judge in any court of Justice. . . ." Among his other publications are four volumes of *Institutes* (1628), of which volume i. is known as *Coke upon Littleton.*

As a man, he evokes admiration more readily than sympathy. More learned a lawyer than Bacon but without his philosophical genius, a just judge but a savage prosecutor, obstinate in his opposition to illegal exercise of authority, but quite incapable of distinguishing between the prerogative, which wanted to override the law in the interests of absolutism, and the chancery, which sought to counteract its rigidity in the cause of justice, he was capable of cringing before the king even in the act of defying the Crown.

See C. W. Johnson, *Life of Sir Edward Coke* (2 vols., 1837); H. W. Woolrych, *The Life of Sir Edward Coke* (1826); Lord Birkenhead, *Fourteen English Judges* (1926); H. Lyon and H. Block, *Edward Coke, Oracle of the Law* (1929). *See Law Reports* of the period.

COKE, SIR JOHN (1563–1644), English politician, was born on March 5, 1563, and was educated at Trinity college, Cambridge. After leaving the university he entered public life as a servant of William Cecil, Lord Burghley, afterwards becoming deputy treasurer and then a commissioner of the navy. He became M.P. for Warwick in 1621 and was knighted in 1624, afterwards representing the University of Cambridge. In the parliament of 1625 Coke acted as secretary of State; in this and later parliaments he introduced the royal requests for money, and defended the foreign policy of Charles I. and Buckingham, and afterwards the actions of the king. His actual appointment as secretary dates from Sept. 1625. Disliked by the leaders of the popular party, his speeches in the House of Commons did not

improve the king's position, but when Charles ruled without a parliament he found Coke's industry very useful to him. The secretary retained his post until 1639, when a scapegoat was required to expiate the humiliating treaty of Berwick with the Scots, and Coke was dismissed. He died at Tottenham on Sept. 8, 1644. Coke's son, Sir John Coke, sided with the parliament in its struggle with the king, and it is possible that in later life Coke's own sympathies were with this party, although in his earlier years he had been a defender of absolute monarchy.

COKE, THOMAS (1747–1814), English divine, the first Methodist bishop, was born at Brecon, where his father was a well-to-do apothecary. He was educated at Jesus college, Oxford, taking the degree of M.A. in 1770 and that of D.C.L. in 1775. From 1772 to 1776 he was curate at South Petherton in Somerset, whence his rector dismissed him for adopting the open-air and cottage services introduced by John Wesley, with whom he had become acquainted. After serving on the London Wesleyan circuit he was in 1782 appointed president of the conference in Ireland, a position which he frequently held, in the intervals of his many voyages to America. He first visited that country in 1784, going to Baltimore as "superintendent" of the Methodist societies in the new world and, in 1787 the American conference changed his title to "bishop," a nomenclature which he tried in vain to introduce into the English conference, of which he was president in 1797 and 1805. Failing this, he asked Lord Liverpool to make him a bishop in India, and he was voyaging to Ceylon when he died on May 3, 1814. Coke had always been a missionary enthusiast, and was the pioneer of such enterprise in his connexion. He was an ardent opponent of slavery, and endeavoured also to heal the breach between the Methodist and Anglican communions. He published a *History of the West Indies* (1808–11), several volumes of sermons, and, with Henry Moore, a *Life of Wesley* (1792).

COKE, COKING AND HIGH TEMPERATURE CARBONIZATION. The product obtained by strongly heating coal out of contact with the air until the volatile constituents are driven off is called coke. It consists essentially of carbon, the so-called "fixed carbon," together with the incombustible matters or ash contained in the coal from which it is derived. In addition to these it contains, almost invariably, small quantities of hydrogen, oxygen and nitrogen, the whole, however, not exceeding 2 or 3%. It also contains water, the amount of which may vary considerably according to the method of manufacture. When produced rapidly and at a comparatively low heat, as in gas-making, it is of a dull black colour, and a loose spongy or pumice-like texture, and ignites with comparative ease, though much less readily than bituminous coal, so that it may be burnt in open fireplaces; but when a long continued heat is used, as in the preparation of coke for iron and steel melting, the product is hard and dense, is often prismatic in structure, has—in the best class of coke—a brilliant semi-metallic lustre and silvery-grey colour, is a conductor of heat and electricity, and can only be burnt in furnaces provided with a strong draught. The strength and cohesive properties are also intimately related to the nature and composition of the coals employed, which are said to be "caking" or "non-caking" according to the compact or fragmentary character of the coke produced.

The first record of the coking of coal is in the 16th century, for in 1590 (*Cal. State Papers* Dom. 1581–90, p. 692) a patent was granted to John Thornborough, dean of York, the object of which was "to purify pit coal and free it from its offensive smell" by coking it. In Derbyshire, coke is mentioned by one Houghton, who wrote in 1693 (*Collection*, Ed. 1727, vol. i. p. 109). It had been used for 50 years in the drying of malt. The coal was "cowkefied" by being piled up in large pyramidal form and charred.

There is an interesting mention of coking coal in Evelyn's diary under date July 11, 1656, "Came home," he writes, "by Greenwich Ferry, where I saw Sir John Winter's new project of *charring sea coale*, to burne without the sulphure and render it sweete. He did it by burning the coales in such earthen pots as the glasse-men melt their mettall, so firing them without consuming them, using a barr of yron in each crucible or pot, which barr has a hook at one end, that so the coales being mealted in a furnace with other crude sea coales under them, may be drawn out of the pots sticking to the yron, whence they are beaten off in great halfe-exhausted cinders, which being rekindl'd make a cleare pleasant chamber fire depriv'd of their sulphure and arsenic malignity. What success it may have time will discover."

William Bray, who edited Evelyn's diary in 1818, adds a footnote: "Some years ago Lord Dundonald revived the project, but with the projected improvement of extracting and saving the tar. Unfortunately his Lordship did not profit by it. The Gas Light Company sell the coal thus charred by the name of *coke*, for fuel for many purposes." So the inventive genius of Lord Dundonald sought to devise thus early a by-product recovery oven.

The quantity of coke imported into London—it was known as "Cinders" in the early days of its use—was in 1800, 7,939 chaldron or 10,122 tons, chiefly from the Tyne.

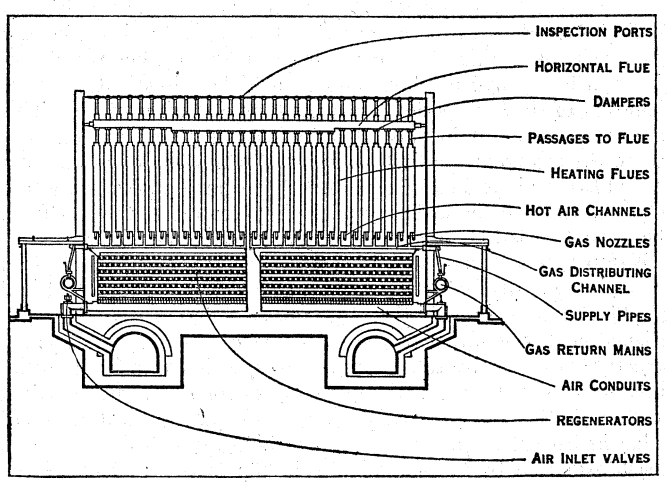
Coke Ovens.—Formerly coke was made from large coal piled in heaps with central chimneys like those of the charcoal burner, or in open rectangular clamps or kilns with air flues in the enclosing walls; but these methods are now obsolete, closed chambers or ovens being used. These vary considerably in construction, but may be classified into three principal types:—(1) direct-heated ovens; (2) flue-heated ovens, (3) condensing ovens. In the first class the heating is done by direct contact or by burning the gases off in coking within the oven, while in the other two the heating is indirect, the gas being burned in cellular passages or flues provided in the walls dividing the coking chambers, and the heat transmitted through the sides of the latter which are comparatively thin. The arrangement is somewhat similar to that of a gas-works retort, whence the name of "retort ovens" is sometimes applied to them. The difference between the second and third classes is founded on the treatment of the gases. In the former the gas is fired in the side flues immediately upon issuing from the oven, while in the latter the gases are first subjected to a systematic treatment in condensers, similar to those used in gas-works, to remove tar, ammonia and condensable hydrocarbons, the incondensable gases, or some portion of them, being returned to the oven and burned in the heating flues. These are generally known as "by-product recovery ovens."

Beehive Oven.—The simplest form of coke oven, but one now rapidly passing out of use, is the so-called "beehive oven." This is circular in plan, from 7 to 12ft. in diameter, with a cylindrical wall about 2½ft. high and a nearly hemispherical roof with a circular hole at the top. The floor, made of refractory bricks or slabs, is laid with a slight slope towards an arched opening in the ring wall, which is stopped with brickwork during the coking, but opened for drawing the finished charge. The ovens are usually arranged in rows or banks of 20 to 30 or more, with their doors outwards, two rows being often placed with a longitudinal flue between them connected by uptakes with the individual ovens on either side. A rail track along the top of the bank brings the coal from the screens or washery. The largest ovens take a charge of about five tons, which is introduced through the hole in the roof, the brick-work of the empty oven being still red hot from the preceding charge, and when levelled fills the cylindrical part nearly to the springing of the roof. The gas fires as it is given off and fills the dome with flame, and the burning is regulated by air admitted through holes in the upper part of the door stopping. The temperature being very high, a proportion of the volatile hydrocarbons is decomposed, and a film of graphitic carbon is deposited on the coke, giving it a semi-metallic lustre and silvery-grey colour. When the gas is burned off, the upper part of the door is opened and the glowing charge cooled by jets of water thrown directly upon it from a hose, and it is subsequently drawn out through the open door. The charge breaks up into prisms or columns whose length corresponds to the depth of the charge, and as a rule is uniform in character and free from dull black patches or "black ends." The time of burning is either 48 or 72 hours, the turns being so arranged as to avoid the necessity of drawing the ovens on Sunday. The longer the heat is continued the denser

the product becomes, but the yield also diminishes, as a portion of the finished coke necessarily burns to waste when the gas is exhausted. For this reason the yield on the coal charged is usually less than that obtained in retort ovens. Coals containing, at most, about 35% of volatile matter are best suited for the beehive oven. With less than 25% the gas is not sufficient to affect the coking completely, and when there is a higher percentage the coke is brittle and spongy and unsuited for blast furnaces or foundry use. The spent flame from the ovens is usually passed to a range of steam boilers before escaping by the chimney.

Retort Ovens.—The retort oven, which has so largely displaced the beehive form, is made in a great variety of forms, the differences being mainly in the arrangement of the heating flues, but all have the central feature, the coking chamber, in common. This is a tubular chamber with vertical or tapering sides and generally a cylindrical roof, about 30ft. long from 17 to 20in. wide, and 6 or 7ft. high, and closed at both ends by sliding doors which are raised by crab winches when the charge is to be drawn.

The general arrangement of a modern type of regenerative coke oven is shown in figs. 1 and 2. These show longitudinal and cross sections through the oven, which is of the vertical flued type. Fig. 1 shows a section through the oven chamber and the heating flues. The oven is a long rectangular chamber, the dimensions of which vary according to the class of coal to be carbonized and as to whether the coal is required to be carbonized in a compressed or uncompressed condition. For carbonizing dry uncompressed coal of normal character, the dimensions of the oven chamber would be 41ft. long by 13ft. high by 14in. wide at the bottom, tapering suitably to the top. Such an oven would take a charge of 12·5 tons and would have a carbonizing period of from 10 to 12 hours. The capacity would be, therefore, up to 20 tons per oven per day. For carbonizing wet compressed charges of coal, the ovens are designed to burn off in 16 to 18



BY COURTESY OF KOPPERS' COKE OVEN COMPANY

FIG. 1.—DIAGRAMMATICAL SKETCH OF A MODERN REGENERATIVE COKE OVEN

The coal is placed in the oven chambers and gradually carbonized. The gases are drawn to a by-product extraction plant, and after removal of tar, ammonia and benzol, are returned to the ovens. At the base of the flues, the gas mingles with heated air and combustion takes place. In this way the heat of the ovens is maintained. A valve system controls the regenerators, which are alternately heated by waste gases passing through them to outlet flues

hours, and have a carbonizing capacity of up to 10 tons of coke per oven per day.

The ovens are heated by the gas evolved from the coal during carbonization after it has passed through the condensing and scrubbing process incidental to the recovery of the by-products. The gas and air for combustion are separately distributed on each side and along the whole length of the oven, and combustion takes place in each flue. Separate regenerator chambers are provided for each oven so that each oven is independent of its neighbour (*see* fig. 2). This construction permits of the air for combustion and the chimney draught being separately regulated. In the older type of regenerative ovens which were arranged with one set of regenerator chambers for a whole battery of ovens, there is a regulating damper over the passage leading from the regenerator chambers to the air distributing channel, which damper has to be set to serve the dual purpose of regulating the admission of air when the ovens are burning in one direction, and of regulating the chimney draught when the ovens are burning in the reverse direction.

The air for combustion passes into the regenerators through the inlet valves (fig. 1). In the regenerator the temperature of the air is raised to 1000° C., the highly-heated air passing out of the regenerators into the vertical heating flues through the openings (figs. 1 and 2). When normal coal is carbonized only from 35 to 40% of the gas evolved is required for heating the ovens. This is returned from the by-product recovery plant to the ovens by mains (fig. 1) running along the whole length of the battery of ovens on each side. Branch supply pipes (fig. 1) conduct the gas into the gas distributing channels (fig. 1 and 2) which are situated directly beneath the oven walls; thence it passes through the gas nozzles into each vertical flue where it ignites with the hot air entering through the passages (conduits). A jet is formed on the level of the oven floor along the whole length of the oven chamber. The supply pipes are each fitted with a regulating cock as well as a second cock fitted with a lever. All the levers are attached to a wire rope communicating with changing gear. The air is admitted to each regenerator by means of a cast-iron air valve which also serves to conduct the waste gases to the chimney flue. These valves are each fitted at the top with a lid connected, like the levers of the gas cocks, with a second wire rope, and the whole arrangement is such that when the changing gear operates, the gas cocks and valve lids on one side of the battery are closed simultaneously with the opening of the corresponding parts on the other side of the battery. When the gas is burning on one side of the ovens, the air valve is open and the air passes into the regenerator. A little below the valve lid there is a sliding shutter which can be set in any desired position and serves to regulate the quantity of air required for each oven.

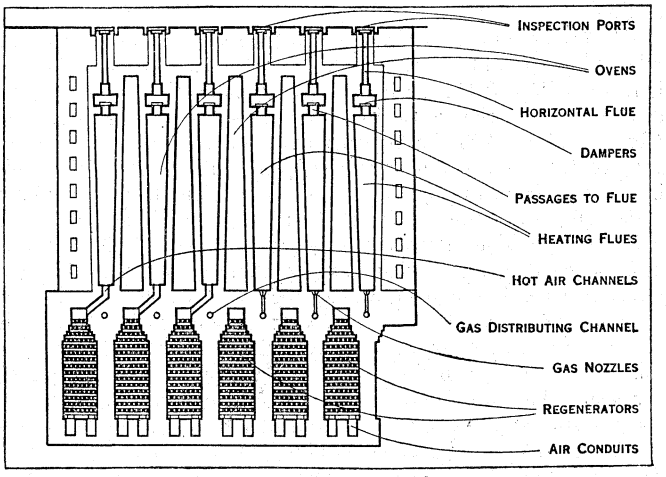
When the gas is burning on the opposite side of the oven, the gas cocks and air valve lids are closed. The waste gases are, therefore, drawn through the cast-iron valve fitting into the chimney flue. At the base end of the cast-iron fittings there is a regulating damper which can be set in any desired position to regulate the draught on each oven. It will be seen, therefore, that by this arrangement, the quantity of air for each oven, and the chimney draught on each oven, can be separately regulated, which is not possible with ovens working with the older form of regenerators.

The employment of regenerators renders it necessary to reverse the heating process after a period of time, usually from 20 to 30 minutes, and the heating flues are divided into two sections so that combustion can take place alternately in each half of the oven wall. When the gas is burning in one half of the wall, the products of combustion pass up the flues and enter the top horizontal flue whence they make their way down the flues in the other half of the oven wall and enter the regenerator through the same passage by which the air is admitted to the flues when the direction of combustion is reversed. On issuing from the regenerators the waste gases pass into the flue leading to the chimney, after having given up their heat to the firebrick chequerwork. When the next half-hourly reversal is made, the heat is given up to the air entering for combustion.

The reversal of the heating process is effected by a simple winch arrangement placed at one end of the battery of ovens. The winch is operated automatically or by hand, and requires the least possible attention. When arranged to work automatically, the gear is so designed that should anything fail to act, an electric alarm is set in action and does not stop until the gear is again at work.

Two of the principal features of this type of oven are the sliding bricks and the openings in the top of the ovens which give access to them. The openings serve not only to provide means for regulating the dampers, but more particularly to give access to the gas nozzles.

In retort ovens when the gas is completely given off the doors are lifted and the charge is pushed out by the ram—a cast-iron plate of the shape of the cross section of the oven, at the end of a long horizontal bar, which is driven by a rack and pinion movement—on to the wharf or bank in front where it falls to pieces and is immediately quenched by jets of water from a hose pipe. When sufficiently cool it is loaded into railway wagons or other conveyances for removal. The ram, together with its motor, and boiler, when steam is used, is mounted upon a carriage running upon a line of rails of about 2ft. gauge along the back of the range of ovens, so that it can be brought up to any one of them in succession.



BY COURTESY OF KOPPERS COKE OVEN CO., LTD.

FIG. 2.—A CROSS-SECTION VIEW THROUGH SEVERAL KOPPERS' OVENS

In some cases instead of the small coal being charged through the roof of the oven and levelled by hand, it is forced into blocks by being stamped in a slightly moistened condition in a mould consisting of a bottom plate or peel on a racked rod like that of the ram, with movable sides and ends. This, when the ends are removed, is pushed forward into the oven, and the bottom plate is withdrawn by reversing the rack motion. The moulding box is mounted on a carriage like that of the ram, the two being sometimes carried on the same framing. The moulding is done at a fixed station in the centre of the range of ovens by a series of cast-iron stampers driven by an electric motor. This system is used for coals low in volatile matter, which do not give a coherent coke under ordinary conditions.

By-product Ovens.—In the distilling or by-product ovens the gases, instead of being burned at the point of origin, pass by an uptake pipe in the roof about the centre of the oven into a water-sealed collecting trough or hydraulic main, whence they are drawn by exhausters through a series of air and water cooled condensers and scrubbers. In the first or atmospheric condensers the tar is removed, and in the second ammoniacal water, which is further enriched by a graduated system of scrubbing with weak ammoniacal liquor until it is sufficiently concentrated to be sent to the ammonia stills. The first treatment by scrubbing with creosote or heavy tar oil removes benzine, after which the permanent gaseous residue consisting chiefly of hydrogen and marsh gas is returned to the ovens as fuel.

The number and kinds of coke ovens in use in Great Britain in the year 1926 were as follows:—

Koppers	1,747	Collins	171
Otto-Hilgenstock	1,726	Huessener	262
Simon Carvés	1,650	Carl Still	72
Semet-Solvay	1,173	Wilputte	74
Simplex	471	Makey Seymour	32
Coppée	444	Other kinds	60
Other kinds of ovens:—			
Coppée	176	Beehive Ovens	2,229
Tredegar	120		

The slow progress that was made in the direction of the replacement of "Beehive" by "Recovery oven" coke was apparently due to a rooted prejudice against its use in blast furnaces, but that has now vanished, and fully three-quarters of the coal carbonized in Great Britain for metallurgical purposes is made in by-product recovery ovens.

Coke from retort ovens is not so dense or brilliant as that made in beehive ovens, but the waste being less there is a decided saving, apart from the value of the condensed products.

In the further treatment of the condensed products by distillation the tar gives burning oil and pitch, the benzene is separated from the creosote oil by steam-heated stills, and the ammoniacal liquor, after some lime has been added to decompose fixed ammonium compounds, is heated to vaporize the ammonia, which is condensed in lead or copper-lined tanks containing strong sulphuric acid to produce a crystalline powder of ammonium sulphate, which accumulates in the receiver and is fished out from time to time. The yield of coke and by-products obtained by the latest high temperature carbonization methods as applied in Great Britain is given below. (*See* Report of the Coal Carbonization Sub-Committee of the Coal Conservation Committee of 1919.)

Percentage Yields Calculated upon the Weight of Dry Coal Carbonized.

Locality of the coal.	Coke.	Anhyd. tar.	Crude benzol.	Refined benzol.	Ammonium sulphate.
Durham	75	3·85	0·93	0·56	1·16
South Yorkshire	70	3·62	1·37	1·60	1·35
Lancashire	70	3·50	1·20	0·54	1·25
South Wales	80	2·62	0·60	0·35	0·95
Scotland	68	3·25	0·70	...	1·00

After the ovens have been heated and steam supplied for the machinery of the condensing plant and the coke ovens, there is usually a surplus of gas, which may be used for lighting or driving gas-engines. For the latter purpose, however, it is necessary to remove the last traces of the tar, which acts very prejudicially in fouling the valves when the gas is not completely purified. The gas given off during the earlier part of the coking process is richer in heavy hydrocarbons and of a higher illuminating value than that of the later period when the temperature is higher. This property is utilized in several large coking plants in America, where the gas from the first 10 hours working is drawn off by a second hydraulic main and sent directly to town gas-works, where it passes through the ordinary purifying treatment, the gas from the second period being alone used for heating the ovens.

Nature of Coke.—Coke is essentially a partially graphitized carbon, its density being about midway between that of coal and graphite, and it should, therefore, occupy less space than the original coal; but owing to the softening of the charge a spongy structure is set up by the escaping gases, which acts in the other direction, so that for equal bulk coke is somewhat lighter than coal. It is this combination of properties that gives it its chief value in iron smelting, the substance being sufficiently dense to resist oxidation by carbon dioxide in the higher regions of the furnace, while the vesicular structure gives an extended surface for the action of heated air and facilitates rapid consumption at the tuyeres. Compact coke, such as that formed on the inner sides of gas retorts (retort carbon) can only be burned with great difficulty in small furnaces of special construction, but it gives out a great amount of heat.

The most deleterious constituents of coke are ash, sulphur and volatile constituents, including water. As the coke yield is only from two-thirds to three-quarters of that of the coal, the original proportion of ash is augmented by one-third or one-half in the product. For this reason it is now customary to crush and wash the coal carefully to remove intermingled patches of shale and dirt before coking, so that the ash may not, if possible, exceed 10% in the coke. According to the researches of F. Wuest (*Journ. Iron and Steel Inst.* 1906) the sulphur is retained in a complex carbon compound which is not destroyed until the coke is actually consumed.

The quantity of coal used in the manufacture of coke in Great Britain, taking the year 1925 as an example, is as follows:—

	Tons.		Tons.
In the manufacture of gas	17,798,725	Coke produced	11,832,842
At coke ovens	16,393,867	do.	11,008,686

(*See* COAL; LOW TEMPERATURE CARBONIZATION.) (R. R.)

UNITED STATES

In the United States of America, the industry of coke-making has attained proportions greatly exceeding those in Great Britain, and has developed on somewhat different lines.

Beehive Coking.—As in Great Britain, so in America, beehive coking has been relegated to a minor rôle, and the principal share of the total coke production (in 1937, 94%) has of late years been in by-product recovery ovens. It is probable, however, owing to the lower initial cost of the beehive ovens, that a limited number of them will continue to be used in the future, especially during periods of peak-load demand in a variable coke market.

The rectangular or longitudinal form of non-recovery oven (as well as the "beehive" form) is used in the United States. Waste heat is recovered at some of the large beehive coking plants and utilized in firing boilers.

Disposal of Coke and Gas.—In England only about one-third of the total coke produced is used in making iron and steel, but in the United States of America, 65 to 70%. In other words, America devotes a much smaller proportion of her coke output to domestic and miscellaneous industrial uses, than does England.

Coke ovens in America are an important factor in the manufactured gas industry as a public utility. In 1937, they produced 150,000,000,000 cu.ft. or about 40% of all manufactured gas publicly distributed in city mains, besides about 312,000,000,000 cu.ft. which was sold direct to industrial users and not included in distribution by public systems. In England a much smaller proportion of the gas for public distribution is derived from coke ovens, although a high percentage of the gas is produced by the carbonization of coal in gas retorts.

By-product Coke Ovens.—In America practically no distinction is made between the "retort oven" and the "by-product oven," the latter being the more common term. About 90% of all the by-product coke is made in ovens heated by vertical flues, employing the regenerative principle of utilizing waste heat, as distinguished from the horizontal-flued type and recuperative heat recovery.

Refractory brick of "silica" material are used in the oven wall construction, having almost entirely superseded clay brick for this purpose. This refractory, owing to its rigidity under load when highly heated, permits the use of higher temperatures in the flues and thus secures more rapid working and greater oven capacity than is attainable with fire-clay brick. Flue temperatures of 1,370° to 1,400° C (2,500° to 2,550° F) are sometimes used in modern American ovens, but their average practice would be at somewhat lower heats.

The modern by-product coke oven in America is a rectangular chamber of about 650–750 cu.ft. coal-charging capacity. It has a length of about 40ft., a height of 12 to 13ft. and an average width (tapering 2 or 3in. throughout the length) of about 16 to 18 inches. With this oven, using finely crushed but not "stamped" coal, a charge of 15 to 19 tons (2,000lb. each) is obtained, and a daily coking capacity of 23 to 28 tons of coal.

The ovens are built closely adjoining one another in batteries or banks, usually about 40 to 60 in a battery, for convenience in operating. The rows of heating flues stand between the ovens, each row serving to heat two ovens, except in the case of the flues at each end of the battery.

A favourite type of by-product oven in the United States is the Becker modification of the Koppers oven. The general arrangement of a typical installation of ovens and heating flues would have a battery provided with both producer-gas heating (from a lower and larger supply pipe), and coal-gas heating (*i.e.*, by surplus coke oven gas), from the upper and smaller supply pipe. These ovens are heated on the regenerative principle, the waste heat of the combustion gases being retained in checker brick chambers below the ovens and at intervals, on reversal of current, given up to the entering air or producer gas. The distinguishing feature of the Becker oven is its provision for conducting the gases of combustion from the top of a row of flues across over the oven and down the row of flues on the other side. The cross-over flues, of an inverted U shape, are in the upper part of the oven battery structure. They pass over alternate ovens only, and are generally six to eight in number, evenly distributed throughout the length of the oven.

Each cross-over flue handles the waste gases from four vertical flues in the heating walls underneath, and each set of four vertical flues is separated from each other set, as far as mixing of the waste gases at this point is concerned, so that the horizontal flow of waste gas is virtually eliminated.

The advantages of this type of oven are concerned chiefly with securing more uniform heating of the ovens and a more stable structure in the upper part of the flue wall. The burning of gases, when reversed in direction, at intervals, for the purpose of regeneration, is not reversed from one-half of a heating wall to the other as in the older types, but from an entire wall on one side to an entire wall on the other side of an oven. This makes for more uniform heating, end to end, of the oven walls. The old horizontal flue of large size (above the row of vertical flues) is, in the new type, structurally absent owing to the provision of cross-over flues, which greatly reduce the volume of gases to be carried in any one section of that part of the oven. This allows heavier wall structure in this region and permits the heating flues to be built up higher without risk of overheating the oven tops, and the charge to be more evenly coked.

About 1934 the Curran-Knowles coal carbonization oven was introduced in the United States. It is of the type known as the "sole-flue heated oven," since the heating of the coal charge is done by flues in the floor of the oven rather than by flues in the side walls. The oven chamber is very low and takes a charge of coal only 12in. deep, but the width of the oven is about 10ft. and the length about 40 feet. After the coking is completed the coke is discharged from the chamber by a pushing machine.

In July 1939 there were, in the United States, completed and in operation the following numbers of by-product ovens of the various types:—

Koppers (including Koppers-Becker)	10,061
Semet-Solvay	1,832
Wilputte	771
Cambria	120
Improved Equipment	60
American-Foundation	55
Curran-Knowles	46
Parker-Russell	27
Roberts-Morrissey	25
Piette	8
Total	13,005

Coke is designated by its method of manufacture, such as By-Product coke, Beehive coke, and Gas Retort coke. It is also designated by the use to which it is put, as Blast Furnace coke (or simply Furnace coke), Foundry coke, Water Gas coke, Domestic coke (for house heating). Another method of designation, chiefly applied to Domestic coke, is according to size. The usual size classification, in the order of the largest size first, is as follows: Egg, Stove, Nut, Range, Pea, Breeze.

Gas Retorts and Ovens.—In addition to beehive and by-product coke ovens, coal is also subjected to high-temperature carbonization in the smaller gas retorts and ovens, primarily for production of city gas. However, whereas in Great Britain a very substantial proportion of city gas is made in gas retorts, the proportion so produced in America is very small. Also, the amount of coke produced in gas retorts in the United States is less than 2% of the total high-temperature coke manufactured there. The vertical retort or oven is commonly used in America, and this may be either intermittent or continuous in method of operation. One type of intermittent vertical gas oven, installed in America, is

heated by producer gas, the air being preheated by recuperation. It is of rectangular shape about 12 in. wide by 10 ft. long and 22 ft. high, and receives a charge of 8,000 lb. coal. Vertical gas ovens have the advantage of discharging the coke by gravity, doing away with the need for pushing machines.

Carbonization Practice.—In America there are some points of difference in high temperature carbonization practice, as compared with that in Britain. When two kinds of coal are mixed, for by-product coking, as is frequently done, the coal is very generally "pulverized," *i.e.*, finely crushed, until at least 75% passes a $\frac{1}{8}$-in. screen. Even when using a single coal this is sometimes done, but now the crushing in that case is more often to about $1\frac{1}{4}$-in. size. For many of the American "high-volatile" coals (31 to 38% volatile matter) it is found advantageous to add 15 to 30% of a lower volatile coal (so-called "semi-bituminous" coal of 17 to 22% volatile matter) in order to obtain best metallurgical cokes. Stamping, or compressing of the coal charge, is not practised in America. The quenching of coke is now done very generally at a quenching station, a short distance away from the oven battery. The car containing the hot coke is quickly moved from the oven to the station, is there quenched with a carefully controlled amount of water, and then brought back to an inclined wharf along the oven battery where it is dumped and undergoes further cooling and drying. "Dry quenching," using inert gases (products of combustion) or steam, is being used in several American plants, with successful results. In the recovery of by-products, the so-called "direct process" of ammonia recovery has been adopted in the majority of American plants. This consists in passing the oven gases, after removal of their tar, directly through sulphuric acid, in lead-lined "saturators," whereby the ammonia is converted into solid crystalline ammonium sulphate.

The following yields of products in by-product coking, according to American practice, are an approximate average, as close as can be estimated under conditions varying so widely:—

Percentage Yields from a Mixture of 80% Pittsburgh and 20% Pocahontas Coal (Dry Basis)

Coke (total)	72.0%
Tar	5.0%
Benzols, crude	1.0%
Ammonium sulphate	1.2%
Gas "surplus," per pound coal, B.t.u. content	2,100

The production of coke in the United States, in 1937, in coke ovens (not including gas works coke from retorts) was:

	Short Tons	*Per cent.*
From by-product ovens	49,210,800	94.0
From beehive ovens	3,164,700	6.0
Total	52,375,500	100.0

Approximately 950,000 tons additional were produced in gas retorts.

BIBLIOGRAPHY.—H. C. Porter, *Coal Carbonization* (1924), J. J. Morgan, *American Gas Practice*, vol. 1 (1931); W. Gluud, *International Handbook of the By-Product Coke Industry*, American Edition by D. L. Jacobson (1932). (H. C. PR.; A. R. PO.)

"COKE OF NORFOLK": *see* LEICESTER OF HOLKHAM, THOMAS WILLIAM COKE, EARL OF.

COL, in physical geography, generally any distinct depression upon a high water-parting offering easy passage from one valley to another. There are numerous cols on the Franco-Italian frontier, *e.g.*, the Little St. Bernard (2,188 ft.) which carries the road from the Dora Baltea to the upper Isère. The col (Fr. for "neck," Lat. *collum*) is usually formed by the headwaters of streams eating backwards towards one another and lowering the water-parting between their valley-heads. In early military operations, the most convenient col controlled the route of the army's movement.

On the weather map a col is an area in which the pressure is neither high nor low and where the winds are calm or light and variable. This condition is possible only between two "highs" and two "lows." This feature is sometimes called a "neutral point" or "saddle point." (*See* CYCLONE; ANTICYCLONE.)

COLBERT, JEAN BAPTISTE (1619–1683), French statesman, was born at Reims, where his father and grandfather were merchants. Through a family connection with Michel le Tellier, secretary of State for war, Colbert obtained a place in the war office before he was 20 and presently became private secretary to the minister. Twelve years later he became agent to Mazarin, driven from Paris (1651) during the supremacy of the Condé family, with the duty of keeping him informed of the progress of events. On his return, Mazarin gratified his agent with honours and places for various members of his family, and gave him his entire confidence. After Mazarin's death, Colbert secured the favour of Louis XIV. and became the chief power in the administration, though he did not at first hold an official position.

The king's new adviser set to work at once to reform the chaotic financial administration of France. He began by striking at the *surintendant*, Nicolas Fouquet, and secured his disgrace. The office of *surintendant* was abolished, and the control of finance was vested for a time in a royal council. Colbert, who contented himself with the title of *intendant*, was the ruling spirit of this council, but did not take over nominal direct control until 1665, when he was made controller-general. His first measures for cleansing the financial administration were ruthless enough. He set up a tribunal to deal with officials who intercepted money due to the treasury. Many were condemned to death, though the death sentences were not carried out; some 4,000 were compelled to disgorge their gains. The tribunal was disbanded in 1665, but it had purified the service. The public debt was handled by drastic methods. Some series of bonds were repudiated on the ground that only a small part of the money had been paid in; others were cancelled by paying the original sum invested less the interest paid. Colbert did not propose the abolition of privilege, but he drew into the net of taxation many who had hitherto escaped by revising the application of the *taille*, or direct tax. Indirect taxes were increased and the tariff revised in 1664, as part of a protective system. The various dues which existed among the provinces could not be swept away, but, although internal fiscal barriers were not destroyed, a measure of uniformity was secured in central France. His reforms in the farming out and collection of taxes and the jealous watch kept on the officials brought large sums into the treasury.

Colbert then turned his attention to the general increase of wealth by the encouragement of industry. He had a narrow conception of prosperity, which in his mind could not be real if neighbouring countries were prosperous. And in his encouragement of industry and trade he used the same minute method of centralized regulation which had brought order into the fiscal system. Every detail was to be controlled. This minute regulation probably accounts for the failure of the great trading corporations which he set up in 1664 for trading in India and in America (the East Indies and West Indies companies), while the British and Dutch monopolistic trading companies, with their operations untrammelled by the home government, prospered. He set up model factories, either financed by State funds as in the case of the Gobelins (founded 1667) or by concessionaries. He sought to standardize the production of staple commodities for all producers; faulty workmanship or deviation from the standard was punished by fine and by exposure in the pillory. These regulations hampered industry and annoyed the producers, and the encouragement given to industry tended to starve agriculture. French industry was to be developed by administrative measures and by a high protective tariff, and the proceeds accruing to the State were to be used for the development of communications and of external trade. The roads and canals were improved. The great canal of Languedoc was planned and constructed by Pierre Paul Riquet (1604–80) under Colbert's patronage.

The greatest and most lasting of Colbert's achievements was the establishment of the French marine. He became minister of the marine in 1669; then, in addition, of the colonies and the king's palace. The royal navy owed all to him, for the king thought only of military exploits. Colbert reconstructed the works and arsenal of Toulon, founded the port and arsenal of Rochefort, and the naval schools of Rochefort, Dieppe, and St. Malo, and fortified, with some assistance from Vauban (who, however, belonged to the party of his rival Louvois), among other ports those

of Calais, Dunkirk, Brest, and Havre. To supply it with recruits he invented his system of classes, by which each seaman, according to the class in which he was placed, gave six months' service every three or four or five years. For three months after his term of service he was to receive half-pay; pensions were promised; and, in short, everything was done to make the navy popular. There was one department, however, that was supplied with men on a very different principle. The galleys used in the Mediterranean service required oarsmen. Colbert wrote to the judges requiring them to sentence to the oar as many criminals as possible; and the convict, once chained to the bench, the expiration of his sentence was seldom allowed to bring him release. Vagrants, contraband dealers, political rebels, Turkish, Russian, and negro slaves, and poor Iroquois Indians, whom the Canadians were ordered to entrap, were pressed into that terrible service. By these means the benches of the galleys were filled, and Colbert took no thought of the long agony of those who filled them.

Encouragement was given to the building of ships for the mercantile marine by allowing a premium on those built at home, and imposing a duty on those brought from abroad; and as French workmen were forbidden to emigrate, so French seamen were forbidden to serve foreigners on pain of death.

Colbert was a patron of art and literature. He possessed a fine private library, rich in valuable manuscripts. He founded the academy of sciences, the observatory, which he employed Claude Perrault to build and brought G. D. Cassini (1625–1712) from Italy to superintend, the academies of inscriptions and medals, of architecture, and of music, the French academy at Rome, and academies at Arles, Soissons, Nîmes, and many other towns, and he reorganized the academy of painting and sculpture which Richelieu had established. He was a member of the French academy. In 1673 he presided over the first exhibition of the works of living painters; and he enriched the Louvre with hundreds of pictures and statues. He gave many pensions to men of letters, among whom we find Molière, Corneille, Racine, Boileau, P. D. Huet (1630–1721) and Antoine Varillas (1626–96), and even foreigners, as Huyghens, Vossius the geographer, Carlo Dati the Dellacruscan, and Heinsius the great Dutch scholar.

Colbert's industry was colossal. He found time to do something for the better administration of justice (the codification of ordinances, the diminishing of the number of judges, the reduction of the expense and length of trials for the establishment of a superior system of police) and even for the improvement of the breed of horses and the increase of cattle. As superintendent of public buildings he enriched Paris with boulevards, quays, and triumphal arches; he relaid the foundation stone of the Louvre, and brought Bernini from Rome to be its architect; and he erected its splendid colonnade upon the plan of Claude Perrault, by whom Bernini had been replaced. He was not permitted, however, to complete the work, being compelled to yield to the king's preference for residences outside Paris, and to devote himself to Marly and Versailles.

Amid all these public labours he directed personally the management of every farm on his estates. He died extremely rich and left fine estates all over France. He had been created marquis de Seignelay, and for his eldest son he obtained the reversion of the office of minister of marine; his second son became archbishop of Rouen; and a third son, the marquis d'Ormoy, became superintendent of buildings.

To carry out his reforms, Colbert needed peace and consistently advocated it, except in the case of the Dutch War, for which his commercial policy was partly responsible; but the war department was in the hands of his great rival Louvois, whose influence gradually supplanted that of Colbert with the king. Louis decided on a policy of conquest. He was deaf also to all the appeals against the other forms of his boundless extravagance which Colbert ventured to make (*Lettres*, vol. ii.). Thus, only a few years after he had begun to free the country from the weight of the loans and taxes which crushed her to the dust, Colbert was forced to heap upon her a new load of loans and taxes heavier than the last. Depressed by his failure, deeply wounded by the king's favour for Louvois, and worn out by overwork, his strength gave way at a comparatively early age.

Colbert was a great statesman, who did much for France. Nevertheless, his rule was a very bad example of over-government. He did not believe in popular liberty; the parlements and the states-general received no support from him. The technicalities of justice he never allowed to interfere with his plans; and he did not hesitate to shield his friends. He trafficked in public offices for the profit of Mazarin and in his own behalf. He caused the suffering of thousands in the galleys. There was indeed a more human side to his character, shown to his own family, but to all outside he was "the man of marble." Madame de Sévigné called him "the North Star." To diplomacy he never pretended.

BIBLIOGRAPHY.—The most thorough student of Colbert's life and administration was Pierre Clément, member of the Institute, who in 1846 published his *Vie de Colbert*, and in 1861 the first of the 9 vols. of the *Lettres, instructions et mémoires de Colbert*. The historical introductions prefixed to each of these volumes have been published by Mme. Clément under the title of the *Histoire de Colbert et de son administration*, 3rd ed. (1892). The best short account of Colbert as a statesman is that in Lavisse, *Histoire de France* (1905), which gives a thorough study of the administration. *See* also Benôit du Rey, *Recherches sur la politique coloniale de Colbert* (1902). Among Colbert's papers are *Mémoires sur les affaires de finance de France* (written about 1663), a fragment entitled *Particularités secrètes de la vie du Roy*, and other accounts of the earlier part of the reign of Louis XIV.

COLBERT DE CROISSY, CHARLES, MARQUIS (1625–1696), French diplomatist, like his elder brother Jean Baptiste Colbert, began his career in the office of the minister of war, Le Tellier. In 1656 he bought a counsellorship at the parlement of Metz, and in 1658 was appointed intendant of Alsace and president of the newly-created sovereign council of Alsace. In this position he had to reorganize the territory recently annexed to France. The steady support of his brother at court gained for him several diplomatic missions—to Germany and Italy (1659–61). In 1662 he became marquis de Croissy and *président à mortier* of the parlement of Metz. After various intendancies, at Soissons (1665), at Amiens (1666) and at Paris (1667), he turned definitely to diplomacy. In 1668 he represented France at the conference of Aix-le-Chapelle; and in August of the same year was sent as ambassador to London, where he was to negotiate the definite treaty of alliance with Charles II. He arranged the interview at Dover between Charles and his sister Henrietta of Orleans, gained the king's personal favour by finding a mistress for him, Louise de Kérouaille, maid of honour to Madame, and persuaded him to declare war against Holland. The negotiation of the treaty of Nijmwegen (1676–78) still further increased his reputation as a diplomatist, and Louis XIV. made him secretary of state for foreign affairs after the disgrace of Arnauld de Pomponne, brought about by his brother, 1679. He at once assumed the entire direction of French diplomacy. It was he, not Louvois, who formed the idea of annexation during a time of peace, by means of the chambers of reunion. He had outlined this plan as early as 1658 with regard to Alsace. His policy at first was to retain the territory annexed by the chambers of reunion without declaring war, and for this purpose he signed treaties of alliance with the elector of Brandenburg (1681), and with Denmark (1683); but the troubles following upon the revocation of the Edict of Nantes (1685) forced him to give up his scheme and to prepare for war with Germany (1688). The negotiations for peace had been begun again when he died, on July 28, 1696.

BIBLIOGRAPHY.—His papers, preserved in the *Archives des affaires étrangères* at Paris, have been partially published in the *Recueil des instructions données aux ambassadeurs et ministres de France* (since 1884). *See* especially the volumes:—*Autriche* (t.i.), *Suède* (t.ii.), *Rome* (t.vi.), *Bavière* (t.viii.), *Savoie* (t.xiv.), *Prusse* (t.xvi.). Other documents have been published in Mignet's *Négociations relatives à la succession d'Espagne*, vol. iv., and in the collection of *Lettres et négociations . . . pour la paix de Nimègue, 1676–77* (La Haye, 1710). In addition to the *Mémoires* of the time, *see* Spanheim, *Relation de la cour de France en 1690*, edit. E. Bourgeois (Lyons, 1900); Baschet, *Histoire du depôt des affaires étrangères;* C. Rousset, *Histoire de Louvois* (1863); E. Bourgeois, "Louvois et Colbert de Croissy," in the *Revue Historique*, vol. xxxiv. (1887); A. Waddington, *Le Grand Électeur et Louis XIV.* (1905); G. Pagis, *Le Grand Électeur et Louis XIV.* (1905).

COLBURN, HENRY (d. 1855), British publisher. In 1814 he originated the *New Monthly Magazine,* of which at various times Thomas Campbell, Bulwer Lytton, Theodore Hook and Harrison Ainsworth were editors. Colburn published in 1818 *Evelyn's Diary,* and in 1825 the *Diary of Pepys,* edited by Lord Braybrooke, paying £2,200 for the copyright. He also issued Disraeli's first novel, *Vivian Grey.* His business was taken over in 1841 by Messrs. Hurst and Blackett. Henry Colburn died on Aug. 16, 1855.

COLBY, FRANK MOORE (1865–1925), U.S. editor, was born in Washington, D.C., Feb. 10, 1865. He received from Columbia university the degrees A.B. (1888) and A.M. (1889). He was acting professor of history at Amherst college (1890–91), lecturer and instructor in history and economics at Columbia university and Barnard college (1891–95) and professor of economics at New York university (1895–1900). In 1893 he joined the editorial staff of *Johnson's Universal Cyclopaedia.* In 1898 he became editor of *The International Year Book,* and he was one of the editors of *The International Cyclopaedia* and of the first and second editions of *The New International Encyclopaedia.* He served as American editor of *Nelson's Encyclopaedia* (1905–06), and after 1907 as editor of *The New International Year Book.* He died in New York city, March 3, 1925. He wrote, among other works, *Imaginary Obligations* (1904); *Constrained Attitudes* (1910) and *The Margin of Hesitation* (1922).

COLCHAGUA, a province of central Chile, bounded north by Santiago and O'Higgins, east by Argentina, south by Curicó and west by the Pacific. Its area, before annexations made in 1928, was 3,851 sq.mi. During the '30s, however, the areal limits of many of the provinces were redefined with the result that the present area of Colchagua is 3,423 sq.mi.; population (1940 census) 138,036. The great longitudinal valley of Chile cuts across the central part of the province, providing a considerable area excellently suited to the production of crops and livestock. Good range land exists in both the coastal mountains and along the lower slopes of the Andes. The principal river is the Rapel which, in its lower reaches, forms a part of the northern boundary of the province. Near the Argentine frontier, on one of the principal tributaries of the Rapel, are the hot springs of Baños de San Fernando, accessible by car from San Fernando, capital of Colchagua. The State central railway from Santiago to Puerto Montt passes through San Fernando (83 mi. S. of Santiago), and a branch line extends west to the popular ocean resort of Pichelemu. San Fernando is one of the several towns founded in 1742 by the governor-general José de Manso.

COLCHESTER, CHARLES ABBOT, 1ST BARON (1757–1829), was born in Abingdon, and educated at Westminster school and Oxford. In 1795, after having practised 12 years as a barrister, he was appointed clerk of the rules in the king's bench and elected member of parliament. To his efforts were due the establishment of the Royal Record commission, the reform of the system which had allowed the public money to lie for long periods in the hands of the public accountants, by charging them with payment of interest, and, most important of all, the act for taking the first census (1801). In March 1801 Abbot became chief secretary and privy seal for Ireland; and in 1802 he was chosen speaker of the house of commons. In response to an address of the commons, he became Baron Colchester, with a pension of £4,000. He died on May 8, 1829.

COLCHESTER, municipal borough, Essex, England; 52 mi. northeast of London, on the river Colne. Pop. (1938) 51,900. Area 18.8 sq.mi. In early British and Roman history it was known as Camulodunum, the capital of the British chief Cunobelin, and is named on his coins. After his death and the Roman conquest, Claudius established a municipality of discharged soldiers. It was stormed and burned A.D. 61 in the rising of Boadicea (*q.v.*), but soon became one of the chief towns in Roman Britain. The town is named after Camulos, the Celtic Mars. Roman sculptures and inscriptions have been discovered and its walls and the guardroom of the principal gate can still be traced. The Domesday book mentions 276 burgesses and land *in commune burgensium.* The ruined castle-keep built by William I about 1080 is quadrangular, turreted at the angles, and is the largest of its kind in England. In the castle is a museum of Roman and other antiquities. The Augustinian priory of St. Botolph (early 12th cent.) retains part of the fine Norman west front (in which Roman bricks occur), and of the nave arcades; and there is the restored gateway of the Benedictine monastery of St. John, a beautiful specimen of Perpendicular work, embattled, flanked by spired turrets, and covered with panel work. The church of Holy Trinity has an apparently pre-Norman tower.

The first charter given in 1189 granted freedom of passage and pontage through England, free warren, fishery and custom as in the time of Henry I. The charters were confirmed and new grants obtained in 1447 and 1535. Colchester returned two members to parliament from 1295 until 1885. Fairs were granted by Richard I in 1189 to the hospital of St. Mary Magdalene, and by Edward II in 1319 on the eve of St. Denis and the six following days. In the 13th century Colchester was an important port, its ships plying to Winchelsea and France. Elizabeth and James I encouraged Flemish settlers in manufacture of baize ("bays and says"). Both Camden and Fuller mention the trade in barrelled oysters and candied eringo-root. The town was held, apparently against the citizens' will, by Royalists in 1648 against Fairfax, and it was fined in consequence by the parliament.

Charles I granted a fresh charter, which was amended in 1653 and a new one granted in 1663; this one remaining in force with modifications until 1741. In 1763 George III made the borough a renewed grant of its liberties. The town has long been an important military centre and is the headquarters of the 4th division and East Anglia area. There is a free grammar school (founded 1539). Castle park is a public ground surrounding the castle. Colchester is the centre of an agricultural district, and has weekly corn and cattle markets, besides extensive nurseries and a large rose-growing industry. The oyster fisheries at the mouth of the Colne belong to the corporation, and are held on lease by the Colne Fishery company. The harbour, with quayage at the suburb of Hythe, is controlled by the corporation. Since 1918 the municipal borough of Colchester together with the rural districts of Lexden and Winstree (except the detached portion of Inworth parish) form the Colchester parliamentary division of Essex.

Colchester was made the see of a bishop suffragan by Henry VIII, and two bishops were in succession appointed by him; no further appointments, however, were made until the suffragan see was re-established under Victoria.

COLCHICUM, the meadow saffron, or autumn crocus (*Colchicum autumnale*), a perennial plant of the family Liliaceae, found wild in rich, moist meadowland in England and Ireland, in middle and southern Europe and in the Swiss Alps. It has pale purple flowers, rarely more than three in number; the perianth is funnel-shaped, and produced below into a long slender tube, in the upper part of which the six stamens are inserted. The ovary is three-celled, and lies at the bottom of this tube. The leaves are three or four in number, flat, lanceolate, erect and sheathing; and there is no stem. Propagation is by the formation of new corms from the parent corm, and by seeds. The latter are numerous, round, reddish-brown and of the size of black mustard-seeds. The corm of the meadow saffron attains its full size in June or early in July. A smaller corm is then formed from the old one, close to its root; and this in September and October produces the crocus-like flowers. In the succeeding January or February it sends up its leaves, together with the ovary, which perfects its seeds during the summer. The young corm grows continuously, till in the following July it attains the size of a small apricot. The parent corm remains attached to the new one, and keeps its form and size till April in the third year of its existence, after which it decays. In some cases a single corm produces several new plants during its second spring by giving rise to immature corms. *C. autumnale* and its numerous varieties, as well as other species of the genus, are well known in cultivation, forming some of the most beautiful of autumn-flowering plants.

Colchicum or colchicine, applied to the skin, causes pain and congestion; inhaled, causes violent sneezing; and taken internally,

increases the amount of bile poured into the intestine. In larger doses it is a violent gastro-intestinal irritant, causing severe colic, vomiting, diarrhoea, haemorrhage from the bowel and ultimately death from collapse. This is accelerated by a depressant action upon the heart and nervous system similar to that produced by veratrine and aconite. The sole medical use of colchicum is in gout. It has an extraordinary power over the pain of acute gout; lessens the severity and frequency of the attacks when given continuously between them, and benefits such symptoms of gout as eczema, bronchitis and neuritis, though inoperative against them when not of gouty origin. The drug is generally given as *vinum colchici*, in doses of 10 to 30 minims. It is apt to render the patient low-spirited and tearful and must only be given with great care. In *colchicum poisoning*, empty the stomach, give white of egg, olive or salad oil and water. Use hot bottles and stimulants, especially trying to counteract the cardiac depression by atropine, caffeine, strophanthin, etc.

Colchicum is a specific for separation of chromosomes. The product is much used in genetics and plant breeding to produce a doubling of the chromosomes. Most of the American supply ordinarily comes from Holland, Italy, Yugoslavia and Hungary.

COLCHIS, in ancient geography, a nearly triangular district of Asia Minor, at the eastern extremity of the Black Sea, bounded on the north by the Caucasus, which separated it from Asiatic Sarmatia, east by Iberia, south by the Montes Moschici, Armenia and part of Pontus, and west by the Euxine. The name of Colchis first appears in Aeschylus and Pindar. It was inhabited by a number of tribes whose settlements lay chiefly along the shore of the Black Sea. These tribes differed so completely in language and appearance from the surrounding nations, that the ancients originated various theories to account for the phenomenon. Herodotus believed them to have sprung from the relics of the army of Sesostris (*q.v.*), and thus regarded them as Egyptians. Apollonius Rhodius (*Argon*, iv. 279) states that the Egyptians of Colchis preserved as heirlooms a number of wooden κύρβεις (tablets) showing seas and highways with considerable accuracy. It is quite possible that there was an ancient trade connection between the Colchians and the Mediterranean peoples. We learn that women were buried, while the corpses of men were suspended on trees. The principal coast town was the Milesian colony of Dioscurias (Roman Sebastopolis; mod. Sukhum Kaleh), the ancient name being preserved in the modern C. Iskuria. The chief river was the Phasis (mod. Rion).

Colchis was celebrated in Greek mythology as the destination of the Argonauts, the home of Medea and the special domain of sorcery. Several Greek colonies were founded there by Miletus. It seems to have been incorporated in the Persian empire, though the inhabitants evidently enjoyed a considerable degree of independence; in this condition it was found by Alexander the Great, when he invaded Persia. From this time till the era of the Mithridatic wars nothing is known of its history. At the time of the Roman invasion it seems to have paid a nominal homage to Mithridates the Great and to have been ruled over by Machares, his second son. On the defeat of Mithridates by Pompey, it became a Roman province. After the death of Pompey, Pharnaces, the son of Mithridates, rose in rebellion against the Roman yoke, subdued Colchis and Armenia, and made head, though but for a short time, against the Roman arms. After this Colchis was incorporated with Pontus, and the Colchians are not again alluded to in ancient history till the 6th century. It had been specially garrisoned by Justinian under first Peter, a Persian slave, and subsequently Johannes Tzibos, who built Petra on the coast as the Roman Headquarters. Tzibos took advantage of the extreme poverty of the inhabitants to create a Roman monopoly by which he became a middleman for all the trade both export and import. Chosroes I. succeeded in capturing Petra (A.D. 541). The missionary zeal of the Zoroastrian priests soon caused discontent among the Christian inhabitants of Colchis, and Gobazes, perceiving that Chosroes intended to Persianize the district, appealed to Rome, with the result that in 549 one Dagisthaeus was sent out with 7,000 Romans and 1,000 auxiliaries of the Tzani (Zani, Sanni). The "Lazic War" lasted till 556 with varying success. Petra was recaptured in 551 and Archaeopolis was held by the Romans against the Persian general Mermeroes. Gobazes was assassinated in 552, but the Persian general Nachoragan was heavily defeated at Phasis in 553.

By the peace of 562 the district was left in Roman possession, but during the next 150 years it is improbable that the Romans exercised much authority over it. In 697 we hear of a revolt against Rome led by Sergius the Patrician, who allied himself with the Arabs. Justinian II. in his second period of rule sent Leo the Isaurian, afterwards emperor, to induce the Alans to attack the Abasgi. The Alans invaded Lazica, and, probably in 712, a Roman and Armenian army laid siege to Archaeopolis. On the approach of a Saracen force they retired, but a small plundering detachment was cut off. Ultimately Leo joined this band and aided by the Apsilian chief Marinus escaped with them to the coast.

From the beginning of the 14th to the end of the 17th century Colchis was governed by an independent dynasty, the Dadians, which was succeeded by a semi-independent dynasty, the Chikovans, who by 1838 had submitted to Russia, though they retained a nominal sovereignty. In 1866 the district was finally annexed by Russia. *See* GEORGIA.

For the kings *see* Stokvis, *Manuel d'histoire*, i. 83.

COLCOTHAR (adapted in Romanic languages from Arabic *golgotar*, which was probably a corruption of the Gr. χάλκανθος from χαλκός, copper, ἄνθος, flower, *i.e.*, copper sulphate), a name given to the brownish-red ferric oxide residue obtained in the preparation of fuming sulphuric (Nordhausen) acid by the dry distillation of ferrous or ferric sulphate. It is used as a polishing powder by jewellers, and as the pigment Indian red. It is also known as *Crocus Martis, Caput Mortuum, Prussian red*, rouge, etc.

COLD, subjectively the sensation which is excited by contact with a substance whose temperature is lower than the normal; objectively a quality or condition of material bodies which gives rise to that sensation. Whether cold, in the objective sense, was to be regarded as a positive quality or merely as absence of heat was long a debated question. Thus Robert Boyle, who does not commit himself definitely to either view, says, in his *New Experiments and Observations touching Cold*, that "the dispute which is the *primum frigidum* is very well known among naturalists, some contending for the earth, others for water, others for the air, and some of the moderns for nitre, but all seeming to agree that there is some body or other that is of its own nature supremely cold and by participation of which all other bodies obtain that quality." But with the general acceptance of the dynamical theory of heat, cold naturally came to be regarded as a negative condition, depending on decrease in the amount of the molecular vibration that constitutes heat.

The question whether there is a limit to the degree of cold possible, and, if so, where the zero must be placed, was first attacked by the French physicist, G. Amontons, in 1702–03, in connection with his improvements in the air-thermometer. In his instrument temperatures were indicated by the height at which a column of mercury was sustained by a certain mass of air, the volume or "spring" of which of course varied with the heat to which it was exposed. Amontons therefore argued that the zero of his thermometer would be that temperature at which the spring of the air in it was reduced to nothing. On the scale he used the boiling-point of water was marked at 73 and the melting-point of ice at $51\frac{1}{2}$, so that the zero of his scale was equivalent to about −240° on the centigrade scale. This remarkably close approximation to the modern value of −273° for the zero of the air-thermometer was further improved on by J. H. Lambert (*Pyrometrie*, 1779), who gave the value −270° and observed that this temperature might be regarded as absolute cold. Values of this order for the absolute zero were not, however, universally accepted about this period. Laplace and Lavoisier, for instance, in their treatise on heat (1780), arrived at values ranging from 1,500° to 3,000° below the freezing-point of water, and thought that in any case it must be at least 600° below, while John Dalton in his *Chemical Philosophy* gave ten calculations of this value, and finally adopted −3,000°C. as the natural zero of temperature. After J. P. Joule

had determined the mechanical equivalent of heat, Lord Kelvin approached the question from an entirely different point of view, and in 1848 devised a scale of absolute temperature which was independent of the properties of any particular substance and was based solely on the fundamental laws of thermodynamics (*see* HEAT and THERMODYNAMICS). It followed from the principles on which this scale was constructed that its zero was placed at −273°, at almost precisely the same point as the zero of the air-thermometer.

In nature the realms of space, on the probable assumption that the interstellar medium is perfectly transparent and diathermanous, must, as was pointed out by W. J. Macquorn Rankine, be incapable of acquiring any temperature, and must therefore be at the absolute zero. That, however, is not to say that if a suitable thermometer could be projected into space it would give a reading of −273°. On the contrary, not being a transparent and diathermanous body, it would absorb radiation from the sun and other stars, and would thus become warmed. (*See* J. H. Poynting, "Radiation in the Solar System," *Phil. Trans.* A, 1903.) The French physicists of the early part of the 19th century held a different view, and rejected the hypothesis of the absolute cold of space. Fourier, for instance, postulated a fundamental temperature of space as necessary for the explanation of the heat-effects observed on the surface of the earth, and estimated that in the interplanetary regions it was little less than that of the terrestrial poles and below the freezing-point of mercury, though it was different in other parts of space (*Ann. chim. phys.*, 1824, 27, pp. 141, 150). C. S. M. Pouillet, again, calculated the temperature of interplanetary space as −142°C. (*Comptes rendus*, 1838, 7, p. 61), and Sir John Herschel as −150°.

To attain the absolute zero in the laboratory, that is, to deprive a substance entirely of its heat, is a thermodynamical impossibility, and the most that the physicist can hope for is an indefinitely close approach to that point. The lowest steady temperature obtainable by the exhaustion of liquid hydrogen is about −262°C. (11° Abs.), and the liquefaction of helium by Prof. Kamerlingh Onnes in 1908 yielded a liquid having a boiling-point of about 4° Abs. which on exhaustion should bring us to within about 1° of the absolute zero. Liquid helium has since been solidified by Prof. Keesom (1926) at 1·13° Abs. under a pressure of 25 atmos. The freezing point rises to 4·2° Abs. under a pressure of 140 atmos. (*See* LIQUEFACTION OF GASES.)

COLD. The common cold (known technically as Acute Coryza) is an acute catarrhal inflammation of the upper respiratory tract, caused by infection with bacteria. The most careful bacteriological studies have failed to demonstrate a single specific germ as the cause of this disease; but the contagious character of many of these infections makes it almost certain that we are dealing with an infectious process. It is more likely that the common cold is not a specific infection like typhoid fever, which is always caused by the same micro-organism, but that it results from infection by any one of a number of different bacteria. The organisms most commonly found in the nasal secretions are the streptococcus, staphylococcus, pneumococcus and influenza bacillus. In addition to these well-known species, certain ultra-microscopic organisms have been isolated from the nasal secretions during colds.

Foster in 1916, and Olitsky and McCartney in 1923, described a filterable virus, which they claimed was capable of transmitting the common cold from infected individuals to healthy individuals. The fact that many species of bacteria are constant inhabitants of the healthy throat and nasopharynx has made bacteriological studies of the common cold extremely difficult, and it has been rather disturbing to find that this bacterial flora undergoes very little change in character during the acute stage of a cold. (Bloomfield, Dochez and others.) The common cold bears considerable resemblance to hay fever, and for this reason a prevalent theory as to its etiology is that acute coryza is an expression of a hypersensitive condition of the nasal mucous membrane to some protein, probably bacterial in nature.

The environmental factors causing the common cold are well-known. Unequal chilling of the body, sudden cooling after exercise, wearing of wet shoes and wet clothing, fatigue and irritants in the air, all predispose to the onset of a cold. The exact effect of chilling of the body is not understood, but Mudd, Grant and Goldman have found that in experiments on human subjects, chilling of the skin invariably causes a lowering of the temperature of the skin, with a reflex lowering in temperature of the mucous membrane of the nose and nasopharynx. They believe that this drop in temperature depresses the resistance in the throat and thereby allows infection to take place.

Colds occasionally become epidemic. Epidemic colds are usually more severe than ordinary colds, and have been spoken of as grip, or influenza. It is probable that these epidemics are caused by some micro-organism, other than that producing the common cold.

The common cold usually starts in the posterior nares, or in the nasopharynx, but it may originate in any portion of the upper respiratory tract. The first symptom is a sensation of burning and discomfort in the part affected. As the infection spreads, the mucous membrane becomes red and swollen, the nostrils are occluded, and there is a profuse watery discharge from the nose. The patient complains of a dull headache, and a sense of congestion in the eyes, nose and throat. The voice is husky and the senses of taste, smell and hearing are impaired. The skin about the nostrils becomes red and excoriated. If the infection extends down into the bronchial tree, hoarseness develops and then a cough, which at first is dry and hacking, but later is accompanied by an expectoration of mucopurulent sputum. Involvement of the bronchial tree causes a sense of tightness and soreness in the chest, which may be increased with breathing.

The constitutional symptoms of acute coryza vary considerably with the patient, and with different infections in the same patient. In mild cases, there may be nothing more than slight languor and disinclination for exertion. In more severe cases there is some fever (100° to 102° F), rapid pulse, chilly sensations and aching in the back and extremities. Some patients develop gastro-intestinal symptoms, such as abdominal cramps, nausea, vomiting and diarrhoea. As a rule the common cold presents no diagnostic difficulty. Some of the infectious diseases, such as measles and scarlet fever, may begin with symptoms which are suggestive of coryza, but by the second or third day characteristic symptoms develop which make the differentiation easy. Grip and influenza are infections which are closely allied to the common cold. The differential diagnosis depends largely upon the severity of the symptoms. Grip is a term which is used rather loosely to designate an acute respiratory infection accompanied by some constitutional symptoms. It is really nothing more than a severe cold. Whether the causative agent is the same as that of the common cold is not known. Influenza is a highly contagious infection of the upper respiratory tract which occurs in large or small epidemics during which it spreads with remarkable rapidity. Many bacteriologists believe that it is caused by the influenza bacillus, but Olitsky and Gates have isolated a filterable virus, known as the *bacterium pneumocintes*, which they believe is the causative agent. The local symptoms of influenza are similar to those of coryza and grip, but the constitutional symptoms are much more marked. The fever is higher, and there is considerable prostration, associated with aching pains in the back and limbs. Influenza nearly always affects the bronchial tree, and a considerable number of patients develop influenzal pneumonia.

The complications of the common cold give the disease its medical significance. As a simple infection it runs a mild, short course, in many cases interfering but little with one's usual routine of life. The complications, however, are numerous and important. Bronchitis occurs so frequently that it can hardly be called a complication. Infection of the accessory sinuses is also extremely common, and sometimes brings on acute constitutional symptoms. More often a sinus infection simply means a prolongation of the nasal symptoms. Not infrequently the condition becomes chronic, and necessitates treatment by a nose and throat specialist. Involvement of the middle ear (otitis media) is a frequent complication, particularly in children, and may lead to a mastoiditis. Occasionally, the infection is not limited to the mastoid,

but extends through the bone and invades the meninges. When this happens, meningitis or brain abscess results. When the infection extends downward, bronchitis may be followed by bronchopneumonia or lobar pneumonia, and these in turn by pleurisy or empyema. In addition to these direct complications, the common cold may be the means of lighting up an old tuberculous process in the lungs, or, by lowering the resistance of the patient, it may lead to an exacerbation of some systemic condition, such as rheumatism, nephritis or heart disease.

TREATMENT

The common cold usually runs a definite course of three to ten days. If the nasal discharge persists longer than this, one should suspect a complicating infection of one of the sinuses. As recovery from the cold progresses, the congestion decreases, and the secretions become scanty and more purulent. The treatment consists largely in the relief of symptoms. Occasionally, a cold may be aborted in the early stage, but once the infection gets a start, efforts to check it are usually futile. Colds have been successfully aborted only when the infection has been checked at the very outset by the local application of some germicide, such as argyrol or silver nitrate. These applications should, of course, be made by a specialist, as it is almost impossible for the patient to reach the infected area with a gargle or spray. It has been claimed by some that measures which promote sweating sometimes check a coryza. The treatment usually advocated is a hot foot bath, some kind of hot drink, and a Dover's powder or a drink of whisky. Even if these measures fail, they tend to make the patient much more comfortable, and are certainly worth a trial. The best treatment for the common cold is rest in bed. Rest should be insisted upon if the temperature rises above 100° F, or if the patient is the victim of some chronic constitutional disease, such as diabetes or heart disease. The patient should be isolated as much as possible, not only to protect others, but to minimize the chances of acquiring a secondary infection at a time when the patient's resistance is at a low ebb. The diet should be simple and nutritious, and fluids should be taken in liberal amounts. Tobacco smoke, cold damp air and other irritants must not be allowed to enter the respiratory tract, as these tend to carry the infection down into the finer divisions of the bronchial tree. A saline cathartic is indicated, even when the bowels are active. Various drugs are used to counteract the unpleasant symptoms. Perhaps the most popular of these is aspirin, but phenacetin and codein are also popular. Locally, various sprays are used to lessen the irritation in the nose and throat. Most of the sprays have an albolene base to which has been added thymol, menthol or eucalyptol. If the infection invades the larynx or trachea, the voice should be rested as much as possible. If the cough becomes violent, some sedative, such as codein, is usually sufficient to control it. A favourite remedy is the old-fashioned croup kettle, containing a pint of hot water and a teaspoonful of compound tincture of benzoin. The patient is placed under a sheet and allowed to inhale the fumes from the steaming croup kettle. If there is much pain and tightness in the chest, counter-irritation with some stimulating liniment, or with a mustard plaster, often gives relief.

One of the most difficult problems which the modern health officer has to face is the prevention of the acute respiratory infections, particularly as the population tends more and more to concentrate in cities. Probably the most effective method of preventing colds is to reduce to a minimum contact with crowds. Yet such a measure is almost impossible to enforce in modern urban life. Antiseptic sprays and gargles have been advocated and are widely advertised, but their value is questionable. Most antiseptics strong enough to kill bacteria will cause irritation to the mucous membrane. Hardening the body by exposure to cold air or to cold water has been recommended to increase one's resistance to respiratory infections, but the value of this procedure has been very much questioned of late.

Vaccines are a very popular prophylactic and appear to have some value, particularly when prepared from the patient's own bacteria. Statistics by Park and Von Sholly among employees of the Metropolitan Life Insurance Company show that subjects inoculated with "stock" vaccines contract colds about as readily as the uninoculated. For those, however, who suffer from repeated infections because of some chronic focus, an autogenous vaccine is well worth trying and often gives much relief.

BIBLIOGRAPHY.—G. B. Foster, "The Etiology of Common Colds. The Probable Rôle of a Filterable Virus as the Causative Factor; A Preliminary Note," *Journal of the American Medical Association,* vol. 66, p. 1,180 (1916); P. K. Olitsky and J. E. McCartney, "Studies on the Nasopharyngeal Secretions from Patients with Common Colds," *Journal of Experimental Medicine,* 1923, Vol. 38, p. 427; A. L. Bloomfield, "Variations in Bacterial Flora of Upper Air Passages during the Course of the Common Cold," Johns Hopkins Hospital *Bulletin* No. 32, p. 121 (1921); A. R. Dochez, G. S. Shibley and F. M. Hanger, "Studies on the Common Cold; Observations of Normal Bacterial Flora of Nose and Throat with Variations Occurring during Colds," *Journal of Experimental Medicine,* March, 1926, Vol. 43, pp. 415–431; S. Mudd, A. Goldman and S. B. Grant, "Experimental Study on Excitation of Infections of Throat," *Journal of Experimental Medicine,* vol. 32, p. 87 (1920); P. K. Olitsky and F. L. Gates, "Experimental Study of the Nasopharyngeal Secretions from Influenza Patients. Preliminary Report," *Journal of the American Medical Association,* vol. 74, p. 1497 (1920); A. I. von Sholly and W. H. Park, "Report on Prophylactic Vaccination of 1536 Persons against Acute Respiratory Diseases in 1919 and 1920," *Journal of Immunology,* vol. 6, No. 1, p. 103 (Jan. 1921).

(R. L. C.)

COLDEN, CADWALLADER (1688–1776), American physician, historian and colonial official, was born at Duns, Scotland, on Feb. 17, 1688. He graduated at the University of Edinburgh in 1705, devoting himself to scientific studies there and in London, and emigrated to Philadelphia in 1710. There he engaged in general mercantile business until after a visit to Great Britain in 1715, when he began the practice of medicine. He was induced to move to New York by Governor Hunter, who appointed him the first surveyor-general of the colony and master in chancery. Becoming a member of the provincial council in 1721, he served for many years as its president; and from 1761 until his death was lieutenant-governor. He was acting-governor when in 1765 the stamped paper to be used under the Stamp Act arrived in the port of New York; a mob burned him in effigy in his own coach in Bowling Green, and he was compelled to surrender the stamps to the city council, by whom they were locked up in the city hall until all attempts to enforce the new law were abandoned. Subsequently Colden secured the suspension of the provincial assembly by an act of parliament. He understood, however, the real temper of the patriot party, and in 1775, when the outbreak of hostilities seemed inevitable, he strongly advised the ministry to act with caution and to concede some of the colonists' demands. When the war began he retired to his country seat near Flushing, N.Y., where he died on Sept. 28, 1776. Colden was widely known among scientists and men of letters in England and America. He was a lifelong student of botany, and was the first to introduce in America the classification system of Linnaeus, who gave the name *Coldenia* to a newly recognized genus. He wrote several medical works of importance in their day, the most noteworthy being *A Treatise on Wounds and Fevers* (1765); he also wrote an elaborate work on *The Principles of Action in Matter* (1751), which, with his *Introduction to the Study of Physics* (*c.* 1756), his *Enquiry into the Principles of Vital Motion* (1766), and his *Reflections* (*c.* 1770), mark him as the first of American materialists and one of the ablest material philosophers of his day. His *History of the Five Indian Nations* (1727, best ed. 1902) is one of the most valuable accounts that have been preserved of the relations with these powerful tribes and of the expansion of the English fur trade to the west.

BIBLIOGRAPHY.—*See* Alice M. Keys, *Cadwallader Colden, A Representative Eighteenth Century Official* (1906); J. G. Mumford, *Narrative of Medicine in America* (1903); and I. W. Riley, *American Philosophy* (1907). Colden's *Letters and Papers* were published in the *Collections* of the New York Historical Society (1917–23).

COLD HARBOR, OLD and NEW, two localities in Hanover county, Virginia, U.S.A., 10 mi. N.E. of Richmond. They were the scenes of a battle between the army of the Potomac under Gen. G. B. McClellan, and the army of Northern Virginia under Gen. R. E. Lee, June 27, 1862 (sometimes called the battle of Gaines' Mill); also of a succession of battles from May 31 to June 12, 1864, between the Union forces under command of Gen. U. S. Grant and the Confederates under Gen. R. E. Lee, who held a

strongly entrenched line at New Cold Harbor. The main union attack on June 3 was delivered by the 2nd (Hancock), 6th (Wright) and 18th (W. F. Smith) corps, and was brought to a standstill in eight minutes. An order from army headquarters to renew the attack was ignored by the officers and men at the front. In the constant fighting of May 31 to June 12 on this ground, Grant lost 14,000 men. (*See* WILDERNESS; AMERICAN CIVIL WAR.)

COLD STORAGE: *see* REFRIGERATION AND ITS APPLICATION.

COLDSTREAM, a small burgh, Berwickshire, Scotland. Pop. (est. 1938) 1,222. It is situated on the north bank of the Tweed, here spanned by John Smeaton's fine bridge of five arches, erected in 1763–1766, 13½ mi. southwest of Berwick by the L.N.E. railway. The station is at Cornhill over the border. Owing to its position on the Border and also as the first ford of any consequence above Berwick, the town played a prominent part in Scottish history during many centuries. Here Edward I crossed the stream in 1296 with his invading host, and Montrose with the Covenanters in 1640. Of the Cistercian priory, founded about 1165 by Cospatric of Dunbar, and destroyed by the 1st earl of Hertford in 1545, which stood a little to the east of the present market place, no trace remains; but for nearly 400 years it was a centre of religious fervour. Here the papal legate, in the reign of Henry VIII, published a bull against the printing of the Scriptures; but the site was occupied in the 19th century by an establishment, under Dr. Adam Thomson, for the production of cheap Bibles. At Coldstream General Monk raised in 1659 the celebrated regiment of Foot Guards bearing its name. Like Gretna Green, Coldstream was long a resort of runaway couples, the old toll house at the bridge being the usual scene of the marriage ceremony. "Marriage House," as it is called, still exists. At Birgham, 3 mi. west, a place of no small importance, in 1188 William the Lion conferred with the Bishop of Durham concerning the attempt of the English Church to impose its supremacy upon Scotland; there in 1289 was held the convention to consider the marriage of the Maid of Norway with Prince Edward of England; and there, too, in 1290 was signed the treaty of Birgham, which secured the independence of Scotland. Seven miles below Coldstream on the English side are the massive ruins of Norham Castle, made famous by Scott's *Marmion,* and from the time of its building by Ranulf Flambard in 1121 a focus of Border history during four centuries.

COLDWATER, a city near the southern boundary of Michigan, U.S.A., surrounded by beautiful lakes; the county seat of Branch county. It is on Federal highways 27 and 112, and is served by the New York Central railway system. The pop. in 1940 was 7,343. It has large Portland cement plants, and manufactures furnaces, marine engines, gray iron castings, brass, clothing, shoes, window display fixtures, wooden sporting goods, sleds and lawn furniture. The Michigan State Children's village is situated here. Coldwater (called Lyons until 1833) was settled in 1829, incorporated as a village in 1837 and as a city in 1861.

COLE: *see* ENNISKILLEN, WILLIAM WILLOUGHBY COLE.

COLE, SIR HENRY (1808–1882), English civil servant, was born at Bath on July 15, 1808. He was a leading member of the commission that organized the Great Exhibition of 1851, and then became secretary to the School of Design, which was transferred in 1853 into the Department of Science and Art. Under its auspices the South Kensington (now Victoria and Albert) Museum, London, was founded in 1855 and Cole practically became its director, retiring in 1873. He originated the scheme for the Royal Albert hall, London. He was active in founding the national schools for cookery and music, the latter the germ of the Royal College of Music. He edited the works of Thomas Love Peacock. He died on April 18, 1882.

See *Fifty Years of Public Work of Sir Henry Cole,* ed. A. S. and H. Cole (1884).

COLE, THOMAS (1801–1848), U.S. landscape painter, was born at Bolton-le-Moors, England, on Feb. 1, 1801. In 1819 the family emigrated to America, settling first in Philadelphia and then at Steubenville (O.), where Cole learned the rudiments of his profession from a wandering portrait painter named Stein. He went about the country painting portraits, but with little financial success. Removing to New York (1825), he displayed some landscapes in the window of an eating-house, where they attracted the attention of the painter Colonel Trumbull, who sought him out, bought one of his canvases, and found him patrons. From this time Cole was prosperous. He is best remembered by a series of pictures consisting of four canvases representing "The Voyage of Life," and another series of five canvases representing "The Course of Empire," the latter now in the gallery of the New York Historical society. They were allegories, in the taste of the day, and became exceedingly popular, being reproduced in engravings with great success. The artist's genuine fame must rest on his landscapes. He had an influence on his time and his fellows which was considerable, and with Durand he may be said to have founded the early school of American landscape painters. Cole spent the years 1829–32 and 1841–42 abroad, mainly in Italy, and at Florence lived with the sculptor Greenough. After 1827 he had a studio in the Catskills which furnished the subjects of some of his canvases, and he died at Catskill (N.Y.) on Feb. 11, 1848. His pictures are in many public and private collections. His "Expulsion from Eden" is in the Metropolitan museum in New York city and is one of the most typical examples of his style.

COLE, TIMOTHY (1852–1931), U.S. wood engraver, was born in London in 1852, his family emigrating to the United States in 1858. He established himself in Chicago, where in the great fire of 1871 he lost everything he possessed. In 1875 he removed to New York, finding work on the *Century* (then *Scribner's*) magazine. He immediately attracted attention by his unusual facility and his sympathetic interpretation of illustrations and pictures, and his publishers sent him abroad in 1883 to engrave a set of blocks after the old masters in the European galleries. These achieved for him a brilliant success. His reproductions of Italian, Dutch, Flemish and English pictures were published in book form with appreciative notes by the engraver himself. Though the advent of new mechanical processes had rendered wood engraving almost a lost art and left practically no demand for the work of such craftsmen, Cole was thus enabled to continue his work, and became one of the foremost contemporary masters of wood engraving. He received a medal of the first class at the Paris exhibition of 1900, and the only grand prize given for wood engraving at the Louisiana Purchase exposition at St. Louis in 1904. He was an honorary member of the Society of Sculptors, Painters and Engravers, London, and a member of the American Academy of Arts and Letters. He was the author of *Notes to Old Italian Masters* and other critical essays. He died May 17, 1931.

COLE, VICAT (1833–1893), English painter, born at Portsmouth on April 17, 1833, was the son of the landscape painter, George Cole, and in his practice followed his father's lead with marked success. He became an academician in 1880, and died in London on April 6, 1893. Most of his subjects were found in the counties of Surrey and Sussex, and along the banks of the Thames. One of his largest pictures, "The Pool of London," was bought by the Chantrey Fund trustees in 1888, and is now in the Tate gallery.

See Robert Chignell, *The Life and Paintings of Vicat Cole, R.A.* (1899).

END OF VOLUME FIVE

W

PRINTED IN THE U. S. A. BY R. R. DONNELLEY & SONS CO.